

THE GEMS KIT BUILDER'S HANDBOOK

by

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Great Explorations in Math and Science (**GEMS**)
Lawrence Hall of Science
University of California at Berkeley





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For further information on GEMS leadership opportunities, or to receive a catalog and the *GEMS Network News*, please contact GEMS at the address and phone number below.

Comments Welcome

Great Explorations in Math and Science (GEMS) is an ongoing curriculum development project. GEMS guides are revised periodically to incorporate teacher comments and new approaches. We welcome your criticisms, suggestions, helpful hints, and any anecdotes about your experience presenting GEMS activities. Your suggestions will be reviewed each time a GEMS guide is revised. Please send your comments to:

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What is GEMS?

Great Explorations in Math

It's exhilarating—students waddling around like penguins on ice . . . exploring a strange green substance said to come from a distant planet . . . playing a math game from China or Africa . . . or solving a “crime” with chemistry. The basis for the GEMS approach is that students learn best by doing—an approach backed by overwhelming educational evidence. Activities first engage students in direct experience and experimentation, before introducing explanations of principles and concepts. Utilizing easily obtained and inexpensive materials, GEMS activities allow teachers without special background in science or mathematics to successfully present hands-on experiences.

Developed at the University of California at Berkeley's Lawrence Hall of Science, and tested in thousands of classrooms nationwide, more than 50 GEMS teacher's guides offer a wide spectrum of learning opportunities from preschool through tenth grade.

Emphasis on teamwork and cooperative learning, the use of a wide variety of learning formats, and reliance on direct experience rather than textbooks makes GEMS highly appropriate for use with populations that have been historically underrepresented in science and mathematics pursuits and careers. In GEMS activities, students are encouraged to work together to discover more, explore a problem, or solve a mystery, rather than fixating on the so-called right answer, or engaging in negatively competitive behavior. Cooperative (or collaborative) learning is one of the most effective strategies for bridging and appreciating differences and diversities of

background and culture. It is also one of the most effective ways to help prepare students for the workplaces of the future.

The GEMS series interweaves a number of educational ideas and goals. GEMS guides encompass important learning objectives, summarized on the front page of each guide under the headings of skills, concepts, and themes. These objectives can be directly and flexibly related to national standards and benchmarks, other science and mathematics curricula, state frameworks, and district guidelines.

The GEMS Kit Builder's Handbook provides a comprehensive guide to making kits for GEMS activities. Other handbooks include *a Teacher's Handbook*, *a Leader's Handbook*, *The Architecture of Reform: GEMS and National Standards*, *A Parent's Guide to GEMS*, and *Once Upon A GEMS Guide* (a literature connections handbook).



Since classroom testing began in 1984, more than 500,000 teachers and at least six million students have enjoyed GEMS activities. In collaboration with thousands of teachers, GEMS activities are adapted for the classroom, for use by teachers who may not have special background in math and science. A national network of teachers and educators take part in GEMS Leadership and Associate workshops and receive a regular newsletter, the *GEMS Network News*. GEMS is a growing series. New guides and handbooks are being developed constantly and current guides are revised frequently. We welcome your comments and letters. Let us hear from you. ■

Acknowledgments

While all the contributing authors played an important role throughout the origination, development, testing, and writing of this handbook, we would like to especially acknowledge the efforts of **Cary I. Sneider**, who was not only one of the primary authors, but took on the awesome task of illustrating the materials lists with such skill and elegance. Also deserving of special mention are **Jan M. Goodman**, former GEMS mathematics specialist, who coordinated the launching of the handbook, and **Alan Gould**, who picked up the coordinator's baton and pulled it all together. **Nancy Kedzierski** assisted in creating early kit lists.

In addition to the main authors of this handbook, the following people from the GEMS staff and from the Lawrence Hall of Science provided invaluable assistance, advice, and thoughtful contributions to, and critical review of, this manuscript or portions thereof: **Jaine Kopp**, **Lincoln Bergman**, **Florence Stone**, and **Stephanie Van Meter**.

We would like to thank the following educators who provided the insightful interviews that enhance

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Last but far from least we thank the many teachers who have generously given us their ideas and feedback on how they have implemented GEMS activities in their classrooms, and of course their students whose inherent feedback continues to teach us about teaching. ■

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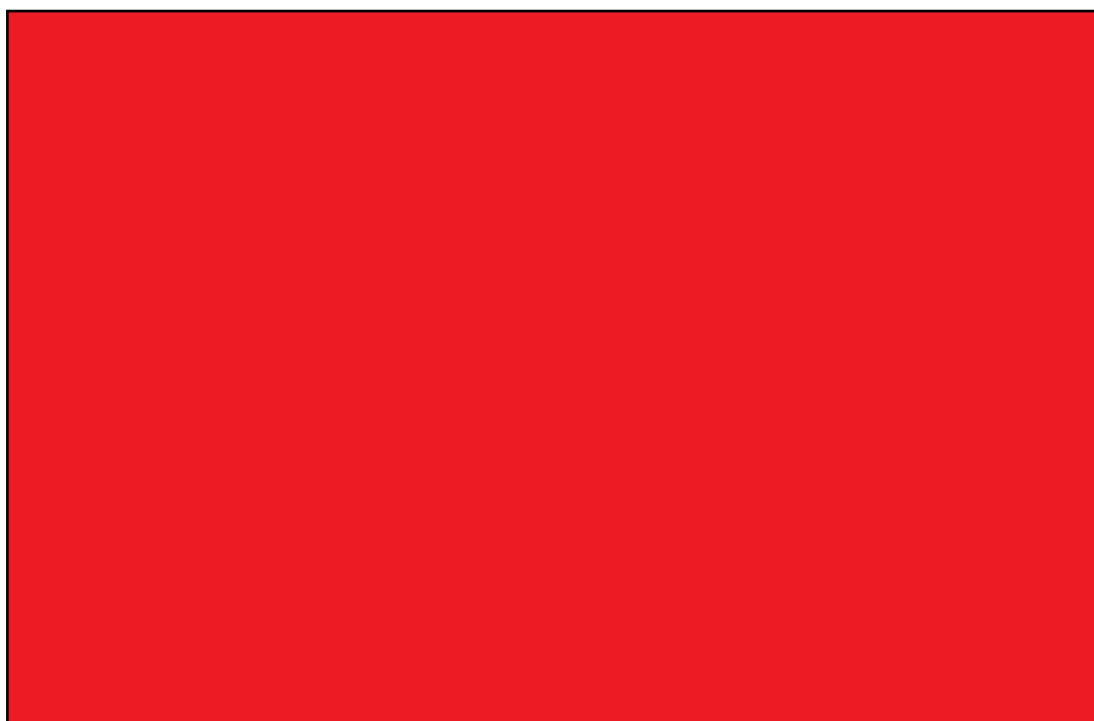
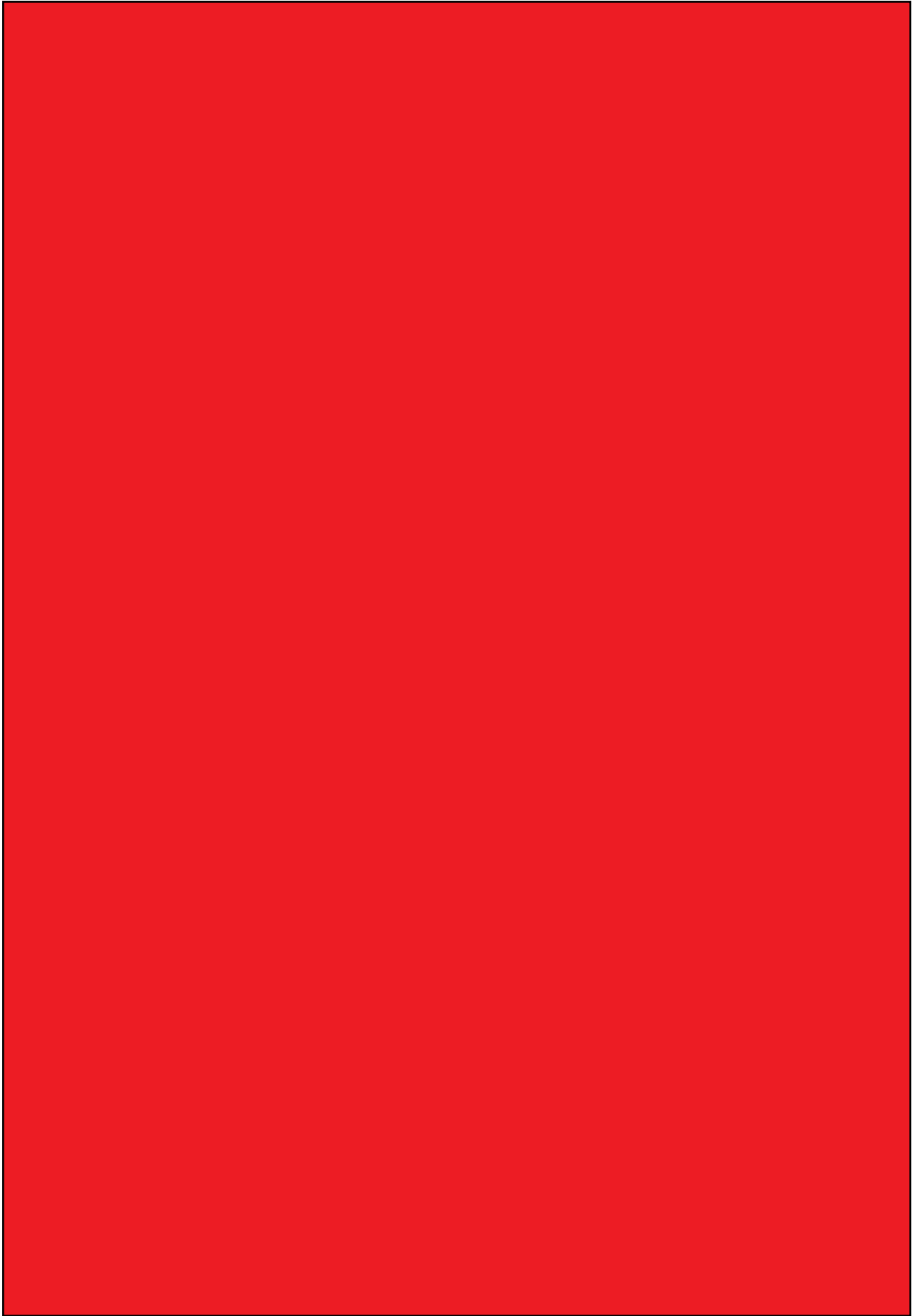


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This handbook is an on-going project and does not include a number of the newer GEMS guides.



I Introduction to GEMS Kits

“Let’s see . . . for this activity, I need plastic cups, string, hand lenses, measuring cups, thermometers, and . . . didn’t I have those things stored somewhere?” Thoughts about materials constantly arise for teachers who provide their students with hands-on math and science experiences. How materials are obtained, organized, maintained, and stored are key issues, and strategies for resolving these issues will vary from teacher to teacher. Educators who have long used activity-based math and science programs have usually worked out their own ways to gather and maintain materials. For all teachers, the fact that GEMS activities feature highly accessible items is a great help. But it’s also true, for many teachers, that the gathering, the organizing, and the maintaining the materials involved in inquiry-based science and math activities can seem a daunting task.

The idea for this handbook came from teachers who use GEMS. One very attractive aspect of GEMS is that the individual teacher need not be dependent on an adoption process, district buy-in, or a budget of thousands of dollars to present excellent inquiry-based units. However, in recent years, we’ve realized that our initial approach to materials, designed for the individual teacher who gathered materials as she went, needed to evolve to fill the needs of those implementing GEMS on a larger scale. More and more teachers are using more

and more GEMS, and as districts nationwide adopt activity-based mathematics and science, materials acquisition, kit assembly, and maintenance are fast becoming a large-scale endeavor. The need for multiple kits, more systematic kit-building, and kit maintenance has grown. Our goal is that

The *GEMS Kit Builder’s Handbook* will make assembling materials easier for both large-scale kit assemblers and the individual GEMS teacher as well.

We have gathered valuable wisdom from those who have been making GEMS kits successfully for years and put that “kit wisdom” in this handbook to serve as a comprehensive resource for teachers, schools, and districts who wish to develop materials kits to make classroom use of GEMS units more practical and time-efficient. Given time constraints and all the other challenges teachers face on a daily basis, we are confident that many more teachers

would use GEMS activities more often if materials were not an obstacle. Streamlining preparation time is equally important, since time is one of our most precious commodities. This handbook is designed to help teachers and the people who support them to be sure the necessary materials are already gathered, easily accessible, and well-organized. We offer this handbook to assist those

GEMS units can be used as a strong support to national standards and other leading guidelines for excellence in science and mathematics education, all of which recognize that inquiry-based activities are essential for effective student learning. To present such activities successfully, materials of diverse kinds are needed. The GEMS approach has been to use relatively easy-to-prepare and inexpensive materials and to carefully trial-test step-by-step presentation guidelines that ensure successful presentation by all teachers for all students. As GEMS activities are used more and more widely, the creation of materials kits rose higher and higher on the agenda.

who already present GEMS units, and to encourage more teachers and districts to do so.

The ultimate in convenience is to purchase ready-made kits from a commercial supplier. As more and more teachers and districts included GEMS units in their science and math curricula, the demand for ready-made GEMS materials kits increased astronomically! In response to this overwhelming need, **GEMS Kits are now available: go to lhsgems.org/gemskits/html**

GEMS Kits!



Working closely with the GEMS kits supplier, we are committed to making these professionally-designed GEMS kits accurate, durable, well-organized, and as inexpensive as possible. **Just as with the GEMS teacher's guides, these authorized GEMS kits will be field tested and, in consultation with GEMS educators who originated the activities, will be refined to best suit the needs of the classroom.** We are confident this close collaboration will yield outstanding results

GEMS kits will also be revised as needed after their initial development, based on any revisions in the guides themselves and on useful suggestions from teachers who use the kits to present GEMS activities.

There are likely to be many teachers and educators who, for a variety of reasons, will still choose to assemble their own kits in inexpensive and innovative ways. They will be able to rely on this handbook for accurate listings and descriptions of needed items for all GEMS teacher's guides. Whether a kit is initially purchased or assembled, the long term maintenance of that kit is essential to its viability and thus its usefulness in reaching successive classes of students.

All the individual items in GEMS kits are now available for purchase, so that is one highly convenient option. In some cases, a teacher may prefer to restock common items through local purchase, collection of materials from parents, or donation from a nearby company.

Most of the materials needed for GEMS units are common, everyday materials that can be either collected or obtained locally (at supermarkets, hardware stores, drug stores, variety stores, and even schools!). A few special items such as slides

or color filters come packaged with certain GEMS Teacher's Guides. Other materials are available from vendors whose names and addresses are listed in the guides. Each GEMS Teacher's Guide has a section entitled "What You Need," a session-by-session listing of materials required. This handbook contains all the items from those "What You Need" lists, including illustrations to help you visualize the collection of materials at a glance.

Over the years, we have heard from teachers, groups of parents, district coordinators, administrators, and others about innovative ways to provide teachers with needed materials.

They told us about great ideas in kit construction, kit maintenance, and ways to acquire free or inexpensive materials. We've put lots of those ideas in this handbook to spark your own ideas for your unique situation.

Bob Box of Mesa, Arizona, whose interview appears later in this handbook, noted: "Two nationwide trends are clear in science education. First, students learn best when science is interactive and hands-on. Second, districts must develop a support system for teachers so that they can implement activity-based science."

The Organization of This Handbook

I. Introduction

You're most of the way through it!

II. Complete Illustrated Kit Inventories

This section includes complete materials lists for all 42 current GEMS guides. Future revisions of this handbook will add materials lists for the recent new guides. We include illustrations to help you visualize what you will need to acquire.

The materials are organized in three categories:

- *Non-consumables*: items that can be reused (e.g., spray bottles, medicine droppers, plastic containers, posters)
- *Consumables*: items that regularly need restocking (e.g., cornstarch, insects, student data sheets)
- *General supplies*: items that are usually available in classrooms (e.g., pencils, glue sticks, scissors, markers).

The lists can be duplicated and given to the person who will purchase supplies (someone at your school or in your district, a parent, a fellow teacher, or yourself). Copies of these same lists can be duplicated and used as inventory checklists in the kit itself. Such lists are invaluable in maintaining kits once they have been developed.

III. The ABC's of Making and Maintaining GEMS Kits

This section gives important insights into the basics of making and maintaining GEMS kits:

- Creative Ways to "Finance" Kits
- Getting Materials
- Assembling Kits
- Distributing Kits
- Storing Kits
- Maintaining Kits

IV. Sources of Materials

This section includes a list of frequently used GEMS items with suggestions for possible vendors.

V. Interviews with Kit Builders

Meet eight experienced kit builders who provide concrete suggestions, creative approaches, and valuable lessons learned. Their input will give you ideas for how to launch or improve your own kit-building ventures.

We hope that The GEMS Kit Builder's Handbook will help you "visualize" kits for all of the teacher's guides in the GEMS series. It has many ideas that can help you transform the images on these pages to real kits in your classroom and to maintain these kits once you have them. While kit building can be a challenging endeavor, ultimately it will make a tremendous difference in your life in the classroom.

II. Complete Illustrated Kit Inventories

This is the heart of this handbook—lists of all items essential for the gathering together and maintenance of GEMS kits. This section includes complete materials lists for 42 GEMS guides as well as packing suggestions. The lists were developed with the following specifications:

- ☛ Quantities are based on a class size of 32 students, with additional materials for the teacher for modeling or demonstration purposes, as appropriate.
- ☛ Specific sizes and amounts are provided if they are crucial to the success of the activity.
- ☛ If a teacher has an option to choose from one or more materials, all choices are listed.
- ☛ We include all materials necessary for each session of the GEMS guide, including optional items, but materials for “Going Further” activities are not on the list. Optional items are listed but not illustrated.
- ☛ If items are available in metric and standard quantities, both measurements are included, with metric values in parentheses, as they appear in most GEMS guides. In the United States, most stores sell items marked with English units. The metric system is the world standard and universally recognized in scientific disciplines. The metric values we have given are approximate values which are fine for almost all ordinary situations. In the rare event that an exact conversion is needed, use the following:

1 quart = .94 liter

1 ounce (liquid) = 29.375 milliliters

1 inch = 2.54 cm

8½" x 11" sheet of paper =
21.6 cm x 27.94 cm

The illustrations show collections of small items in plastic bags or boxes. These packing containers do **not** appear in the lists since they are not essential for the activity and are only suggestions for how you might organize the materials in the boxes. There are many other possible packing and packaging options.

Keep in mind the three categories of items that are found on the materials list.

NON-CONSUMABLE ITEMS

These items need to be acquired only once because they can be reused each time you teach the unit. It is wise to have a designated person make sure that these items remain in good condition from year to year.

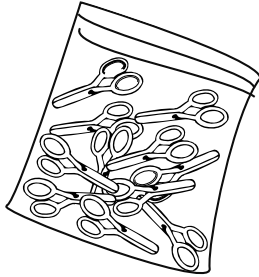
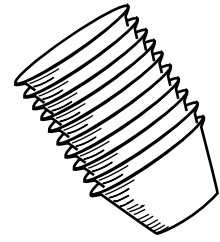
CONSUMABLE ITEMS

These are items that are depleted while doing the activities and therefore, regularly need restocking. The rate at which these items are consumed might be fairly rapid, requiring frequent restocking (such as cabbage juice) or fairly slow, requiring replenishment after several months (such as a roll of masking tape). If it will run out, it's classified as a consumable.

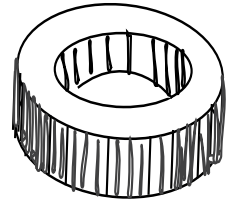
The quantities you purchase should be based on the rate at which the material is consumed, which in turn depends on the number of students who will use the supplies before the kit must be restocked. It is helpful to overestimate the amount of each item that you will need, to ensure that there will be ample quantities if spillage or overuse occur.

GENERAL SUPPLIES

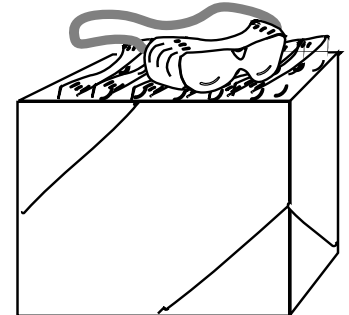
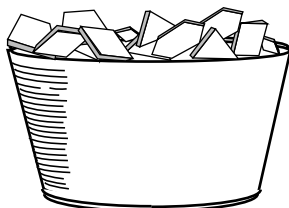
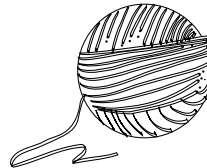
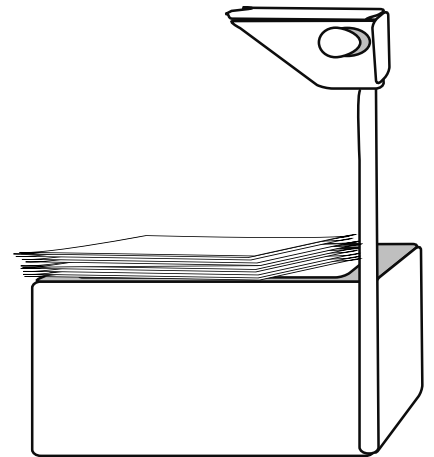
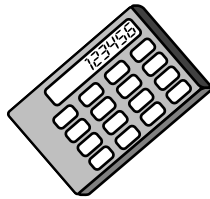
These are items that are usually available in classrooms and can be used repeatedly for a variety of units and purposes in many curriculum areas. Most kit builders do not include these general supplies in kits because it is assumed that these materials will be easily accessible to the classroom teacher. Money can be saved if teachers maintain classroom sets of common items (such as scissors) for use with several GEMS units, rather than packing these materials away in the kit boxes. Be aware that a general supply at an elementary school (like crayons or tempera paint) may not be readily available in a middle school. Some kinds of graph paper might be harder to find in an elementary school. A list of all “General Supplies” items in all GEMS guides may be found on page 153.



Complete Illustrated



Kit Inventories



Acid Rain

Non-Consumables

- 1 *Acid Rain* Teacher's Guide
- 8 cafeteria trays
- 8 clear graduated cylinders for measuring 20 ml quantities
- 1 glass graduated cylinder or pipette for measuring 1 ml quantities of acid
- 5 containers for vinegar solutions for seed germination experiment (8–10 oz. glass bottles—such as soda bottles)
- 1 container for baking soda solution (plastic, half liter, with lid)
- 1 container for making acid rain solution (plastic, 2 liter, with lid)
- 8 plastic squeeze bottles with lids for Universal Indicator Solution, 1–2 oz. (30–60 ml)
- 16 medium plastic squeeze bottles with lids, 8–12 oz. (150–300 ml)
- 42 wide-mouthed plastic cups, 8–12 oz. (150–300 ml), clear, colorless, flexible
- 32 tall plastic cups, 8–12 oz. (150–300 ml), clear, colorless, flexible
- 1 measuring spoon (tablespoon size)
- 16 reaction trays (can use white styrofoam egg cartons with lids, plastic paint palettes, white ice cube trays, or chemical reaction trays)
- 40 medicine droppers
- 8 Universal Indicator Color Charts (If you make them yourself, you'll need a set of crayons or colored pencils and 8 small white index cards.)
- 40 meters of cotton string or acrylic yarn
- 20 pieces of 8½" x 11" (22 cm x 28 cm) card stock
- 32 rubber bands
- 8 popsicle sticks or toothpicks for probing seed germination experiment

Copies of the following:

- 8 *Acid Rain: The Play*

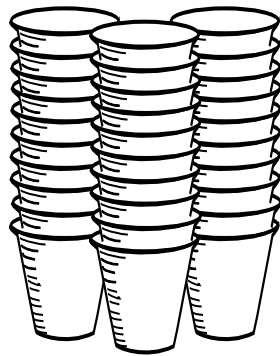
Consumables

- 16 wide-mouthed plastic cups (for seed germination; 10 oz., clear, colorless, flexible)
- 100 sunflower seeds (suitable for germination)
- 100 pea seeds (suitable for germination)
- 110 sentence strips, about 3" x 24" (7 cm x 60 cm)
- several drinking straws
- 1 roll of plastic wrap (two sheets large enough to cover the tops of the plastic cups)

List continued on page 8



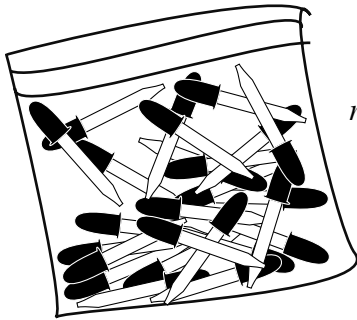
wide-mouthed plastic cups



tall cups

reaction trays

indicator color charts



rubber bands

medicine droppers

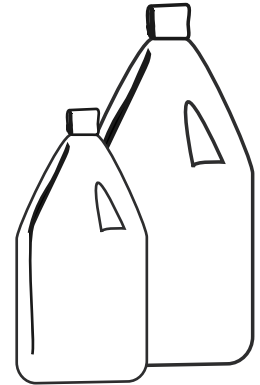
pea seeds

sunflower seeds



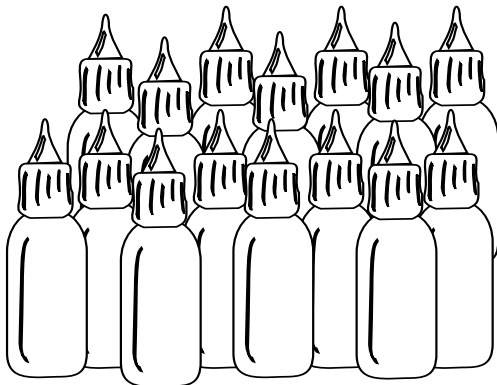
measuring spoon

popsicle sticks

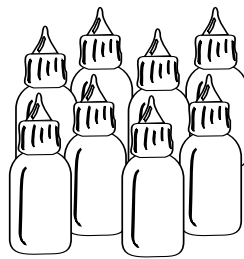


1/2 liter

2 liter

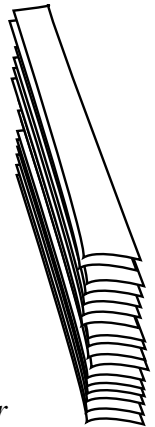


medium squeeze bottles

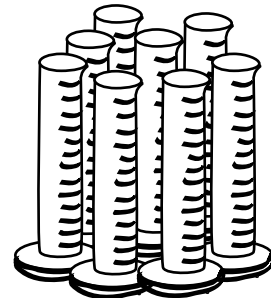


small squeeze bottles

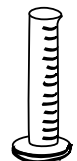
containers for vinegar



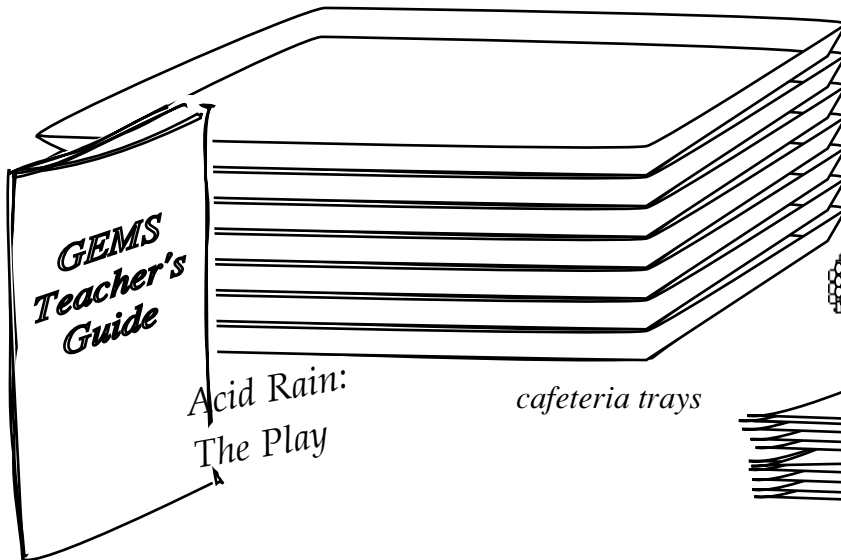
sentence strips



graduated cylinders



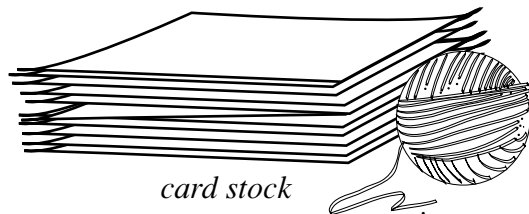
glass cylinder



cafeteria trays



straws



card stock

string or yarn

roll of plastic wrap

Acid Rain

List continued from page 6

Consumables (continued)

- 32 paper coffee filters, 8" diameter (20 cm.), basket-type
- 10 TUMS tablets
- 125 ml Universal Indicator Solution*
- 1 ml of 1 molar sulfuric acid solution*
- several tablespoons of several different kinds of soils
- 1½ qts tap water (1.5 liters)
- 5 qts distilled water (5 liters)
- 24 oz. white distilled vinegar (750 ml)
- 16 oz. lemon juice (500 ml)
- 4 tablespoons baking soda

*For information on where to order chemical supplies, see pages 164–169.

Copies of the following:

- 32 Acids in Your Life
- 32 pH data sheets
- 32 Pollution, Acid Rain, and You
- 8 Startling Statements
- 32 Acid Rain data sheets
- 8 each of the interest group descriptions (Welcome to Laketown; Manufacturers; Fishing People; Politicians; Local Residents)
- 32 Efforts Continue Against Acid Rain
- 1 each of the Possible Solutions sheets (4 sheets total)

General Supplies

- 8 wide-tipped markers (at least one marker should be of a second color)
- 8 fine-tipped markers that can write on plastic
- 32 pairs of safety goggles
- 80 pieces of 8½" x 11" (22 cm. x 28 cm.) white scratch paper
- paper towels
- 1 roll of masking tape
- 1 pair of scissors
- 1 single-hole paper punch
- lots of butcher paper (about 20 meters)
- additional butcher paper and markers (if no chalkboard is available)
- if no sink is available—2 buckets, one yogurt or other small wide-mouthed container, and one or two large squeeze bottles of water such as empty dishwashing soap bottles



coffee filters



TUMS



baking soda



universal indicator solution



sulfuric acid solution



bags of different soils



lemon juice



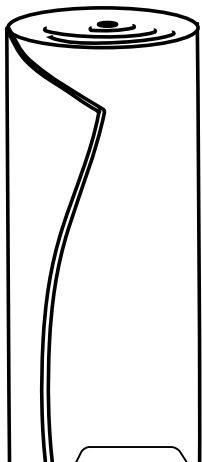
white distilled vinegar



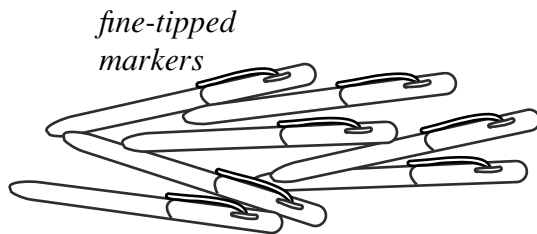
distilled water



tap water



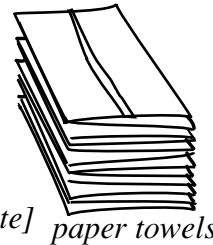
butcher paper



fine-tipped markers



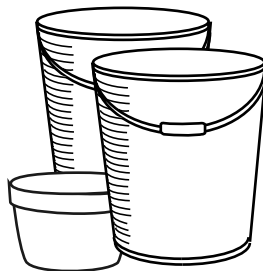
wide-tipped markers



paper towels

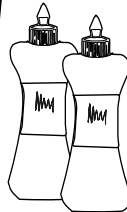


masking tape

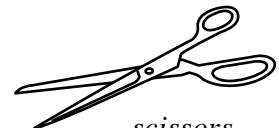


[sink substitute]

buckets



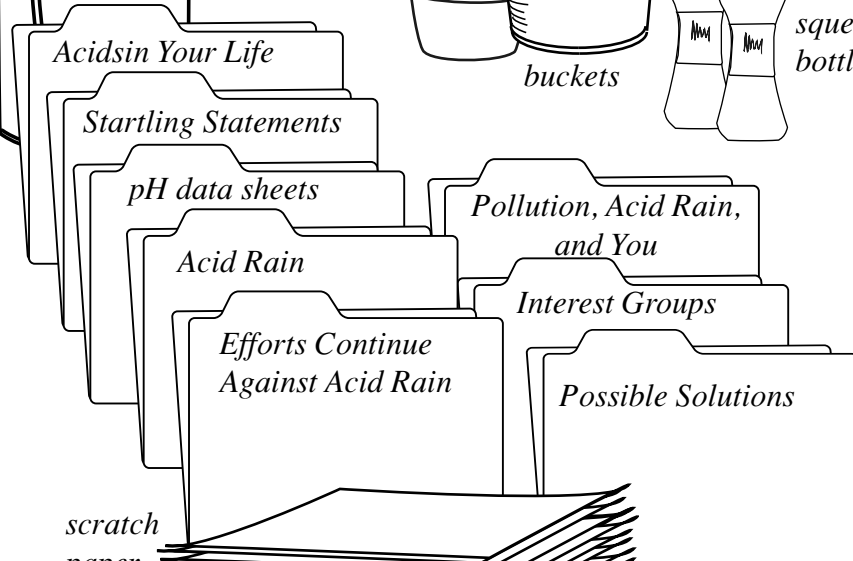
squeeze bottles



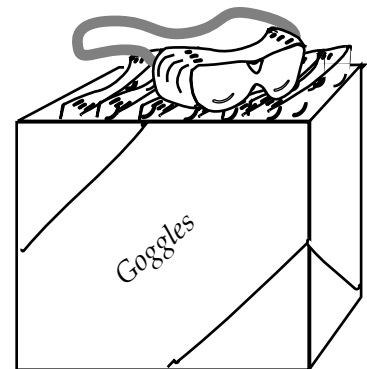
scissors



paper punch



scratch paper



Goggles

goggles

Animal Defenses

Non-Consumables

- 1 *Animal Defenses* Teacher's Guide
- 1 piece of 9" x 12" (23 cm x 30 cm) brown construction paper for Tyrannosaurus rex
- 2 pieces of 9" x 12" (23 cm x 30 cm) green construction paper for the paper ferns
- 3+ stuffed (toy) animals or large photos of modern day animals with physical and behavioral defenses

Copies of the following:

- 1 defenseless animal (pattern A) pattern
- 1 Tyrannosaurus (pattern B) pattern
- 1 volcano (pattern C) pattern
- 1 set of 3 posters: Tyrannosaurus rex, Stegosaurus, and Triceratops

* Folders made of colored acetate, available from most drug or office supply stores, are a good source of cellophane.

Optional:

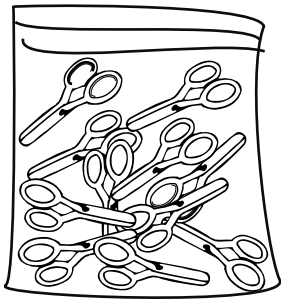
- 1 piece of 12" x 12" (30 cm x 30 cm) dark blue transparent acetate or cellophane*
- 1 piece of 3½" x 3½" (9 cm x 9 cm) yellow acetate or cellophane*
- 1 piece of 2" x 5" (5 cm x 13 cm) red acetate or cellophane*
- 1 copy of Moon (pattern D)
- 1 copy of lava (pattern E)

Consumables

- 8 pieces of 9" x 12" (23 cm x 30 cm) green construction paper—when cut in quarters, these make 32 sheets, 4½" x 6" (12 cm x 15 cm)
- scraps of paper left over from defenseless animal cut outs

General Supplies

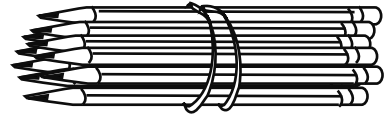
- 1 single-hole paper punch for making eyes
- 1 overhead projector
- 1 screen or large white wall for projection
- 1 large pair of scissors for pre-cutting
- 1 roll of transparent tape
- 1 tray for demonstration
- 32 pencils (only 1 needed if students cannot write their names)
- 32 pairs of scissors (only 1 needed if students don't use scissors)
- 32 glue sticks or 32 containers of white paste or glue
- old newspapers
- 1 large paper bag



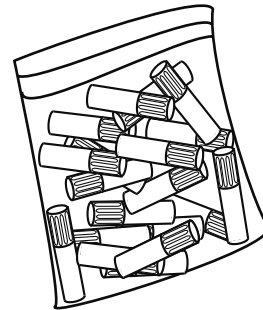
class set of scissors



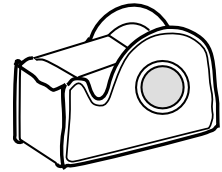
scraps of construction paper



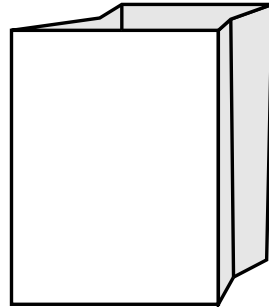
pencils



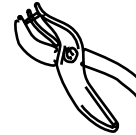
glue sticks



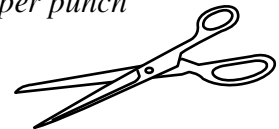
transparent tape



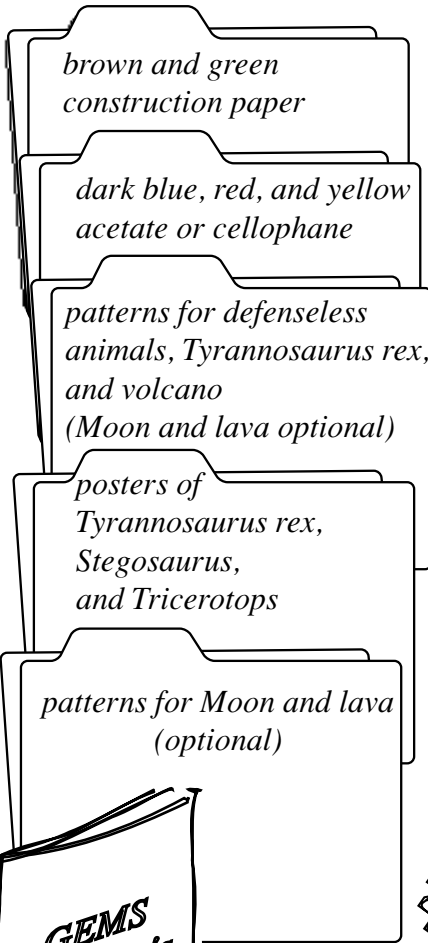
paper grocery bag



paper punch



large scissors



brown and green construction paper

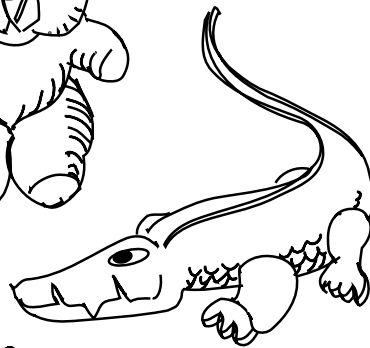
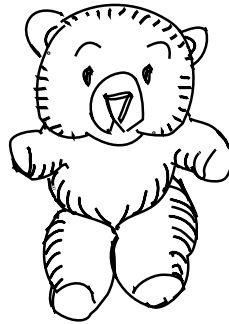
dark blue, red, and yellow acetate or cellophane

patterns for defenseless animals, Tyrannosaurus rex, and volcano (Moon and lava optional)

posters of Tyrannosaurus rex, Stegosaurus, and Triceratops

patterns for Moon and lava (optional)

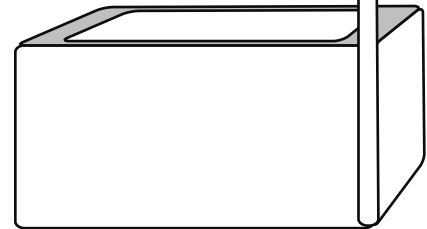
**GEMS
Teacher's
Guide**



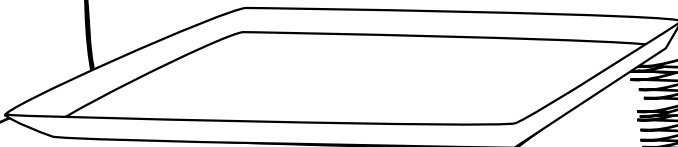
toy animals



newspaper



overhead projector



demonstration tray



green construction paper

Animals in Action

Non-Consumables

- 1 *Animals in Action* Teacher's Guide
- 6–7 cardboard boxes, about 18" x 18" x 24" (45 cm. x 45 cm. x 60 cm.)
- 1 utility knife to cut boxes
- animal cages
- variety of stimulus items such as branches, sponges soaked with scents, toys, yarn, mirrors, colored paper, flowers, leaves, foods, straws for blowing air or bubbles, spray bottles, flashlights with filters, or other animals of the same species
- 8 sets of two animals of the same species such as guppies, crayfish, crickets, garden snails, mealworms, beetles, butterfly larvae, milkweed bugs
- 2–3 small active animals (such as rats, gerbils, guinea pigs) that are compatible in the same corral
- 8 animal observation containers such as dish tubs, metal baking pans, shoe boxes, milk cartons, small aquaria, plastic sweater boxes

Consumables

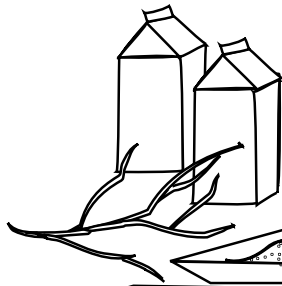
- 1 roll of strapping or duct tape
- bedding material for animals
- food and water for animals

Copies of the following:

- 8 *Animal Behavior Experiment* data sheets
- 32 *Observing Animal Behavior* data sheets

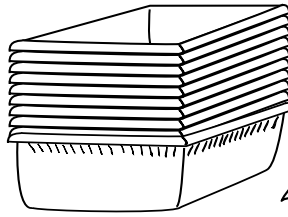
General Supplies

- 1 wide-tipped marker
- old newspapers or drop cloths for under corrals
- 6–8 large pieces of butcher paper for recording class observations
- paper towels
- soap and water
- sponges
- masking tape
- 32 clipboards or books to use as writing surfaces

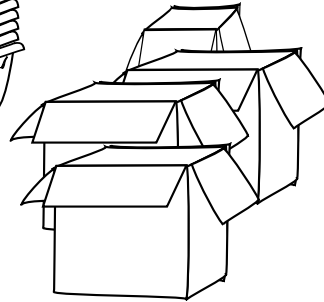


stimulus items

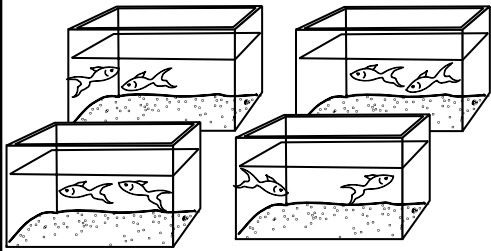
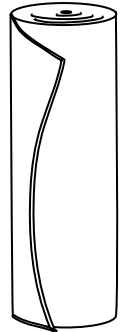
animal observation containers



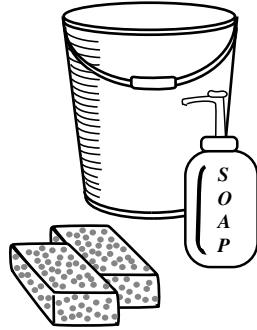
cardboard boxes



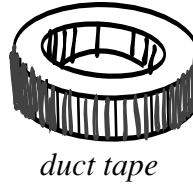
butcher paper



8 sets of two animals



soap, water, sponges



duct tape



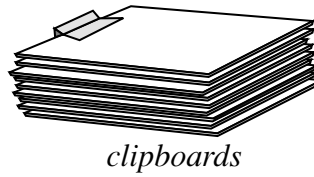
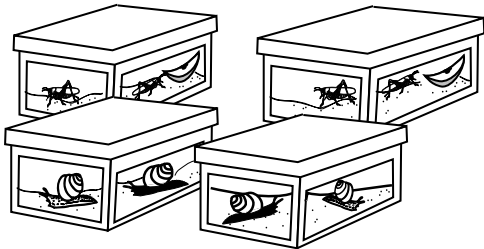
masking tape



marker



utility knife



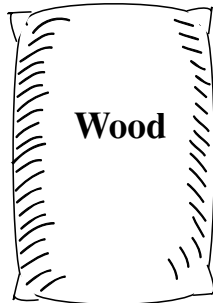
clipboards



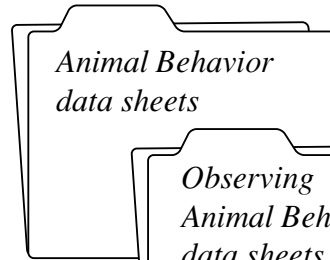
paper towels



newspaper

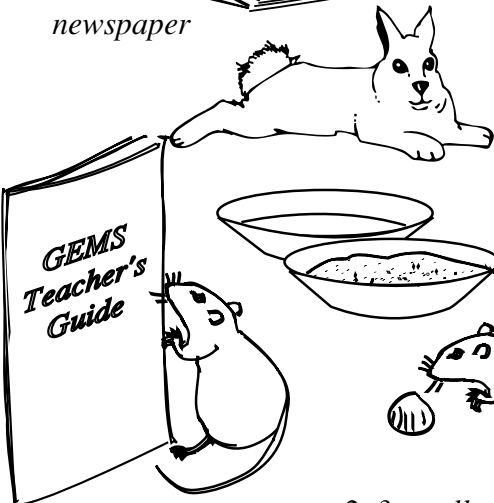


bedding

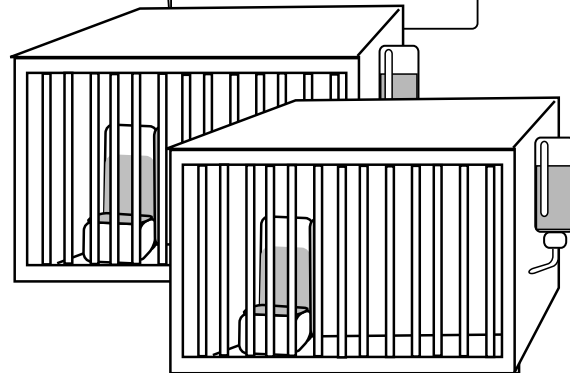


Animal Behavior data sheets

Observing Animal Behavior data sheets



2-3 small active animals



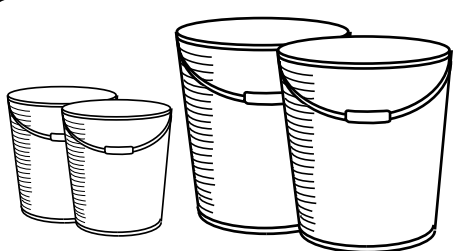
animal cages

Bubble Festival

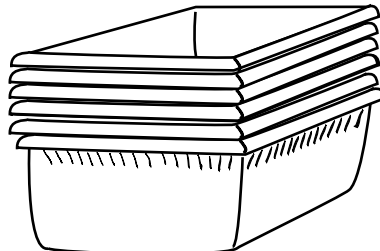
Non-Consumables

- 1 *Bubble Festival* Teacher's Guide
- 2–4 buckets with lids (5 gallon capacity)
- 2 buckets (1 gallon capacity or more)
- 1 large, see-through 4 gallon bucket/ container (sturdy; cylindrical; or square; try restaurant supply stores; a glass aquarium can be substituted)
- 1 container, no lid necessary (1 gallon capacity)
- 1 measuring cup—1 or 2 cup capacity (250–500 ml)
- 3+ squeegees with at least a 4" (10 cm) blade, no sponge
- 1 plastic squirt bottle for vinegar (an empty dishwashing liquid bottle works well)
- 12 large rectangular tubs
- 10 wide-mouthed plastic containers, yogurt type, about 16 oz. (500 ml.) capacity
- 4 water resistant 1 meter measuring tapes with centimeters marked
- 4 plastic metric rulers or meter sticks
- 4 protractors
- 50 unifix cubes (or other uniform, waterproof cubes—about 1 cm edges)
- 15+ bubble makers—one of each to make 15 or more (items such as a flower pot, washer, funnel, strainer, rubber band, berry basket, small tin can, protractor, string, mason jar lid, tea ball, drinking straw, toilet paper roll, scissors, wire, spring, paper, rubber stopper with holes, plastic rings from a six pack, medicine dropper, rope, paper/plastic/styrofoam cup, mesh screens, aluminum foil, etc.)
- 4 black or brown plastic trash bags, about 2' x 3' (60 cm x 100 cm)
- 2 plastic wallpaper troughs, about 30" x 6" x 6" (90 cm x 15 cm x 15 cm)
- 2 wooden dowels, each about 28" (70 cm) long, 1/2" (1.5 cm) diam. (must fit in trough)
- 4 stainless steel washers, about 1 1/2" (4 cm) diam.
- 2 whisks
- 2 egg beaters
- 2 plastic cups (8–10 oz. capacity)
- 4 small, plastic magnifying lenses
- 1 pair thick cotton-lined leather or canvas gloves for handling dry ice
- 1 cooler for dry ice
- 1 "stacking" apparatus made from 2 sheets of plexiglass
- 2 2' (60 cm) lengths of flexible, plastic tubing; diameter large enough to fit a straw in
- 1 tub, about 16" x 21" (40 cm x 55 cm), rectangular, at least 3" (7 cm) deep
- 1 child's wading pool, about 3'–4' (1 meter) diam., inflatable or folding kind alright
- 1 hula hoop that fits into pool
- 1 sturdy, waterproof crate or box to stand on in pool (such as a milk crate)

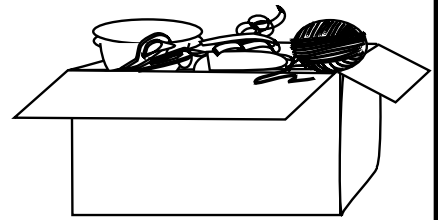
List continued on page 16



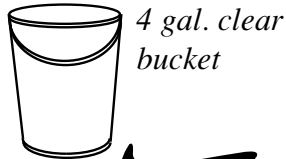
1 gal. buckets 5 gal. buckets



large rectangular tubs



bubble makers



4 gal. clear bucket



plastic cups



plastic magnifying lenses



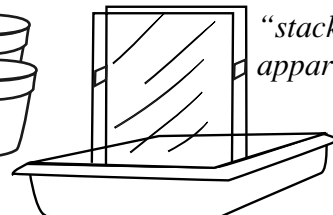
plastic trash bags



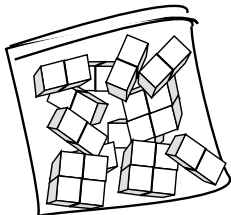
measuring cup



wide-mouthed containers



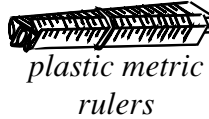
"stacking" apparatus



unifix cubes



metric measuring tapes



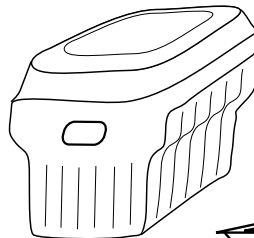
plastic metric rulers



lengths of plastic tubing



washers

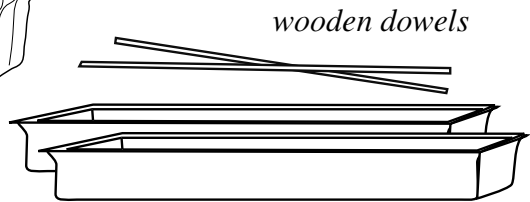


cooler



leather or canvas gloves

squeegees



wooden dowels

wallpaper troughs



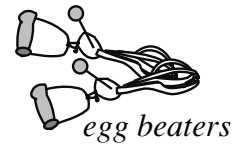
squirt bottle for vinegar



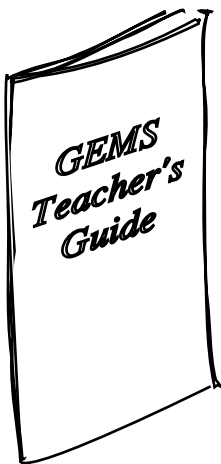
protractors



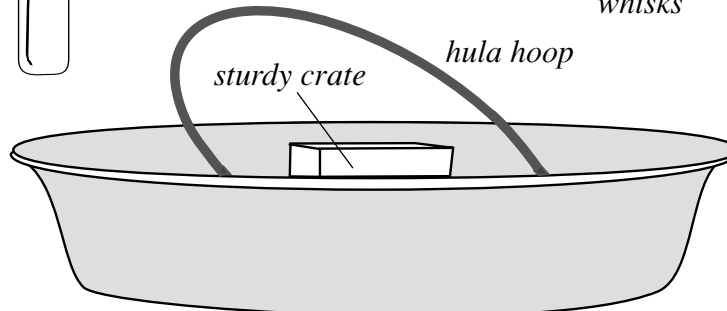
whisks



egg beaters



GEMS
Teacher's
Guide



child's wading pool

hula hoop

sturdy crate



1 gal. container

Bubble Festival

List continued from page 14

Non-Consumables (continued)

Copies of the following:

- 1 each of the festival signs, mounted on manila folders, and laminated (need access to laminator) or covered with clear contact paper

Consumables

- 6 bottles Dawn® or Joy® dishwashing liquid (22 oz.)
- 3 cups glycerin
- 200 drinking straws, about $\frac{1}{4}$ " diam.
- 1 qt. bottle of vinegar
- 1 ball of string or yarn
- 10 yds. (meters) of absorbent, cotton string
- 2 rolls duct tape
- 10 popsicle sticks
- 8 pieces of $8\frac{1}{2}$ " x 11" (22 cm x 28 cm) white paper or tagboard
- 60 plastic coffee stirrers (either one- or two-holed kind)
- 50–60 pipe cleaners that will fit into the stirrers
- 1 slab dry ice (and cooler or stack of newspaper for transporting) to be supplied by teacher; check local Yellow Pages for source

Optional:

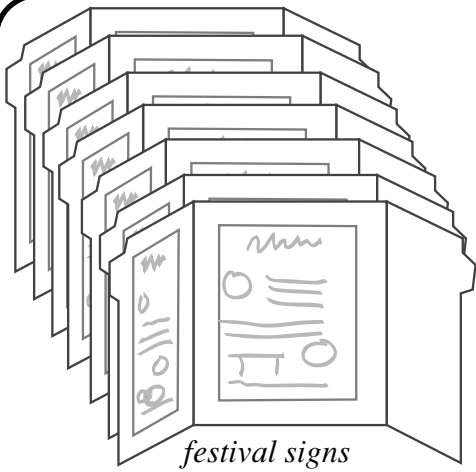
- toothpicks or other uniform objects (buttons, laminated circles of labeled diameters)

General Supplies

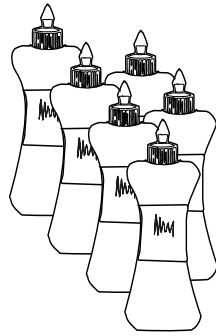
- 32 pencils
- old newspapers
- paper towels
- 2 pairs of adult scissors
- 1 roll of masking tape
- lots of water

Optional:

- 6 drop cloths, old towels, sheets
- access to a hot glue gun and wire cutters for preparing the Skeletons station



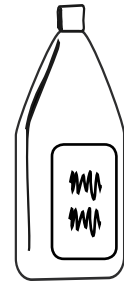
festival signs



dishwashing liquid



glycerin



vinegar



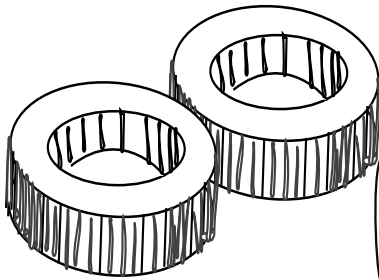
straws



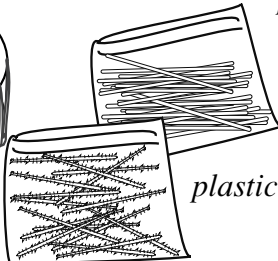
popsicle sticks



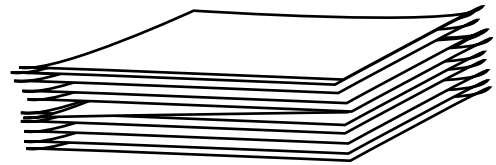
dry ice



duct tape



plastic stirrers



white paper or tagboard



*toothpicks
(optional)*



masking tape



*glue gun
(optional)*



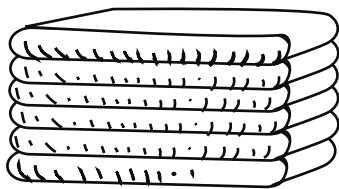
*wire cutters
(optional)*



paper towels



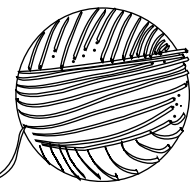
scissors



*drop cloths or towels
(optional)*



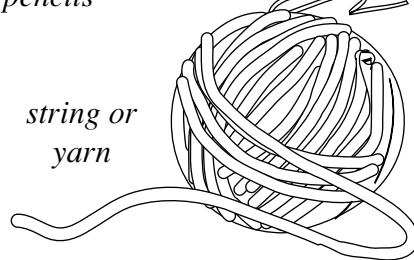
pencils



*cotton
string*



newspaper



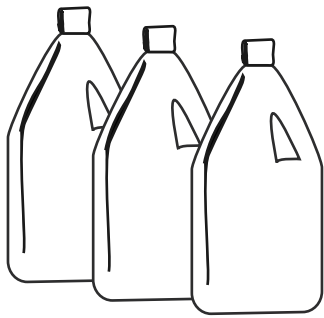
*string or
yarn*

Bubble-ology

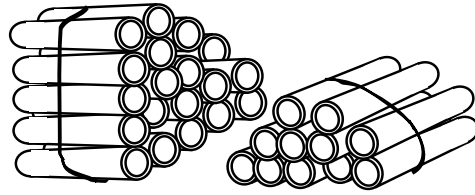
Non-Consumables

- 1 *Bubble-ology* Teacher's Guide
 - 6–12 measuring cups, 8 oz. capacity (250 ml)
 - 3 plastic containers with screw-top lids, 1 gallon (4 liter) capacity
 - 10+ bubble makers—one of each to make 10 or more (items such as a flower pot, washer, funnel, strainer, rubber band, berry basket, tin can, protractor, string, paper, tea ball, rubber stopper with holes, medicine dropper, turkey baster, rubber tubing, paper/styrofoam/plastic cups, various screen mesh sizes, aluminum foil, oatmeal box, mason jar lid, tea ball, drinking straw, toilet paper roll, scissors, wire, spring, etc.)
 - 16 wide-mouthed plastic containers without lids (yogurt type; about 16 oz. capacity)
 - 6–10 medicine droppers
 - 8 large containers (such as dishtubs or foil pie pans)
 - 16 water resistant 1 meter measuring tapes marked in centimeters
 - 1 squirt bottle for vinegar (not spray bottle)
 - 4 squeegees (4" or bigger, no sponge)
 - 1 assortment of materials—containers such as large jars, bake pans, dishpans; container covers such as plexiglass, plastic wrap, trays; humidifying materials such as a turkey baster, sponge, spray bottle; solution additives such as sugar, glycerin, corn syrup, glue; measuring devices such as measuring cups, spoons, medicine droppers
 - 32 tubes, about 7"–11" (17–28 cm) in length, 1"–2" (2.5–5 cm) in diameter—such as plastic golf club covers or polyvinylchloride (PVC) pipes cut in pieces
- Optional:
- 16 calculators
 - 32 medicine droppers

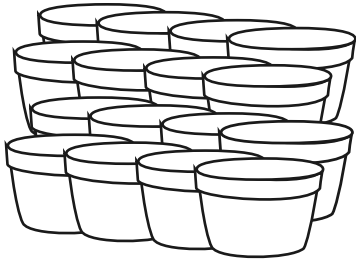
List continued on page 20



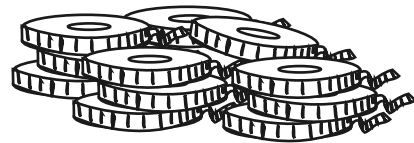
*1 gallon containers
with screw-top lids*



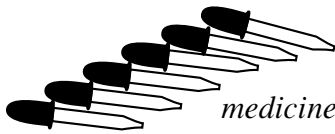
plastic tubes



wide-mouthed containers



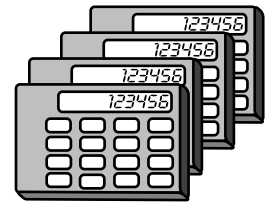
metric measuring tapes



*medicine
droppers*

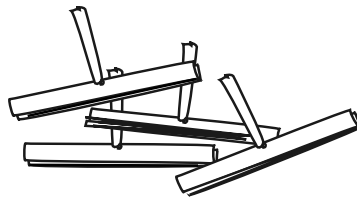


measuring cups

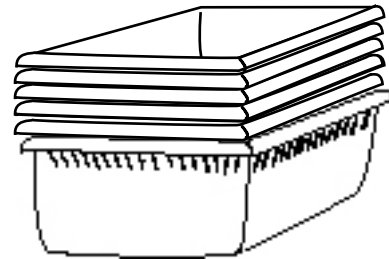


*calculators
(optional)*

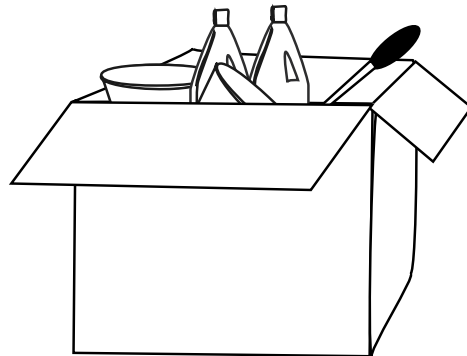
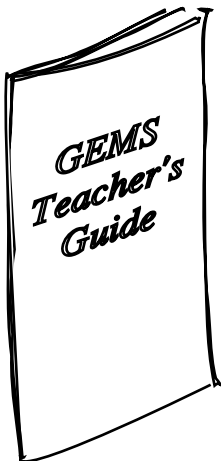
*squirt
bottle
for
vinegar*



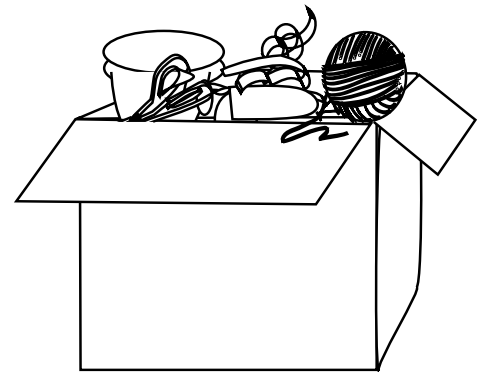
squeegees



dishtubs



assortment of materials



bubble makers

Bubble-ology

List continued from page 18

Consumables

- 150 non-flexible, plastic drinking straws, about $\frac{1}{4}$ " diam.
- 1 bottle of glycerin, 8 oz. or larger
- 32 3" x 5" (8 cm x 13 cm) index cards
- 2 cups (about) white vinegar
- 100 pieces of $8\frac{1}{2}$ " x 11" (22 cm x 28 cm) white paper
- 3 different brands of dishwashing liquid as follows: 2 bottles Dawn (22 oz. each); 1 bottle Palmolive or other medium-priced brand (8 oz.; not Joy); 1 bottle inexpensive or generic brand (8 oz.)
- paper towels

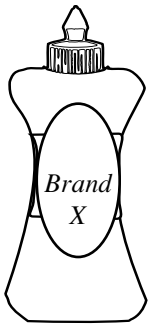
Copies of the following:

- 16 Bubble Solutions
- 16 Experimenting with Glycerin
- 16 Graphing Sheet
- 16 Long-Lived Bubbles

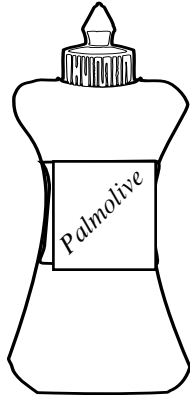
General Supplies

- 12 large plastic trash bags, cut in half to cover tables
- 3 rolls masking tape
- paper towels
- old newspapers
- 1 tall, clear, colorless cup or glass
- 1 pitcher, any size
- water
- pencils

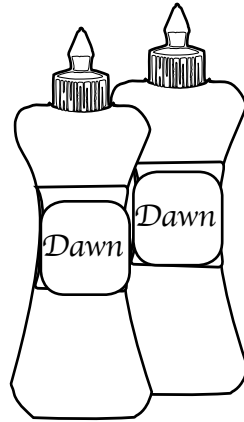
Plastic trash bags, cut in half, can replace cafeteria trays with black construction paper in Session 5.



generic dishwashing liquid



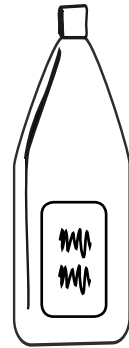
medium-priced brand



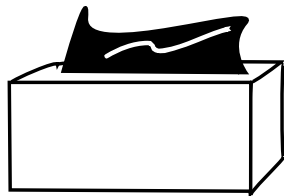
Dawn



glycerin



white vinegar



large plastic trash bags



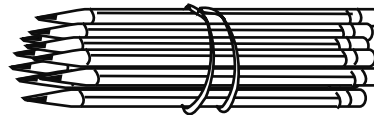
tall, clear glass



pitcher



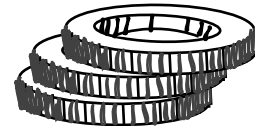
straws



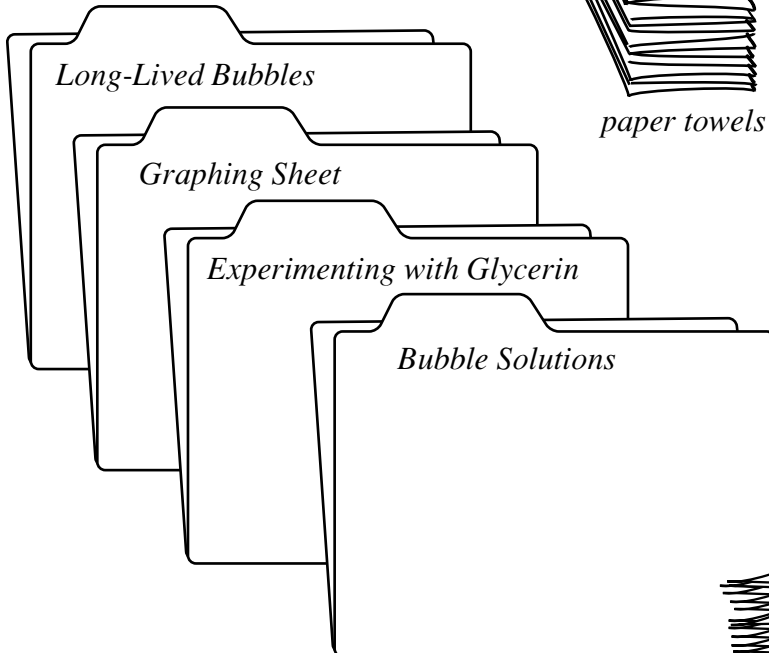
pencils



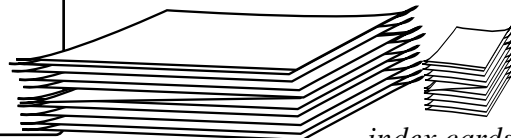
paper towels



masking tape



newspaper



white paper

index cards

Build It! Festival

Non-Consumables

(Materials required for one station)

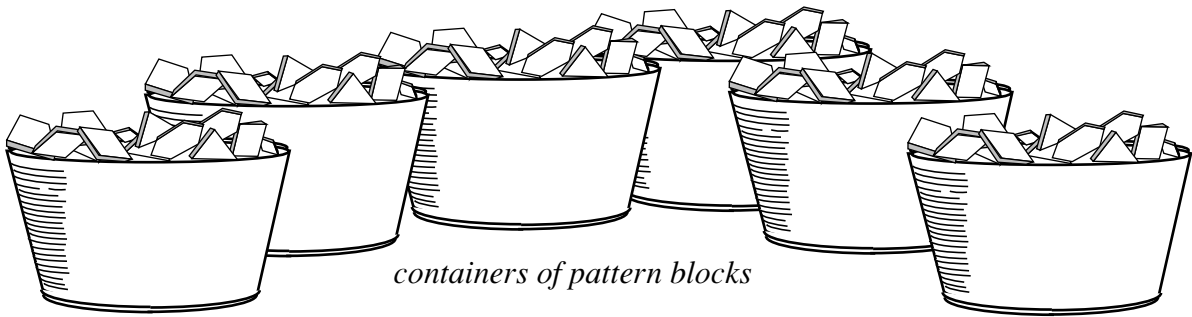
- 1 *Build It! Festival* Teacher's Guide
- 6 containers of 250 wooden pattern blocks each—each container will hold a mixture of triangles, squares, parallelograms, trapezoids, and hexagons
- 16 manila folders or hard-bound books
- 6 Create-A-Shape templates (on card stock)
- 50 triangle polydrons
- 50 square polydrons
- 25 pentagon polydrons
- 1 container to store the polydrons
- 32 Fill-A-Shape cards (on card stock)
- 32 Symmetry cards (on card stock)
- 32 What Comes Next? cards (on card stock)
- 32 Tessellations cards (on card stock)

Optional:

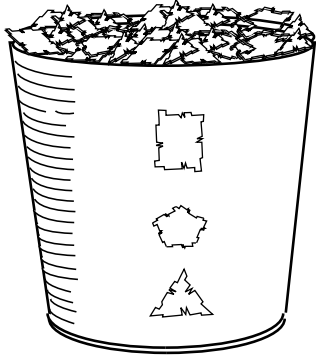
- 16 small mirrors
- for station direction signs: white paper and extra manila folders (two per sign)
- 1 each of the six shapes from the Pattern Block Carpet Tiles*

*The Carpet Tiles have to be purchased in a set with more than one of each shape. For your classroom kit, you only need one of each of the six shapes. One purchase of Carpet Tiles can make several classroom kits.

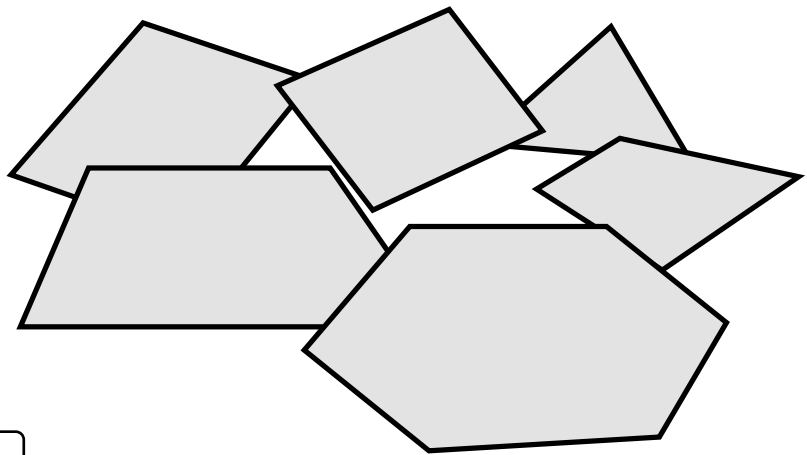
List continued on page 24



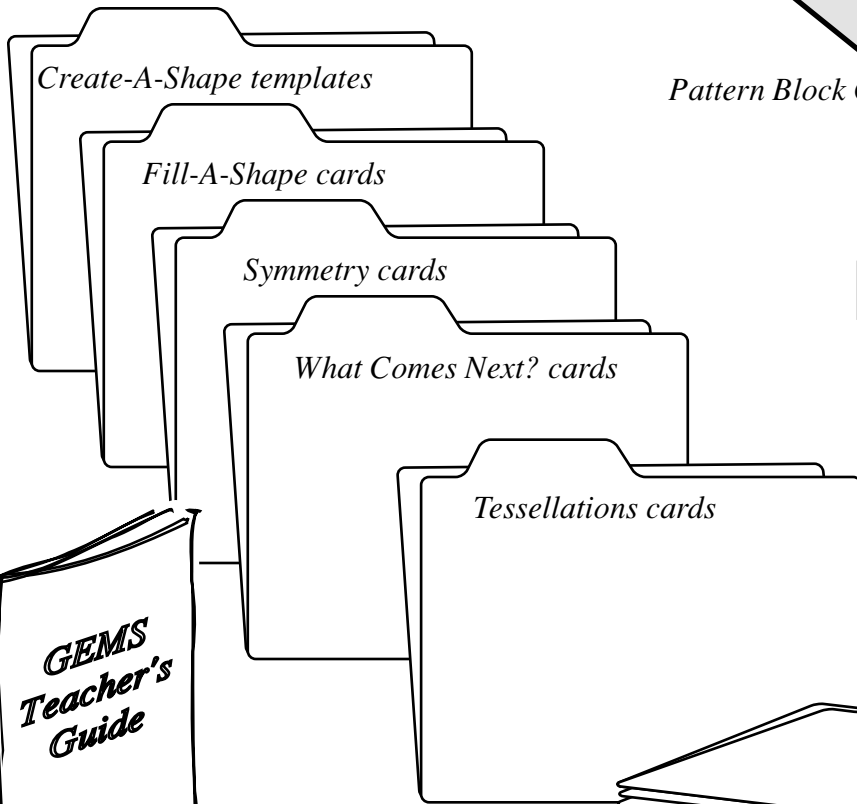
containers of pattern blocks



container of polydrons



Pattern Block Carpet Tiles (optional)



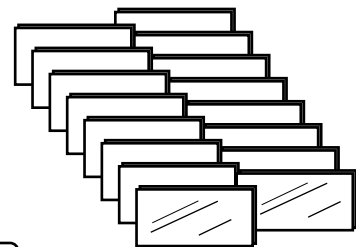
Create-A-Shape templates

Fill-A-Shape cards

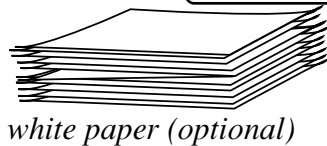
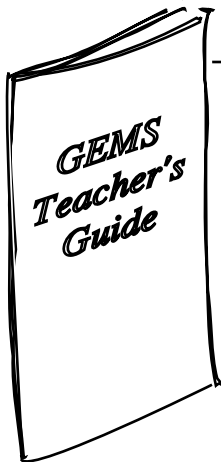
Symmetry cards

What Comes Next? cards

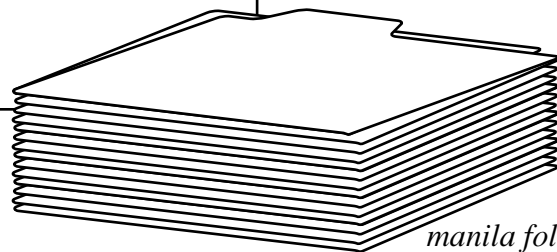
Tessellations cards



small mirrors (optional)



white paper (optional)



manila folders

Build It! Festival

List continued from page 22

Consumables

- 32 copies of the Tangram master duplicated on 4 different colors of paper (8 of each color) **or**
- 32 sheets of paper, 8½" x 8½" (22 cm x 22 cm), 8 each of 4 different colors
- 1 large square of paper, approximately 12" x 12" (30 cm x 30 cm), to model making tangrams
- 100 non-flexible, plastic drinking straws, cut into thirds
- 300 sheets of old newspaper to make dowels

Optional:

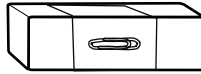
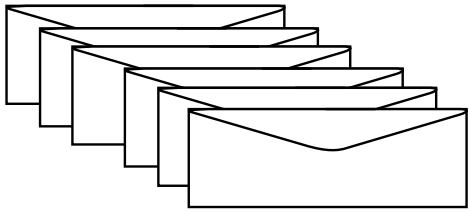
- 32 envelopes or paper clips to hold tangram shape pieces

General Supplies

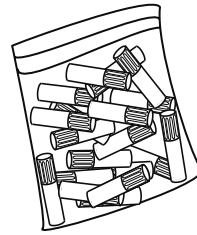
- 6 containers for straws cut into thirds
- 1 ream of white card stock for activity cards
- 6 scissors per station for Create-A-Shape and Tangram stations
- 6 pencils per station for Create-A-Shape
- 16 glue sticks
- 16 sets of markers, colored pencils, and/or crayons
- 6+ rolls of masking tape
- 1 box of paper clips
- 16 rulers
- 12 sheets large construction paper
- butcher paper and markers **or** overhead projector, transparencies, and markers (if no chalkboard is available)

Optional:

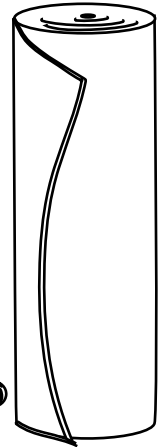
- 1 laminator (or clear contact paper)
- rubber cement to glue signs onto manila folders
- 1 roll of transparent tape



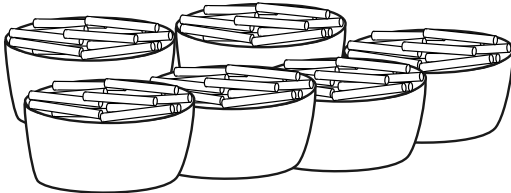
*envelopes or
paper clips
(optional)*



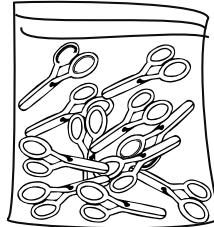
glue sticks



*butcher paper
and markers;
OR overhead
projector,
transparencies,
and markers;
OR chalkboard*



containers of cut straws



scissors



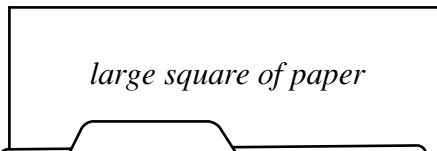
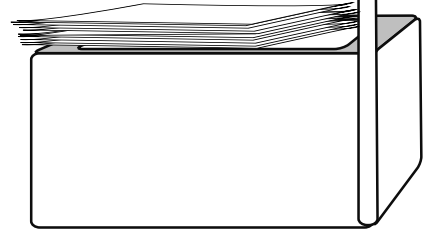
*transparent tape
(optional)*



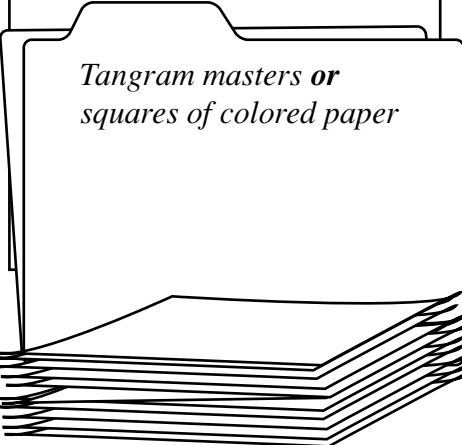
rulers



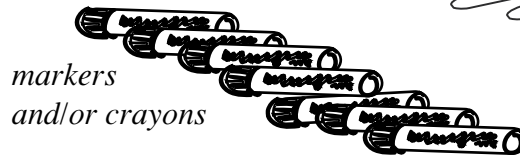
pencils



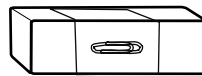
large square of paper



*Tangram masters or
squares of colored paper*



*markers
and/or crayons*



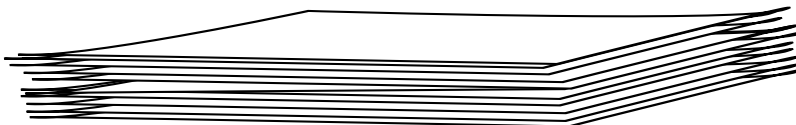
paper clips



newspaper

white card stock

large construction paper



masking tape



lanimator or clear contact paper (optional)

*rubber
cement
(optional)*



Buzzing A Hive

Non-Consumables

- 1 *Buzzing A Hive* Teacher's Guide
The following posters are included in the Teacher's Guide on heavy stock "tear out" pages: The Honey Bee; Bee Covered with Pollen; Bee's Pollen Baskets; Bee's Proboscis; Beehives; Inside the Hive; Bee with Wax Scales; Bees Hanging in Chains; The Queen Bee and Her Eggs; The Larvae; The Pupae
- 1 chunk of wax (beeswax if possible)
- other wax objects, such as birthday candles, crayons, and lipstick
- 4 cafeteria trays
- 18 containers for paper pollen, stamens, and live flowers (plastic cups and/or small yogurt containers work well)
- 6 dead bees
- 6 cotton balls
- 1 egg carton

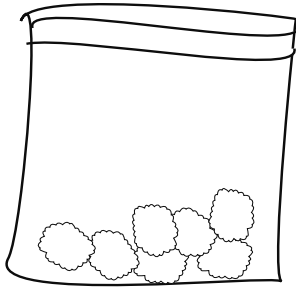
Optional:

- several empty pieces of honeycomb
- 6 magnifying lenses

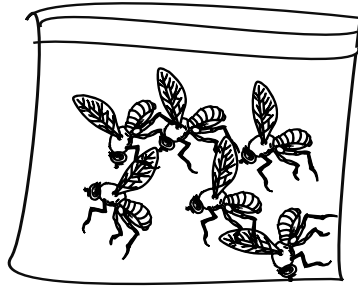
Consumables

- 1 piece of 4' x 18' (1.3 meters x 18 meters) blue butcher paper
- 1 piece of 3½' x 8' (1 meter x 8 meters) yellow, brown, or white butcher paper
- 28 pieces of 9" x 12" (23 cm x 30 cm) white construction paper
- 16 pieces of 9" x 12" (23 cm x 30 cm) orange construction paper
- 20 pieces of 9" x 12" (23 cm x 30 cm) green construction paper
- 12 pieces of 9" x 12" (23 cm x 30 cm) yellow construction paper
- 2 pieces of 9" x 12" (23 cm x 30 cm) brown construction paper
- 36 pieces of 9" x 12" (23 cm x 30 cm) black construction paper
- 33 live flowers with pollen
- 1 bunch of live flowers
- 66 cotton balls
- 1 bottle or can of fruit juice, 64 oz.
- 1 jar of honey, 8 oz.
- 1 roll of waxed paper
- 100 paper cups, 3 oz.
- 33 non-flexible, plastic drinking straws

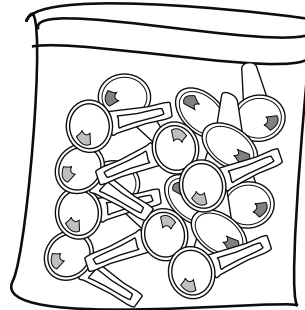
List continued on page 28



cotton balls



dead bees



magnifiers (optional)



colored
butcher
paper

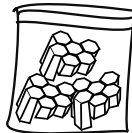


live flowers
with pollen

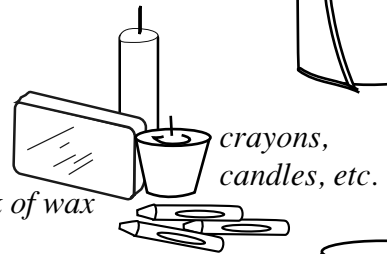
cups



bunch
of live
flowers

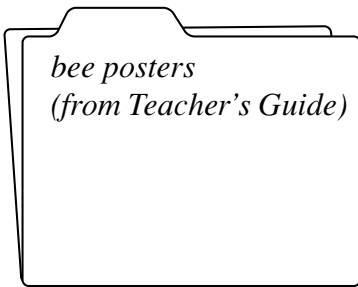


pieces of empty
honeycomb (optional)



chunk of wax

crayons,
candles, etc.



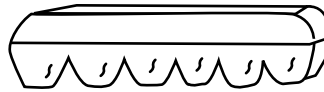
bee posters
(from Teacher's Guide)



straws



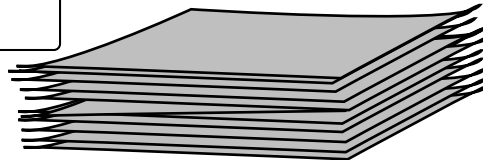
containers



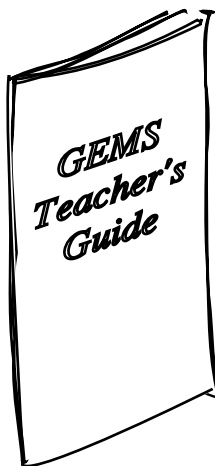
egg carton



waxed paper



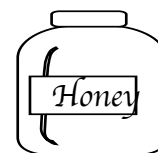
white, orange, green, yellow, brown, and
black construction paper



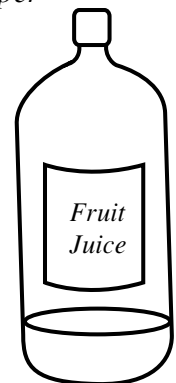
GEMS
Teacher's
Guide



cafeteria trays



honey



fruit juice

Buzzing A Hive

List continued from page 26

Consumables (continued)

- 33 cardboard egg cartons, preferably yellow
- 1 container of honeycomb, 8 oz.
- 4 graham crackers and a small bag (paper or plastic) for crunching the crackers
- 1 bottle of peppermint extract or any familiar scent

Copies of the following:

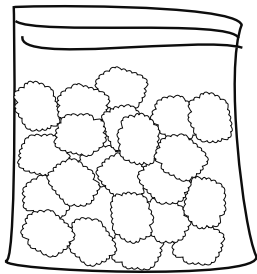
- 35 Honeybee Poster

Optional:

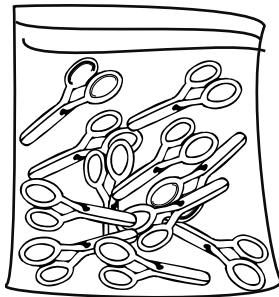
- 1 bottle of another familiar scent or extract
- 12+ cotton balls
- 1 plastic bag for cotton balls
- 3 bee frames containing brood chambers, honey, pollen
- 1 bunch of flowers full of pollen
- toothpicks
- 32 large brown paper grocery bags

General Supplies

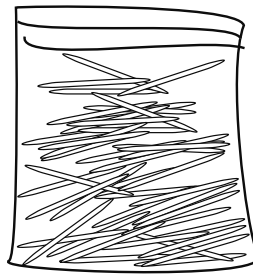
- 32 scissors
- 33 pencils
- white glue or paste
- old newspapers
- 1 pair of adult scissors
- paper towels
- sponges
- 33 white crayons or pieces of chalk



more cotton balls
(optional)



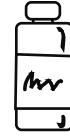
scissors



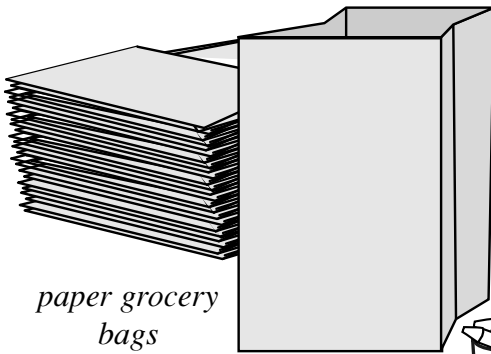
toothpicks
(optional)



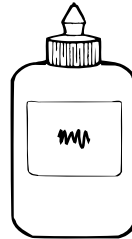
peppermint
extract



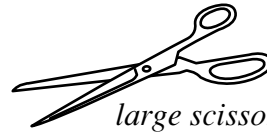
different scent
(optional)



paper grocery
bags



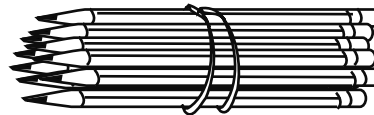
glue



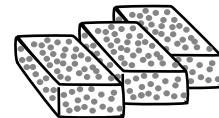
large scissors



flowers
with pollen
(optional)



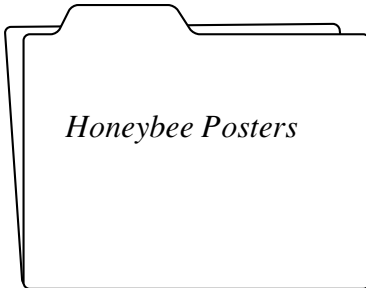
pencils



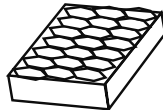
sponges



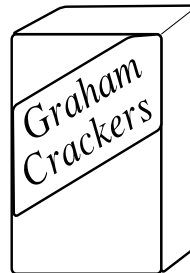
white crayons or chalk



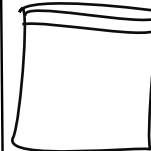
Honeybee Posters



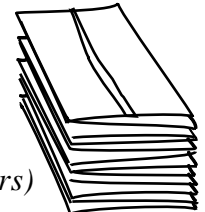
honeycomb



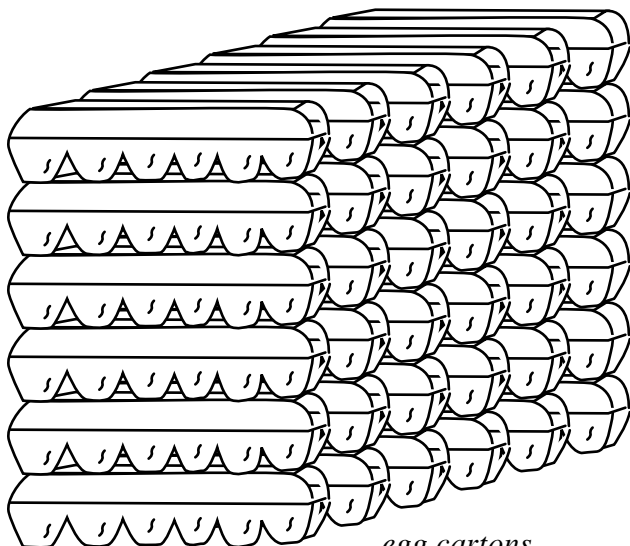
graham crackers



small bag (for
smashing crackers)



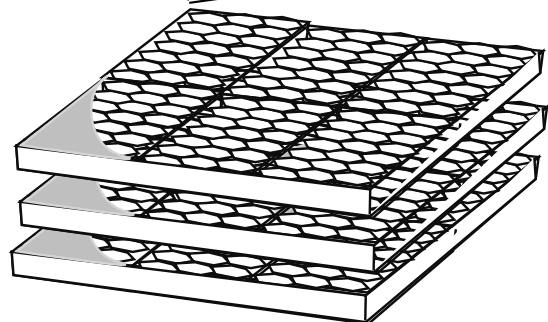
paper towels



egg cartons



newspaper



bee frames with
brood chambers, honey, pollen (optional)

Chemical Reactions

Non-Consumables

- 1 *Chemical Reactions* Teacher's Guide
- 8 cafeteria trays
- 8 clear, plastic graduated cylinders for measuring 10 ml quantities
- 16 medium-sized plastic squeeze bottles with lids (8–12 oz.; 250–375 ml)
- 16 wide-mouthed plastic containers with lids (yogurt type, 12–16 oz. capacity)
- 16 measuring spoons, teaspoon size
- 16 plastic stir sticks
- 32 plastic vials, about 15–25 ml capacity
- 1 large container for making phenol red solution, plastic, screw top, about 4 liter (1 gal.) capacity
- 1 plastic bucket, about 1 gal. (4 liter) capacity or larger
- 1 pair of rubber gloves

Consumables

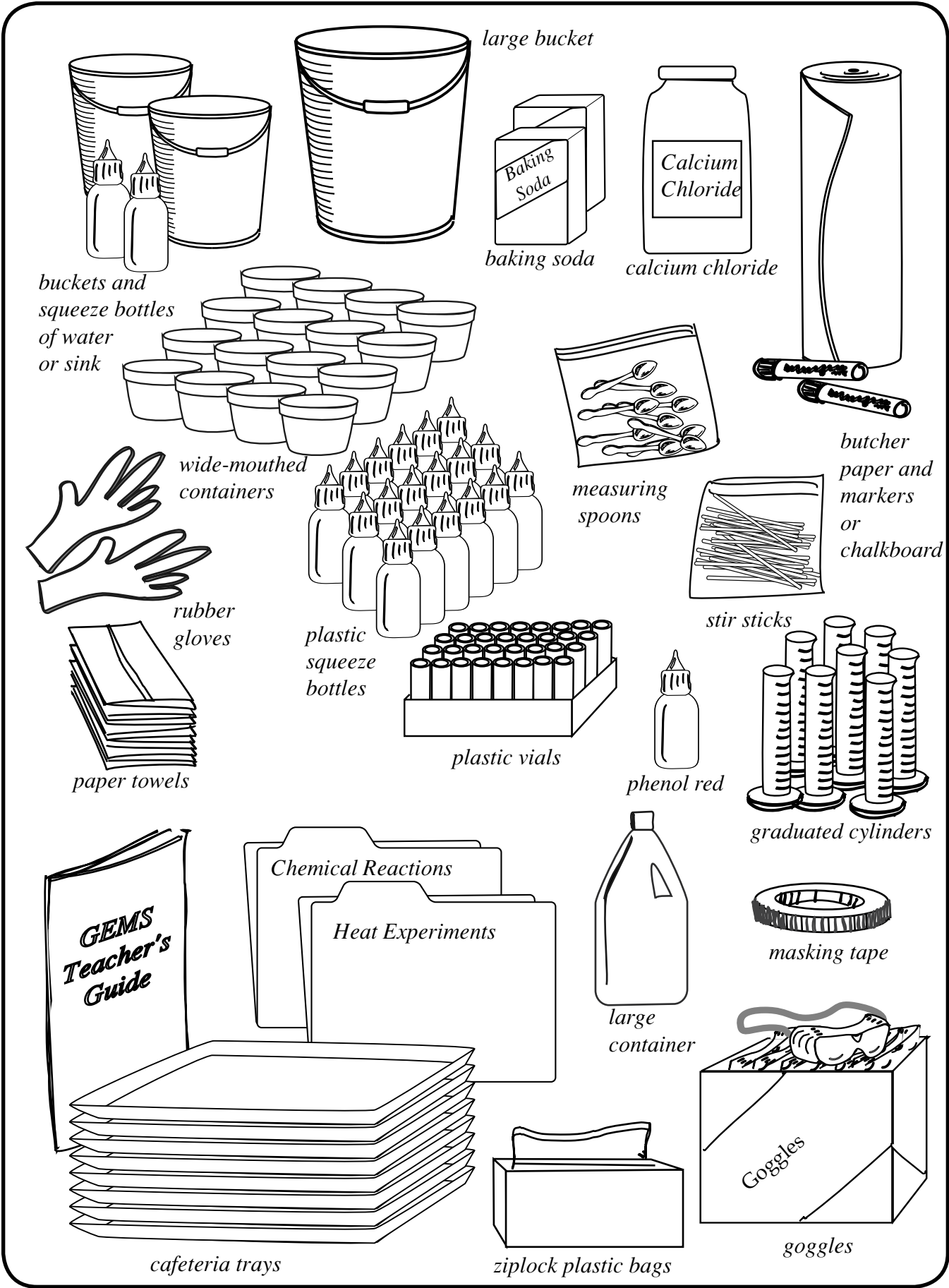
- 1½ lbs. baking soda
- 3 lbs. (about 1.5 kg) calcium chloride
- 1 small bottle of phenol red powder (about 5 g)
or about 1 gallon (4 liters) of dilute phenol red solution
- 80 ziplock plastic bags (1 qt. capacity)
- tap water

Copies of the following:

- 32 *Chemical Reactions*
- 80 *Heat Experiments*

General Supplies

- 32 pairs of safety goggles
- paper towels
- 1 roll of masking tape
- butcher paper and markers (if no chalkboard is available)
- 2 buckets and squeeze bottles of water (if no sink is available)



Color Analyzers

Non-Consumables

- 1 *Color Analyzers* Teacher's Guide
- 1 packet* of materials containing: 1 piece of red filter gel, 6" x 6" (15 cm x 15 cm); 1 piece of green filter gel, 6" x 6" (15 cm x 15 cm); 1 piece of diffraction grating, 6" x 6" (15 cm x 15 cm)
- 1 lamp with no shade
- 1 light bulb, 60–100 watts
- 3 pieces of construction paper (one each of red, green, and black)
- 5–6 various colored lights (such as Christmas lights, gas discharge lamps, fluorescent lights, and colored light bulbs)

Optional:

- 1 slide projector and prism

*One packet of filter gels and diffraction grating material comes attached to the inside of the back cover of the *Color Analyzers* Teacher's Guide. New packets may be ordered from the GEMS kits supplier (lhsgems.org/gemskits.html)

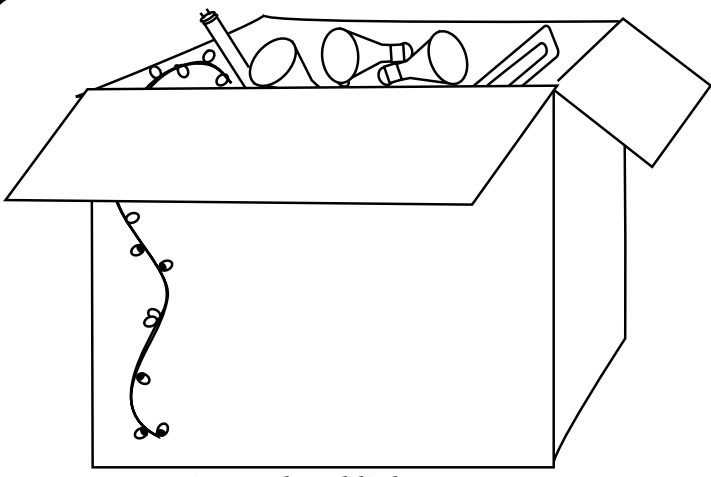
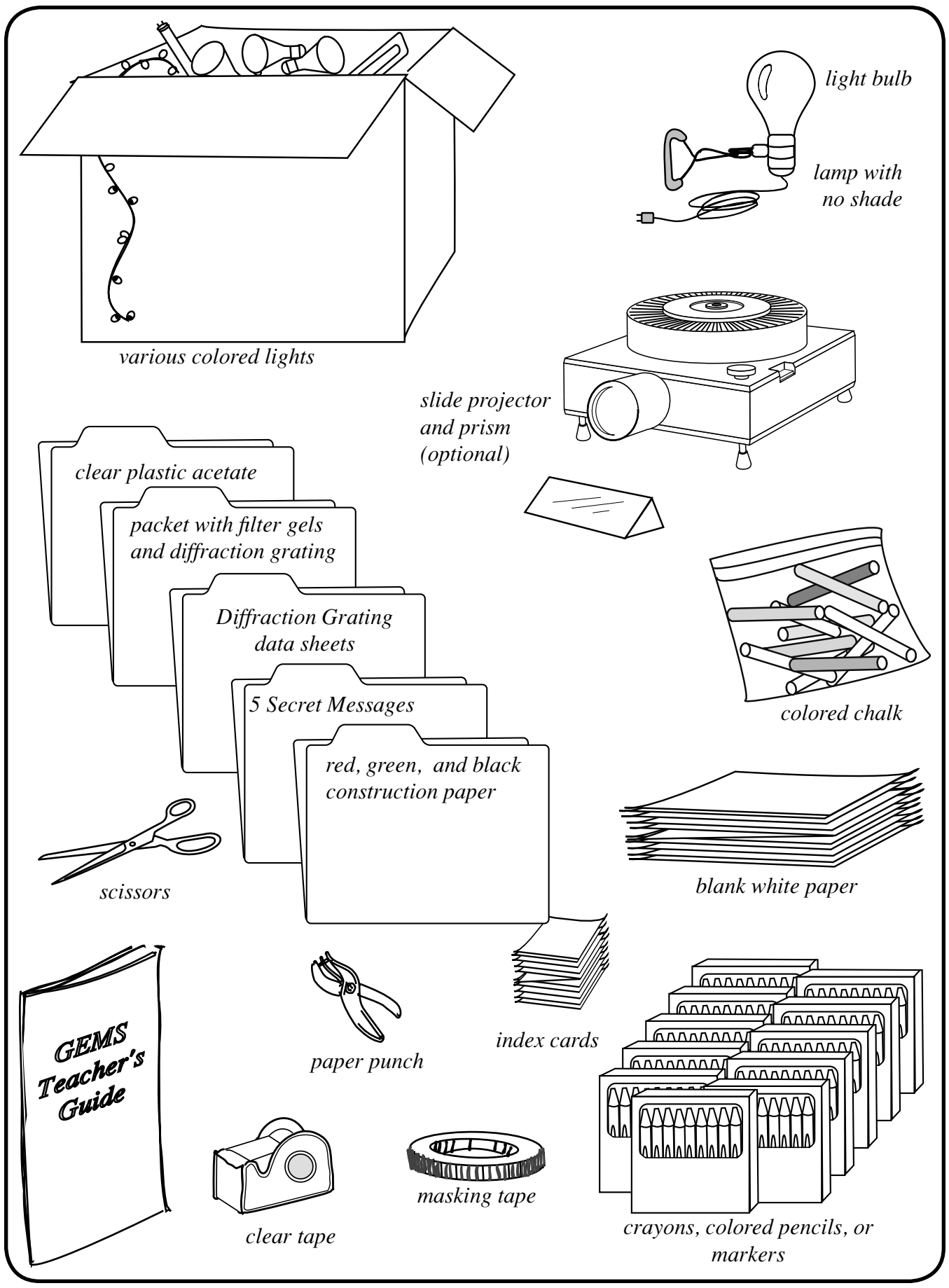
Consumables

Copies of the following:

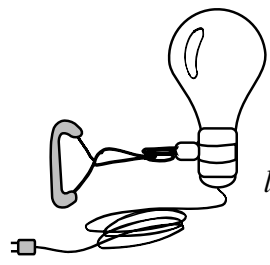
- 8 sets of the 5 Secret Messages
- 33 Diffraction Grating data sheet

General Supplies

- 1 box of colored chalk or large piece of paper and colored markers
- 9 sets of crayons, colored pencils, or markers containing: red, orange, yellow, green, blue, and purple
- 1 roll of masking tape
- 70 pieces of blank white paper
- 1 paper cutter or pair of scissors
- 1 roll of clear tape
- 1 single-hole paper punch
- 1 piece of thin, clear, plastic acetate, such as an overhead transparency
- 36 3" x 5" (8 cm x 13 cm) index cards

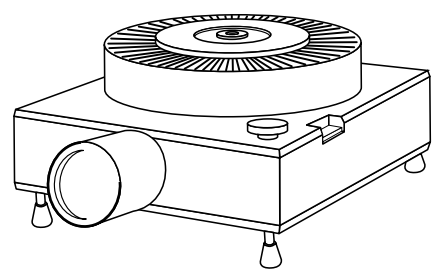


various colored lights

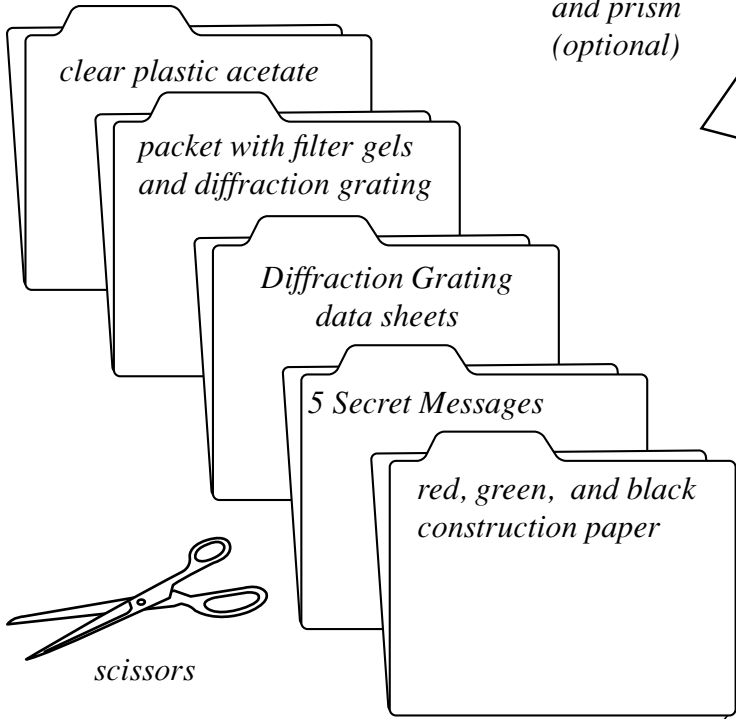


light bulb

lamp with no shade



slide projector and prism (optional)



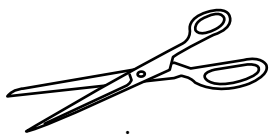
clear plastic acetate

packet with filter gels and diffraction grating

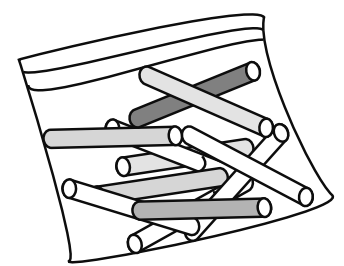
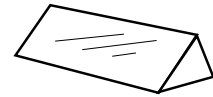
Diffraction Grating data sheets

5 Secret Messages

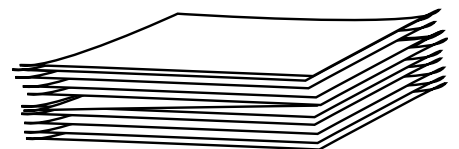
red, green, and black construction paper



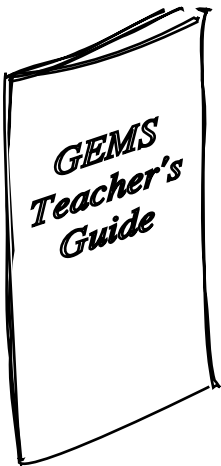
scissors



colored chalk



blank white paper



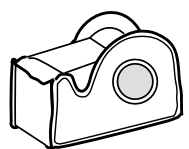
GEMS Teacher's Guide



paper punch



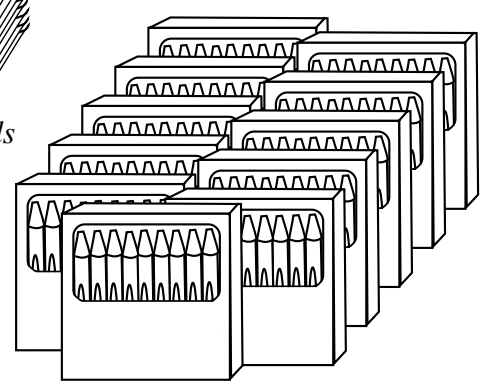
index cards



clear tape



masking tape



crayons, colored pencils, or markers

Convection: A Current Event

Non-Consumables

- 1 *Convection: A Current Event* Teacher's Guide
- 4 pitchers, bottles, or jugs, at least 1 liter
- 1 electric coffee maker to provide 4 liters (1 gal.) very hot water
- 8 wide-mouthed paper or plastic cups (6 oz.)
- 8 pans, made of thin, clear plastic, about 8" diam.*
- 8 medicine droppers
- 32 styrofoam cups (6 oz. or 8 oz.)
- 1 deep basin, large bowl, or bucket (4–10 liters; 1–3 gal.) for collecting used water
- 1 Pyrex Petri dish or some other wide-mouthed heat resistant container (no top needed)
- 1 hot plate
- 1 hot pad holder or tongs
- 1 peanut butter jar or 500 ml beaker

Consumables

- 1 short votive candle
- matches
- 1 box of baking soda (need 1 tablespoon)
- 1 small bottle of vinegar (need about $\frac{1}{2}$ cup—100 ml)
- 2 small squeeze bottles of blue or green food color, 1 oz.
- 1 bottle flavored extract, strawberry, coconut, or lemon, 1 oz.

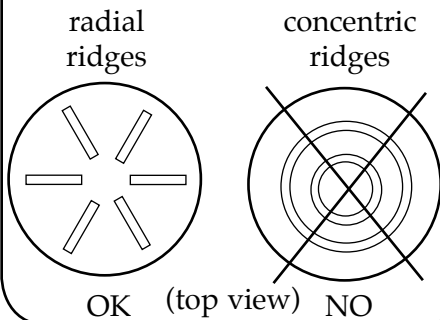
Copies of the following:

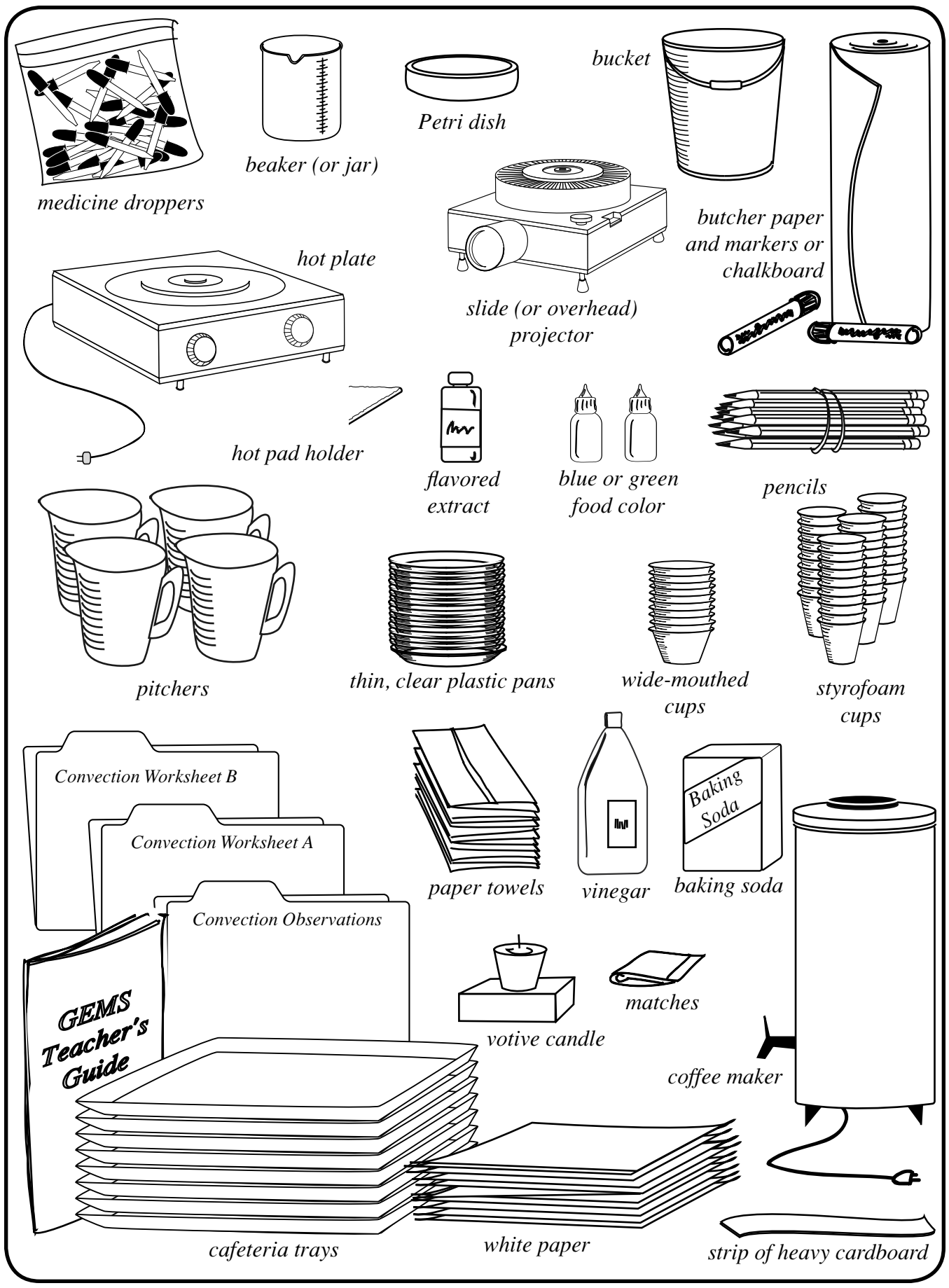
- 100 Convection Observations
- 32 Convection Worksheet A
- 32 Convection Worksheet B

General Supplies

- 1 overhead projector or slide projector
- 1 strip of heavy stock cardboard, about 12" x 3" (30 cm x 8 cm)
- butcher paper and markers (if no chalkboard is available)
- 16 pieces of $8\frac{1}{2}$ " x 11" (22 cm x 28 cm) white paper
- pencils
- 8 cafeteria trays
- paper towels

* Clear plastic pans made to keep under plants work well. Certain clear plastic flat-bottomed fast food containers can work also. Aluminum pie pans may be substituted. Pans must be thin enough to easily conduct heat. Ridges on bottom can be radial, but not concentric.





medicine droppers

beaker (or jar)

Petri dish

bucket

butcher paper and markers or chalkboard

hot plate

slide (or overhead) projector

hot pad holder

flavored extract

blue or green food color

pencils

pitchers

thin, clear plastic pans

wide-mouthed cups

styrofoam cups

Convection Worksheet B

Convection Worksheet A

Convection Observations

paper towels

vinegar

baking soda

GEMS Teacher's Guide

votive candle

matches

coffee maker

cafeteria trays

white paper

strip of heavy cardboard

Crime Lab Chemistry

Note: Guide has been revised since handbook was developed. Please check teacher's guide for updated listing.

Non-Consumables

- 1 *Crime Lab Chemistry* Teacher's Guide
- 96 unsharpened pencils
- 10 wallpaper troughs, about 30" x 6" x 6" (76 cm x 15 cm x 15 cm), found in hardware stores
- 12 black felt-tipped pens (2 each of the following 6 suggested brands—all with fine- or medium-fine points: Flair, Sanford Sharpie (permanent), Pentel #S360 fine point, Marvy LePen, NIJI Stylist, Sanford's Vis-a-Vis Overhead Pen)

Optional:

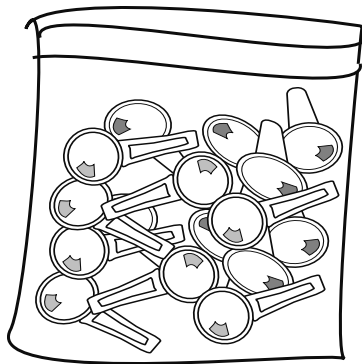
- 16 magnifying lenses

Consumables

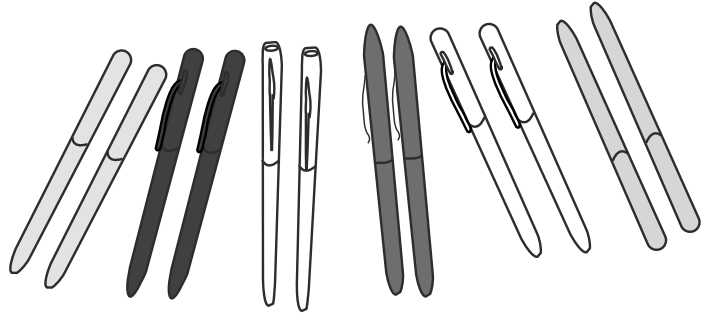
- 100 *white* paper towels (institutional or generic; must be all the same; large round white coffee filters may be used; white household paper towels can be used in a pinch, but don't work as well)

General Supplies

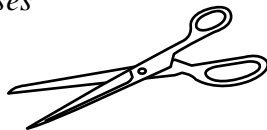
- 1 pair of adult scissors
- paper towels
- 1 ruler, 12" (30 cm)
- 1 roll of masking tape
- 16 pieces of 8½" x 11" (22 cm x 28 cm) white paper
- water—in pitchers if no sink is available; also bucket for liquid discard



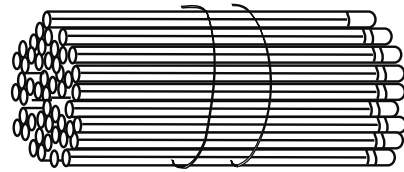
*magnifying lenses
(optional)*



*felt-tipped pens,
two each of six brands*



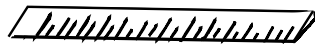
large scissors



*unsharpened
pencils*

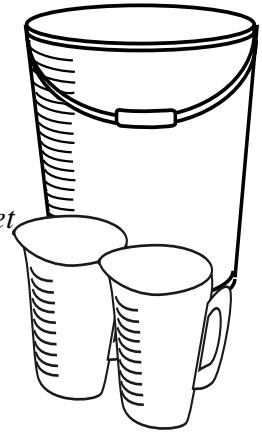


masking tape

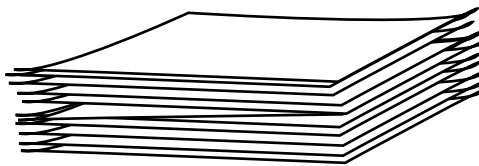


ruler

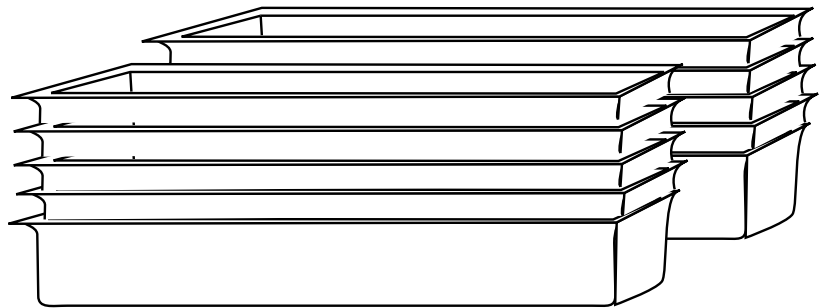
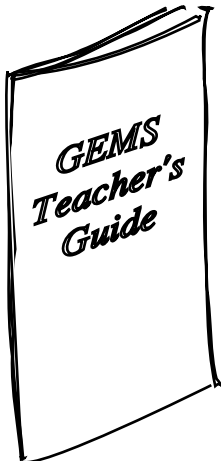
*pitchers of
water and
discard bucket
or sink*



*white paper
towels*



white paper



*wallpaper
troughs*

Discovering Density

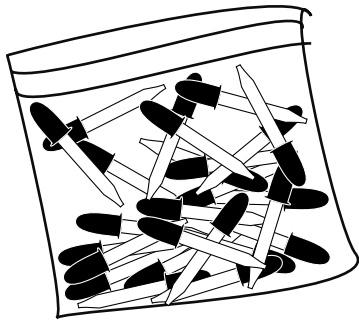
Non-Consumables

- 1 *Discovering Density* Teacher's Guide
- 8 wide-mouthed plastic containers with screw-top lids—1 qt. (1 liter) capacity
- 13 measuring spoons (1 tablespoon size)
- 1 measuring cup, 2–3 cup (500–750 ml) capacity
- 8 measuring cups, 1–2 cup (250–500 ml) capacity
- 32 medicine droppers with glass tubes
- 8 wide-mouthed plastic containers, yogurt type, 16 oz. (500 ml)
- 22 plastic stirrers
- 1 small bag marbles (12 or more)
- 108 wide-mouthed plastic cups, about 9 oz. (250 ml), clear, colorless, flexible
- 1 sharp knife for cutting potatoes
- 1 cup sand or gravel
- 1 cup rice puffs cereal
- 3 business size envelopes
- 4 paper clips

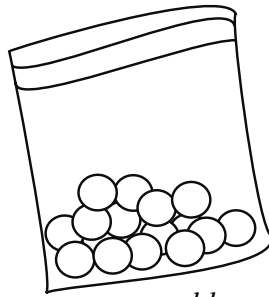
Optional:

- a spring scale or balance
- calculator

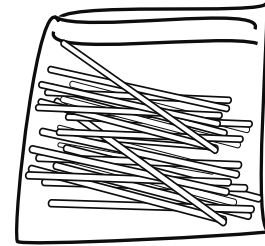
List continued on page 40



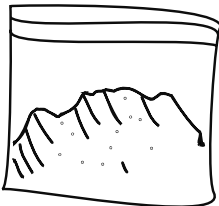
medicine droppers



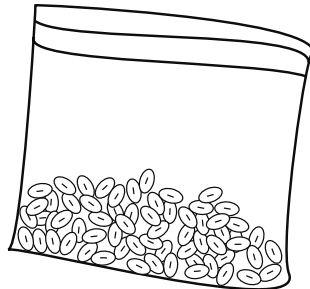
marbles



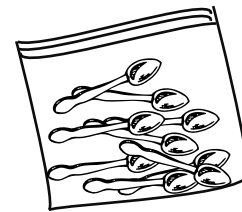
plastic stirrers



sand or gravel



rice puffs cereal



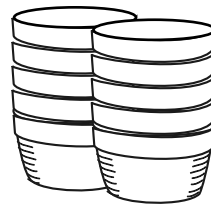
measuring spoons



small measuring cups



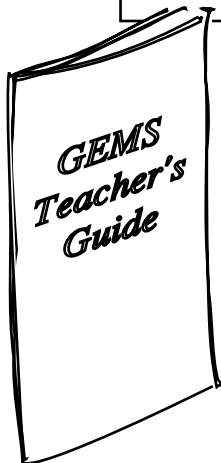
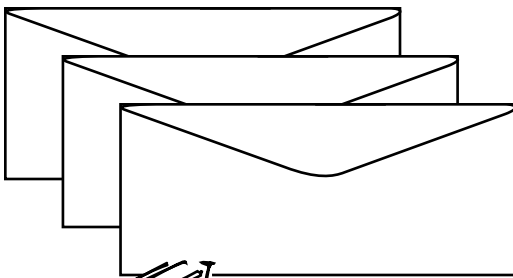
large measuring cup



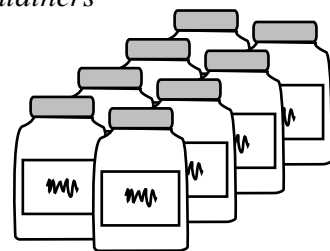
wide-mouthed plastic containers



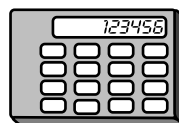
sharp knife



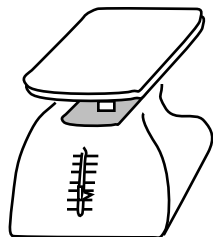
paper clips



wide-mouthed containers with screw-top lids



calculator (optional)



scale (optional)



wide-mouthed plastic cups

Discovering Density

List continued from page 38

Consumables

- 4 small squeeze bottles (with screw-top lid) of red food color
- 4 small squeeze bottles (with screw-top lid) of blue food color
- 4 small squeeze bottles (with screw-top lid) of yellow food color
- 4 small squeeze bottles (with screw-top lid) of green food color
- 2 large boxes kosher salt, 48 oz. each
- 1 bottle glycerin, 16 oz.
- 150 clear, plastic straws, about $\frac{1}{4}$ " diam.
- 1 bottle alcohol, 16 oz. (500 ml), denatured or isopropyl/rubbing alcohol
- 1 5 lb. bag of potatoes

Copies of the following:

- 56 Liquid Layers data sheets
- 1 Secret Formulas Team 1 sheet
- 1 Secret Formulas Team 2 sheet
- 1 Secret Formulas Team 3 sheet
- 1 Puzzling Scenarios data sheet

In Session 5, the teacher will need $\frac{1}{2}$ cup each of ice water and "very hot" water. These are not listed as part of the kit, but it would be a good idea to put a special label on the kit container as a reminder to the teacher that those items will be needed.

General Supplies

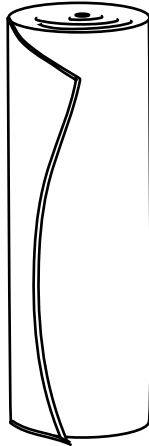
- 1 roll masking tape
- paper towels
- 1 pair of adult scissors
- 8 plastic cafeteria trays
- water, about 1 qt. (1 liter)—in pitchers if no sink is available; also a bucket for liquid discard
- 32 pencils
- paper, $8\frac{1}{2}$ " x 11" (22 cm x 28 cm)

Optional:

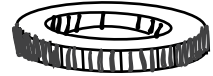
- large paper and crayons or markers



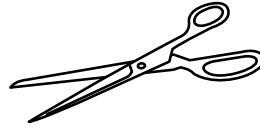
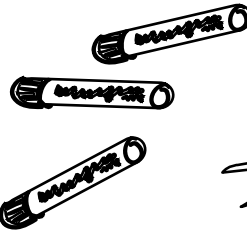
clear plastic straws



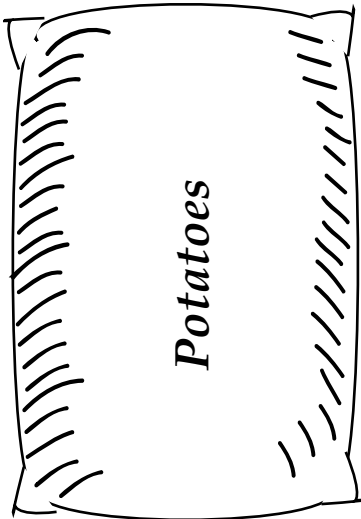
large paper and
crayons or markers
(optional)



masking tape



scissors



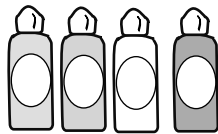
potatoes



pitchers of water
and discard bucket
or sink



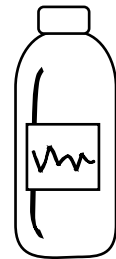
paper towels



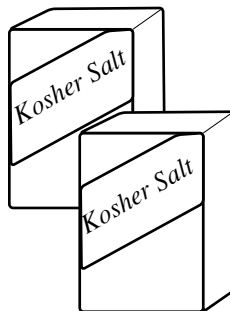
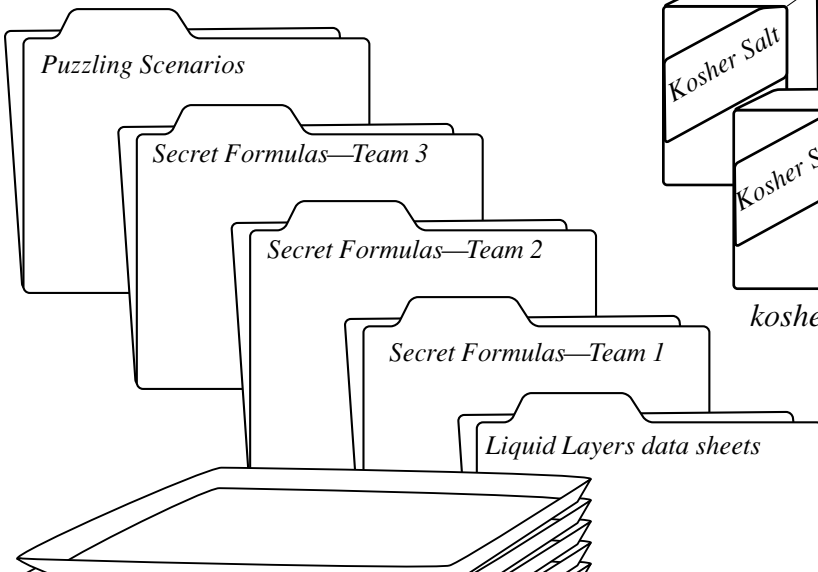
red, blue, yellow,
and green food color



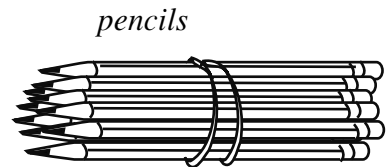
alcohol



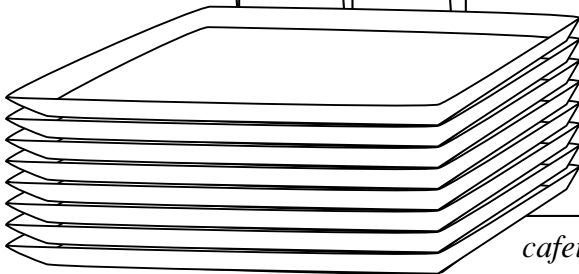
glycerin



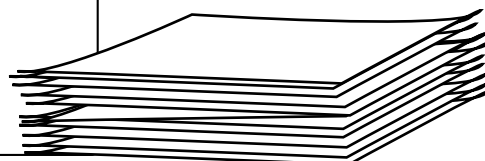
kosher salt



pencils



cafeteria trays



paper

Earth, Moon, and Stars

Non-Consumables

- 1 *Earth, Moon, and Stars* Teacher's Guide
- 8 Earth globes, solid or inflatable, or other large balls
- 8 small bowls or rolls of tape to support globes
- 1 lamp with no shade
- 1 extension cord, 25' (8 meters)
- 1 clear light bulb, 40–60 watt
- 1 clear light bulb, 75–100 watt
- 40 polystyrene balls or other opaque balls, about 2" (5 cm) diam.
- 1 box of large gold stars or large yellow round adhesive dots
- 1 box of small gold stars or small yellow round adhesive dots

Consumables

- 32 paper fasteners

Copies of the following:

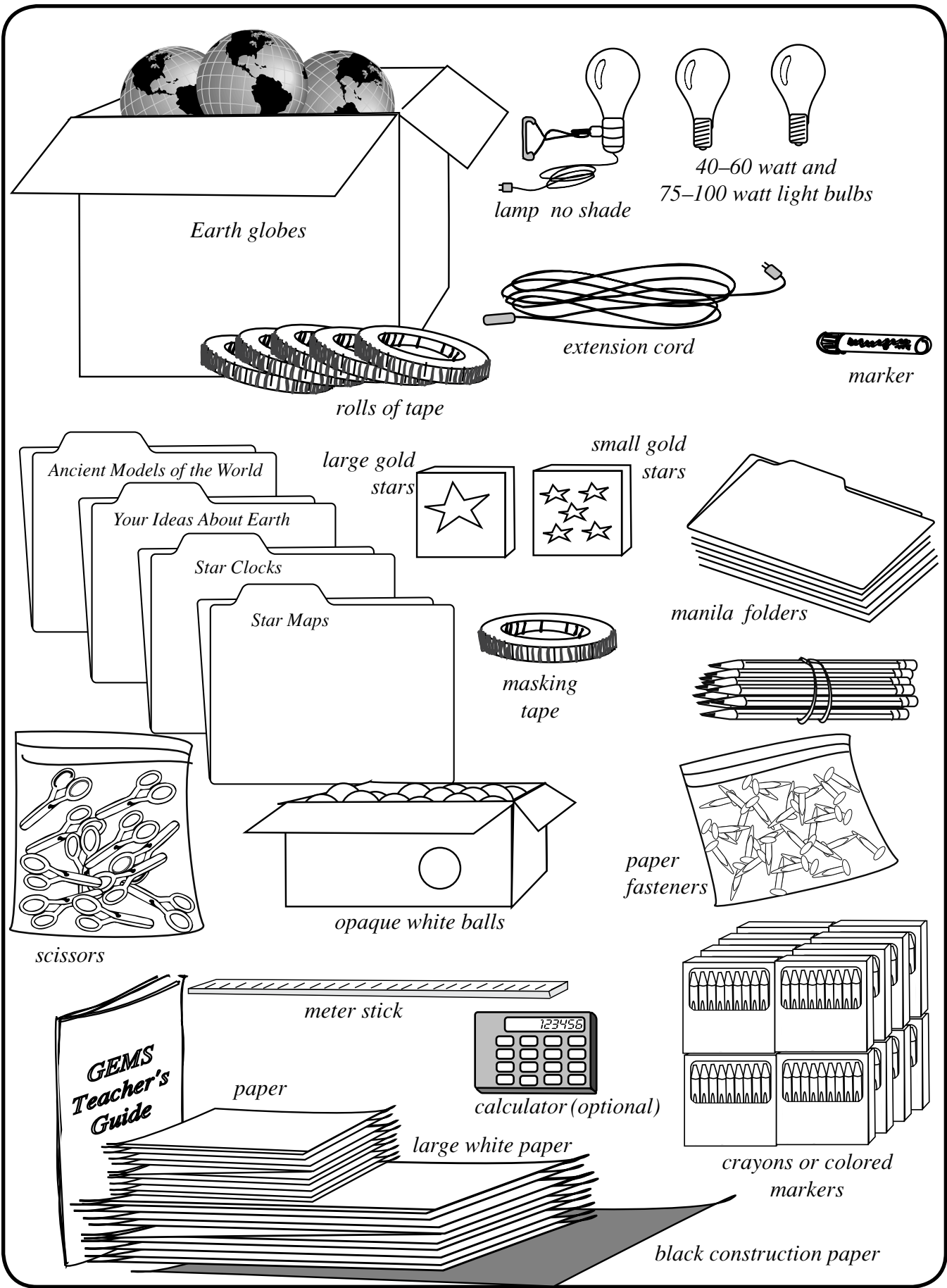
- 32 Ancient Models of the World
- 40 What Are Your Ideas About the Earth?
- 32 Instruction Sheets for Star Clocks
- 32 Current star maps

General Supplies

- 1 piece of black construction paper, 16" x 20" (40 cm x 50 cm) or larger
- 1 meter stick
- 1 marker
- 16 sets of crayons or colored markers
- 18 large pieces of white paper (butcher paper) or cardboard
- pencils
- 1 roll of masking tape
- 320 pieces of 8½" x 11" (22 cm x 28 cm) blank paper for student records of the moon
- 32 manila folders
- 32 scissors

Optional:

- 1 calculator



Earthworms

Non-Consumables

- 1 *Earthworms* Teacher's Guide
- 1 timepiece with second hand
- 3 Celsius thermometers for water
- 3 water misters
- 3 wide-mouthed containers for water, 2 qt. (2 liter) capacity
- 1 bag of damp soil (or container with lid) for earthworms
- 1 container to hold at least 20 ice cubes
- 1 large thermos or coffee pot to hold or heat water to 35° C (95° F)
- 32 earthworms (redworms)
- 16 plastic Petri dishes (tops and bottoms)

Optional:

- 32 clear, colorless plastic cups
- 32 magnifying lenses

Consumables

- 5 gallons of aged tap water, pond water, or river water
- 20 ice cubes
- 19 paper towels

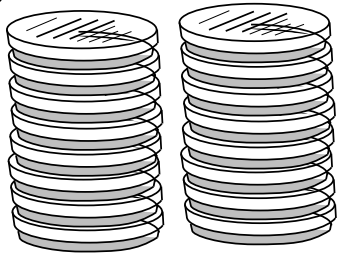
Copies of the following:

- 16 Student Data Sheets
- 16 Earthworm Graphing Sheets

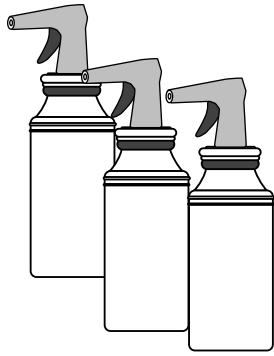
You may want to put a label on the kit container reminding teachers to get ice (at least 20 cubes).

General Supplies

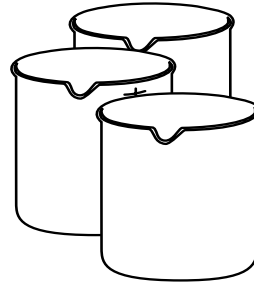
- 3 labels **or** 1 indelible marker to label water containers
- 16 containers for waste water
- 16 pencils
- 16 pieces of 8½" x 11" (22 cm x 28 cm) white paper



Petri dishes



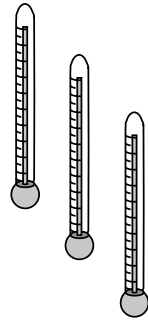
water misters



*wide-mouthed
containers*



pencils



*Celsius
thermometers*



*5 gallons of
aged water*



containers



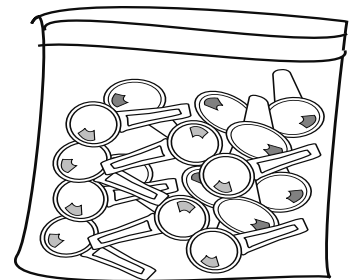
ice cubes



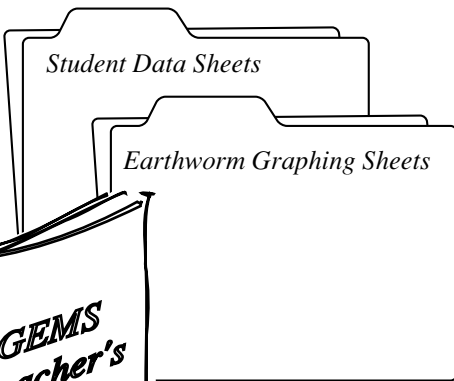
labels or indelible marker



clear plastic cups (optional)



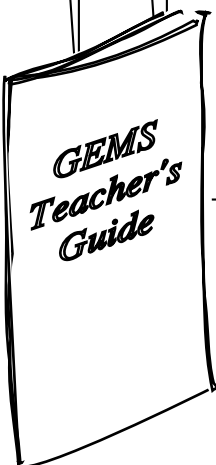
*magnifying lenses
(optional)*



Student Data Sheets

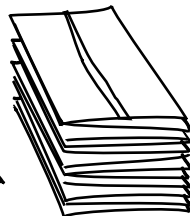
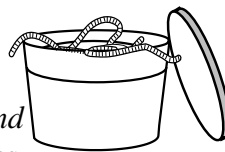
Earthworm Graphing Sheets

*timepiece
with second
hand*

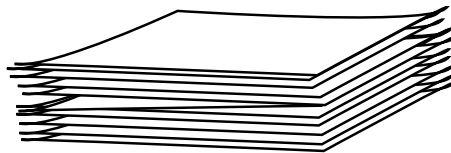


**GEMS
Teacher's
Guide**

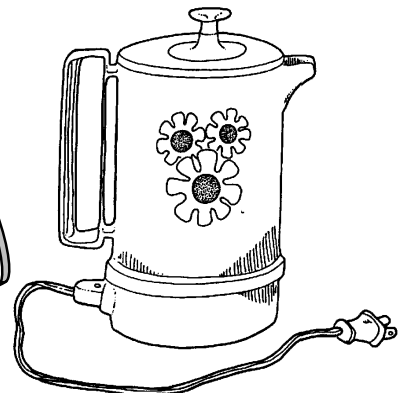
*container
with damp
soil, lid, and
earthworms*



paper towels



white paper



coffee pot (or thermos)

Experimenting with Model Rockets

Non-Consumables

- 1 *Experimenting with Model Rockets* Teacher's Guide
- 32 Height-O-Meters*
- 1 completed "Estes Viking" model rocket**
- 1 launch pad***
- 1 launch control device with batteries***
- 4 medium-size cardboard boxes, one with dividers, for class supplies****
- 12 shoe boxes for storing team supplies****
- 1 balloon for demonstrating rocketry principles
- 1 pair of pliers for removing engines
- 4 postal scales

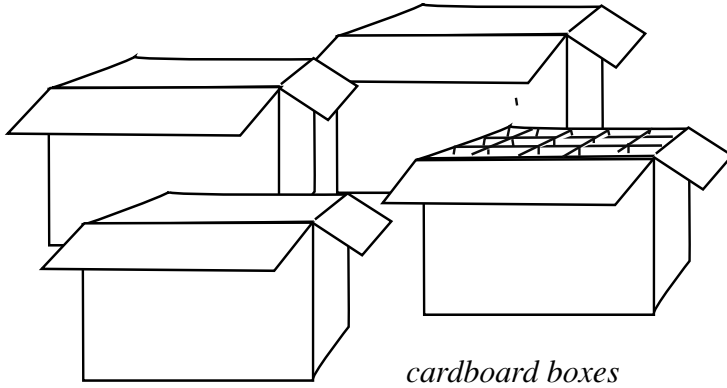
*The GEMS *Height-O-Meter* unit should be done before *Experimenting with Model Rockets*. In that unit, students make altitude-measuring instruments called Height-O-Meters which they use to measure the height of their rockets.

**Model rocketry materials are available from Estes Industries, Inc., 1295 H St., Penrose, CO 81240, (800) 525-7561.

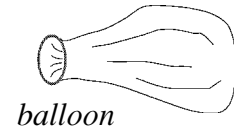
***These materials are included in one of the Estes Starter Kits.

****Pack the materials for each team of students into a shoe box. Organize materials for the entire class into two medium-size cardboard boxes: the Leader's Flight Box, with all of the launch supplies, and the Leader's Construction Box, with materials for building model rockets. Two other medium cardboard boxes are also useful: one for mounting the launch controller and one, with dividers, to store the students' completed rockets before launch.

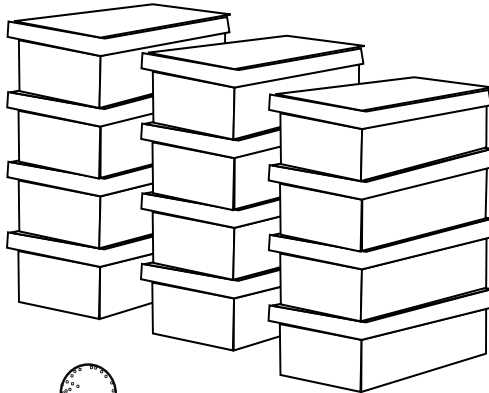
List continued on page 48



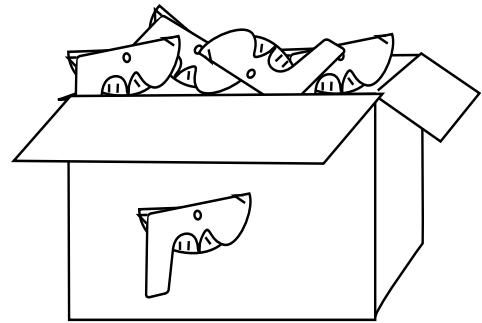
*cardboard boxes
(one with dividers)*



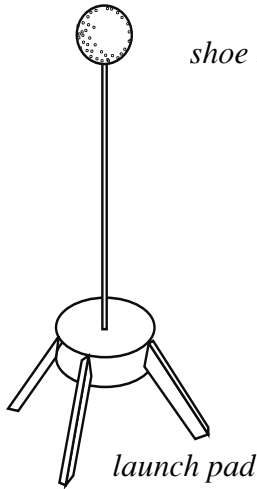
balloon



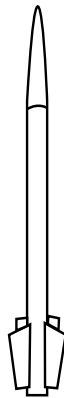
shoe boxes



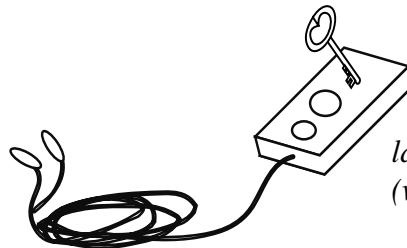
Height-O-Meters



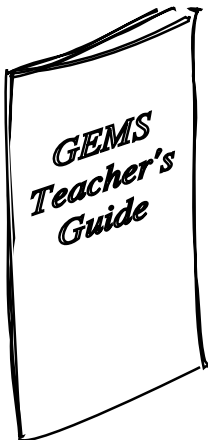
launch pad



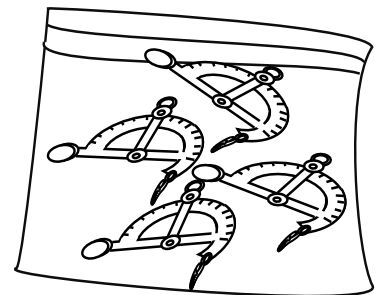
*"Estes Viking"
model rocket*



*launch control device
(with batteries)*



pliers



postal scales

Experimenting with Model Rockets

List continued from page 46

Consumables

- 14 "Estes Viking" model rocket kits*
- 15 model rocket engines**
- 1 tube plastic cement
- 1 package of flat toothpicks
- 4 sheets of medium sandpaper cut into 2" (5 cm) squares
- 12 small bottles of white glue (can be refilled)
- 3 sticks of plasticene clay
- 2 packages of extra Solar Igniters**
- 2 packages of fireproof wadding**

Copies of the following:

- 12 Experimenter's Guides (32 pages in length)
- 1 Leader's Launch Day Record
- 2 Captain's Launch Day Record
- 1 Countdown Checklist

General Supplies

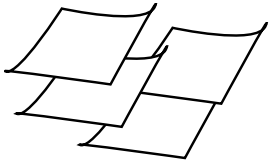
- old newspapers
- 5 rolls masking tape
- 5 pairs of scissors (to cut thin cardboard in rocket assembly)
- 1 utility knife for helping students with construction
- 1 ball of string, 50' (15.4 meters)
- 12 rulers
- 12 pencils
- 12 paper towels
- 12 plastic cups

Optional:

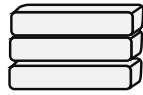
- 20-40 markers of assorted colors for coloring rockets
- 1 calculator

*Model rocketry materials are available from Estes Industries, Inc., 1295 H St., Penrose, CO 81240, (800) 525-7561.

**Engine size depends on the diameter of the launch area. For a very large launch areas, at least 200' (60 meters) in diameter, you can purchase the A8-5 engines. If the area is smaller than that, you should order the less powerful 1/2A6-2 engines.



medium sandpaper



plasticene clay



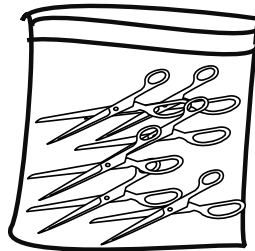
utility knife



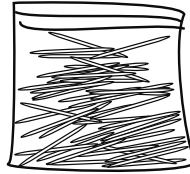
rulers



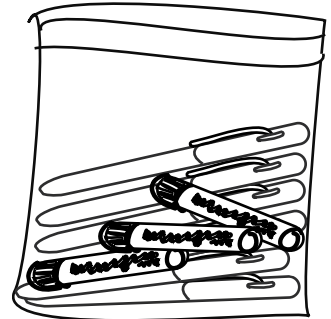
masking tape



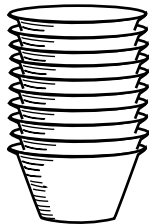
scissors



flat toothpicks



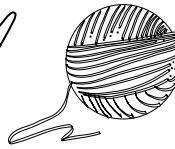
markers (optional)



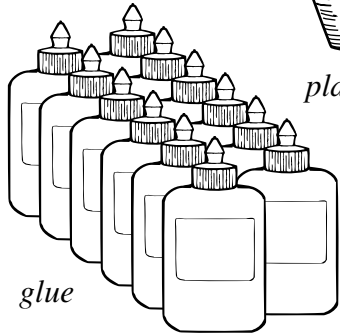
plastic cups



plastic cement



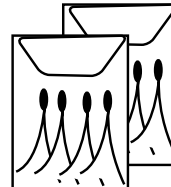
string



glue



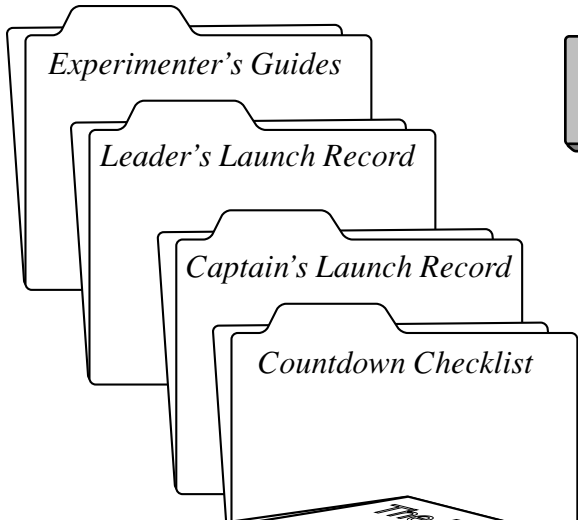
pencils



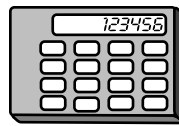
Solar Igniters



fireproof wadding



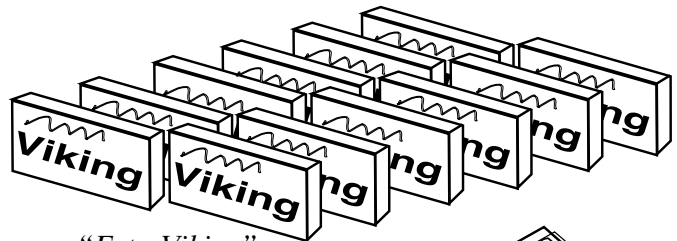
newspaper



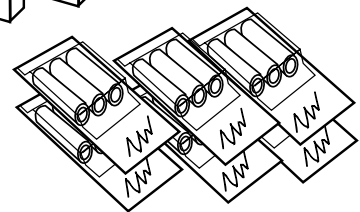
calculator (optional)



paper towels



"Estes Viking" model rocket kits



model rocket engines

Fingerprinting

Non-Consumables

- 1 *Fingerprinting* Teacher's Guide
- 8 tape dispensers
- 16 small envelopes (or paper clips) for organizing sets of 10 fingerprints
- 1 overhead transparency of Fingerprint Patterns
- 16 magnifying lenses
- 16 "10 Fingerprints"*

* The 16 sets of "10 Fingerprints" are cut from photocopies of the "10 Fingerprints" page and put as sets into the 16 small envelopes. Use a high quality photocopier. You may choose to laminate them for greater durability.

Consumables

- 8 rolls of $\frac{3}{4}$ " wide (minimum) "Magic™" transparent tape

Copies of the following:

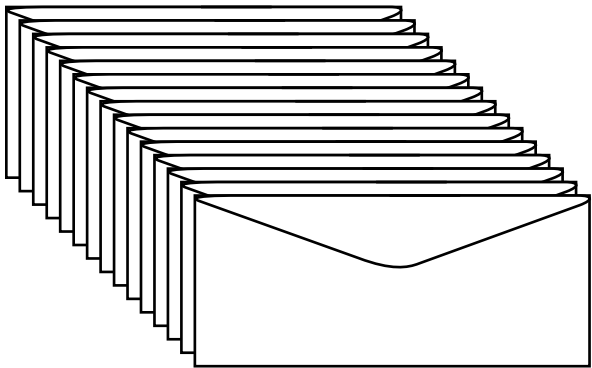
- 32 Your Fingerprints
- 32 Fingerprint Patterns
- 32 Suspects
- 32 Safe with Prints

General Supplies

- 32 sharpened Number 2 pencils
- 32 pieces of white scratch paper
- 1 overhead projector
- 1 pair of scissors
- 32 paper towels
- butcher paper and markers (if no chalkboard is available)

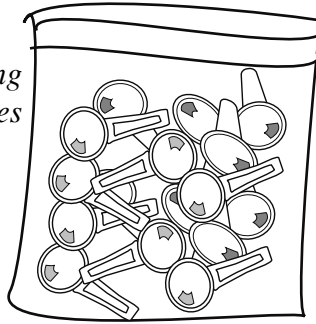
Optional:

- laminator or clear contact paper

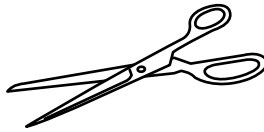
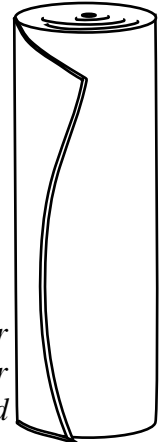


sets of "10 Fingerprints"

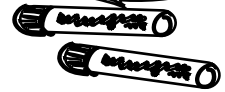
magnifying lenses



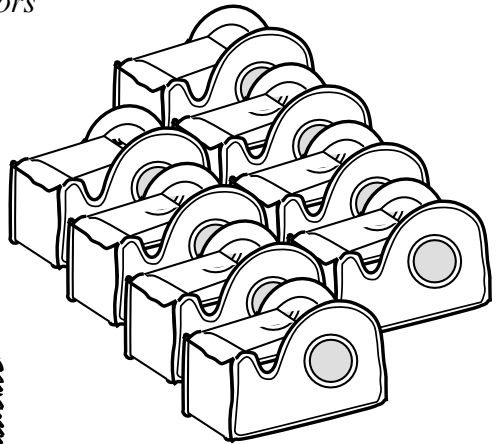
butcher paper and markers or chalkboard



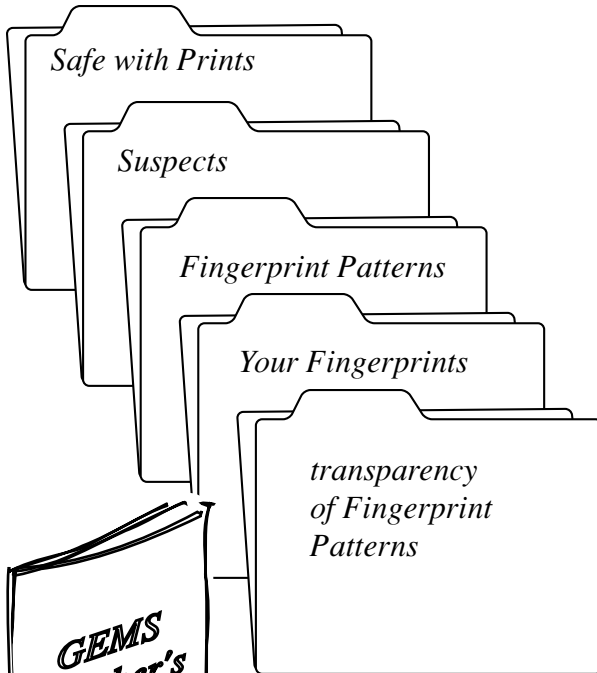
scissors



laminator or clear contact paper (optional)



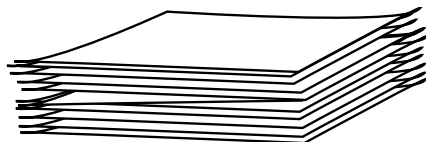
transparent tape



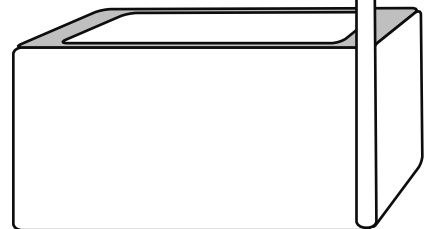
paper towels



pencils



white scratch paper



overhead projector

Frog Math: Predict, Ponder, Play

Non-Consumables

- 1 *Frog Math: Predict, Ponder, Play* Teacher's Guide
- 1 copy of *Frog and Toad Are Friends*, by Arnold Lobel
- 1 light blue felt board, 18" x 24" (45 cm x 60 cm)*
- 1 set of 6 felt buttons with shapes, sizes, number of holes, and thicknesses indicated on page 53, for Sessions 1 and 2**
- 1 set of 22 felt buttons with colors, shapes, sizes, and number of holes indicated on page 53, for Session 2**
- 3 yarn loops (bright color; 2 yds. each)
- 1 graphing grid—made from a piece of butcher paper, 70" x 24" (60 cm x 175 cm)
- 1 collection of 800 buttons that are as diverse as possible in size, color, shape, texture, and number of holes
- 16 paper cups or containers to hold buttons
- 8 single-hole paper punches
- 288 small plastic frogs (12 per pair of students + 96 for estimation/attribution; see page 169 for sources)
- 1 small plastic jar, approximately 4" (10 cm) height x 3" (7 cm) diam.
- 10 plastic cups, 2" in diam. for use with large place value board
- 32 small containers (8 oz. capacity)
- 256 small paper cups (8 per student—use with place value board)
- 3 lbs. large lima beans
- 4 large ziplock plastic bags
- 10 large plastic frogs (to use with the Frog Pond board; see page 168 for sources)
- 1 pair of large dice
- 32 standard dice—preferably 16 each of 2 different colors
- 8 yarn loops, bright color, 1 yd. (1 meter) each, not same color as felt board

* The feltboard can be made from a piece of 18" x 24" (46cm x 61 cm) heavy corrugated cardboard with a piece of 22" x 28" (56 cm x 71 cm) light blue felt attached.

** To make all the felt buttons (one-time task), you will need:

- 1 piece of white felt, 12" x 18" (30 cm x 45 cm)
- 1 piece of black felt, 6" x 6" (12 cm x 12 cm)
- 1 piece each of red, dark blue, yellow, pink, black, and white 9" x 12" (11 cm x 15 cm)

Optional:

- 1 copy of *The Button Box* by Margarete Reid
- 16 plastic strawberry baskets
- 288 markers, such as bottle caps, buttons, beans, etc., as alternatives to small plastic frogs

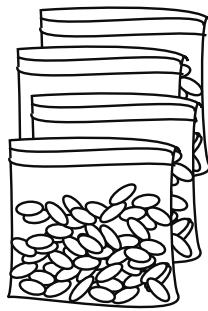
For extra-large Frog Pond (optional):

- 1 piece green tagboard or matté board, 18" x 26" (45 cm x 65 cm)
- 1 piece of blue construction paper or fadeless paper, 16" x 24" (40 cm x 60 cm)
- 10 paper frogs, photocopied on green paper, 8½" x 11" (22 cm x 28 cm)

List continued on page 54



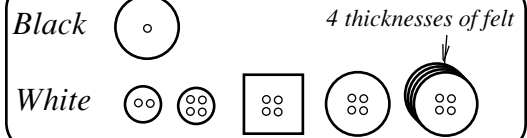
buttons



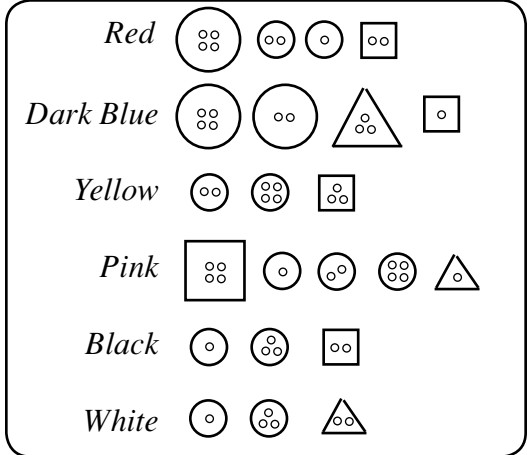
large lima beans

In the button sets below, large buttons are about 4" (10 cm.) wide and small ones are about 2³/₄" (7 cm.) wide.

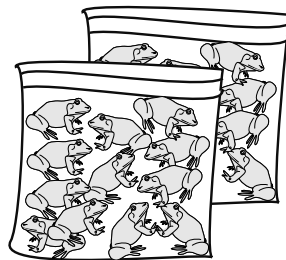
Set for Session 1:



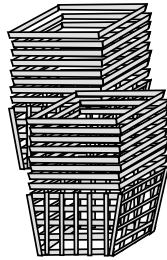
Set for Session 2:



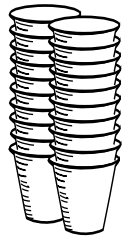
markers (as alternatives to frogs—optional)



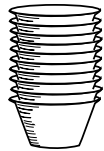
small plastic frogs



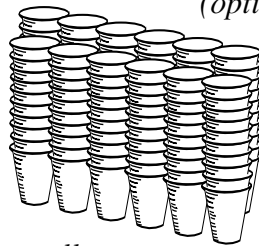
strawberry baskets (optional)



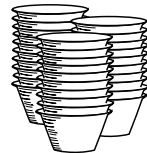
paper cups



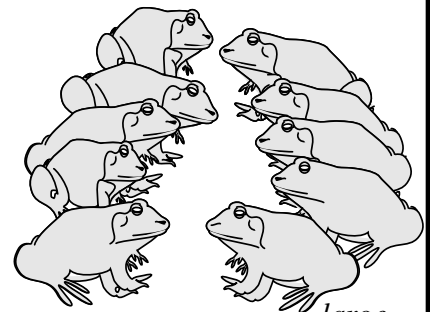
plastic cups



small paper cups



small containers



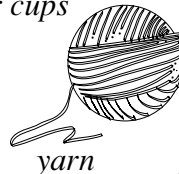
large plastic frogs



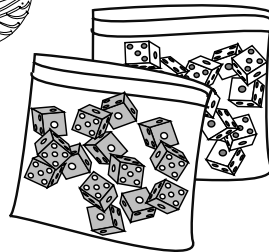
small plastic jar



large dice



yarn



standard dice



large ziplock bags

felt board

blue construction paper (optional)

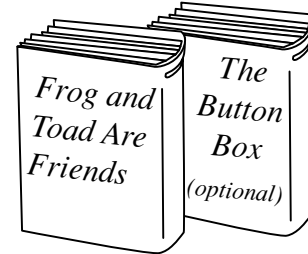
green tagboard or matté board (optional)

green paper (optional)

GEMS Teacher's Guide



paper punches



Frog and Toad Are Friends

The Button Box (optional)

butcher paper

Frog Math: Predict, Ponder, Play

List continued from page 50.

Non-Consumables (continued)

Student gameboards

Copy the following on $8\frac{1}{2}$ " x 11" (22 cm x 28 cm) card stock of the indicated colors:

- 32 Place Value Boards—yellow
- 16 Frog Pond Gameboards—green
- 16 Hop to the Pond Gameboards with 6 frogs—blue

Copy the following on $8\frac{1}{2}$ " x 14" (22 cm x 36 cm) of any color but yellow, green or blue:

- 16 Hop to the Pond Gameboards with 12 frogs

Large gameboards

Copy the following on white paper, 11" x 17" (28 cm x 43 cm) and glue them onto the indicated color tagboard or matté board, 12" x 18" (30 x 45 cm):

- 1 Place Value Board—yellow
- 1 Frog Pond Gameboard—green
- 1 Hop to the Pond Gameboard with 6 frogs—blue
- 1 Hop to the Pond Gameboard with 12 frogs—any color but yellow, green, or blue

Consumables

- 6 sentence strips or card stock for use as sorting labels, about 3" x 10" (7 cm x 25 cm)
- 6 sheets of white card stock, $8\frac{1}{2}$ " x 11" (22 cm x 28 cm), or large Post-it® Notes, 4" x 5" (10 cm x 12 cm)—for labels for graphs
- 2 pads of 3" square Post-it® Notes (each pad a different color)
- 1 pad of 2" x $1\frac{1}{2}$ " Post-it® Notes

Copies of the following:


- 32 Button Templates (duplicated on white card stock is preferable)

General Supplies

- 32 pieces of white paper
- 32 pencils or pens
- 1 large container of white glue
- 2 dark markers for labeling, recording
- 8 sets of crayons or markers for drawing (include blue and green)
- 1 container of rubber cement (for making counting board and gameboards)
- 32 pairs of scissors
- 1 pair of adult scissors
- 2 rolls of masking tape

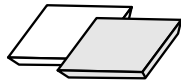
Optional:

- 1 laminator (or clear contact paper)

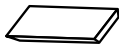
 card stock or large Post-it® Notes



clear contact paper or laminator (optional)



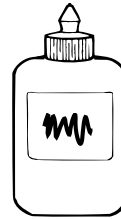
square Post-it® Notes



small Post-it™ Notes



dark markers



glue



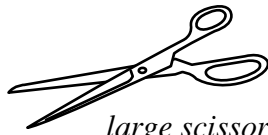
scissors

Student
Place Value Counting Boards

Student
Frog Pond Gameboards

Student
Hop to the Pond
Gameboards—6 frogs

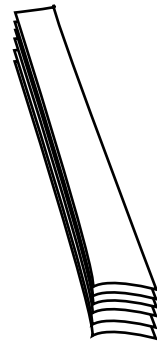
Student
Hop to the
Pond Gameboards—12 frogs



large scissors



pencils



sentence strips

Large
Place Value Board

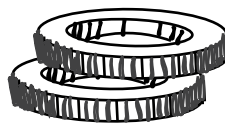
Large
Frog Pond Gameboard

Large
Hop to the Pond Gameboard—6 frogs

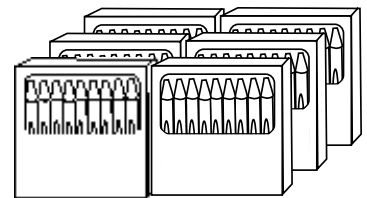
Large
Hop to the Pond Gameboard—12 frogs



rubber
cement

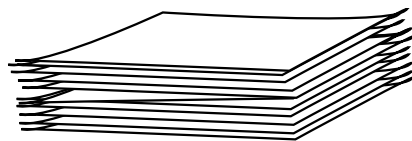


masking tape



crayons or markers

Button Templates



white paper

Global Warming & the Greenhouse Effect

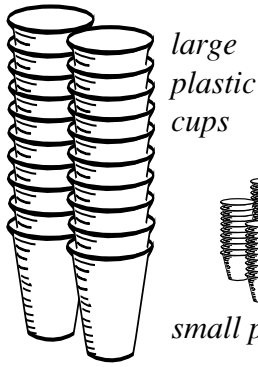
Non-Consumables

- 1 *Global Warming & the Greenhouse Effect* Teacher's Guide
- 16 clear, colorless, plastic soda bottles with tops cut off (2 liter capacity)
- 16 thermometers, about 15° C to 40° C range
- 48 cups potting soil, about 6 cups of soil per team
- 8 clip-on lamps with 100 watt bulbs and no shades
- 8 extension cords, if needed to stretch from lamps to outlets
- 24 plastic cups, 8 oz. (237 ml)
- 40 plastic cups, 3½ oz. (200 ml), graduated medicine cups are excellent
- 1 bag of dry red kidney beans, 1 lb.
- 1 bag of dry white lima beans, 1 lb.
- 8 pennies
- 8 dropper bottles, about 6 oz. size (400 ml)
- 1 air, hand, or foot pump for blowing up balloon
- 1–8 graduated cylinders, 100 ml (8 graduated cylinders is ideal, but not essential)
- 8 tall, empty glass wine bottles (about 750 ml) to mix vinegar and baking soda
- 8 measuring spoons (teaspoon size)
- 8 rubber bands for securing plastic wrap on 2-liter bottles
- 64 plastic straws for CO₂ testing
- 8 gameboards and sets of cards for Global Warming Game
- 1 automobile

Consumables

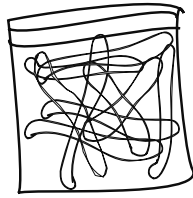
- 1 gallon bromothymol blue, mixed with water until a deep sky blue
- 80 balloons, four different colors, about 20 of each color, 8"–10" diameter size
- 80 twist ties to secure balloons
- 1 box of baking soda for generating CO₂
- 1 bottle of vinegar, 32 oz. (1 liter) for generating CO₂
- 1 short votive candle
- matches

List continued on page 58

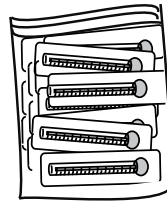


large plastic cups

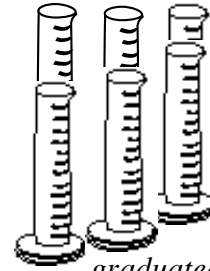
small plastic cups



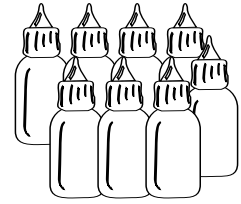
rubber bands



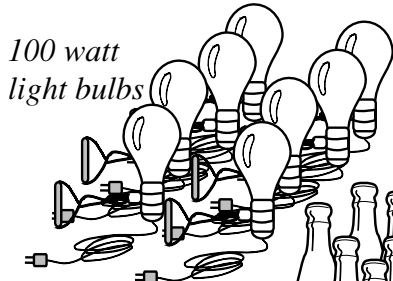
thermometers



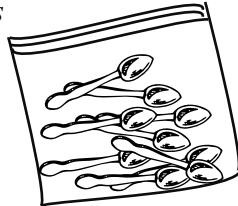
graduated cylinders



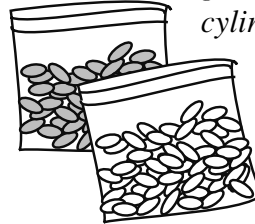
dropper bottles



100 watt light bulbs



measuring spoons

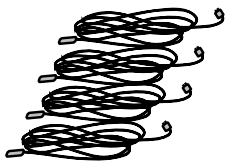


red and white beans

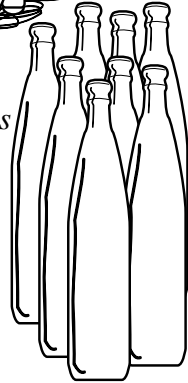


pennies

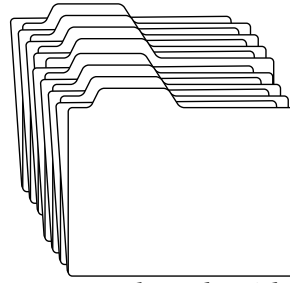
lamps with no shades



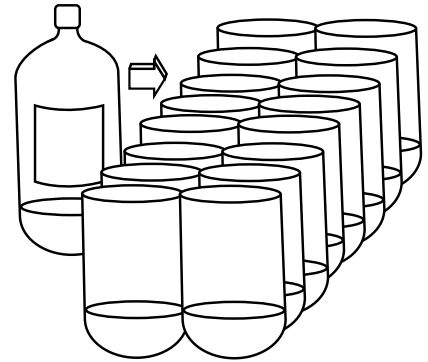
extension cords



wine bottles



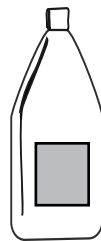
gameboards with card sets



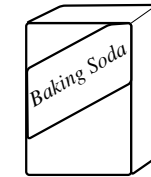
cutoff clear soda bottles



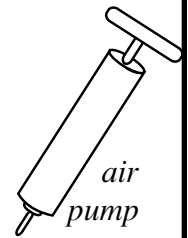
straws



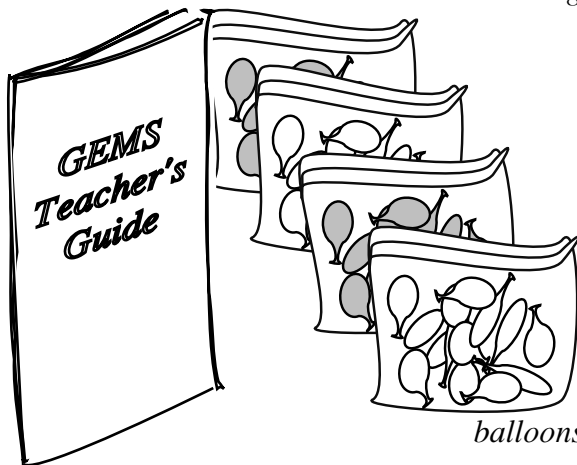
vinegar



baking soda

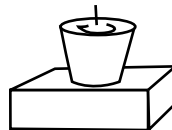


air pump



GEMS Teacher's Guide

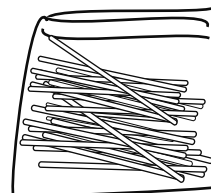
balloons



votive candle



matches



twist ties



potting soil

Global Warming & the Greenhouse Effect

List continued from page 56

Consumables (continued)

Copies of the following:

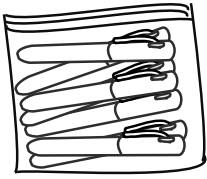
- 32 Everyone Likes to Talk About the Weather... (homework sheet)
- 32 Average Global Temperatures in the... Past (handouts)
- 32 Global Temperatures and CO₂ ... Past 160,000 Years
- 32 Global Temperatures and Carbon Dioxide
- 32 Surprise Increase in Atmosphere's CO₂! (homework sheet)
- 40 Air and Carbon Dioxide data sheets
- 40 Four Gas Samples: data sheet
- 32 Carbon Dioxide in the Atmosphere... (homework sheet)
- 32 Possible Effects of Climate Change (article for homework)
- 32 Effects Wheel Master
- 16 The Greenhouse Effect data sheet
- 8 sets of Role Play Information sheets
- 2 Flash! Messages for... (handouts)

General Supplies

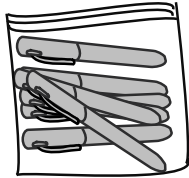
- 45 sentence strips, 24" x 3" (8 cm x 60 cm) strips of heavy paper
- 16 cardboard strips, about 1" x 1/2" to cover thermometer
- 8 pieces of plastic wrap, about 6" x 6" (15 cm x 15 cm) squares
- 4 pieces of construction paper— yellow, red, blue, and brown
- 56 pieces of blank white paper
- 9 rolls of masking tape (one roll for each group, and one for the class)
- 1 roll transparent tape for the class
- 16 fine- or medium-tipped markers, 8 red and 8 green
- 8 wide-tipped markers, any dark colors
- 1 length of white string, about 4 1/2' (135 cm) long
- 1 utility knife for cutting tops off plastic soda bottles
- 11 pieces of white butcher paper, 3' x 6' (1 meter x 2 meters) wide
- 1–8 scissors for preparing board game and experiments
- 1 manila folder—to be used as a funnel for auto exhaust
- 1 pad 3" x 1 1/2" Post-it® Notes for Effects Wheels activity
- 8 cafeteria trays for distributing equipment
- 8 books or large pieces of wood for securing clip-on lamps

Optional:

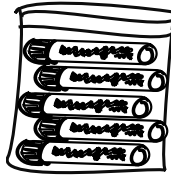
- 1 calculator
- 8 manila folders—for game boards



red markers



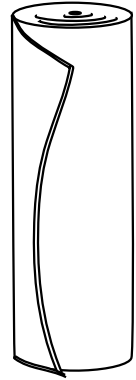
green markers



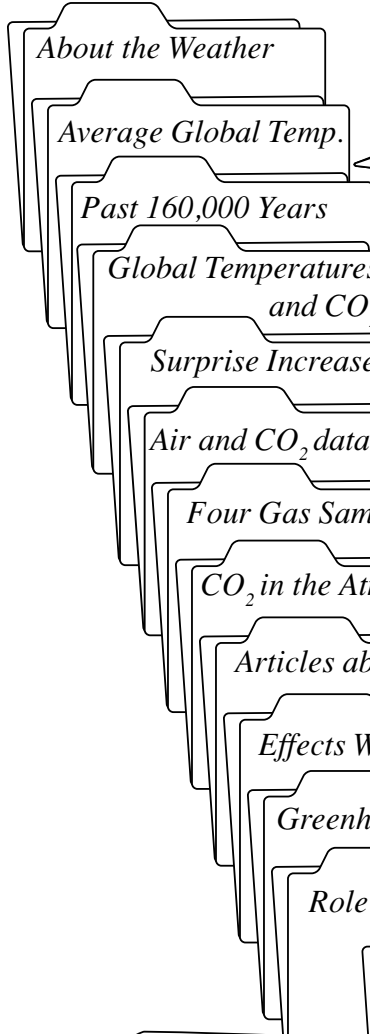
wide-tipped
markers



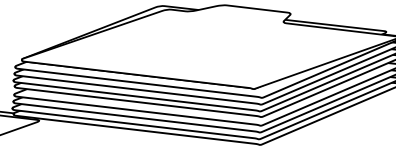
cardboard strips



butcher paper



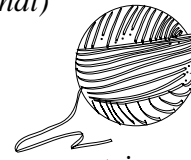
manila folder
(for auto exhaust)



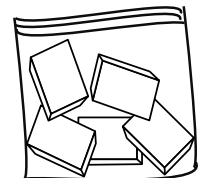
manila folders
(optional)



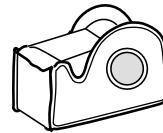
utility knife



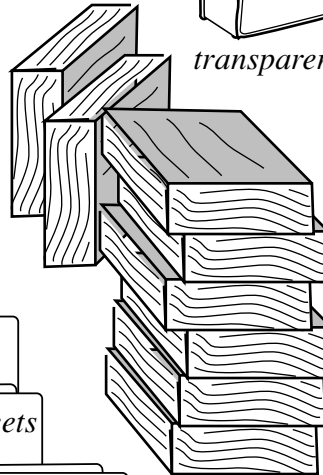
string



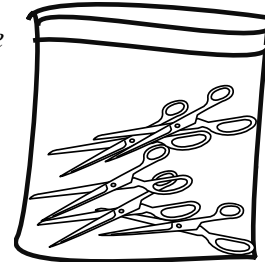
Post-it® pads



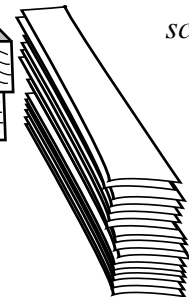
transparent tape



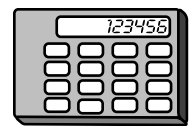
wood



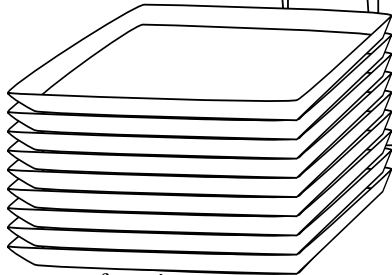
scissors



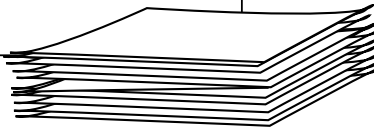
sentence strips



calculator
(optional)



cafeteria trays



white paper



plastic wrap



construction paper



masking tape

Group Solutions

Cooperative Logic Activities for Grades K–4

Non-Consumables

- 1 *Group Solutions* Teacher's Guide
- 456 standard size white envelopes (4 $\frac{1}{4}$ " x 9 $\frac{1}{2}$ ")
- 57 letter-size pocket folders (expandable to 2") to store 8 envelopes for each activity and related student sheets
- 5 banker's boxes to store pocket folders for each family of activities
- 5 reams (250 pieces each) of card stock (60 lb. weight paper) in several light colors—include at least one ream of white
- 8 sets of Teddy Bear counters, each set containing 5 each of red, green, blue, and yellow (total: 40 bears of each color); **or** paper bears as described in Teacher's Guide
- 8 collections of real coins or play money; each collection containing 20 pennies, 15 nickels, 10 dimes, and 10 quarters (total of 160 pennies, 120 nickels, 80 dimes and 80 quarters)
- 8 plastic cups for Coin Count #1–6
- 8 sets of wood cubes, each set containing 7 each of red, blue, green, yellow, and orange (total of 56 cubes of each color); **or** paper squares as described in Teacher's Guide

Optional:

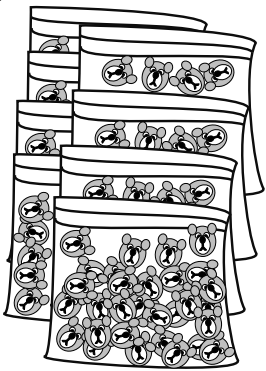
- 8 copies each of Bear Park, Bear Street, and Cubeville Maps on 11" x 17" (28 cm x 43 cm) paper
- 1 set of large clue cards for modeling with whole group
- 8 pieces of 9" x 12" (23 cm x 30 cm) construction paper as central work area for each group
- 8 muffin tins, coin boxes, or 4-compartment containers to sort/store coin collections

General Supplies

- 500 sheets (a ream) of white paper to copy Fifty Charts, Hundred Charts, Coin Count Record Sheets, and optional Casebooks and blank cards to create new problems
- scratch paper
- pencils and markers
- glue sticks
- at least one paper cutter, to cut activity sheets (additional paper cutters are necessary if you have an "assembly line" of volunteers to create the kit)
- medium-tipped markers: four each of red, yellow, blue, green (to color bears on clue cards), silver, copper/tan (to color coins on clue cards)

Optional:

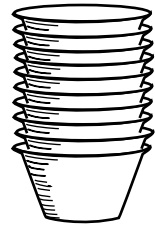
- 1 laminator
- 1 overhead projector
- 8 grease pencils or dry mark pens
- 1 transparency of "Hundred Chart" or "Fifty Chart"



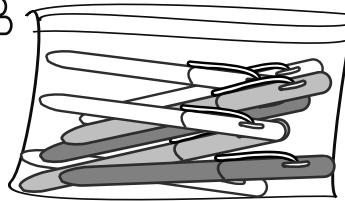
Teddy Bear counters



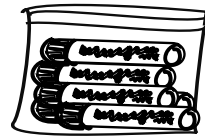
pencils



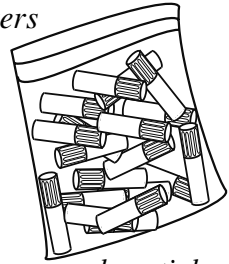
plastic cups



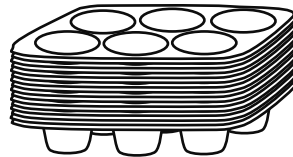
medium-tipped markers



markers



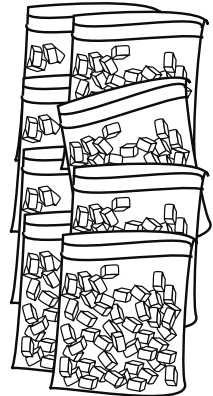
glue sticks



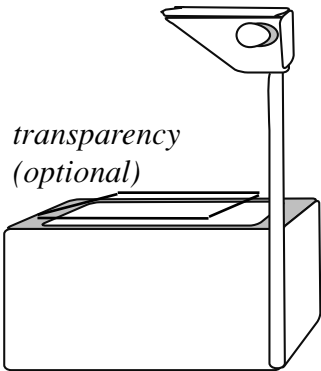
muffin tins (optional)



coins

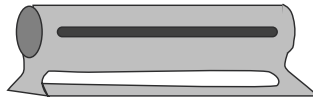


wood cubes

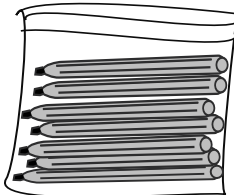


transparency (optional)

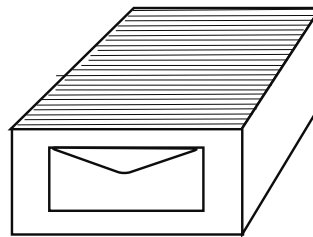
overhead projector (optional)



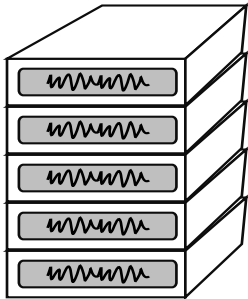
laminator (optional)



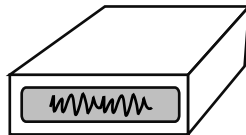
grease pencils (optional)



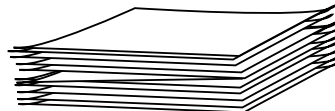
envelopes



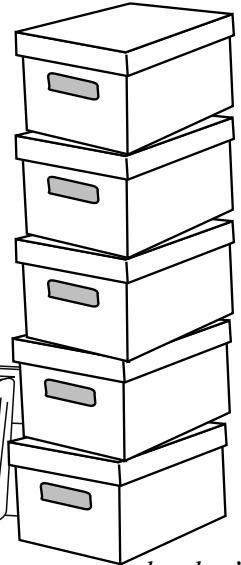
reams of card stock



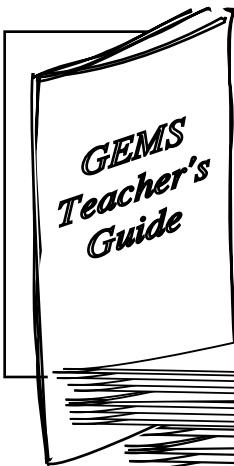
ream of white paper



scratch paper

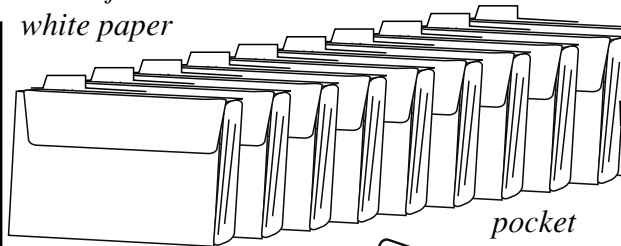


banker's boxes



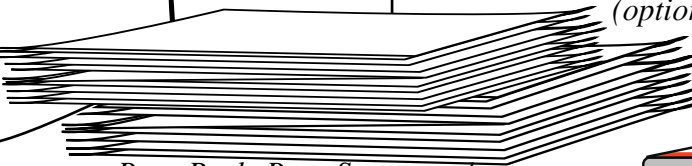
**GEMS
Teacher's
Guide**

large clue cards (optional)

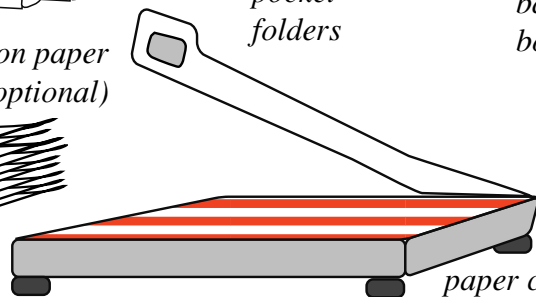


construction paper (optional)

pocket folders



Bear Park, Bear Street, and Cubeville Maps (optional)



paper cutter

Height-O-Meters

Non-Consumables

- 1 *Height-O-Meters* Teacher's Guide
- 6 metric tape measures or meter sticks
- 1 rubber ball, about 2"–3" (5 cm–8 cm) in diameter
- 1 styrofoam ball, same size as rubber ball
- 1 50' (18 meters) ball of white string
- 5 sticks of colored chalk

Consumables

- 32 blocks of wood, cork, or pencil erasers*
- 32 push pins*

Copies of the following:

- 34 Height-O-Meter sheets
- 32 Height-Finder Charts—1 observer
- 32 Height-Finder Charts—2 observers

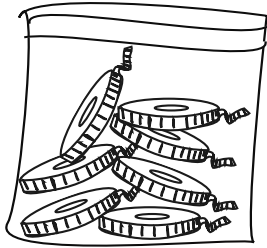
*A rivet machine (available in sewing stores) can be used instead of the push pins and blocks of wood. The rivets work very well as long as they are not applied too tightly.

General Supplies

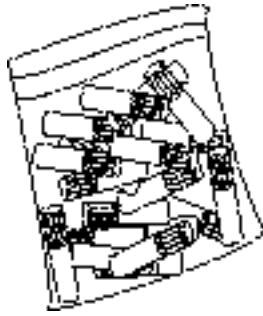
- 8 rulers
- 8 pairs of sturdy scissors
- 32 pencils
- 1 roll of masking tape
- 8 glue sticks
- 32 pieces of 8½" x 11" (22 cm x 28 cm) thin cardboard (file folder stock, tagboard, or matté board)
- 32 large paper clips, used to "zero" Height-O-Meters

Optional:

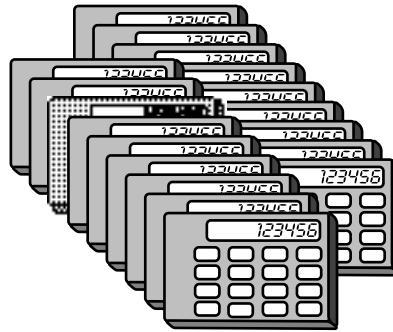
- 32 calculators



metric measuring tapes



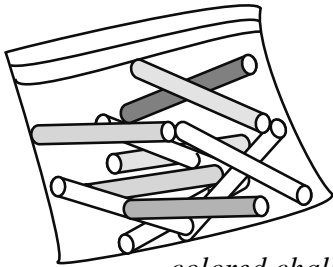
glue sticks



calculators (optional)



large paper clips



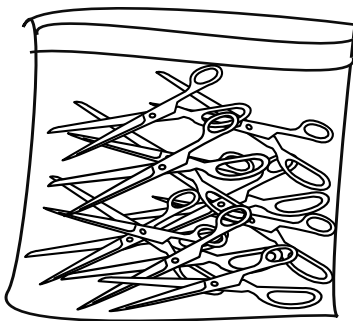
colored chalk



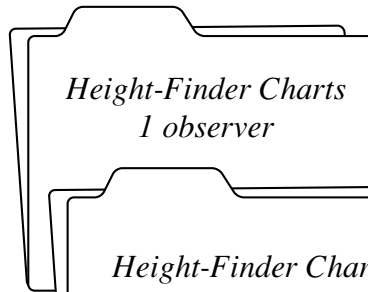
wood blocks



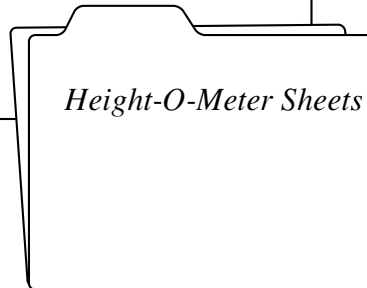
push pins



scissors



*Height-Finder Chart
2 observers*



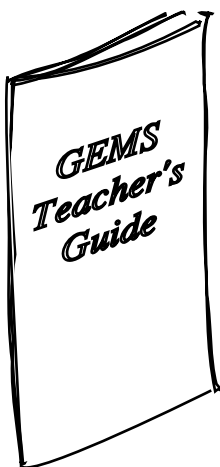
Height-O-Meter Sheets



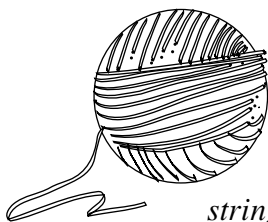
rubber ball



styrofoam ball



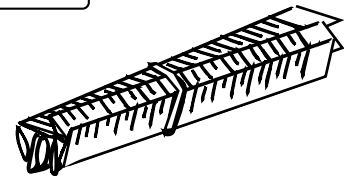
**GEMS
Teacher's
Guide**



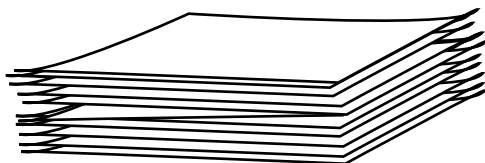
string



masking tape



rulers



thin cardboard



pencils

Hide A Butterfly

Non-Consumables

- 1 *Hide A Butterfly* Teacher's Guide
- 1 picture of a flower or a real flower
- 1 tray for teacher demonstration
- 6 (or so) pictures of different varieties of butterflies

Consumables

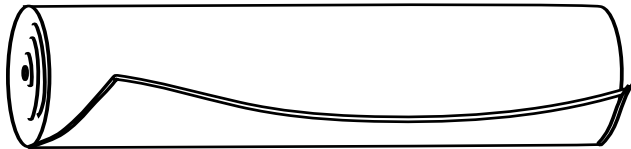
- 1 piece of blue butcher paper, 24' (8 meters) long, 4' (130 cm) wide
- 33 pieces of 9" x 12" (24 cm x 30 cm) white construction paper
- 35 pieces of 9" x 12" (24 cm x 30 cm) orange construction paper
- 19 pieces of 9" x 12" (24 cm x 30 cm) green construction paper
- 9 pieces of 9" x 12" (24 cm x 30 cm) yellow construction paper
- 2 pieces of 9" x 12" (24 cm x 30 cm) black construction paper **or**
- 64 $\frac{3}{4}$ " (1 cm) diam. black round adhesive dots
- 34 brown paper lunch bags
- 1 tray with assorted scraps of variously colored paper

Copies of the following:

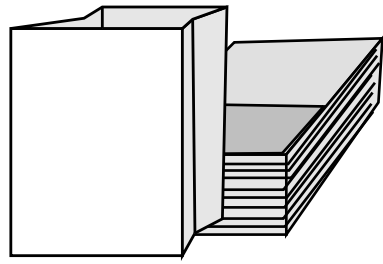
- 1 copy of the Flower Blossom pattern
- 1 copy of the Butterfly pattern

General Supplies

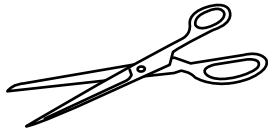
- old newspapers
- 1 pair of adult scissors
- 3–4 paper clips
- 1 large brown paper grocery bag
- 32 scissors
- 32 pencils
- white glue or paste



blue butcher paper



paper lunch bags



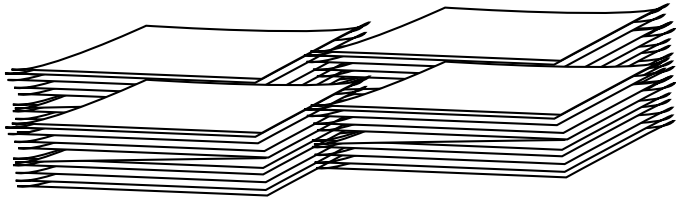
scissors



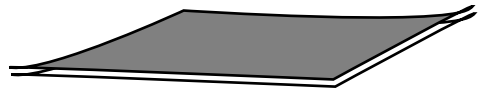
pencils



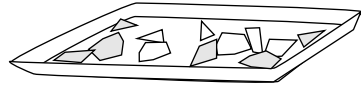
glue



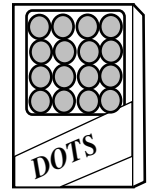
white, orange, green, and yellow construction paper



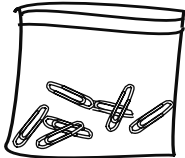
black construction paper or round adhesive dots



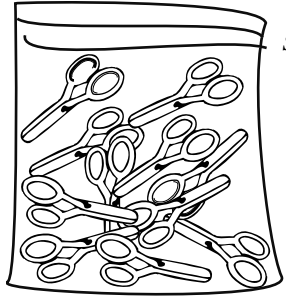
tray with colored paper scraps



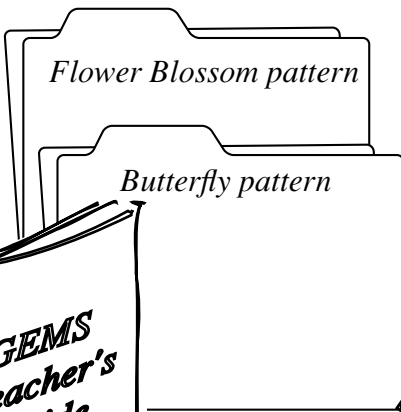
pictures of butterflies



paper clips

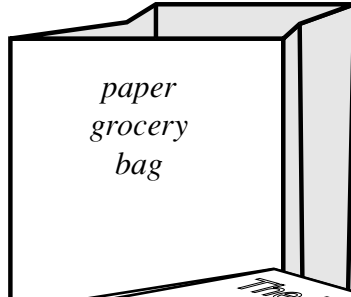


scissors

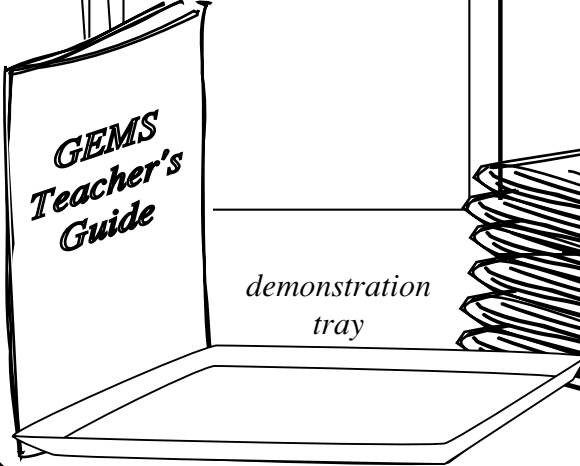
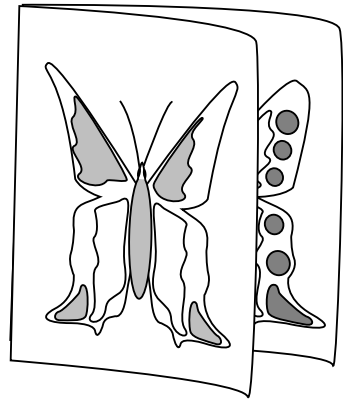


Flower Blossom pattern

Butterfly pattern



paper grocery bag



demonstration tray



newspaper



picture of a flower or real flower

Hot Water and Warm Homes from Sunlight

Non-Consumables

- 1 *Hot Water and Warm Homes from Sunlight* Teacher's Guide
- 32 Celsius thermometers*
- 32 pieces of corrugated cardboard, 6" x 8" (15 cm x 20 cm)
- 32 paper cups
- 32 aluminum pie pans
- 1 minute timer or watch with second hand
- 2 buckets or basins for water
- 16 clear plastic bags (standard size for produce) with twist ties to cover pans
- 10 heavy duty (1 qt. capacity) ziplock plastic bags **or**
5 pieces of 8½" x 11" clear acetate to cut up for windows

* Inexpensive glass thermometers with a Celsius scale are available from a variety of school supply houses.

Optional:

- 1 transparency of Model House Cut-Out
- 1 package of dry white beans, 1 lb. (for greenhouse effect game)
- 1 package of dry red beans, 1 lb. (for greenhouse effect game)

Consumables

Copies of the following:

- 32 Growing Plants Experiment
- 32 Model House Cut-Out
- 32 Data Sheet: The Solar House Experiment
- 32 "Results and Conclusions" Sheet for Solar House Experiment
- 32 "Data and Results" Sheet for Solar Water Heater Experiment

Optional:

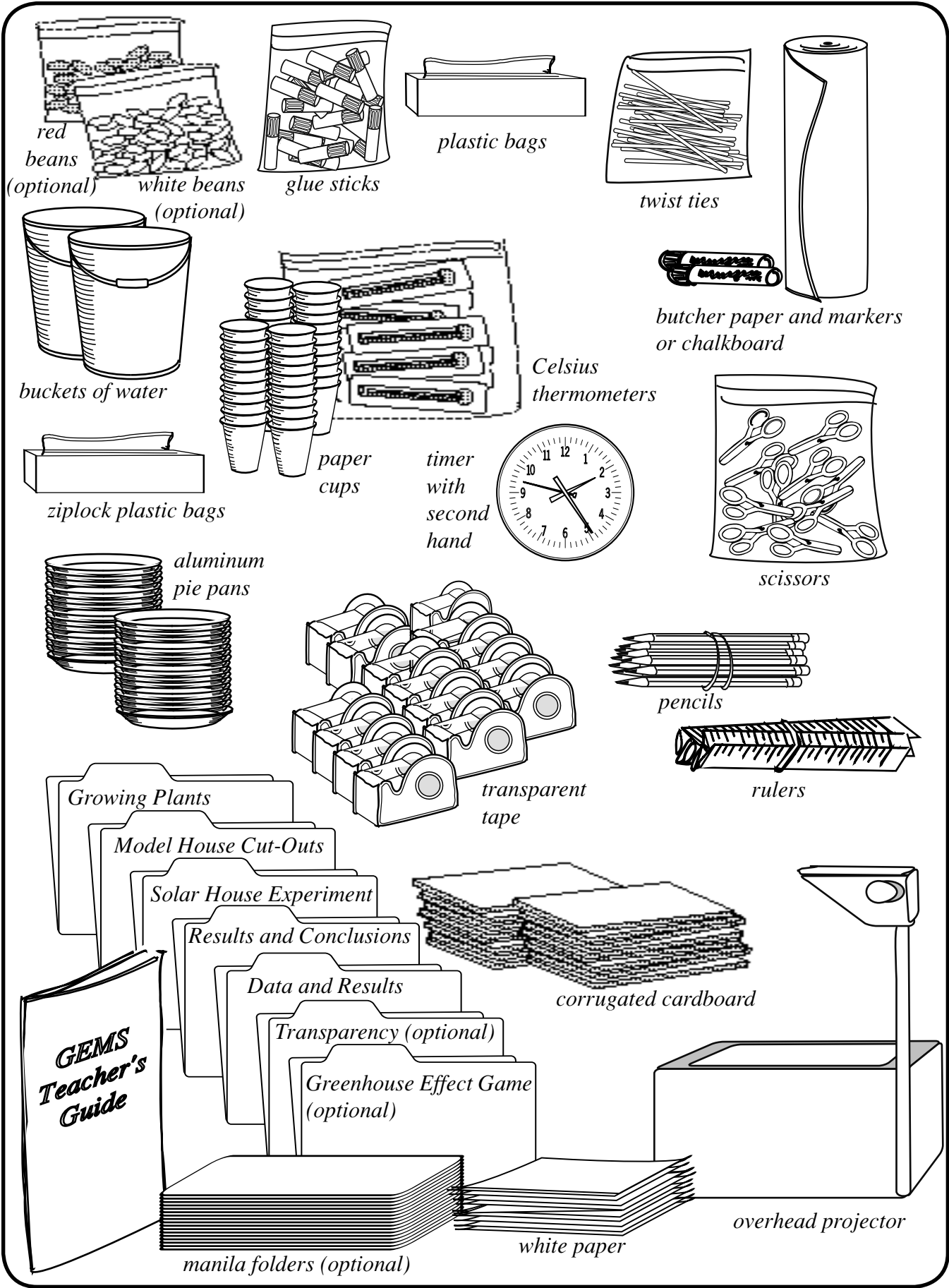
- 8 copies of Greenhouse Effect Game Board

General Supplies

- 32 pencils
- 16 rolls of transparent tape
- 4 pieces of white paper to cut up for window shades
- 32 scissors
- 32 rulers
- butcher paper and markers (if no chalkboard is available)
- 6 qts. (liters) of water in pitchers, buckets, or basins

Optional:

- 16 glue sticks
- 1 overhead projector
- 32 manila file folders or clipboards as writing boards for recording data outside



red beans (optional) white beans (optional)

glue sticks

plastic bags

twist ties

butcher paper and markers or chalkboard

buckets of water

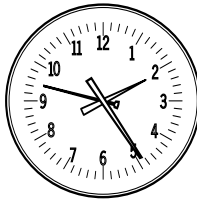
Celsius thermometers

markers

ziplock plastic bags

paper cups

timer with second hand



scissors

aluminum pie pans

transparent tape

pencils

rulers

Growing Plants
 Model House Cut-Outs
 Solar House Experiment
 Results and Conclusions
 Data and Results
 Transparency (optional)
 Greenhouse Effect Game (optional)

corrugated cardboard

GEMS Teacher's Guide

manila folders (optional)

white paper

overhead projector

Note: Guide has been revised since handbook was developed. Please check teacher's guide for updated listing.

In All Probability

Investigations in Probability and Statistics

Non-Consumables

- 1 *In All Probability: Investigations in Probability and Statistics* Teacher's Guide
- 40 pennies
- 51 beans or other markers (17 each of red, yellow, and blue)
- 32 graphs from old newspapers or magazines (at least one per student)
- 32 dice (16 each of 2 colors)
- 32 crayons (16 each of 2 colors to match the colors of the dice)
- 204 lima beans or counters—chips, cubes, or other small items (12 per pair of students and 12 for the teacher)
- 16 plastic bags or small containers for beans or counters
- 204 tongue depressors (12 per pair of students and 12 for teacher)
- 3 sets of spinners*
- 32 pieces of $8\frac{1}{2}$ " x 11" (22 cm x 28 cm) card stock to make gameboards for Track Meet and Horse Race
- 1 transparency of each data sheet, spinners 1, 2, and 3, and gameboard listed under "Consumables" on page 70

Optional:

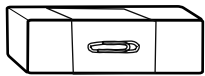
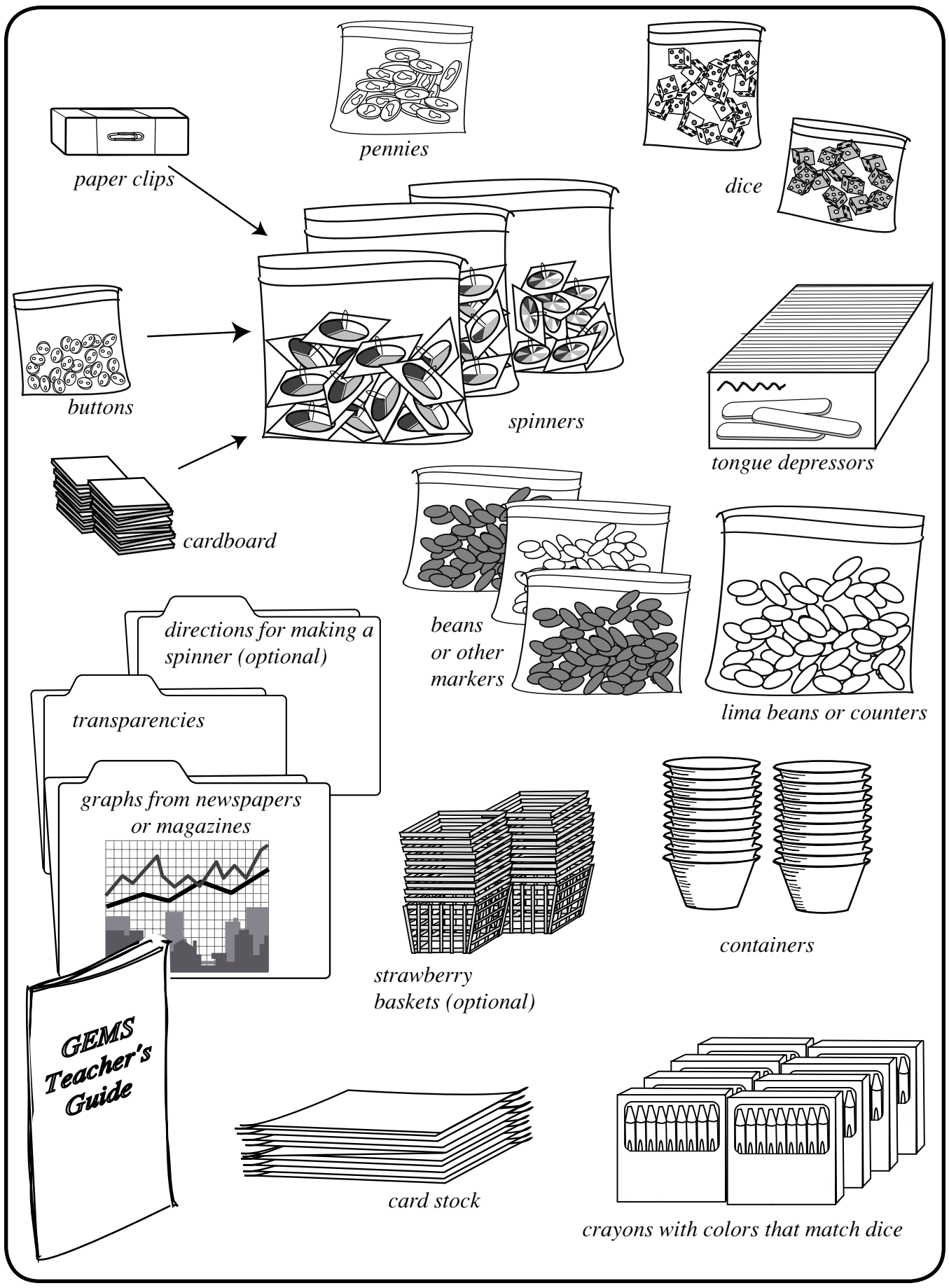
- 16 strawberry baskets for rolling dice
- 16 directions for making a spinner

* Make spinners with the following materials:

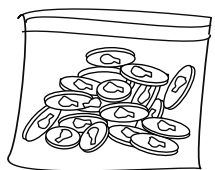
- 52 4" squares of cardboard or other heavy paper for making spinners*
- 32 paper clips for making spinners*
- 32 small buttons for making spinners

If you would like each class of student to make their own spinners, then squares of cardboard, paper clips, small buttons, and copies of the spinner tops will need to be replenished. Alternatively, the first class of students can make spinners which will remain in the kit for use by other students.

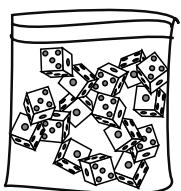
List continued on page 70



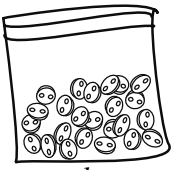
paper clips



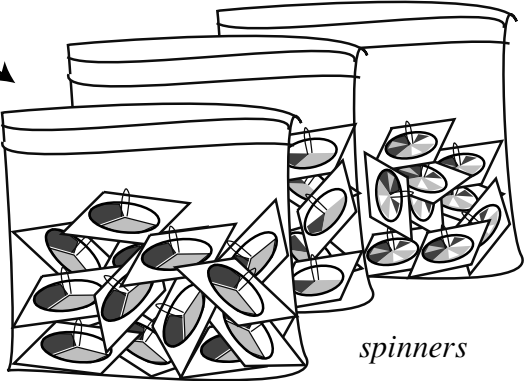
pennies



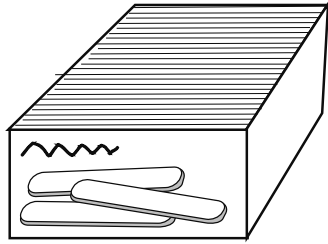
dice



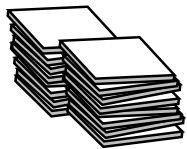
buttons



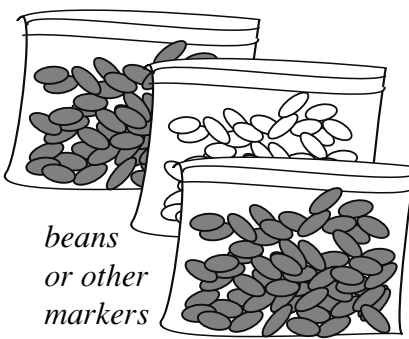
spinners



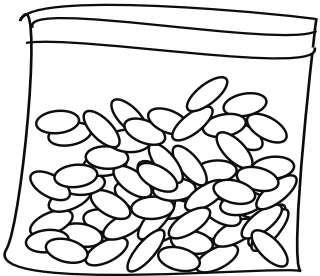
tongue depressors



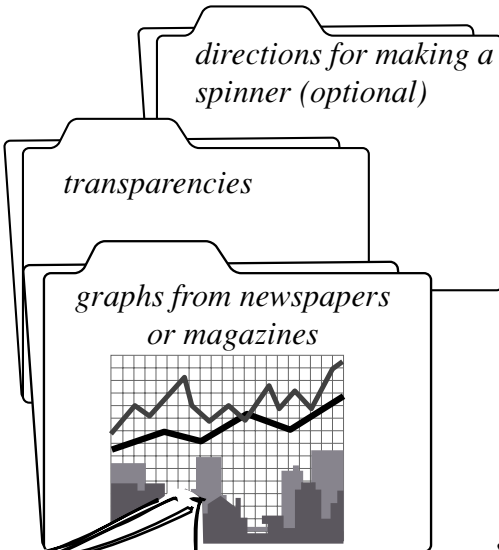
cardboard



*beans
or other
markers*



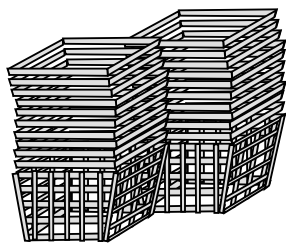
lima beans or counters



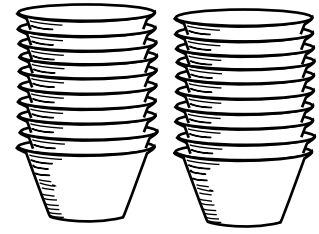
*directions for making a
spinner (optional)*

transparencies

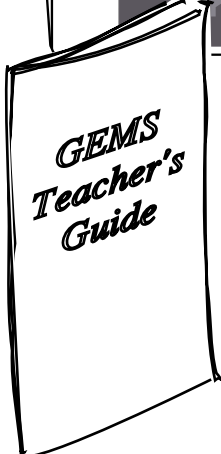
*graphs from newspapers
or magazines*



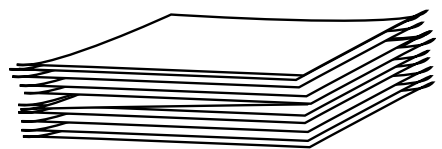
*strawberry
baskets (optional)*



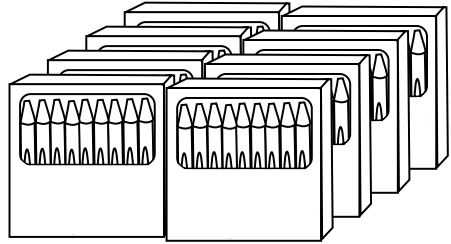
containers



**GEMS
Teacher's
Guide**



card stock



crayons with colors that match dice

In All Probability

List continued from page 68

Non-Consumables (continued)

Copies of the following:

- 4 Spinner 1
- 4 Spinner 2
- 4 Spinner 3
- 16 Track Meet Gameboard (on card stock)
- 16 Horse Race Gameboard (on two sheets of card stock)

Consumables

Copies of the following:

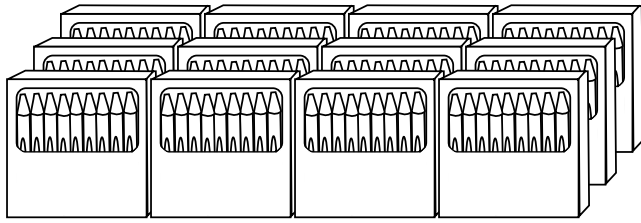
- 16 Penny Flip data sheet
- 16 Roll A Die data sheet
- 16 Keeping Track Chart
- 16 Centimeter Grid Paper
- 16 Game Sticks data sheet
- 16 Traditional Designs from California

General Supplies

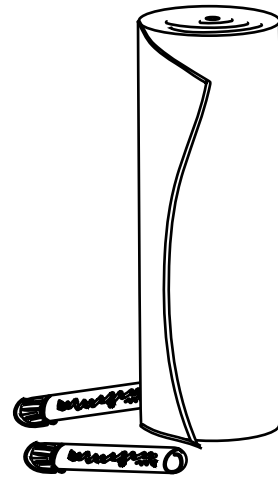
- 1 roll of butcher paper **or** 10 sheets of large graph paper and markers
- 1 roll of masking tape
- 1 sponge or paper towel to clean overhead projector and transparencies
- 32 pieces of blank white paper
- 32 pieces of graph paper or copies of Centimeter Grid Paper
- 16 sets of crayons, markers, or colored pencils
- 32 rulers or straight edges
- 32 pencils
- 1 overhead projector and set of overhead projector markers
- 32 scissors (if students make spinners)

Optional:

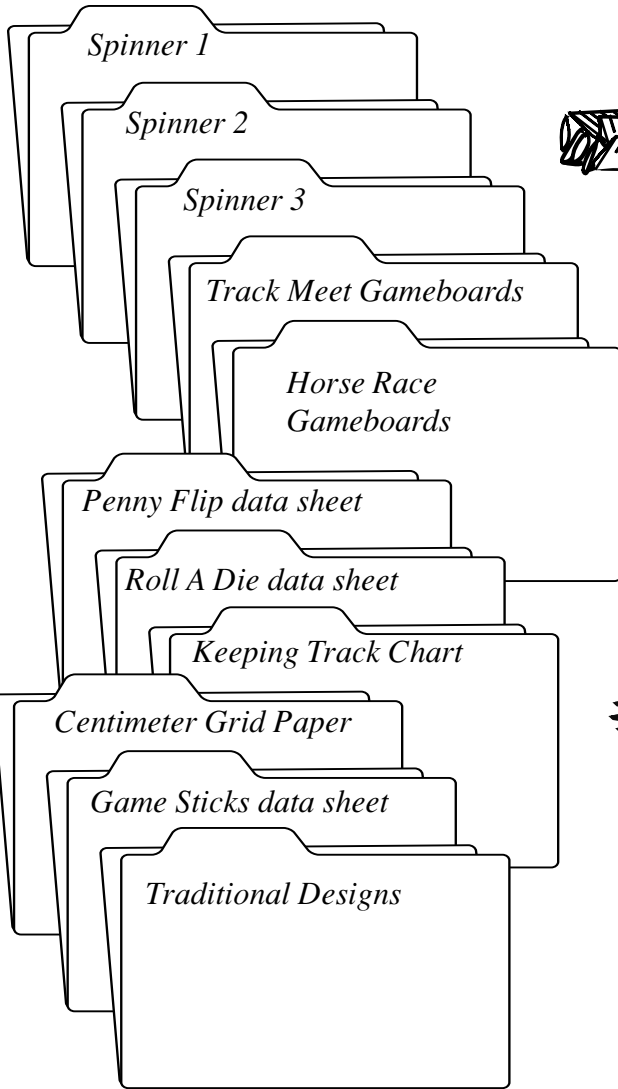
- 1 box of transparencies to record class data



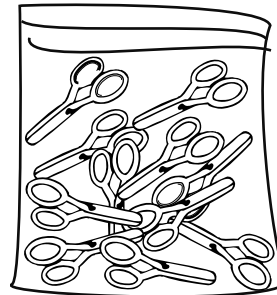
crayons, markers, or colored pencils



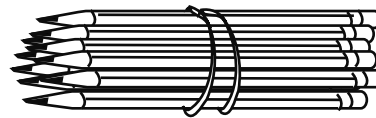
*butcher paper
and markers*



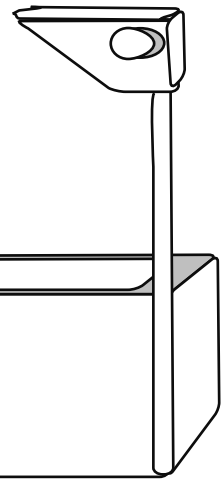
rulers



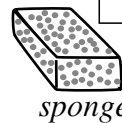
masking tape



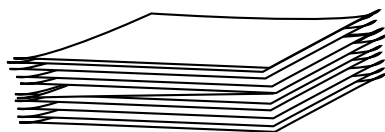
pencils



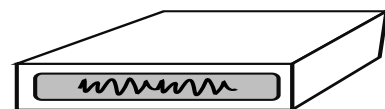
*overhead projector and
markers*



sponge



white paper



*box of transparencies
(optional)*

Investigating Artifacts

Making Masks, Creating Myths, Exploring Middens

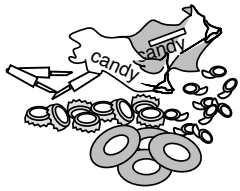
Non-Consumables

- 1 *Investigating Artifacts: Making Masks, Creating Myths, Exploring Middens*
Teacher's Guide
- 5–10 samples of natural (leaves, sticks, seeds, rocks) and non-natural objects
(bottle caps, candy wrappers, etc.)
- 9 large brown paper grocery bags
- 1 large litter bag
- 18–26 yarn loops, 15" (38 cm) diameter, 2–3 different colors
- 5 pieces of colored construction paper, 11" x 19" (28 cm x 48 cm)
- 1 object that represents something 2,000 years old (arrowhead or burnt wood)
- 1 object that represents something 10–50 years old (horseshoe, coin or old spoon)
- 1 modern bottle cap (or other modern object)
- 1 spray bottle for misting middens
- 12 shoe boxes with lids
- 11 trays or boxes for soil after midden dig
- 11 toothbrushes or small stiff bristle paintbrushes
- 33 small plastic spoons
- 22 plastic strawberry baskets
- 11 egg cartons without lids
- 17 lbs. of potting soil* to fill shoe boxes
- 1 large drawing of the midden site

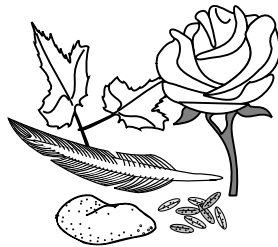
List continued from page 72

*Soil should not have Styrofoam beads or vermiculite. Can be re-used. Store artifacts separately from soil between uses.

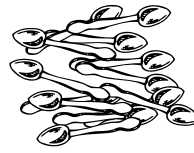
List continued on page 74



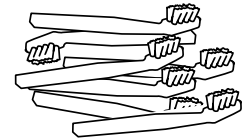
non-natural objects



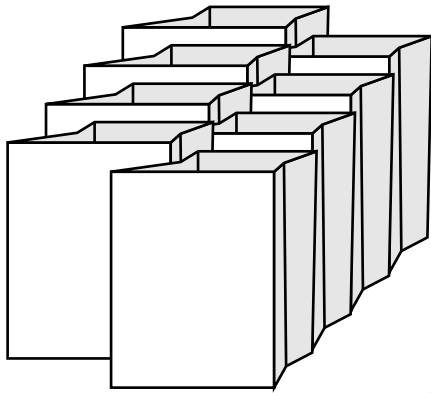
natural objects



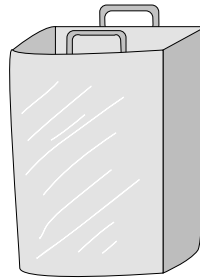
plastic spoons



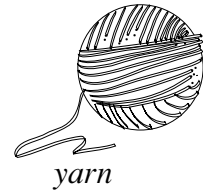
toothbrushes



paper grocery bags



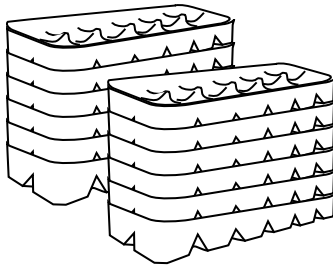
large litter bag



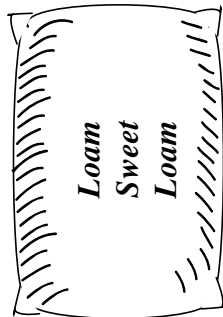
yarn



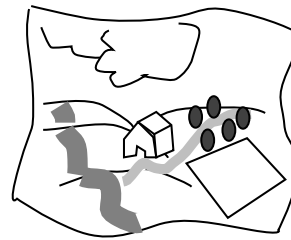
"2,000 year old" object



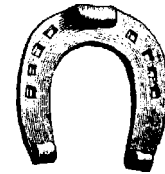
egg cartons without lids



potting soil



drawing of midden site (optional)

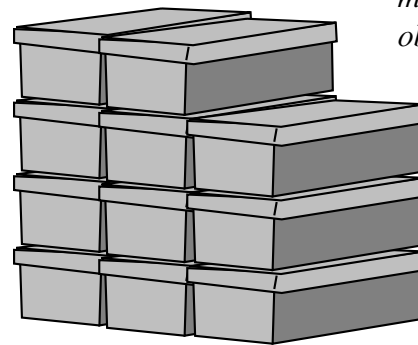


"10-50 year old" object

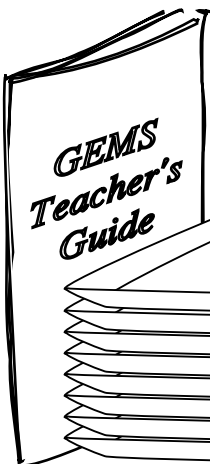


modern object

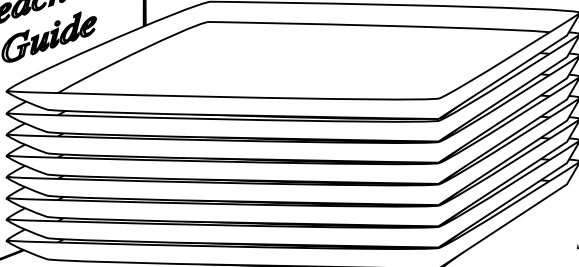
strawberry baskets



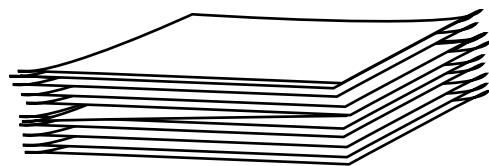
shoe boxes



cafeteria trays



spray bottle



construction paper

Non-Consumables (continued)

- 11 of each object for midden “artifacts” (one is for a demonstration): shells with holes (as from a necklace); shells without holes (oyster, clam, etc.); broken pieces of earth-colored unglazed clay pot; chicken bones; popping corn; dried beans; small pieces obsidian (not sharp); wood, small burned and unburned pieces; leather or rawhide (natural colors); small pieces of woven grass mat or jute string (natural colors); feathers (not artificially colored). On page 75, these objects are shown in separate bags to clearly illustrate the materials that are needed. For actual storage, it is best to include just ONE of each object in each of the bags, to form eleven sets of “artifacts.”
- 5 full-page pictures of the stars, Moon, Sun, rainbow, and butterfly

Optional:

- clothing props
- a timeline chart showing the present and going back 2000 years

Consumables

- 24 3" x 5" (8 cm x 13 cm) index cards
- 32 card stock squares (8" x 8"; 20 cm x 20 cm) or paper plates
- 1 large brown paper grocery bag of leaves to cover middens

Copies of the following:

- 10 Archaeologist Checklist Task Cards

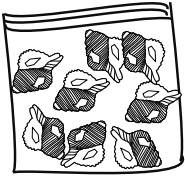
Optional:

- 1 pad Post-It® Notes
- 1 bag of sand, 50 lbs.

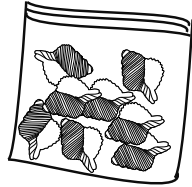
General Supplies

- 32 pieces of white paper, 11" x 19" (28 cm x 48 cm), for making myth drawings
- 66 pieces of 8½" x 11" (22 cm x 28 cm) white paper
- 40 pieces of 8½" x 11" (22 cm x 28 cm) lined paper
- 32 scissors
- 1 roll of masking tape
- 32 small bottles of white glue
- 16 sets of crayons or markers
- old newspapers
- pencils
- 11 rulers
- 1 wide-tipped marker
- 1 string (about 6 yards) for making a grid)

Optional:



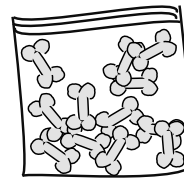
shells with holes



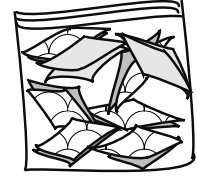
shells without holes



broken pottery



chicken bones



leather



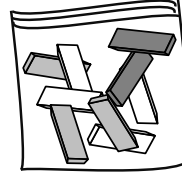
dried beans



pieces of obsidian



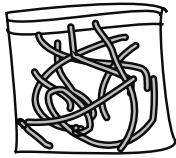
popping corn



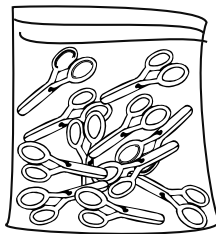
wood



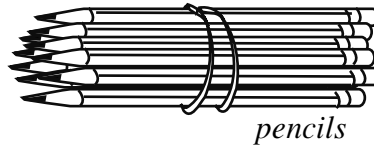
feathers



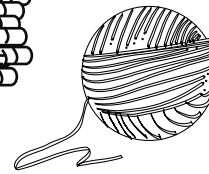
jute string



scissors



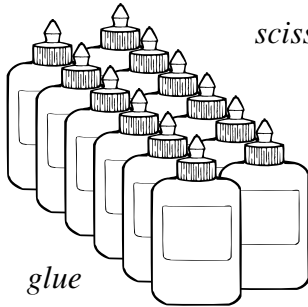
pencils



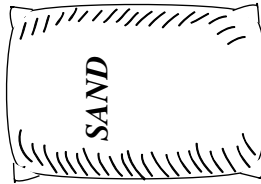
string
(optional)



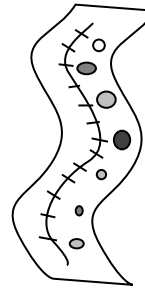
masking tape



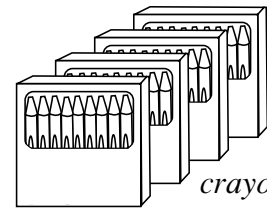
glue



sand



timeline chart
(optional)



crayons or
markers

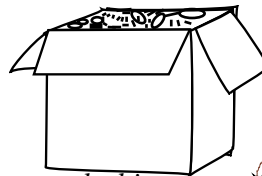


marker (optional)

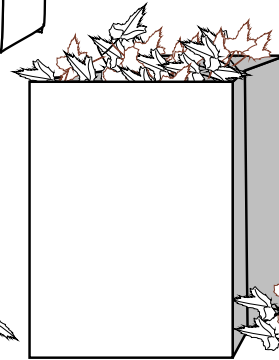


Archaeologist Checklist

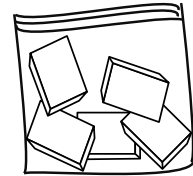
full-page pictures of stars,
Sun, Moon, etc.



clothing
props
(optional)



big bag of leaves



Post-It® Notes



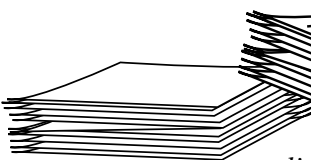
rulers



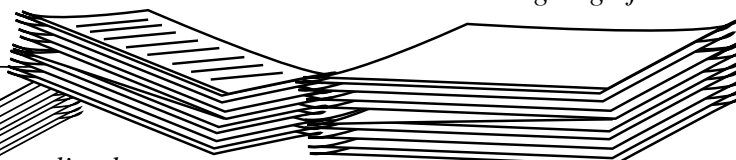
index cards



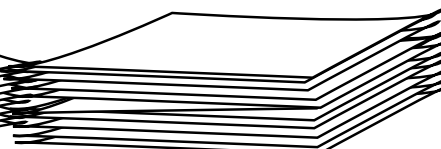
newspaper



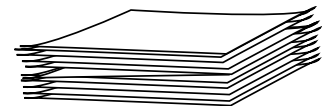
white paper



lined paper



drawing paper



card stock

Involving Dissolving

Non-Consumables

- 1 *Involving Dissolving* Teacher's Guide
- 2 pitchers, 1–2 qt. (liter) capacity or larger
- 1 small container with pouring spout, about 1 cup capacity
- 16 measuring spoons (teaspoon size), or teaspoon-sized plastic spoons
- 1 thermometer (must have 45° C in the temperature range)
- 4 plastic jugs (1 gallon capacity)
- 4 clear, colorless plastic soda bottles (1 liter capacity)
- 16 wide-mouthed plastic containers (cottage cheese type, about 8–12 oz. capacity)
- 37 tall plastic cups (8–12 oz., clear, colorless, flexible)
- 32 plastic stir sticks

Optional:

- 32 magnifying lenses

Consumables

- 37 tall plastic cups (8–12 oz., clear, colorless, flexible)
- 64 plastic stir sticks
- 32 teaspoon-sized plastic spoons to eat with
- 1 gallon of clear fruit juice (not pineapple)
- 48 packets of unflavored gelatin, about $\frac{1}{4}$ oz.
- 32 flexible, high-sided, plastic lids, about 6" diam. (such as those lids used for containers of liver sold in the meat department of a grocery store)
- 2–3 small squeeze bottles of different food colors
- 32 small, sturdy paper plates
- 1 skein of yarn
- 20 paper coffee filters, about 10" (25cm.) diameter (cone variety). Paper towels may be substituted.
- 18 small styrofoam meat trays

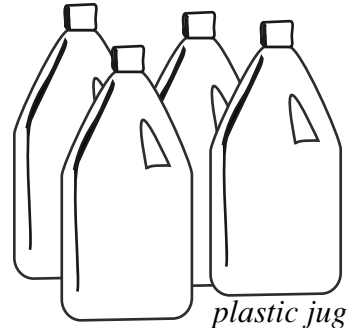
List continued on page 78.



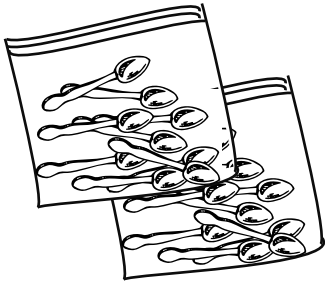
wide-mouthed containers



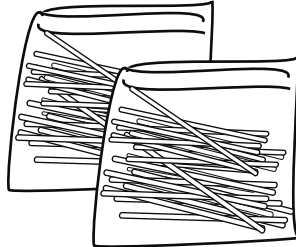
Celsius thermometer



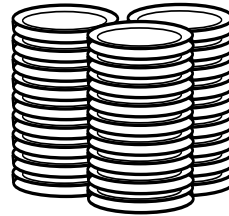
plastic jugs



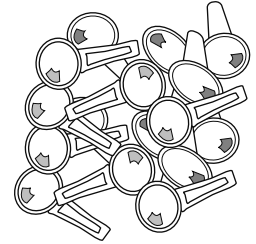
spoons



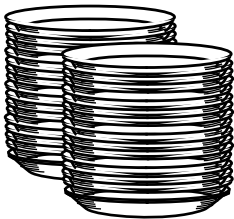
stir sticks



*high-sided
plastic lids*



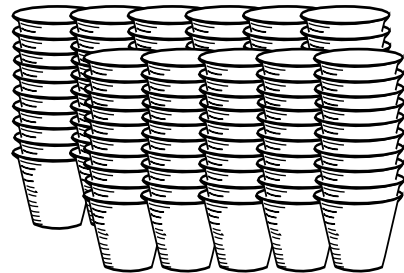
*magnifying lenses
(optional)*



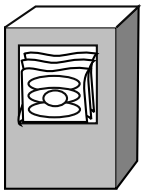
sturdy paper plates



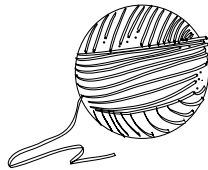
different food colors



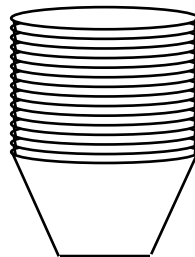
tall plastic cups



envelopes of gelatin



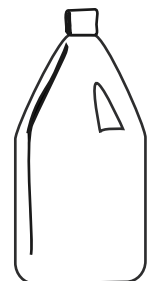
yarn



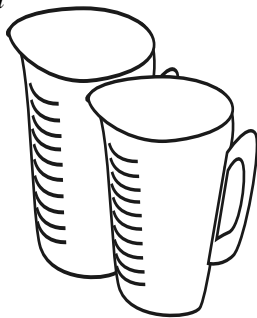
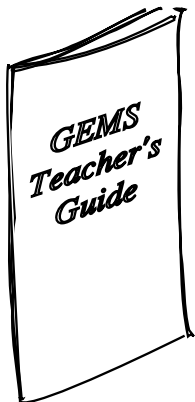
coffee filters



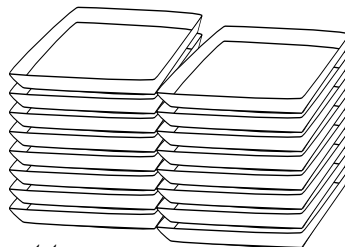
*clear plastic
soda bottles*



clear fruit juice



pitchers



meat trays



*container with
pouring spout*

Involving Dissolving

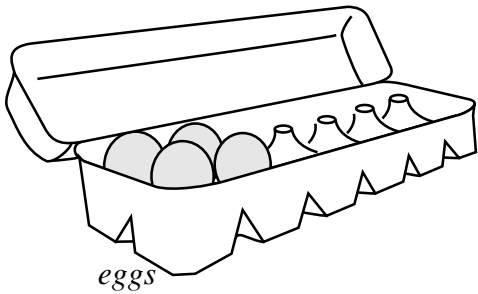
List continued from page 76

Consumables (continued)

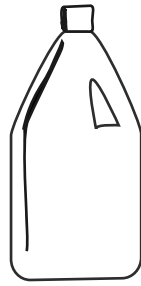
- 3 pieces of 8½" x 11" (22 cm x 28 cm) black construction paper
- 1 cup of kosher salt (pickling or sea salt can be substituted)
- ½ cup coarsely ground pepper (fine-ground is unsuitable)
- 4 eggs
- 12 oz. white distilled vinegar
- 32 white or yellow crayons

General Supplies

- 2 cafeteria trays
- 32 pencils
- 6 pieces of white paper
- 1 pair of scissors
- 3 crayons or markers of different colors
- 1 single-hole paper punch
- old newspapers
- sponges or paper towels
- 1 roll of masking tape
- 1 electric coffee maker, microwave oven or 1 gallon capacity thermos
or 1 hot plate with 1 gallon pot
- water, 1½ qt. (1½ liter)
- 1 plastic bag for discarding eggs
- butcher paper and markers (if no chalkboard is available)



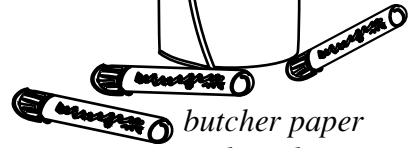
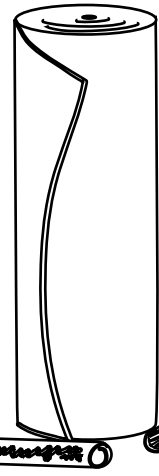
eggs



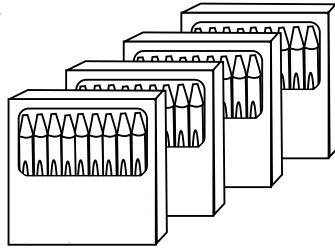
vinegar



water



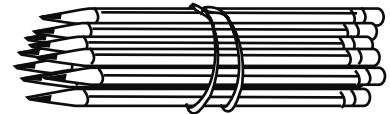
butcher paper
and markers
or chalkboard



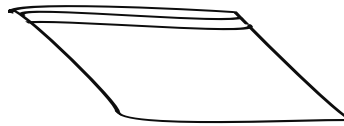
white or yellow crayons



crayons or markers of
different colors



pencils



plastic bag



scissors



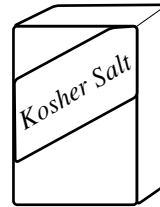
masking tape



paper punch



cafeteria trays



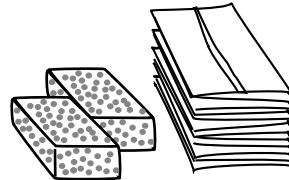
kosher salt



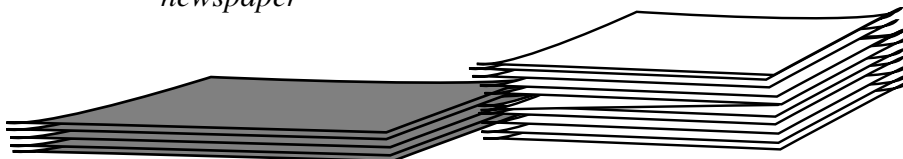
coarsely ground
pepper



newspaper

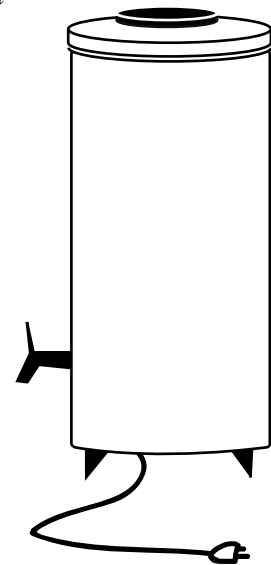


sponges or
paper towels



black construction paper

white paper



coffee maker

Ladybugs

Non-Consumables

- 1 *Ladybugs* Teacher's Guide including color pictures showing ladybugs, aphids, ladybug eggs, and larvae; as well as one each of the posters: Ladybug; Flying Ladybug; Ladybug Eating Aphids; Ladybug Egg and Baby Ladybugs; Larvae and Pupae; Ladybug Eggs, Larvae and Pupae; Scale on a Branch
- 1 clear plastic or glass jar with lid
- 1 clear plastic or glass container such as a fishbowl to hold live ladybugs
- 1 piece of nylon stocking
- 33 plastic cups with lid or bug-viewing boxes
- 1 branch with oranges
- 1 branch with scale
- 33 live ladybugs
- 1 rubber band
- plant leaves and stems covered with live aphids (on rose bushes, dandelions, nasturtiums, strawberry, bean, pea, and tomato plants)
- plant leaves covered with live ladybug eggs and larvae
- 1 spray bottle
- 1 piece of yarn, 4' (120 cm) long
- 1 brown, tan, green, or gray blanket, sheet, or bedspread

Optional:

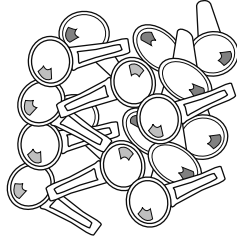
- 1 sharp knife or pair of scissors
- 1 small plastic yogurt container with lid
- 32 magnifying lenses

Consumables

- 33 pieces of 9" x 12" (22 cm x 30 cm) white tissue, waxed, or construction paper
- 17 pieces of 9" x 12" (22 cm x 30 cm) white construction paper
- 61 pieces of 9" x 12" (22 cm x 30 cm) orange construction paper
- 36 pieces of 9" x 12" (22 cm x 30 cm) green construction paper
- 5 pieces of 9" x 12" (22 cm x 30 cm) yellow construction paper
- 51 pieces of 9" x 12" (22 cm x 30 cm) black construction paper
- 99 pieces of 9" x 12" (22 cm x 30 cm) red construction paper
- 1 piece of 12" x 18" (30 cm x 45 cm) green construction paper
- 1 piece of 12" x 18" (30 cm x 45 cm) brown construction paper
- 1 piece of 12" x 18" (30 cm x 45 cm) waxed paper
- 1 piece of 24" x 30" (60 cm x 75 cm) blue paper or poster board

List continued on page 82

branch with scale



magnifying lenses (optional)

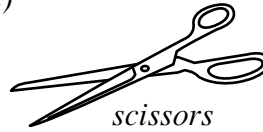


clear jar with lid



spray bottle

leaves with live aphids

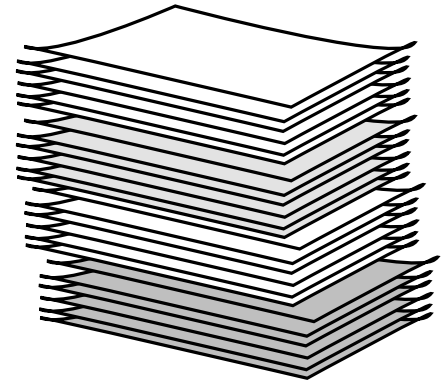


scissors

leaves with ladybug eggs and larvae



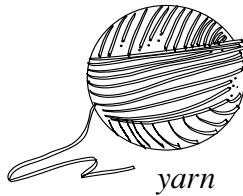
branch with oranges



white, orange, green, yellow, black and red construction paper

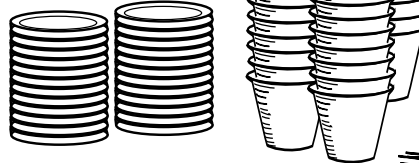


yogurt container with lid (optional)

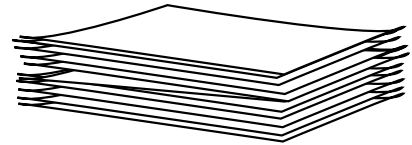


yarn

clear cups with lids



white tissue paper



ladybug pictures and posters (from Teacher's Guide)

GEMS Teacher's Guide

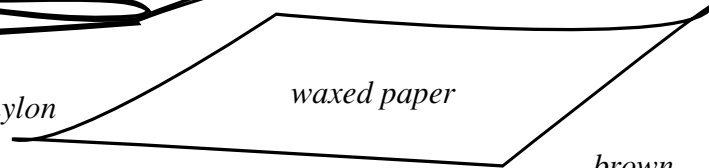


fishbowl with live ladybugs

blanket



waxed paper



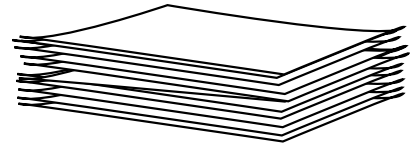
a piece of nylon stocking held in place with a rubber band



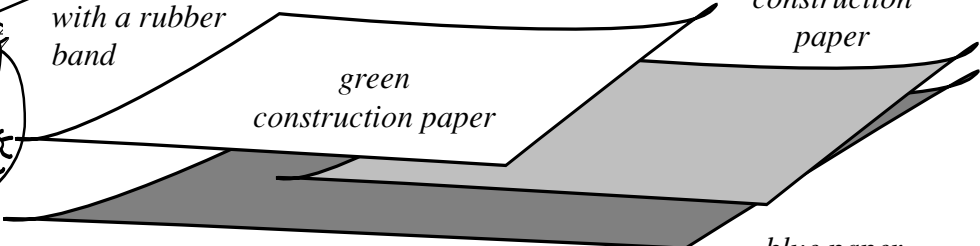
green construction paper



brown construction paper



blue paper



Ladybugs

List continued from page 80

Consumables (continued)

- 33 pieces of 2½' (75 cm) long black or red yarn
- 33 cotton swabs or small paintbrushes
- 17 containers of black paint
- 6 oranges
- 33 white crayons or chalk
- 33 black crayons or markers
- 5 ¾" diam. white round adhesive dots
- 33 ¾" diam. black round adhesive dots
- 1 container of orange juice, 96 oz.
- 33 wooden popsicle sticks
- 33 paper cups, 3 oz.

Copies of the following:

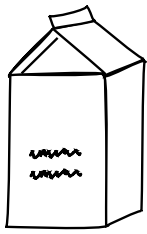
- 1 Ladybug patterns sheet
- 1 Aphids pattern sheet
- 1 Egg, Larva, Pupa patterns sheet
- 33 Ladybug Spots sheets

Optional:

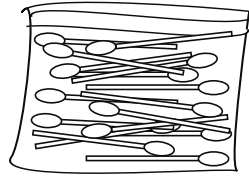
- 32 copies of Ladybug Life Stages sheet for student books or sequence cards

General Supplies

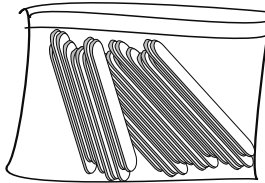
- 1 cafeteria tray
- 1 red marker or red watercolor paint and a paintbrush
- 1 brown crayon
- scissors
- white glue or paste
- old newspapers
- 1 pair of adult scissors
- paper towels
- sponges
- felt pens
- crayons
- different colored paper
- several single-hole paper punches
- 1 stapler
- 1 roll of double-stick tape
- 1 roll of masking tape



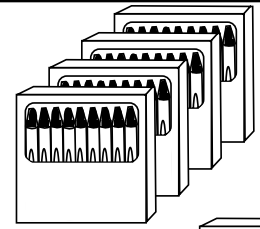
orange juice



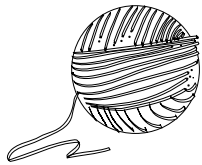
cotton swabs



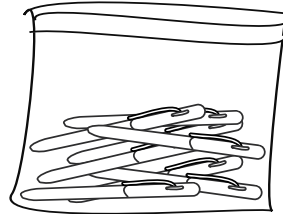
popsicle sticks



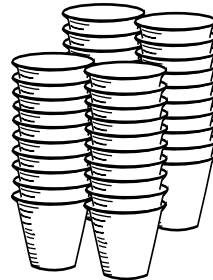
black
crayons
or
markers



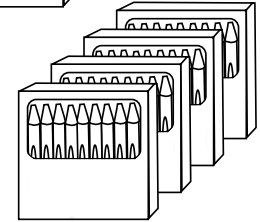
yarn



felt pens



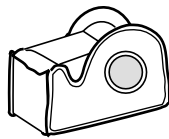
paper cups



white crayons or chalk



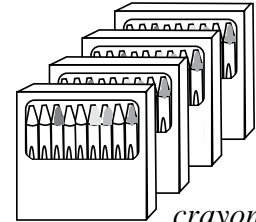
paper towels



double-stick tape



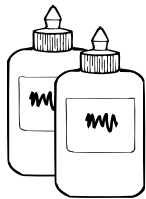
masking tape



crayons



red marker



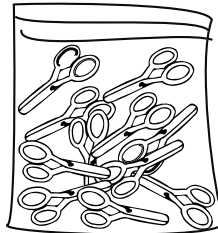
glue



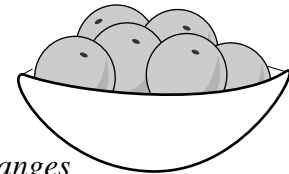
stapler



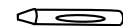
scissors



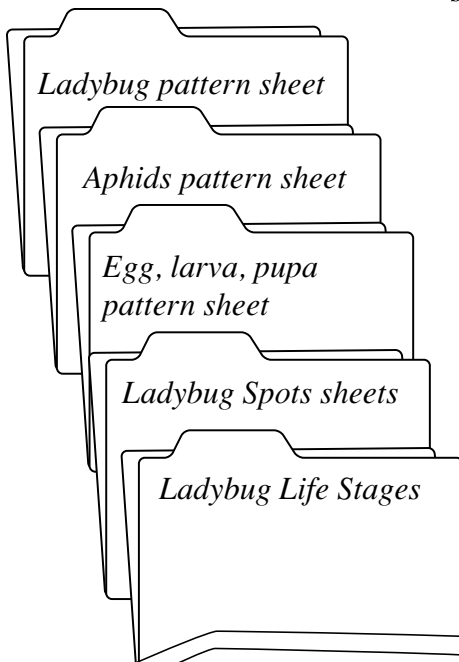
scissors



oranges



brown crayon



Ladybug pattern sheet

Aphids pattern sheet

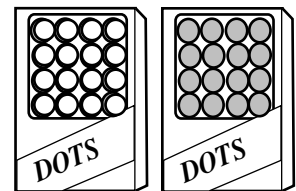
Egg, larva, pupa
pattern sheet

Ladybug Spots sheets

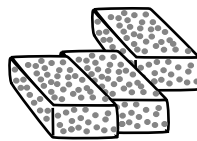
Ladybug Life Stages



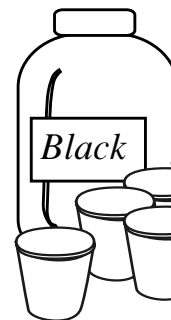
paper punches



black and white
adhesive dots



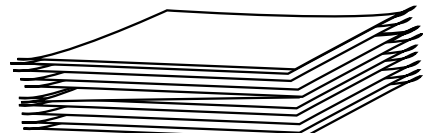
sponges



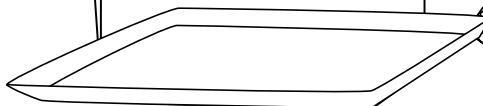
black paint



newspaper



colored paper



cafeteria tray

Liquid Explorations

Non-Consumables

- 1 *Liquid Explorations* Teacher's Guide
- 10–20 clear, colorless jars with tight fitting lids (preferably all the same size and shape)
- 5–15 liquids such as shampoo, baby oil, cooking oil, liquid starch, corn syrup, water, tempera paint, soy sauce, hair conditioner, glycerin, rubbing alcohol, molasses, dishwashing liquid
- 1 box for upright storage of the 10–20 jars of liquids
- 1 pitcher, 2–4 qt. (2–4 liter) capacity
- 1 large wide-mouthed, clear, colorless jar or other similar container, 2–4 qt. (2–4 liter) capacity
- 1 measuring spoon (tablespoon size)
- 16 plastic stir sticks
- 16 measuring spoon (teaspoon size)
- 1 long handled spoon
- 52 tall plastic cups (8–12 oz., clear, colorless, flexible)
- 48 wide-mouthed plastic containers (yogurt type, about 4–8 oz. capacity)
- 16 high rimmed bottle caps (such as those on screw top bottles)
- 1 small funnel
- 1 tall bottle with tight lid (plastic, clear, colorless)
- 1 large ziplock plastic bag to hold tall bottle

Consumables

- 4 small squeeze bottles of different food colors, including red and blue
- 32 small paper cups
- 40 paper plates, about 9" (23 cm) diameter
- 7 yds. (7 meters) waxed paper
- 32 drinking straws (preferably clear)
- 32 jars with tight lids (4–8 oz.), baby food or jam jars work well
- 32 ziplock plastic bags to fit jars
- 2 lemons

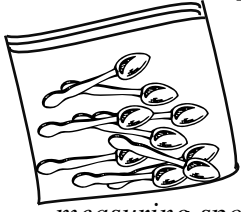
List continued on page 86



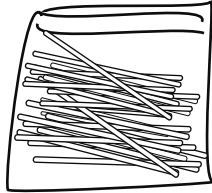
pitcher



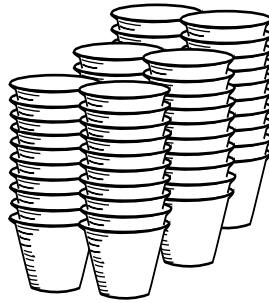
5-15 different liquids



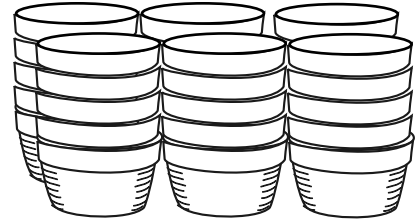
measuring spoons



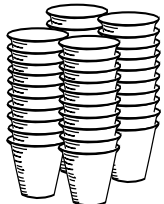
stir sticks



plastic cups



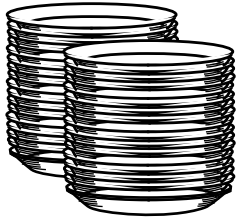
wide-mouthed containers



paper cups



high rimmed bottle caps



paper plates



different food colors



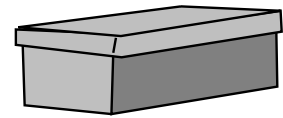
funnel



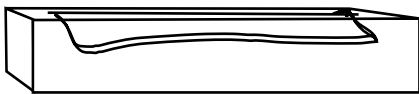
straws



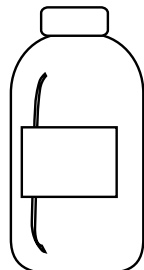
lemons



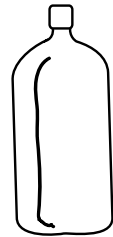
box



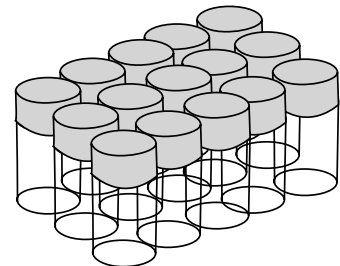
waxed paper



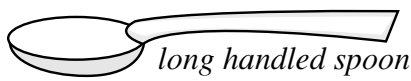
wide-mouthed clear jar



bottle with tight lid



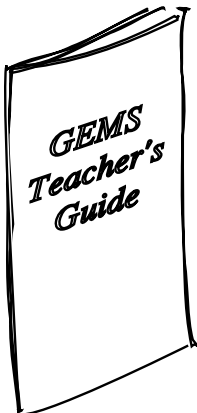
clear jars with tight lids



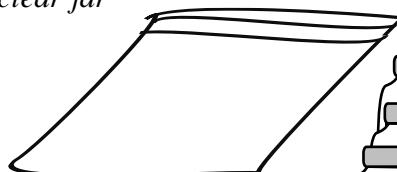
long handled spoon



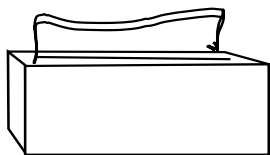
tablespoon



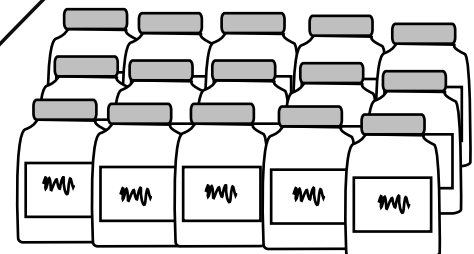
**GEMS
Teacher's
Guide**



plastic bag



ziplock plastic bags



jars with tight lids

Liquid Explorations

List continued from page 84

Consumables (continued)

- $\frac{3}{4}$ cup sugar
- 3 qts. (liters) salt-free seltzer water
- 1 box (3 lbs.) kosher salt
- 1 pint (500 ml) baby oil (mineral or paraffin oil work well too)
- $2\frac{1}{2}$ qts. (liters) salad or cooking oil
- 1 qt. (liter) vinegar—cider or wine
- $\frac{1}{2}$ cup (about $\frac{1}{2}$ oz.) rosemary
- $\frac{1}{2}$ cup (about $\frac{1}{2}$ oz.) oregano
- $\frac{1}{2}$ cup (about $\frac{1}{2}$ oz.) sage
- $\frac{1}{2}$ cup (about 2 oz.) coarsely ground pepper
- $\frac{1}{2}$ cup (about 6 oz.) salt
- water

Copies of the following:

- 32 Swirling Colors
- 32 Secret Salad Dressing

General Supplies

- 1 cafeteria tray
- 32 pencils
- 5 pieces of $8\frac{1}{2}$ " x 11" (22 cm x 28 cm) construction paper (five different colors)
- lots of crayons
- 1 pair of scissors
- 1 knife to cut a lemon
- dishwashing soap
- several pieces of blank white paper
- old newspapers
- sponges or paper towels
- 1 roll of masking tape
- butcher paper and markers (if no chalkboard is available)
- 2 buckets and squeeze bottles of water (if no sink is available)



rosemary



oregano



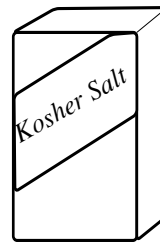
sage



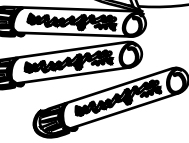
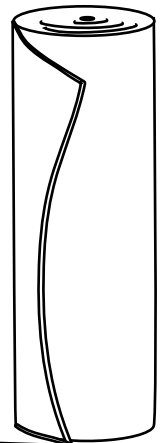
coarsely
ground pepper



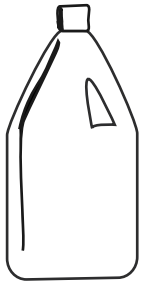
salt



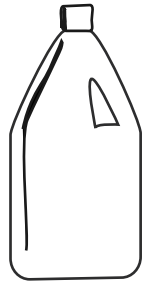
kosher salt



butcher paper
and markers or
chalkboard



vinegar



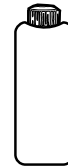
water



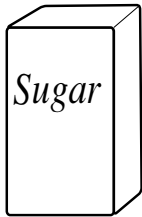
salt-free seltzer water



cooking
oil



baby oil



sugar



dishwashing soap



squeeze bottles
of water and
buckets or sink



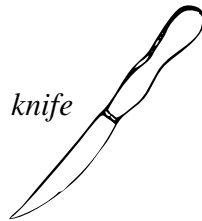
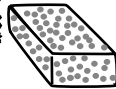
pencils



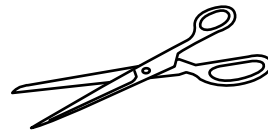
sponges or
paper towels



masking tape



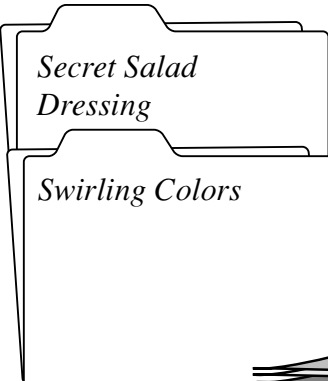
knife



scissors

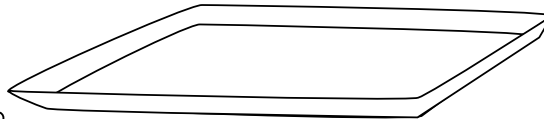


newspaper

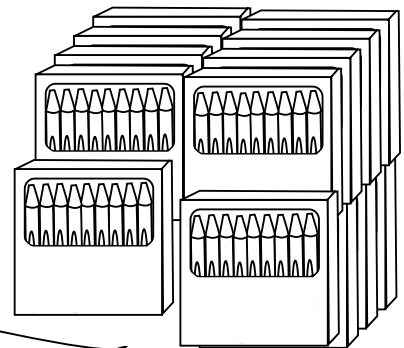


Secret Salad
Dressing

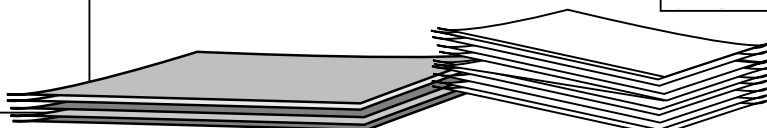
Swirling Colors



cafeteria tray



crayons



construction paper

white paper

Mapping Animal Movements

Non-Consumables

- 1 *Mapping Animal Movements* Teacher's Guide
- 8–10 active crickets from a pet store
- 1 cricket cage with apple slices as food
- 4 active hamsters (or gerbils, mice, rats)
- 4 cages and water bottles
- 4 ziplock plastic bags for observing crickets
- 4 plastic dishpans, 12" x 18" x 8" (30 cm x 45 cm x 20 cm)
- sand or soil to cover bottoms of dishpans
- 4 cardboard boxes, 30" (75 cm) long x 24" (60 cm) wide x 12" (30 cm) high
- 11 yogurt container lids

Consumables

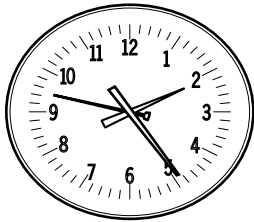
- 3 large pieces of paper, about 24" x 30" (60 cm x 75 cm)
- bedding, food, water for the animals
- 1760 $\frac{1}{2}$ " diam. adhesive dots, 880 each of two colors
- 20 $\frac{1}{2}$ " diam. adhesive dots of any color
- 11 manila folders
- 33 $8\frac{1}{2}$ " x 11" (22 cm x 28 cm) cardboard sheets to make hamster shelters
- 11 2" x 3" (5 cm x 8 cm) pieces of black paper to make cricket shelters
- shelled peanuts or sunflower seeds
- apple slices

Copies of the following:

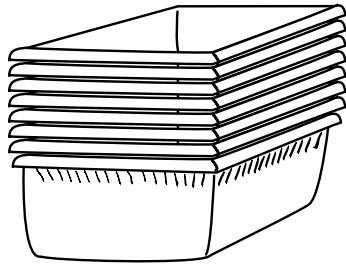
- 32 Mapping the Movements of Tule Elk student sheets
- 22 Mapping Animal Movements data sheets
- 22 Bar Graph of Movement Samples data sheets
- 11 sets Team Task Cards

General Supplies

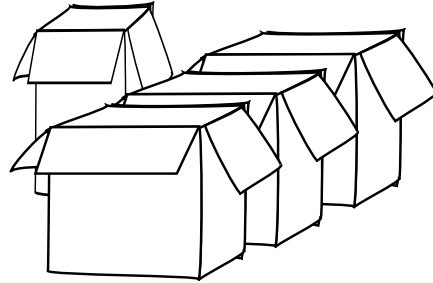
- 1 wide-tipped marker
- 32 pencils
- 1 large clock with second hand
- 1 roll of masking tape
- sponges and paper towels
- butcher paper or newsprint



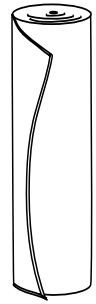
large clock with second hand



plastic dish tubs



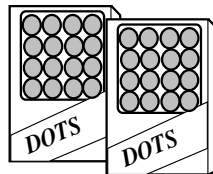
cardboard boxes



butcher paper



masking tape



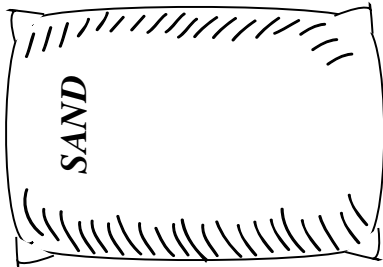
adhesive dots



apple slices and peanuts



yogurt container lids



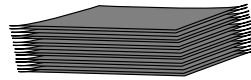
sand



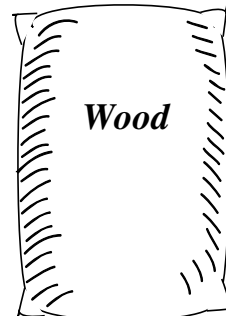
pencils



marker



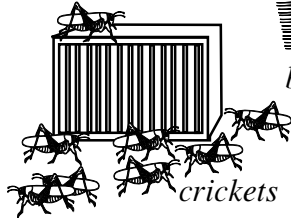
black paper



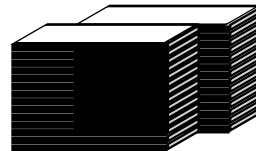
bedding



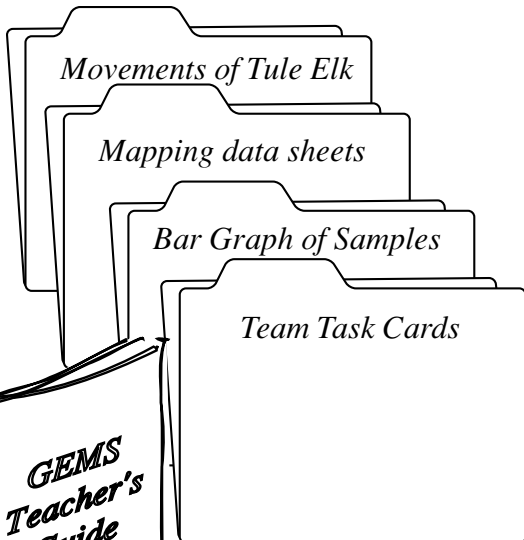
ziplock plastic bags



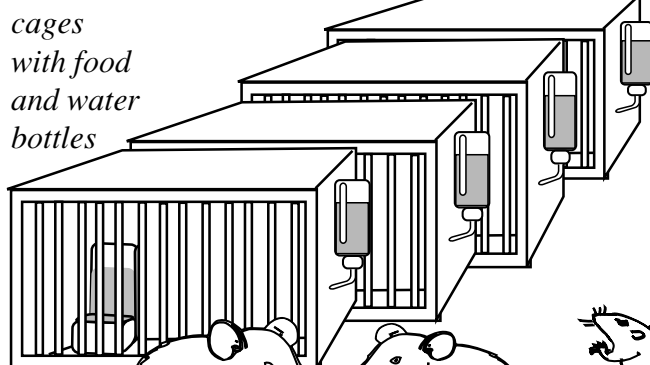
crickets and cage



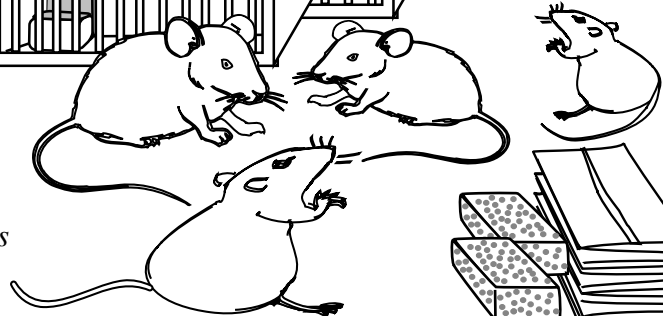
cardboard



manila folders



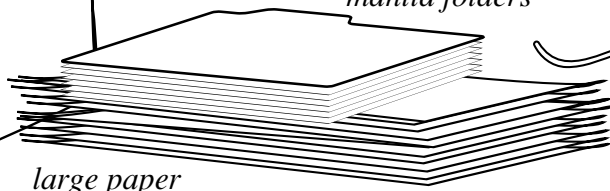
cages with food and water bottles



small rodents



sponges and paper towels



large paper

Mapping Fish Habitats

Non-Consumables

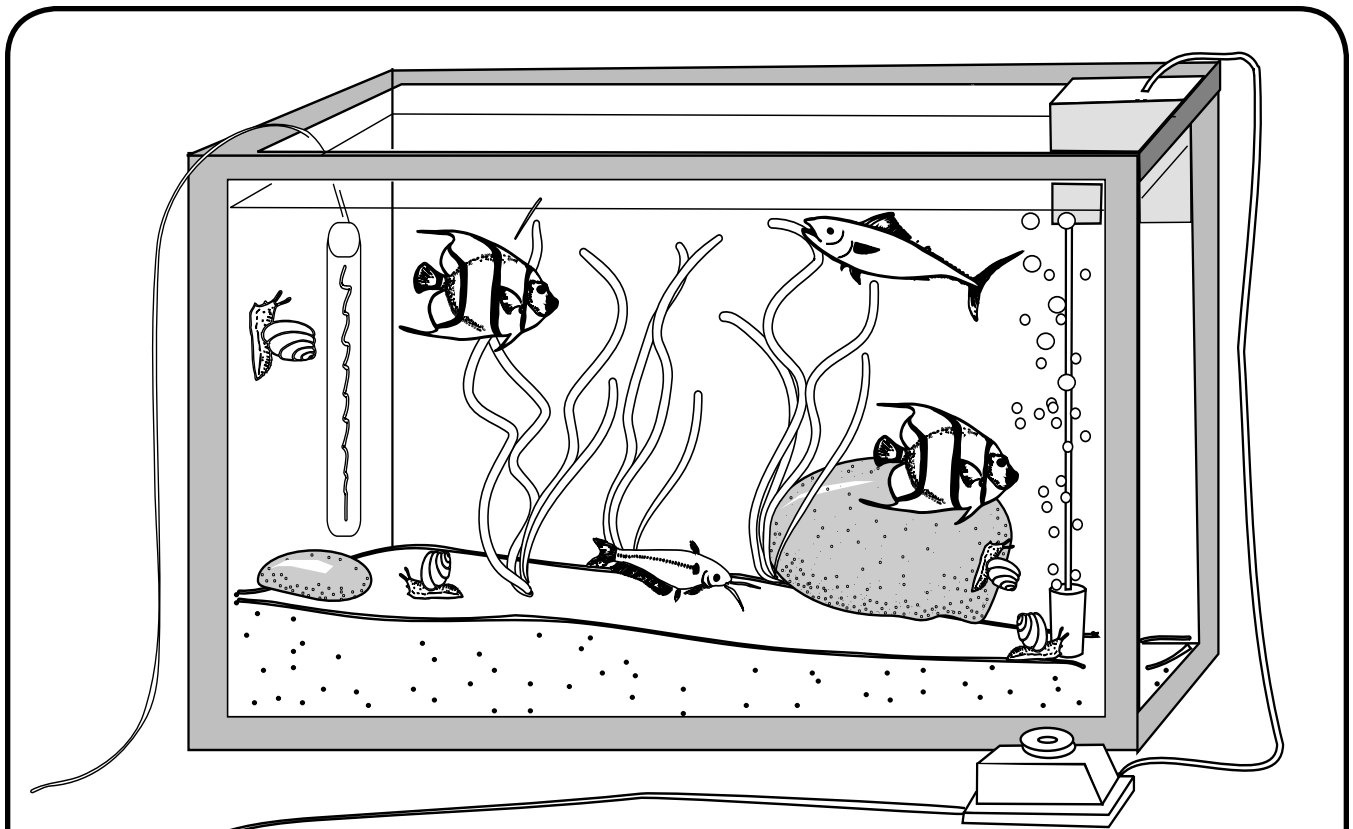
- 1 *Mapping Fish Habitats* Teacher's Guide
- 1 aquarium, 10–20 gallon
- 1 resource guide on the care of aquarium fish
- 1 plastic or metal aquarium cover
- 1 air pump with aerator and filter
- gravel for aquarium, about 2 lbs. (1 kg) for each gallon (4 liters) of water in your tank
- 1–2 large rocks
- live water plants (such as Elodea, Vallisneria, or Egeria) or several plastic plants
- 1 fishbowl or gallon jar
- 1 thermometer
- 1 small fish net
- 1 siphon tube for aquariums
- 1 sieve or dishpan for washing gravel
- 5–6 fish of three different species
- 1 piece of cardboard slightly larger than the front wall of the aquarium
- objects for experiments, such as rocks, plants, wood, additional fish, a mirror, black paper, fluorescent lamp

Optional:

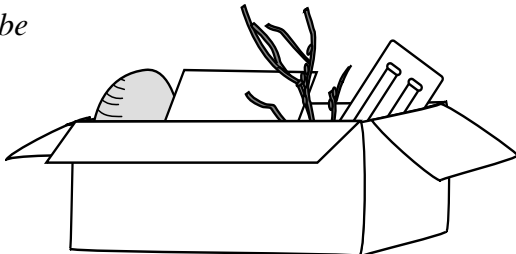
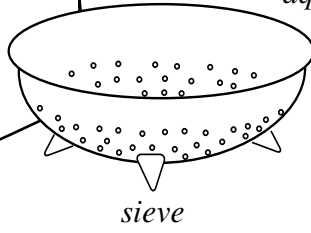
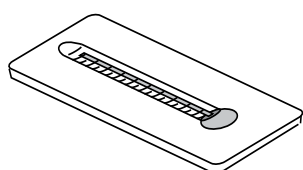
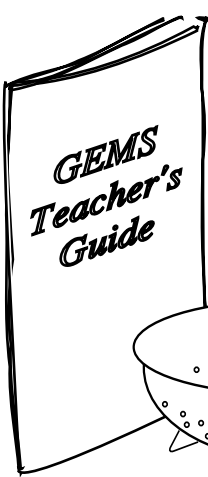
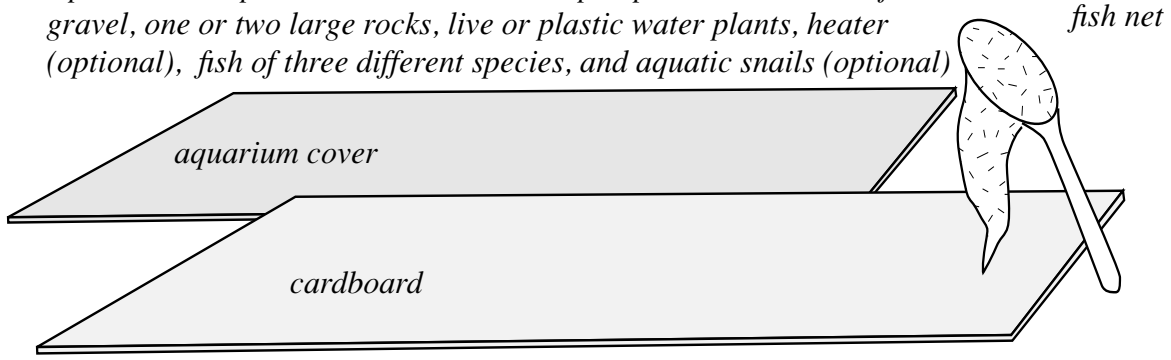
- 1 aquarium heater
- 5–10 aquatic snails

List continued on page 92

Mapping Fish Habitats



aquarium with plastic or metal cover, air pump with aerator and filter, gravel, one or two large rocks, live or plastic water plants, heater (optional), fish of three different species, and aquatic snails (optional)



objects for experiments

List continued from page 90

Consumables

- 1 container of flake fish food
- 1 container of tablet food for the bottom feeding fish
- 1 pH kit for aquariums
- 7 pieces of clear acetate or plastic, cut to fit the front wall of the aquarium
- 1260 $\frac{1}{2}$ " diam. adhesive dots, 140 of each color (one color for each fish)
- 7 manila folders

Copies of the following:

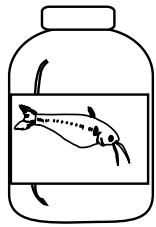
- 96 Fish Observations sheets
- 7 Fish Facts sheets

Optional:

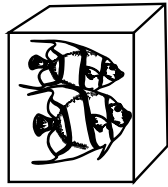
- live fish food (tubifex worms, brine shrimp, daphnia, or small insects)
- 1 bottle of dechlorination liquid or tablets
- 1 test kit for nitrites

General Supplies

- 1 wide-tipped marker
- 4 pieces of 12" x 18" (30 cm x 45 cm) paper
- 1 ruler
- 32 pieces of lined paper
- 32 pencils
- 1 roll of masking tape
- 1 grease pencil for drawing on acetate
- 1 roll of clear tape
- butcher paper and markers if no chalkboard is available



*tablet food for
bottom feeding fish*



flake fish food



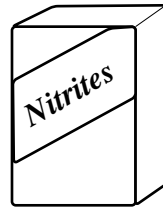
*live fish food
(optional)*



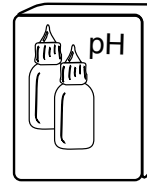
*dechlorination
liquid or tablets
(optional)*



ruler



*test kit for nitrites
(optional)*



*pH kit for
aquariums*



grease pencil



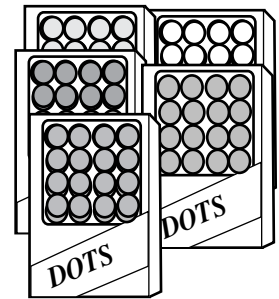
marker



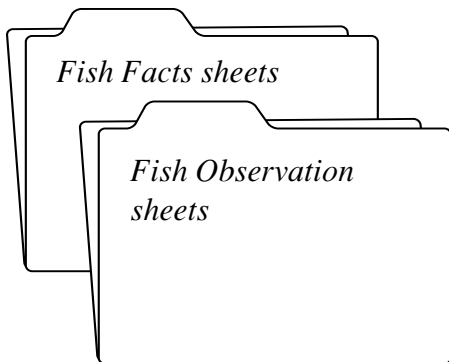
pencils



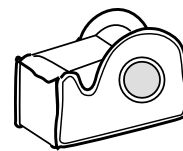
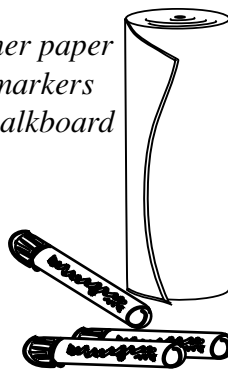
masking tape



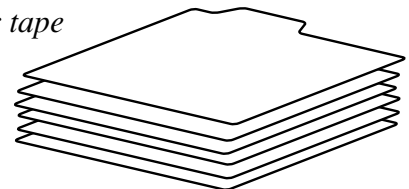
adhesive dots



*butcher paper
and markers
or chalkboard*

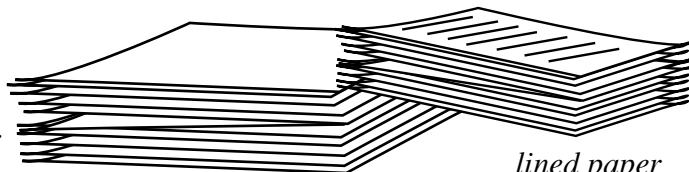


clear tape



manila folders

paper



lined paper



clear acetate

Moons of Jupiter

Non-Consumables

- 1 *Moons of Jupiter* Teacher's Guide and set of 23 slides*
- 2 balls of very different sizes, such as a softball and a ping pong ball
- 8 shallow basins, such as a dishtubs, aluminum roasting pans, or cardboard boxes, to make craters
- 8 paper or plastic cups
- 8 small rocks, about $\frac{1}{4}$ " ($\frac{1}{2}$ cm) diameter
- 8 medium rocks, about $\frac{3}{4}$ " (2 cm) diameter
- 8 large rocks, about $1\frac{1}{2}$ " (4 cm) diameter
- 8 plastic or metal spoons
- 1 Earth globe, blue balloon, or ball, about 10" (25 cm) diameter
- 2 white balloons or balls, about 3" (7 cm) diameter
- 1 model car or any other example of a scale model

*One set of slides comes with the *Moons of Jupiter* Teacher's Guide. Additional sets are available from GEMS at Lawrence Hall of Science.

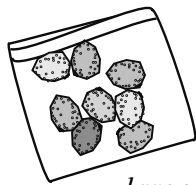
Optional:

- 1 set of various tools for use by the teacher, or by students under supervision, such as pliers for bending wire, or a utility knife for cutting tubes and styrofoam
- 4 transparencies of the Tracking Jupiter's Moons data sheet

Consumables

- 1 container of instant chocolate milk powder for crater activity
- 4 bags of white flour (5 lbs. each) for crater activity
- 1-2 boxes of "doo-dads" (raw materials for building models of space settlements, such as empty containers and packaging materials, tubes, straws, corks, colored paper)
- 1-2 skeins of colored yarn or string
- 1-2 rolls of aluminum foil
- 1 roll of plastic wrap
- 1 box of toothpicks
- 1 box of straws
- 8 pieces of posterboard, about 1' x 2' (30 cm x 60 cm)

List continued on page 96



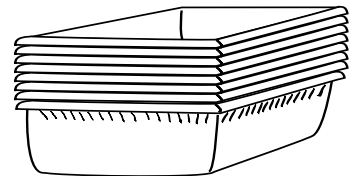
large rocks



toothpicks



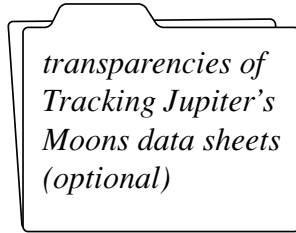
cups



dishtubs



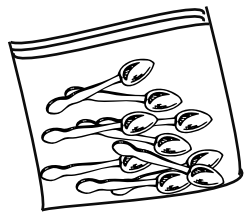
medium rocks



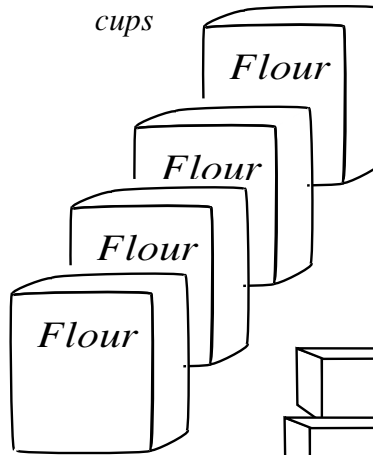
transparencies of
Tracking Jupiter's
Moons data sheets
(optional)



small rocks



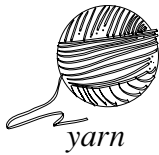
spoons



flour



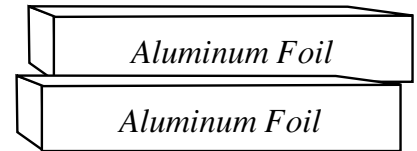
chocolate milk powder



yarn



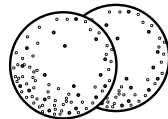
straws



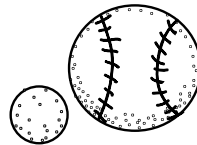
plastic wrap



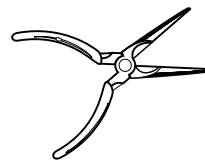
Earth globe



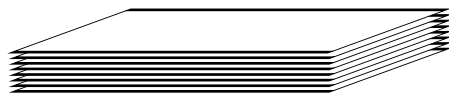
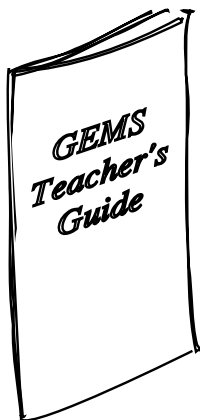
white balls



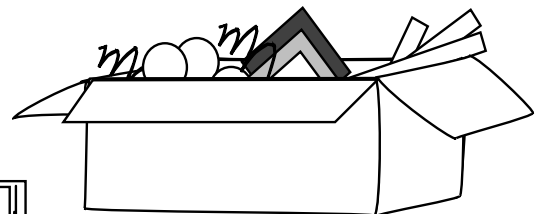
two balls



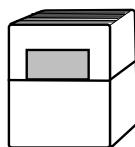
tools (optional)



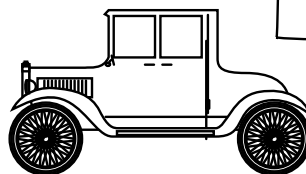
posterboard



"doo-dads"



set of slides



model car

Moons of Jupiter

List continued from page 94

Consumables (continued)

Copies of the following:

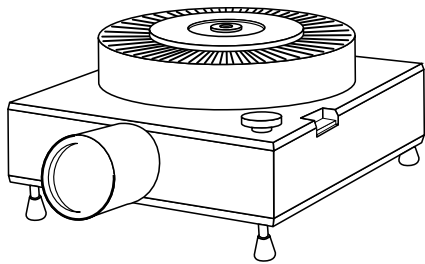
- 32 Tracking Jupiter's Moons data sheets
- 32 Craters activity sheets
- 33 Data Sheets—Callisto and Ganymede
- 33 Data Sheets—Io and Europa with US map for scale
- 1 set of Teacher Fact Sheets (4 pages)
- 8 each of the 4 Scientific Mission Sheets

Optional:

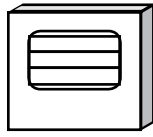
- 32 Moon Maps

General Supplies

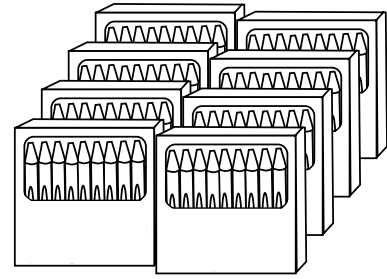
- 1 slide projector and screen
- 1 broom or whisk broom and dustpan to clean up spills
- 32 pencils
- 1 sheet of old newspaper
- 8 rolls of masking or clear tape
- 1 meter stick
- 1 piece of chalk
- 1 length of string, 5' (1 ½ meter) long
- 4 manila file folders
- 1 wide-tipped black marker
- 8 boxes of crayons or markers, various colors
- small glue bottles or glue sticks
- 16 pairs of scissors
- 1 package of blank, rectangular adhesive labels for labeling moon base
- 1 overhead projector and screen
- 1 set of overhead projector pens (four different colors)
- markers, assorted colors



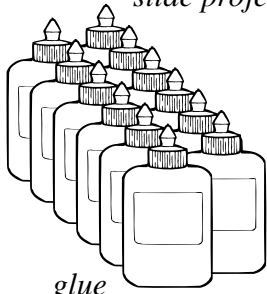
slide projector



adhesive labels



crayons or markers



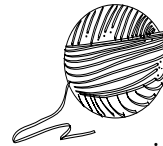
glue



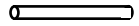
masking tape



pencils



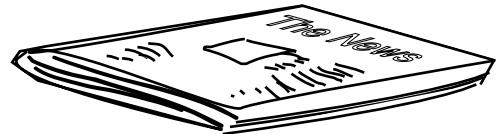
string



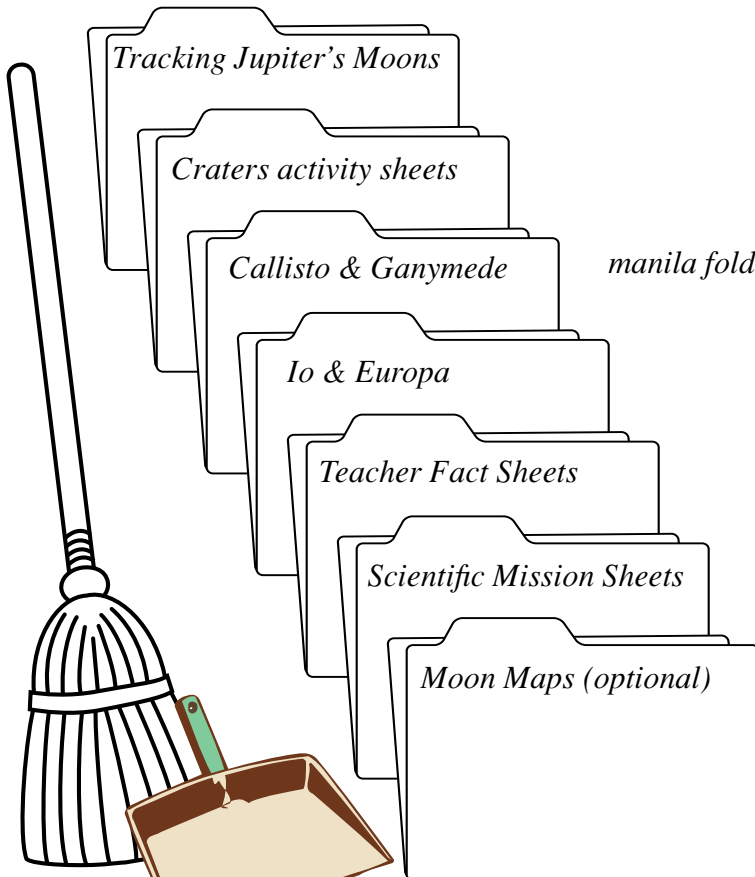
chalk



meter stick



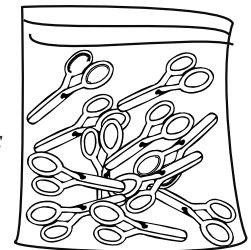
newspaper



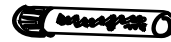
manila folders

broom

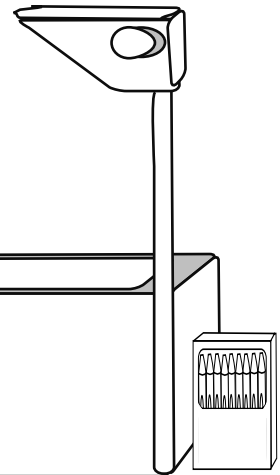
dustpan



scissors



black marker



overhead projector and markers

More Than Magnifiers

Non-Consumables

- 1 *More Than Magnifiers* Teacher's Guide
- 1 clear glass jug or jar, 1 gallon capacity
- 1 inexpensive portable lamp with no shade; clip-on lamp works well
- 1 extension cord, 25'
- 1 red light bulb, 40–75 watt
- 10 lenses, 40–100 mm focal length*
- 10 lenses, 80–300 mm focal length*
- 30 paper, plastic, or styrofoam cups, 8 oz.
- 10 color slides (any images, sharply focused)
- 10 flashlights

*Class sets of lenses are available from GEMS at the Lawrence Hall of Science.

Optional:

- 1 commercial lens-type camera
- 1 lens-type (refractor) telescope

Consumables

Copies of the following:

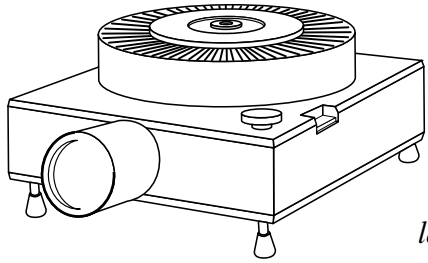
- 32 Magnifiers data sheets
- 32 Cameras data sheets
- 32 Telescopes data sheets
- 32 Projectors data sheets

General Supplies

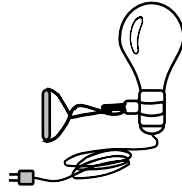
- 1 sheet of old newspaper
- 1 roll of masking tape
- 2 pieces of lightweight tracing paper
- butcher paper and markers (if no chalkboard is available)
- 10 wide-tipped markers
- 10 pieces of white paper

Optional:

- 1 slide projector

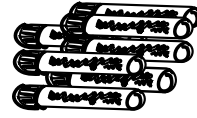


slide projector (optional)

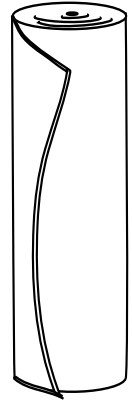


red light bulb

lamp with no shade



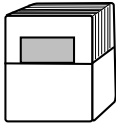
markers



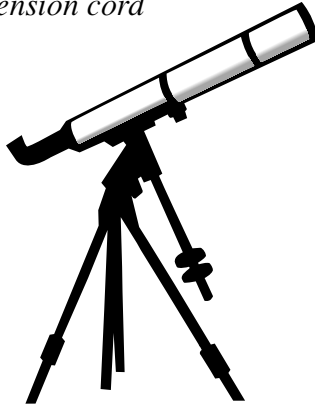
butcher paper and markers or chalkboard



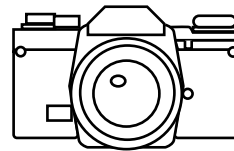
extension cord



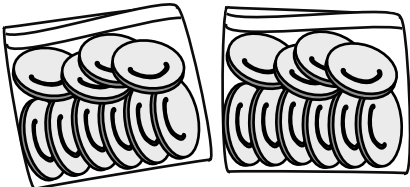
slides



telescope (optional)



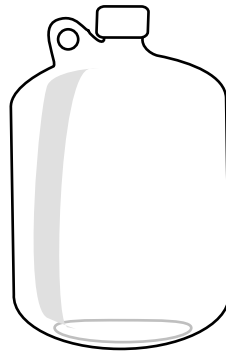
camera (optional)



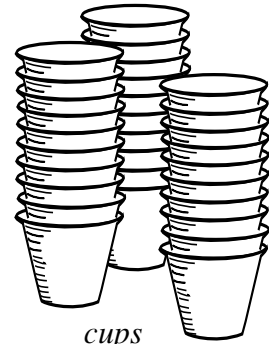
short and long focus lenses



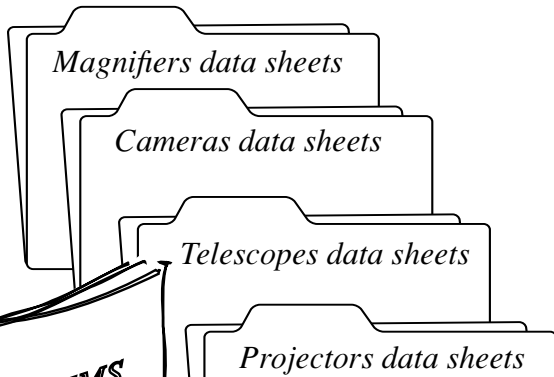
masking tape



clear glass jug



cups

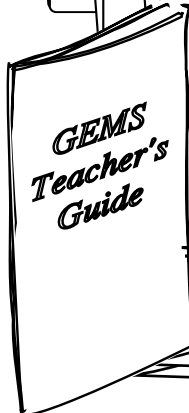


Magnifiers data sheets

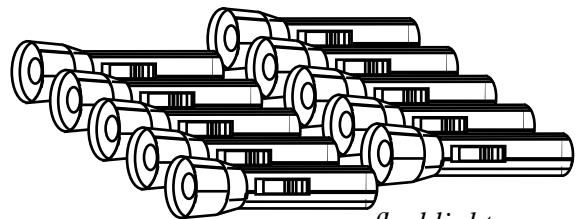
Cameras data sheets

Telescopes data sheets

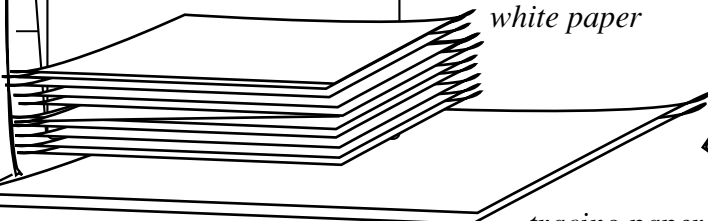
Projectors data sheets



GEMS Teacher's Guide



flashlights



white paper

tracing paper



newspaper

Mystery Festival

Mr. Bear Mystery

Non-Consumables

- 1 *Mystery Festival* Teacher's Guide
- 5 stuffed animals (one must be a bear)
- 1 piece of string, rope, or yellow caution tape, about 50' (15 meters)
- 1 brown, water-base marker
- 1+ markers (variety of colors is ideal)
- 1 piece white butcher paper, about 40' (12 meters)
- 16 plastic cups (clear, colorless)
- 3 empty film canisters with lids
- 1 ice cube tray
- 2 white test trays (made from styrofoam egg cartons cut in half or white plastic paint trays from an art store or white ice cube trays)
- 1-4 small dropper bottles (such as empty medicine dropper bottles, saline bottles, or similar small bottles)
- 2 empty cola cans
- 3 measuring spoons ($\frac{1}{8}$, $\frac{1}{4}$, and 1 teaspoon sizes)
- 1 yardstick
- 1 plastic stirrer
- 1 paintbrush (any kind)
- 1 paint container (such as a plate or cup)
- 2 colognes or perfumes, very different from each other
- 1 wastebasket
- 4 small mirrors, preferably with stands
- 1 large plastic trash bag
- 1 sponge

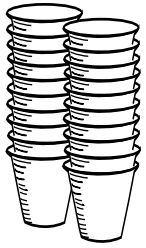
Copies of the following:

- 1 each of the 21 pages of footprints for the scene of the crime
- 4 backwards "Bill" secret notes (made for Session 1: Scene of the Crime)
- 4 pictures of the suspects

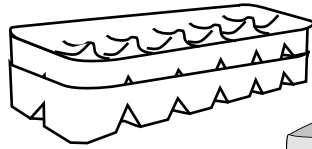
Optional:

- 1 Polaroid or video camera

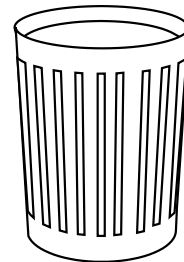
List continued on page 102



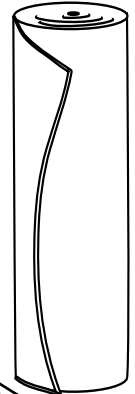
plastic cups



white test trays



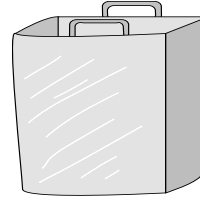
wastebasket



butcher paper



ice cube tray



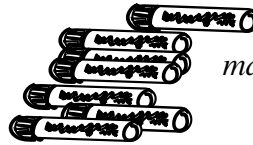
plastic trash bag



brown water-base marker



yardstick



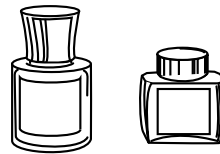
markers



paint container



measuring spoons



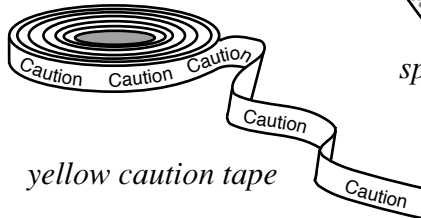
colognes



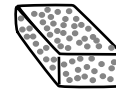
dropper bottles



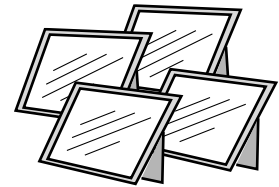
paintbrush



yellow caution tape



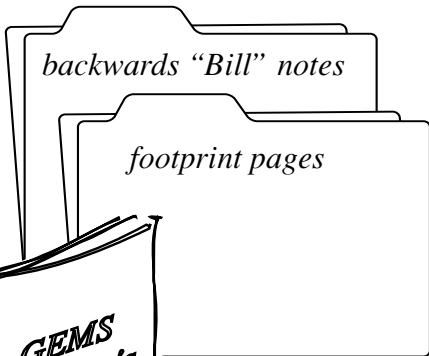
sponge



mirrors

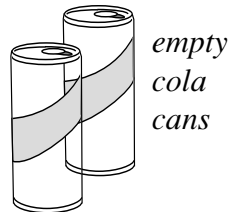


plastic stirrer

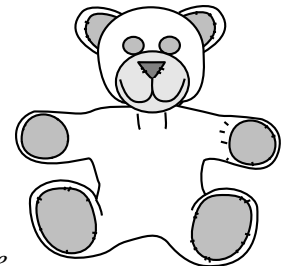


backwards "Bill" notes

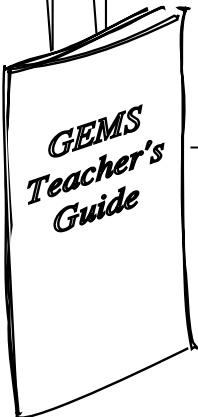
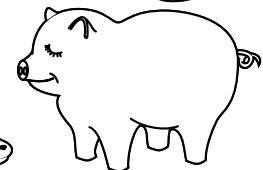
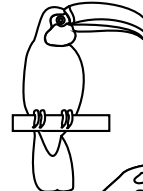
footprint pages



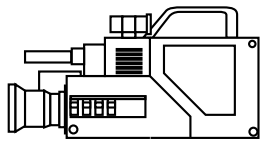
empty cola cans



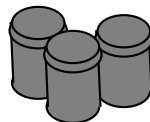
five stuffed animals



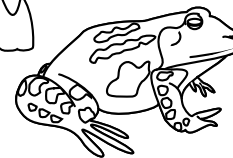
GEMS Teacher's Guide



video or Polaroid camera (optional)



film canisters



Mystery Festival

Mr. Bear Mystery

List continued from page 100

Consumables

- 1 skein of white cotton yarn
- 1 skein of colored cotton yarn
- 1 skein of colored wool yarn (best if the yarn looks “woolly”)
- 2 pieces of 8½" x 11" (22 cm x 28 cm) white paper
- 1 roll of Universal pH paper
- 1 can of cola (12 oz.)
- 1 oz. of iodine
- 2 tablespoons of red food color
- 1 tablespoon of green food color
- 1 package white paper towels
- 1 box baking soda (about 8 oz.)
- 1 box cornstarch (about 16 oz.)
- 1 teaspoon of salt
- 2 teaspoons of sugar
- 30+ strands of pet hair (such as dog or cat hair)
- 1 handful of grass

Copies of the following:

- 4 Whose Fingerprints are on the Cup? sheets
- 4 Suspect Fingerprint sheets
- 4 each of the 10 station signs
- 16 Mr. Bear Footprints sheets
- 16 Mr. Bear Mystery data sheets (2 pages each)
- clueboard

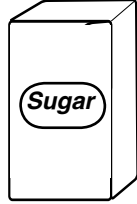
General Supplies

- 1 roll of clear adhesive tape
- 1 roll of masking tape
- 1 pair of scissors
- 16 pencils

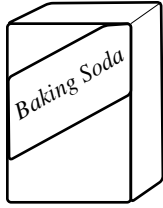
List continued on page 104



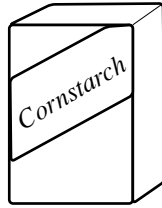
salt



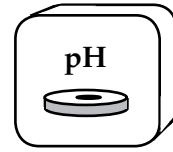
sugar



baking soda



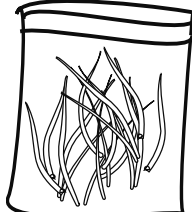
cornstarch



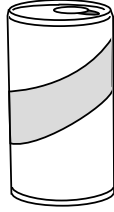
Universal pH paper



pet hair



grass



cola



iodine



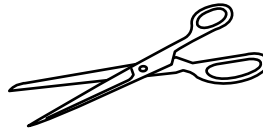
red food color



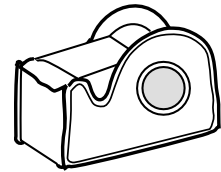
green food color



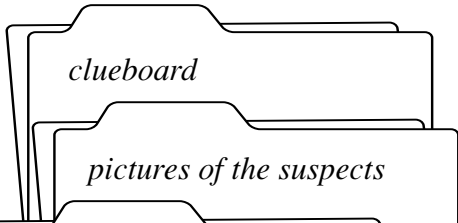
white paper



scissors

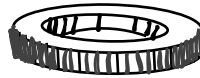


clear adhesive tape



clueboard

pictures of the suspects



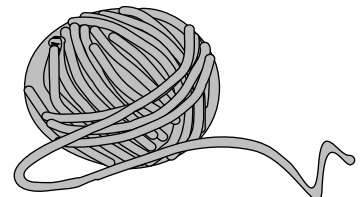
masking tape

Whose Fingerprints are on the Cup?

Suspect Fingerprint



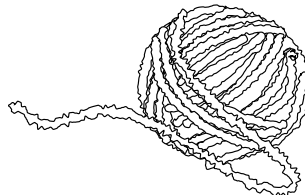
pencils



colored cotton yarn

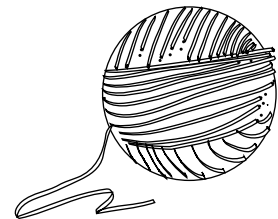
station signs

Mr. Bear Footprints



colored wool yarn

Mr. Bear Mystery data sheets



white cotton yarn



white paper towels

Mystery Festival

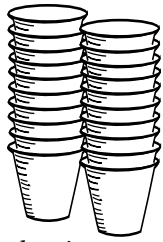
Felix Mystery

List continued from page 102

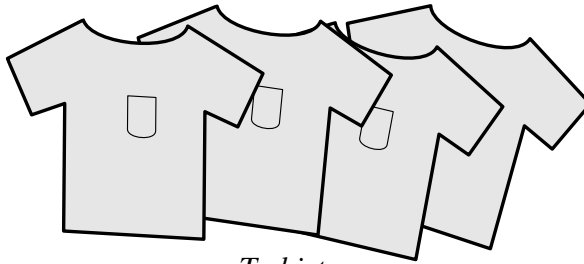
Non-Consumables

- 1 *Mystery Festival* Teacher's Guide
- 1 piece of string, rope, or yellow caution tape, about 50' (15 meters)
- 2 markers (one permanent)
- 1 brown, water-base marker
- 1 piece white butcher paper, about 40' (12 meters)
- 1 piece of tagboard, about 8½" x 11" (22 cm x 28 cm), for the "Secret Note"— the cardboard back of a notepad works well
- 18 plastic cups (clear, colorless)
- 6 empty film canisters with lids
- 4 colognes or perfumes, very different from each other
- 2 white test trays (made from styrofoam egg cartons cut in half or white plastic paint trays from an art store or white ice cube trays)
- 2–5 dropper bottles (such as empty medicine dropper bottles, saline bottles, or similar small bottles)
- 2 empty cola cans
- 5 measuring spoons (⅛ or ¼ teaspoon size)
- 1 measuring spoon (1 teaspoon size)
- 1 ice cube tray
- 1 paintbrush (any kind)
- 1 paint container (such as a plate or cup)
- 1 wastebasket
- 1 chocolate candy wrapper
- 1 white cotton towel
- 1 comb with several strands of human hair
- 1 "broken" alarm clock
- 1 pair plastic gloves
- 4 pairs of metal tweezers, tongs, or equivalent
- 4 small mirrors, preferably with stands
- 2 "eggs" of Silly Putty
- 1 large plastic trash bag
- 1 sponge
- 4 old sweaters or T-shirts

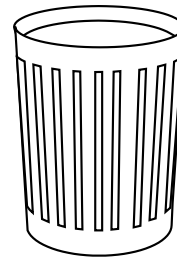
List continued on page 106



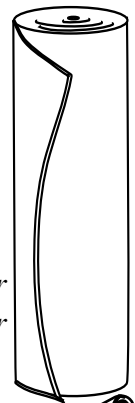
plastic cups



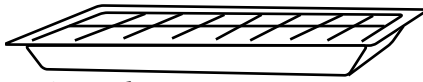
T-shirts



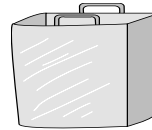
wastebasket



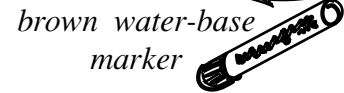
butcher paper



ice cube tray



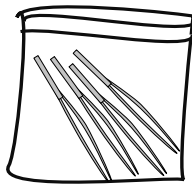
plastic trash bag



brown water-base marker



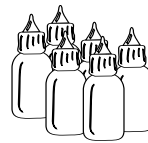
paint container



tweezers



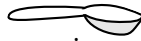
measuring spoons
 $\frac{1}{8}$ or $\frac{1}{4}$ teaspoon size



dropper bottles



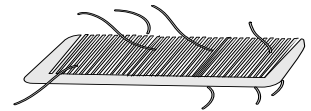
markers



measuring spoon
1 teaspoon size



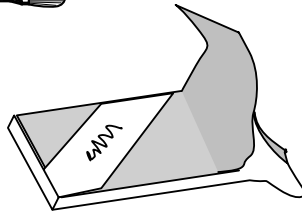
colognes



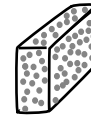
comb with strands of hair



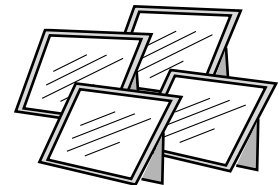
paintbrush



chocolate candy wrapper



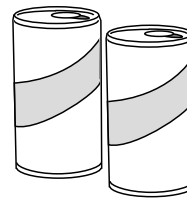
sponge



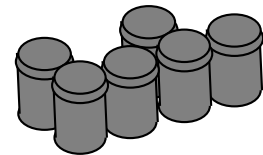
mirrors



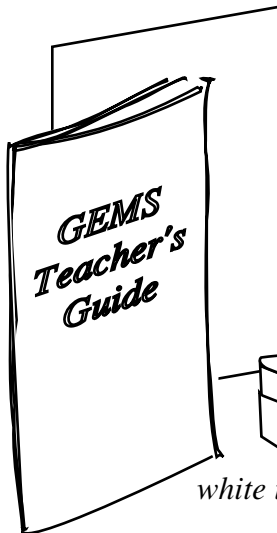
plastic gloves



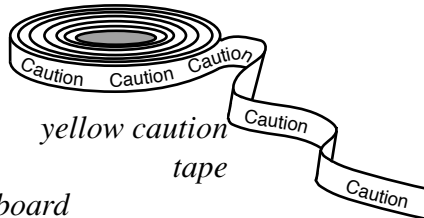
empty cola cans



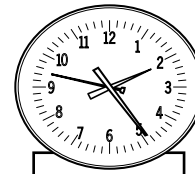
film canisters



**GEMS
Teacher's
Guide**

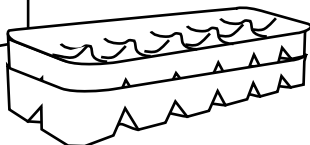


yellow caution tape



"broken"
alarm clock

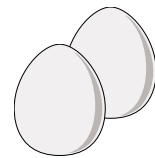
tagboard



white test trays



towel



"eggs" of
Silly Putty

Mystery Festival

Felix Mystery

List continued from page 104

Non-Consumables (continued)

Copies of the following:

- 1 each of the 21 pages of footprints
- 4 each of the 10 station signs
- 4 pictures of the suspects

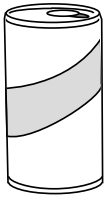
Optional:

- 1 Polaroid or video camera
- 1 guitar pick
- 1 pair of sunglasses
- 1 clip-on earring
- 1 laminator, or clear contact paper, to laminate station signs
- 1 package of carpet tacks

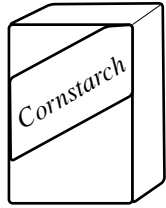
Consumables

- 1 skein of white cotton yarn
- 1 skein of colored cotton yarn
- 1 skein of colored wool yarn (best if the yarn looks “woolly”)
- 12 pieces of 8½" x 11" (22 cm x 28 cm) white paper
- 50+ lined 3" x 5" (8 cm x 13 cm) index cards
- 1 pad of 100 Post-it® Notes (2" x 2" or larger)
- 1 roll of Universal pH paper with color chart
- 2 ziplock plastic bags (1 gallon capacity)
- 1 oz. of iodine
- 1 box baking soda (about 8 oz.)
- 1 box cornstarch (about 16 oz.)
- 1 can of cola (12 oz.)
- 3 tablespoons of red food color
- 1 tablespoon of green food color

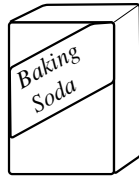
List continued on page 108



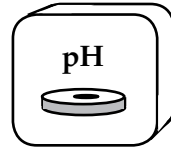
cola



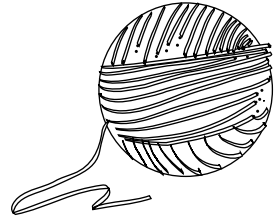
cornstarch



baking soda



*Universal pH
paper*



white cotton yarn



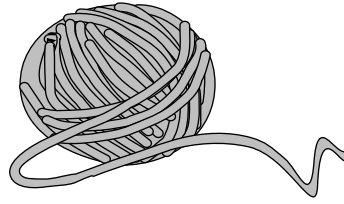
*red food
color*



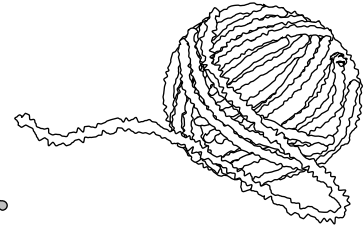
*green food
color*



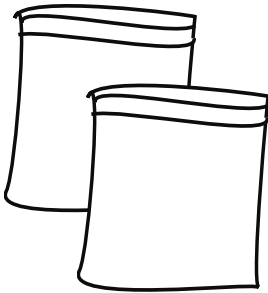
iodine



colored cotton yarn



colored wool yarn



large ziplock plastic bags



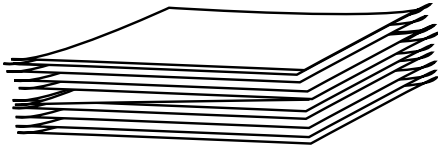
laminator or clear contact paper (optional)



lined index cards



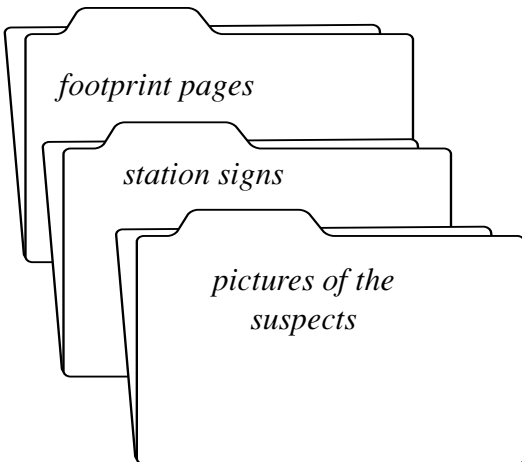
*Post-it®
Notes*



white paper



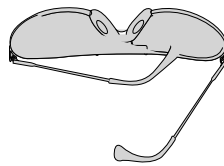
*carpet tacks
(optional)*



footprint pages

station signs

*pictures of the
suspects*



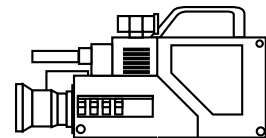
*sunglasses
(optional)*



*guitar pick
(optional)*



*clip-on earring
(optional)*



*video or Polaroid
camera (optional)*

Mystery Festival

Felix Mystery

List continued from page 106

Consumables (continued)

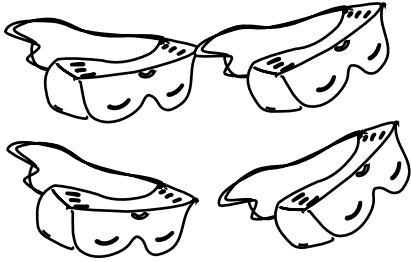
- 1 package white paper towels
- 1 small container of Krazy Glue
- 4 pieces of aluminum foil, about 12" x 16" (30 cm x 40 cm)
- 4 votive candles
- matches
- 4 large brown paper or plastic grocery bags
- 30+ strands of pet hair (such as dog or cat hair)

Copies of the following:

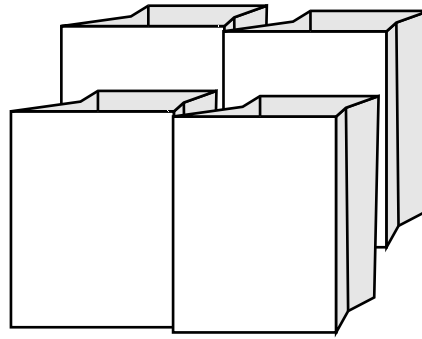
- 8 Suspect Footprints sheets
- 16 Felix Mystery data sheets (2 pages each)
- 4 DNA Fingerprints sheets
- 1 Suspect Fingerprint sheet
- 1 Handwriting Samples sheet
- 1 Tape Lift Examples sheet
- 8–32 Who Done It? sheets

General Supplies

- 21 pencils
- 1 roll of clear adhesive tape
- at least 1 pair of safety goggles (4 pairs would be ideal; swimming, snorkeling, or ski goggles are all fine)
- 1 roll of masking tape
- 1 pair of scissors
- 1 meter stick or yardstick
- 1 metric ruler



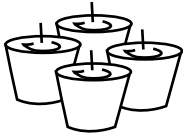
goggles



paper grocery bags



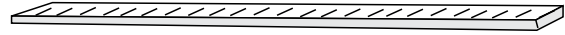
pet hair



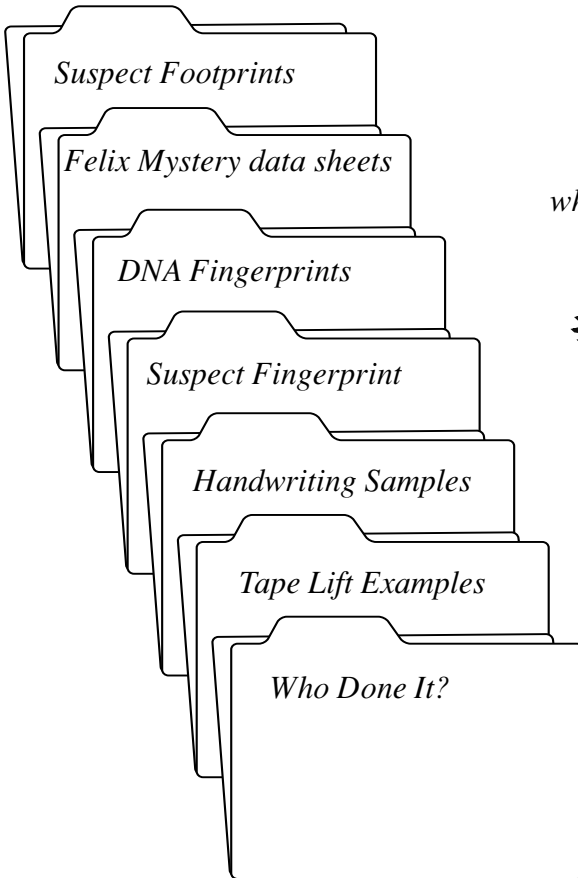
votive candles



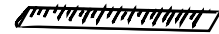
matches



meter stick



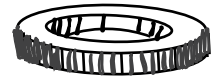
white paper towels



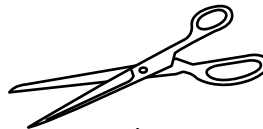
metric ruler



pencils



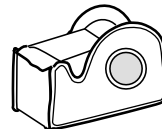
masking tape



scissors



Krazy Glue



clear adhesive tape



aluminum foil

Of Cabbages and Chemistry

Non-Consumables

- 1 *Of Cabbages and Chemistry* Teacher's Guide
- 8 cafeteria trays
- 1 large plastic container with lid for storing cabbage juice (4 qt./4 liter capacity)
- 1 large funnel
- 7 large containers with lids for making and storing chemicals solutions (about 2 qt./2 liter capacity or larger)
- 1 set of measuring spoons or a metric balance
- 1 measuring cup (1 cup capacity or larger)
- 100 wide-mouthed plastic cups (8–12 oz., clear, colorless, flexible)
- 96 medicine droppers
- 32 reaction trays (can use white styrofoam egg cartons or white plastic paint trays with at least 6 depressions)
- 8 wide-mouthed plastic containers (yogurt type, 16 oz. capacity or larger) for using as waste buckets at student tables

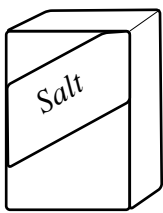
Consumables

- 1 red cabbage
- 3 teaspoons (25 g) table salt
- 30 teaspoons (160 g) baking soda
- 40 aspirin tablets
- 40 antacid tablets
- $\frac{1}{2}$ teaspoon (3 g) dry drain cleaner
- 64 oz. (2 liters) rubbing alcohol
- 16 oz. (500 ml) white distilled vinegar
- 64 oz. (2 liters) lemon juice
- water
- several beverages (juice, tea, coffee, milk, soda pop)
- several cleaning products (window cleaner, floor cleaner, laundry detergent, cleanser)
- several bathroom products (toothpaste, shampoo, mouthwash, soap, aftershave lotion, hair conditioners, skin lotions)
- colored chalk (including purple, pink, green, and/or blue)

List continued on page 112



baking soda



salt



aspirin



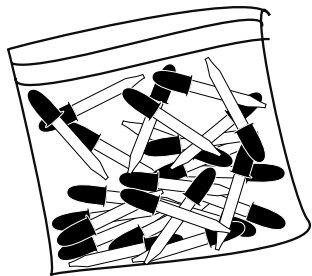
antacid tablets



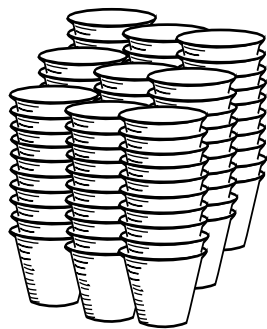
dry drain cleaner



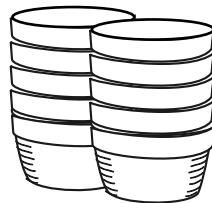
vinegar



medicine droppers



plastic cups



wide-mouthed containers



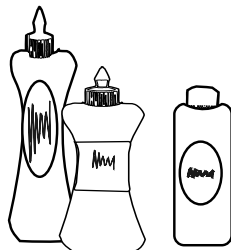
lemon juice



alcohol



bathroom products



cleaning products



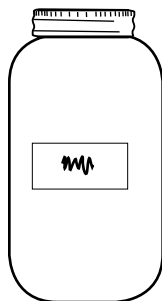
beverages



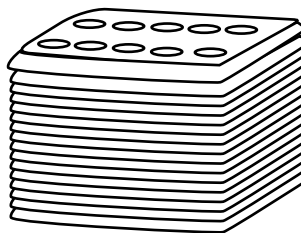
water



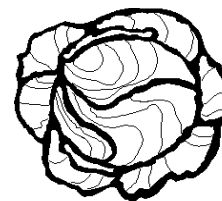
containers with lids



large container with lid



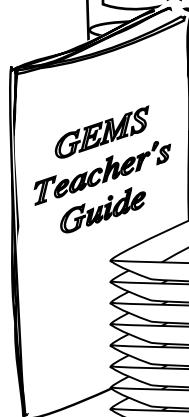
reaction trays



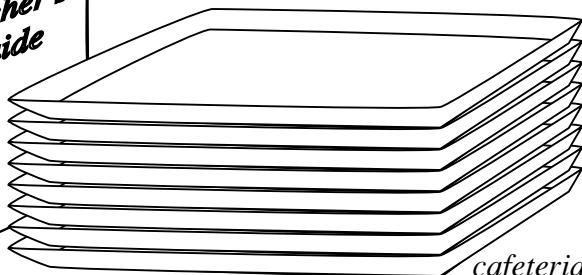
red cabbage



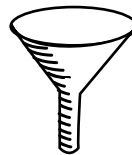
measuring cup



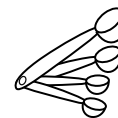
GEMS Teacher's Guide



cafeteria trays



funnel



measuring spoons



colored chalk

Of Cabbages and Chemistry

List continued from page 110

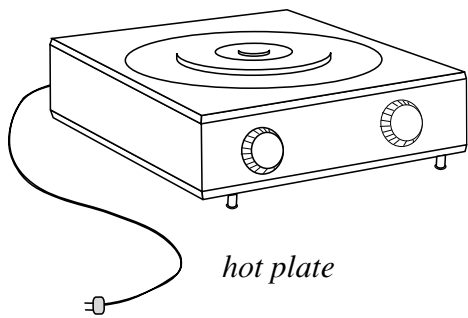
Consumables (continued)

Copies of the following:

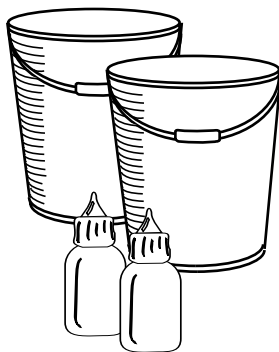
- 32 Telltale Colors
- 32 Presto Change-O
- 32 More or Less Acid
- 32 More or Less Base
- 32 Acid + Base = Neutral
- 32 Household Mysteries

General Supplies

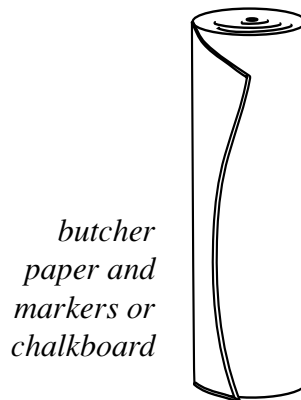
- 32 pencils
- 8 sets of crayons/colored pencils
- 1 fine-tipped permanent marker
- 32 pairs of safety goggles
- 1 knife for cutting cabbage
- 1 large non-aluminum pot for cooking cabbage, 1 gal. (4 liters) or larger
- 1 strainer
- 1 stove or hot plate
- paper towels
- 1 roll of masking tape or mailing labels
- sponges
- butcher paper and markers (if no chalkboard is available)



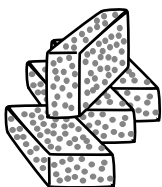
hot plate



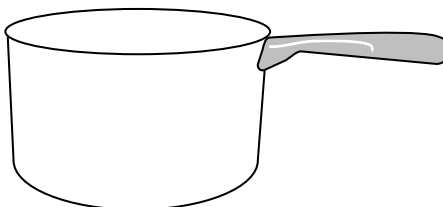
buckets and squeeze bottles
of water or sink



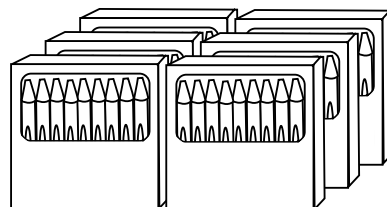
butcher
paper and
markers or
chalkboard



sponges



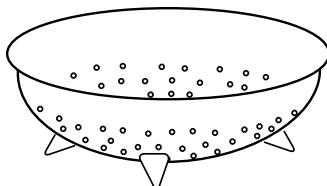
non-aluminum pot



crayons or
colored pencils



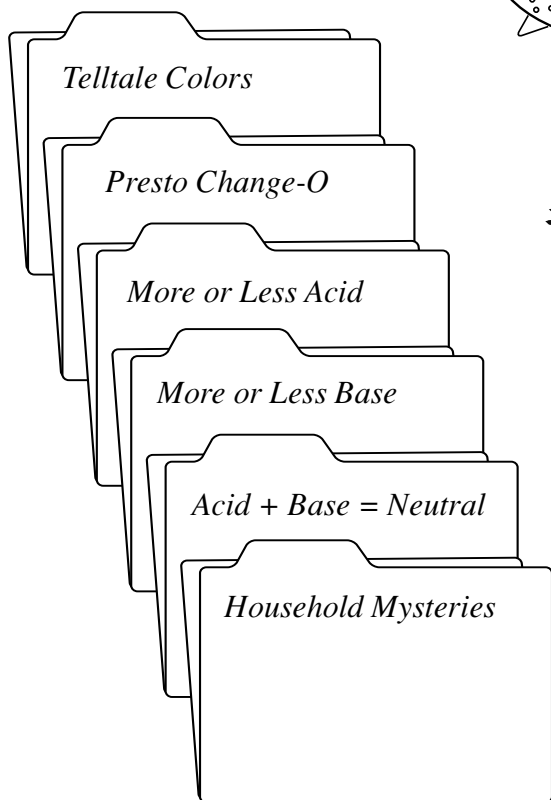
knife



strainer



masking tape



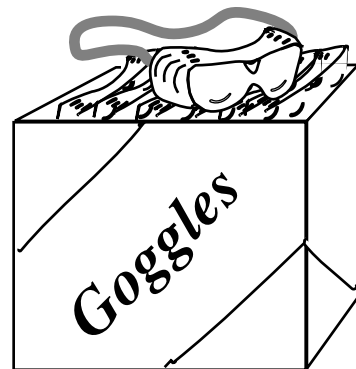
pencils



fine-tipped marker



paper towels



goggles

Oobleck: What Do Scientists Do?

Non-Consumables

- 1 *Oobleck: What Do Scientists Do?* Teacher's Guide and poster
- 8 plastic bowls
- 1 measuring cup (1–4 cup capacity)
- 1 large mixing bowl, 1½–2 gal. (6–8 liters)

Optional:

- 1 plastic bag
- 1 medicine dropper (if using glass bottle of food color instead of squeeze bottle)
- selection of small objects of wood, paper, plastic, metal (toothpicks, popsicle sticks, plasticware, small paper cups, paper clips, straws, etc.)
- 1 hot plate and saucepan

Consumables

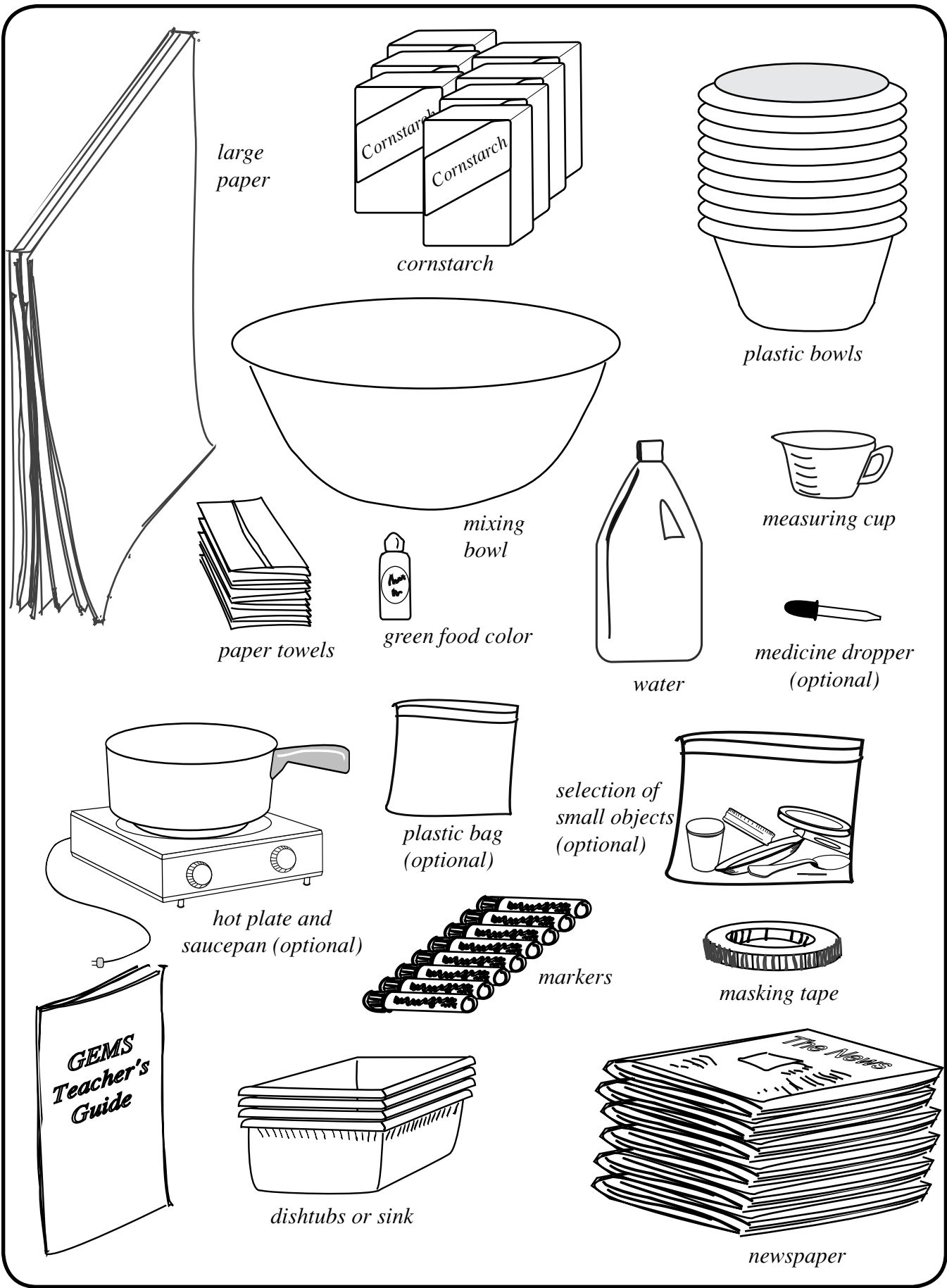
- 1 small squeeze bottle of green food color
- 7 boxes of cornstarch*

*The bowls of Oobleck can be used by several classes, with the addition of a little water and mixing before each new class.

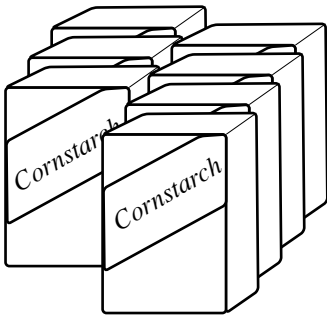
General Supplies

- 8 wide-tipped markers
- 8 pieces of paper, 16" x 20" (40 cm. x 50 cm.) or larger
- old newspapers
- paper towels
- 1 roll of masking tape
- 4 rectangular dishtubs (if no sink is available)
- water

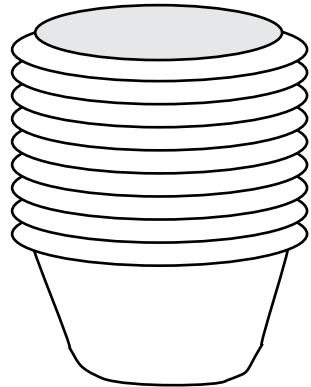
Tip: Pack materials into stacked dishpans, and pack these into a box.



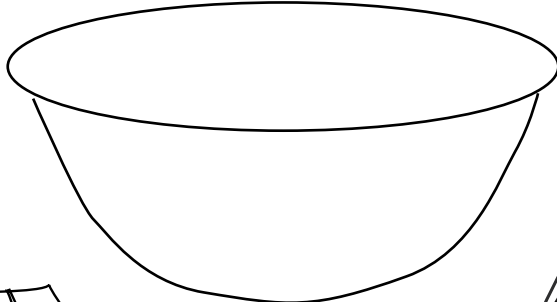
large paper



cornstarch



plastic bowls



mixing bowl



measuring cup



paper towels



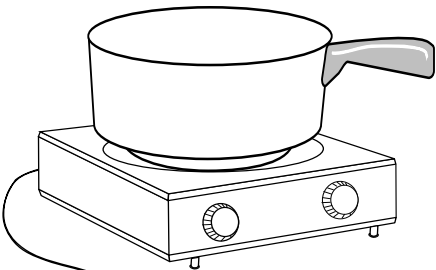
green food color



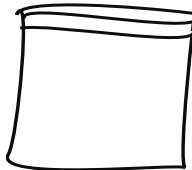
water



medicine dropper (optional)



hot plate and saucepan (optional)

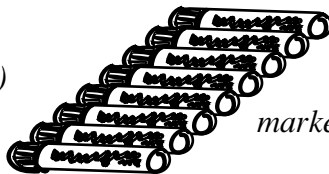
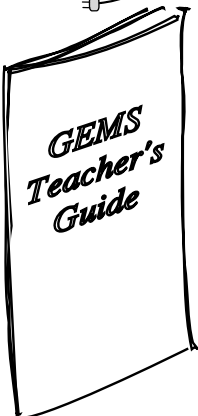


plastic bag (optional)

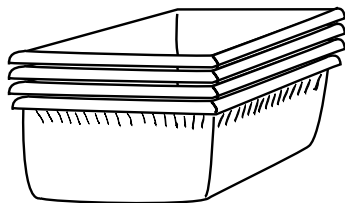
selection of small objects (optional)



masking tape



markers



dishtubs or sink



newspaper

Paper Towel Testing

Non-Consumables

- 1 *Paper Towel Testing* Teacher's Guide
- 12 lbs. small objects to use as weights (rust resistant, not sharp; large metal washers, nuts or bolts are good)
- 8 medicine droppers
- 8 plastic measuring spoons (teaspoon size)
- 8 measuring cups (8 oz. capacity)
- 8 foil pie plates
- 1 dishtub or bucket (if no sink is available)
- 8 cups (6–8 oz.)

Consumables

- 4 brands of paper towels* (1 roll of each)

Copies of the following:

- 32 Wet Strength Test Results
- 32 Absorbency Test Results
- 32 Cost Per Sheet

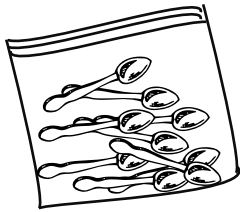
* When the paper towels are purchased, record the price for each and give them to the teacher.

General Supplies

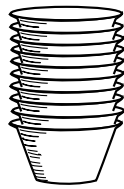
- butcher paper and markers (if no chalkboard is available)
- 8 cafeteria trays
- 1 permanent marker to label brands of towels
- 32 pencils
- 1+ calculators
- 32 sheets of scratch paper
- water

Optional:

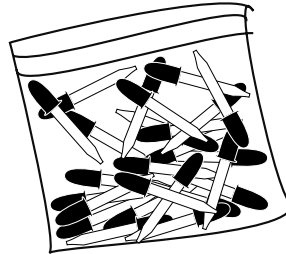
- 8 graduated cylinders



measuring spoons



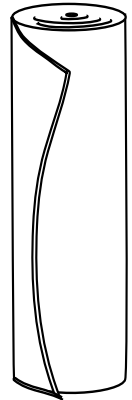
cups



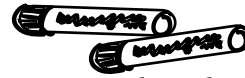
medicine droppers



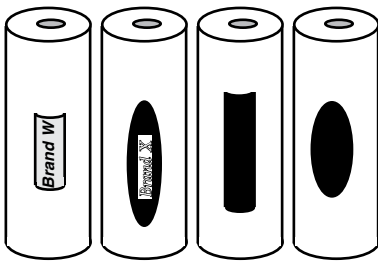
bucket or sink



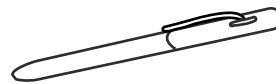
butcher paper and markers
or chalkboard



pencils



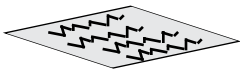
different brands of paper towels



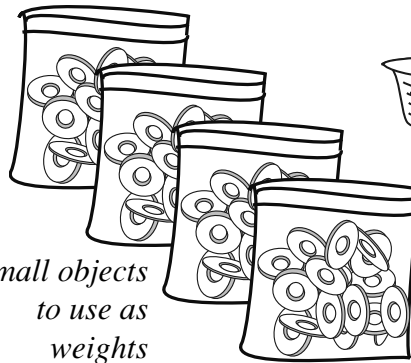
permanent marker



water



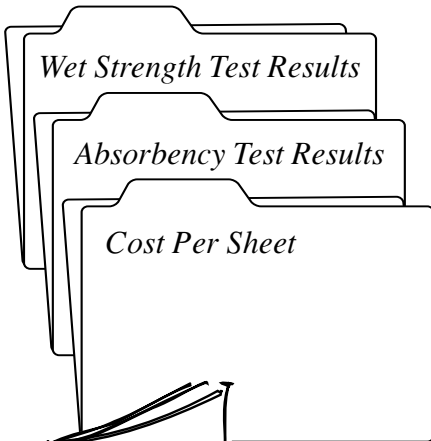
paper towel prices



small objects
to use as
weights



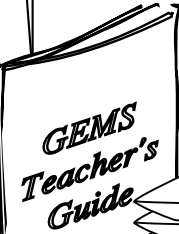
measuring cups



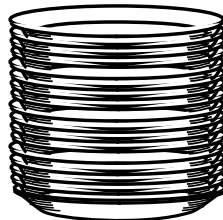
Wet Strength Test Results

Absorbency Test Results

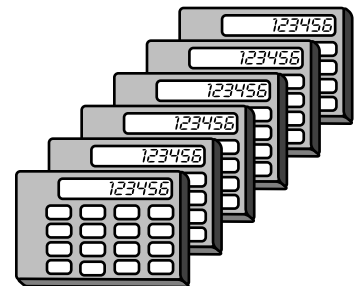
Cost Per Sheet



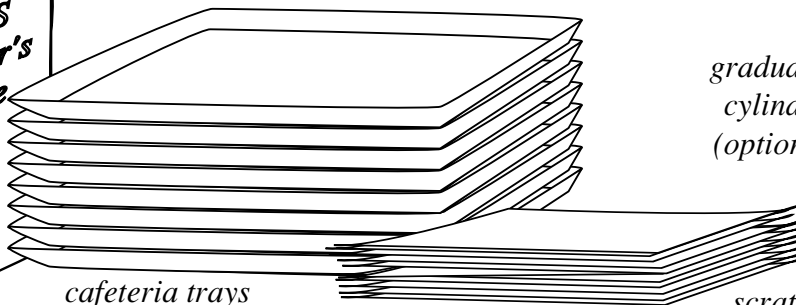
GEMS
Teacher's
Guide



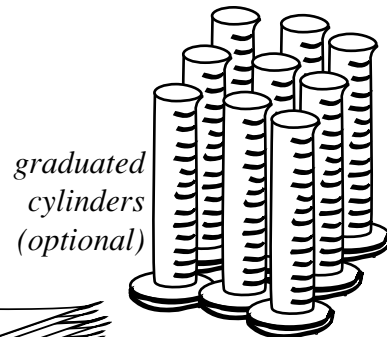
foil pie plates



calculators



cafeteria trays



graduated
cylinders
(optional)



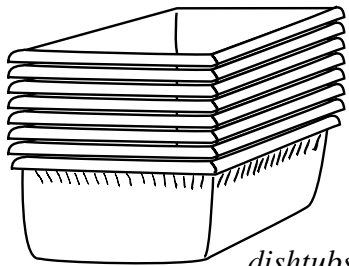
scratch paper

Penguins And Their Young

Non-Consumables

- 1 *Penguins And Their Young* Teacher's Guide and posters
 - 5+ waterproof cafeteria trays
 - 1 large ice chest
 - several feathers
 - 1 piece of white paper at least 18" x 24" (40 cm x 60 cm), or white sheet or pillowcase
 - 1 piece of blue paper at least 36" x 48" (90 cm x 120 cm), or a blue sheet or rug
 - 1 piece of blue paper, 12" x 18" (30 cm x 48 cm)
 - 1 black adult-size jacket or sweater
 - 1 pillow in a white, preferably king-size, pillowcase
 - 1 piece of white yarn or a sash long enough to tie around a child's chest
 - 1 plastic egg
 - 1 assortment of interesting object that hold water, such as balloons, large half shells, plastic cups, plastic sand molds, plastic bags, or rubber gloves
 - twist ties for balloons and rubber gloves
 - 2 large bowls for water
 - 8 large dishtubs, about 20" x 15" x 5" (50 cm x 37 cm x 13 cm) or use a water table
 - 8 empty half-gallon milk cartons or loaf pans
 - 8 towels
 - 32 corks or plastic penguins, about 2" high
 - 32 plastic fish, about 1" long
 - 32 black markers or pencils
 - 33 gloves, mittens, or large, thick socks
 - 33 orange or yellow crayons
 - 1 photocopy each of paper bag penguin patterns (A—beak, B—wing, C—foot),
 - several baby Emperor penguin and Emperor penguin egg drawings
- Optional:
- 32 black crayons
 - 32 white crayons or white chalk, if you use brown paper lunch bags for penguins
 - 32 changes of clothing
 - 1 toy penguin
 - pictures of animals that live on ice, such as polar bears, seals, and walruses
 - 1 full-length mirror
 - baby penguin activity charts

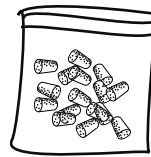
List continued on page 120



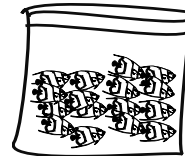
dishtubs



black jacket



corks



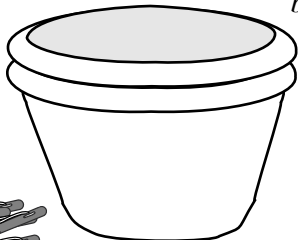
plastic fish



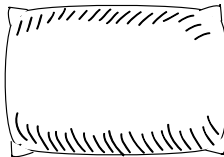
feathers



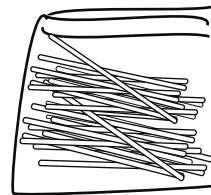
white yarn



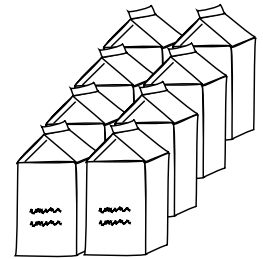
bowls



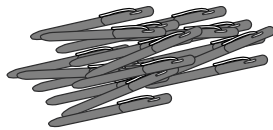
pillow in large white pillowcase



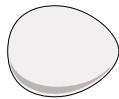
twist ties



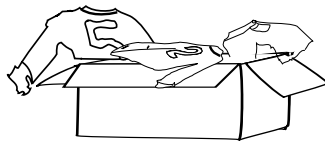
empty milk cartons



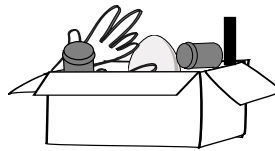
black markers



plastic egg

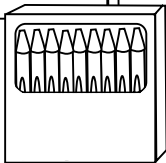
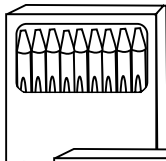


changes of clothing (optional)

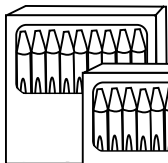


objects that hold water

white crayons or chalk (optional)



black crayons (optional)

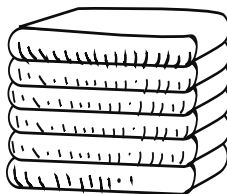
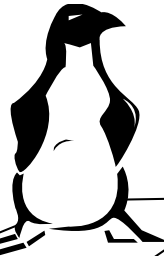


orange or yellow crayons

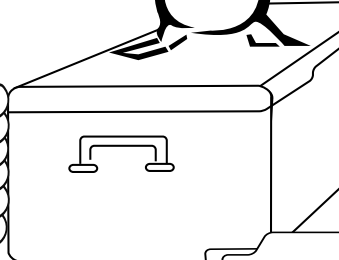


mittens or gloves

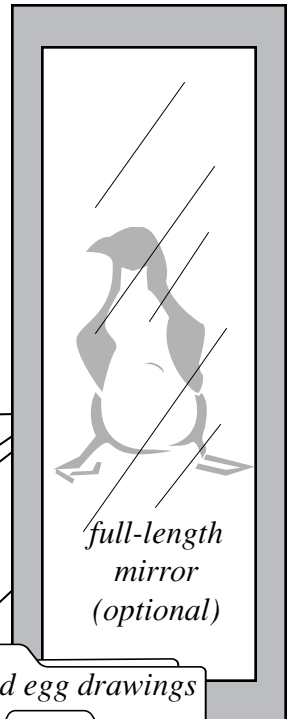
toy penguin (optional)



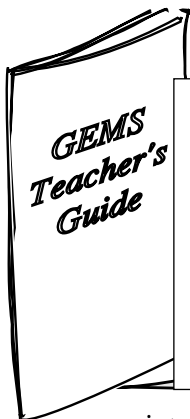
towels



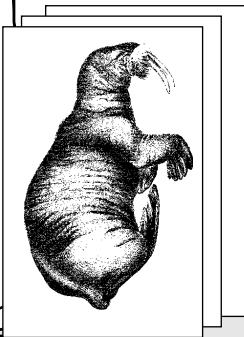
ice chest



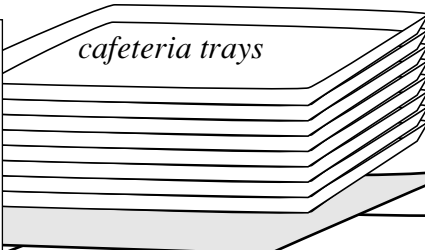
full-length mirror (optional)



pictures of animals that live on ice (optional)



white paper or pillowcase



cafeteria trays

baby and egg drawings

paper bag penguin patterns

baby penguin activity charts (optional)

blue paper

blue paper, sheet, or rug

Penguins And Their Young

List continued from page 118

Consumables

- water for ice and water play in tubs
- 1 piece of 9" x 12" (23 cm x 30 cm) yellow or orange construction paper for fish
- 33 pieces of 9" x 12" (23 cm x 30 cm) black paper
- 33 pieces of 8½" x 11" (22 cm x 28 cm) blue paper
- fish-shaped cracker, about 18 oz.
- 33 pieces of paper about the size of a child
- 231+ ice cubes
- 33 brown or white paper lunch bags
- 33 pinches of cotton or pillow stuffing
- 33 hollow plastic eggs large enough for a paper baby penguin to fit inside
- 33 paper cups, 5 oz.
- 96 plastic cups, 5 oz.
- 33 paper cups, 3 oz.
- 198 oz. of fruit juice
- 33+ berries and slices of banana, orange, or apple

Optional:

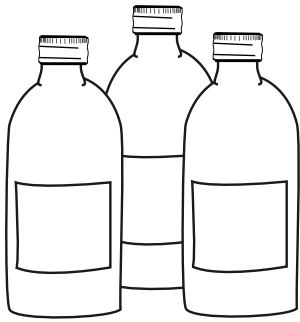
- 3 bottles of food color, 1 each of red, blue, and yellow

General Supplies

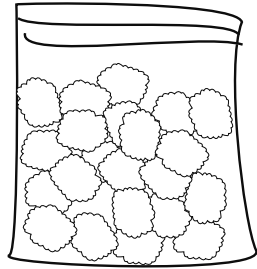
- 32 pencils
- access to a freezer (large enough to hold 8 half-gallon milk cartons)
- 1 water-proof black marker
- 1 roll of masking tape
- 1 large pair of scissors
- old newspapers
- glue and 33 containers
- 32 crayon assortments

Optional:

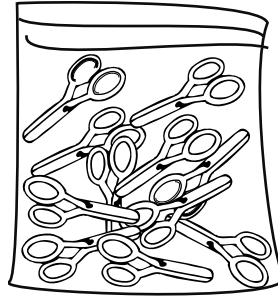
- additional scissors
- 1 black crayon
- 1-3 rolls of adding machine tape



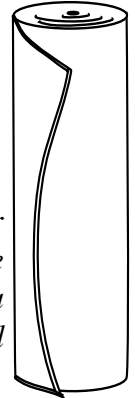
fruit juice



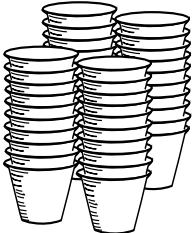
cotton



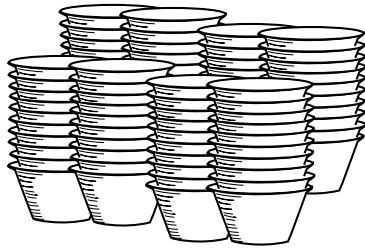
scissors (optional)



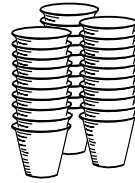
paper
the size
of a
child



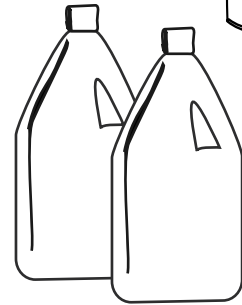
paper cups



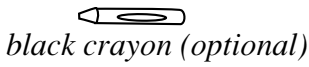
plastic cups



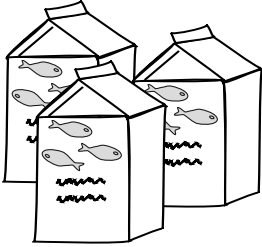
small paper cups



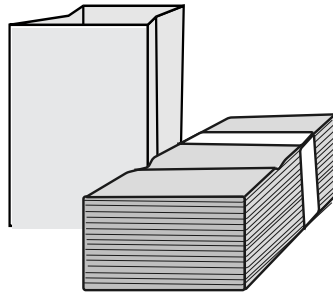
water



black crayon (optional)



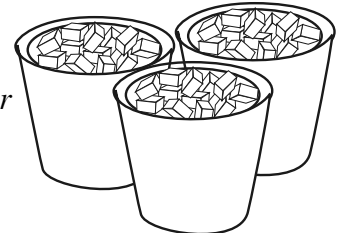
fish-shaped crackers



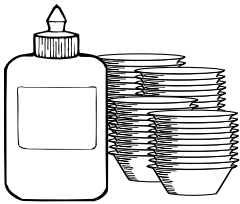
paper lunch bags



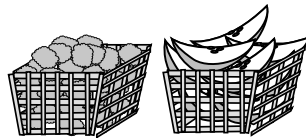
red, blue, and
yellow food color



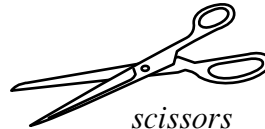
ice cubes



glue and containers



berries and fruit slices



scissors



pencils



water-proof
black marker



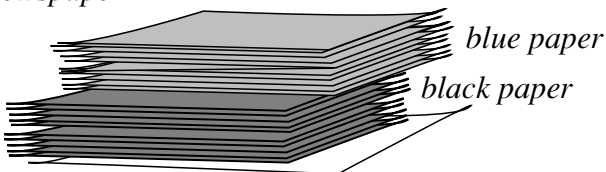
masking tape



newspaper



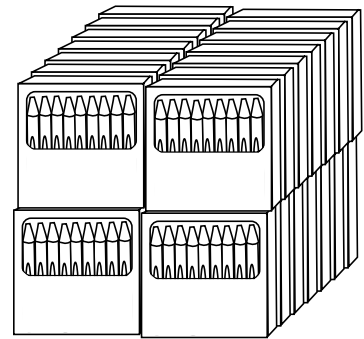
adding machine
tape (optional)



yellow or orange paper



plastic eggs



crayons

QUADICE

Non-Consumables

- 1 *QUADICE* Teacher's Guide
- 1 large piece of butcher paper
- 22 blank dice to be numbered from 1–6
- 22 blank dice to be numbered from 7–12
- 11 dice cups (or strawberry baskets)

Copies of the following:

- 32 *QUADICE* Rules of Play

Consumables

Copies of the following:

- 320 *QUADICE* score sheets
- 32 Puzzle Sheet A
- 32 Puzzle Sheet B
- 32 Discussion Sheet
- 32 Mystery Puzzles

General Supplies

- 32 pencils
- 1 marker
- tape or thumb tacks to post butcher paper
or 1 blank transparency for overhead projector

Optional:

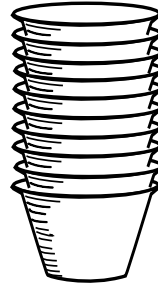
- 1 overhead transparency and pens
- 1 overhead projector



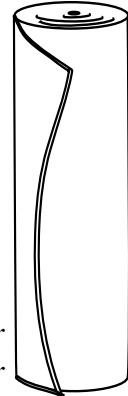
pencils



tape



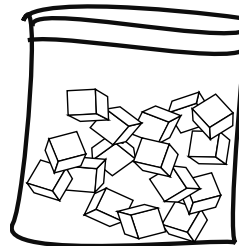
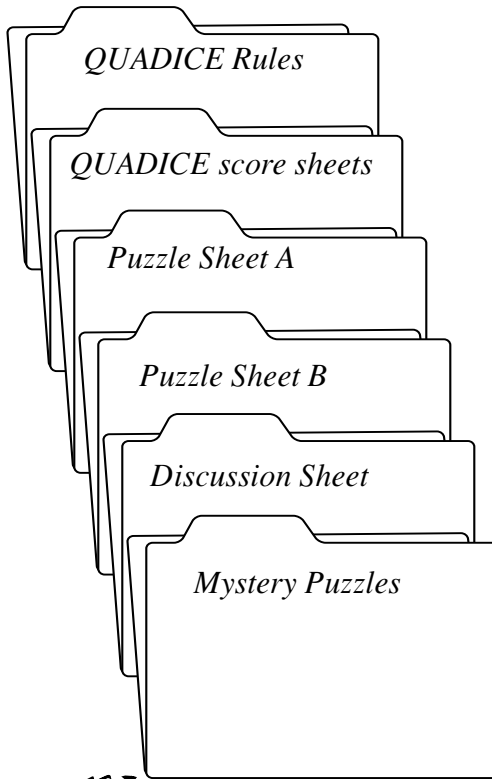
dice cups



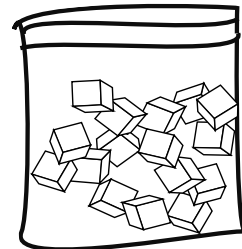
*butcher
paper*



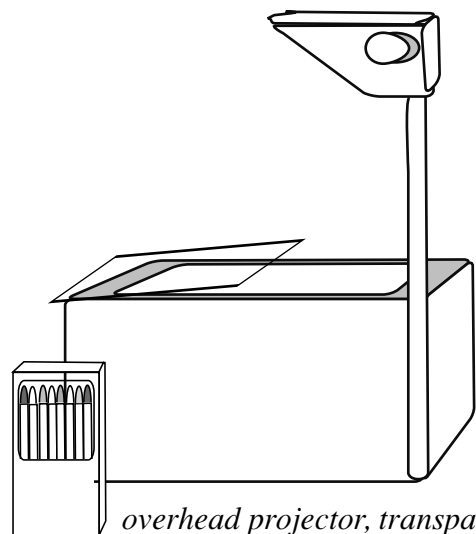
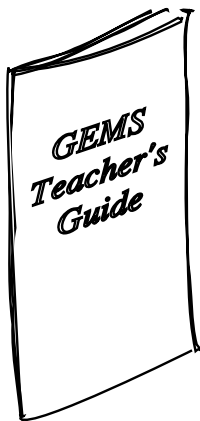
marker



*blank dice to
number 1-6*



*blank dice to
number 7-12*



*overhead projector, transparency,
and pens (optional)*

River Cutters

Non-Consumables

- 1 *River Cutters* Teacher's Guide
- 1 disposable dust mask
- 1 measuring cup, 1 qt. (1 liter) capacity
- 2 pitchers, about 2 qts. (2 liters) each
- 1 bucket
- 1 spray bottle of water—to simulate rain over an entire watershed
- 8 small containers (such as small boxes, strawberry baskets, envelopes)
- 5–8 dripper systems (See the third edition of the guide to choose the system best suited for your needs.)

Note: Guide has been revised since handbook was developed. Please check teacher's guide for updated listing.

For each Rain Cloud dripper system:

- 1 drink bottle, such as the strong plastic type used for some athletic drinks and bottled waters, 1 pt. to 1 qt. size
- silicone caulk (the type that remains flexible when dry) or hot glue gun
- 1 5" piece of flexible aquarium air hose
- 1 adjustable plastic aquarium control valve
- 1 Phillips screwdriver, medium to large size (slightly less than the diameter of the aquarium hose)
- 1 cigarette lighter or candle for heating screwdriver to melt a hole in plastic bottle
- 1 metal coffee can, sturdy box or plastic container to support the plastic bottle 8"–10" (20 cm x 25 cm) above the table (the piece of wood used to slope the earth can also be used)

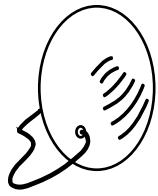
Optional:

- 1 "T" valve that fits inside the air hose, as an additional valve, to run two rivers at the same time

For each Siphon dripper system:

- 1 wide-mouthed, tapered, soft plastic cup (9 oz.; 270 ml) with notch cut on edge
- 1 plastic stir stick with two small holes (commonly used as coffee stirrers)
- 1 piece of wire, 4" (10 cm) long (20 gauge or .035" in diameter), small enough to go through one hole in the stir stick
- 1 small squeeze bottle of liquid detergent
- 5–8 sturdy plastic tubs, 5"–7" (12–18 cm) deep, at least 20" (50 cm) long, and 15" (38 cm) wide. We recommend restaurant dish bussing tubs.
- 5–8 sponges, about 1" x 3" x 5" (2 cm x 8 cm x 13 cm)
- 5–8 aluminum pie pans, 9" (23 cm) diameter
- 5–8 pieces of wood, 2" x 4" x 8" (5 cm x 10 cm x 20 cm); some children's large wooden blocks work well

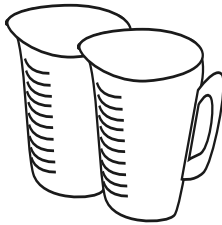
List continued on page 126



dust mask



measuring cup



pitchers



bucket

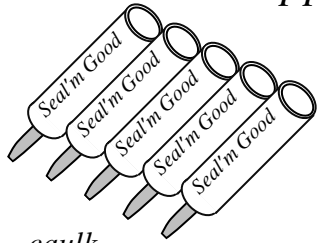


spray bottle

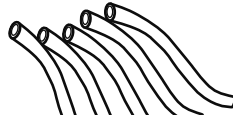
drinker systems



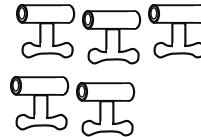
plastic drink bottles



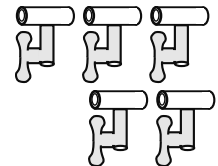
caulk



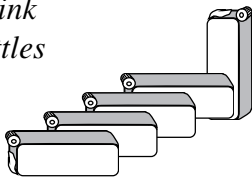
aquarium air hose



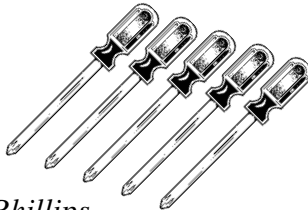
aquarium control valves



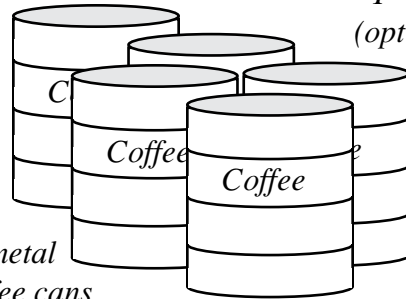
"T" valves (optional)



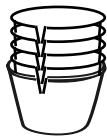
cigarette lighters



Phillips screwdrivers



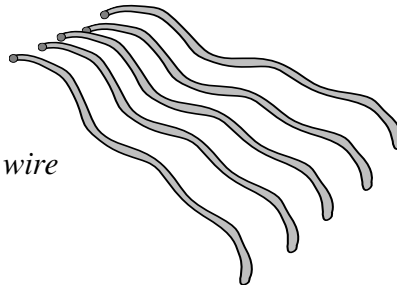
metal coffee cans



plastic cups with notches



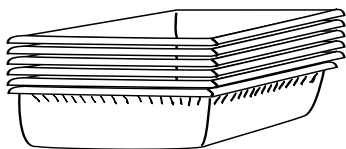
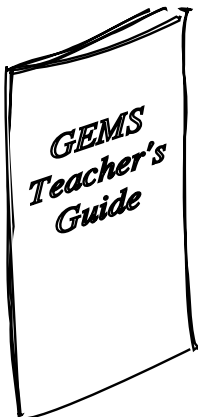
stir sticks



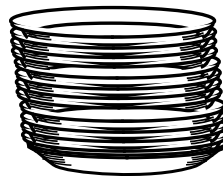
wire



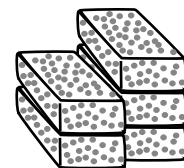
liquid detergent



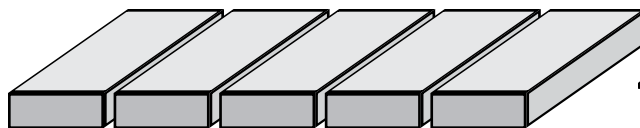
large plastic tubs



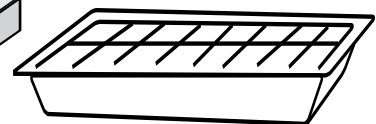
aluminum pie pans



sponges



wood



ice cubes

River Cutters

List continued from page 124

Non-Consumables (continued)

- 5–8 trowels or sturdy spoons
- collection of magazine pictures of the earth, and geology textbooks with photos of river features and geological landscapes

Consumables

- 20 lbs. (9 kg) diatomaceous earth purchased from a swimming pool supply store or donated from local high school or swim center
- 3+ bottles of blue food color, 1 oz. (30 ml), preferably in dropper bottles
- 1 bottle of food color, 1 oz. (30 ml), not blue—yellow and red are best
- 4 flexible plastic overlays or overhead transparencies, 8" x 10" (20 cm x 25 cm), for making dams (used or scratched transparencies work well)
- 32+ 3" x 5" (8 cm x 13 cm) index cards for river feature flags
- 5–8 clear plastic straws
- 8 ice cubes
- 32 cotton swabs

Copies of the following:

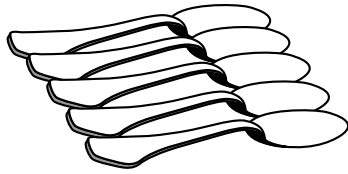
- 32 Timeline data sheets
- 8 Past Event data sheets
- 32 Two River Valley hand outs
- 32 Geological Features hand outs

Optional:

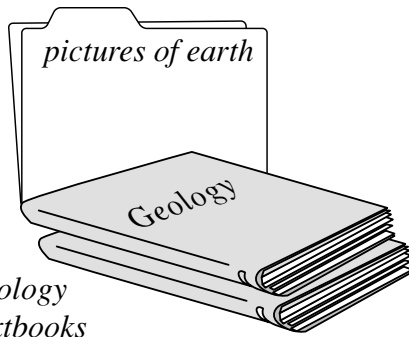
- large garbage bags for covering the surfaces of the stacked tubs
- 2–3 cotton swab sticks cut in half
- 5–8 envelopes or plastic bags to hold river feature flags

General Supplies

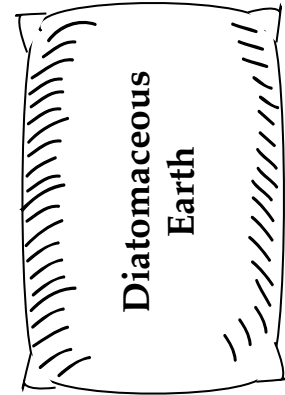
- plenty of water
- paper towels
- 1 watch/clock with second hand
- overhead projector, transparencies, and markers (if no chalkboard is available)
- 5–8 pairs of scissors
- 32+ pieces of white paper
- 32 pencils



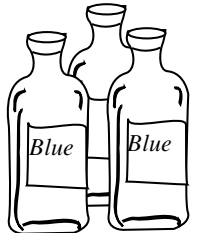
sturdy spoons



geology textbooks



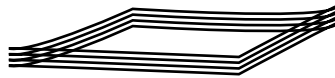
diatomaceous earth



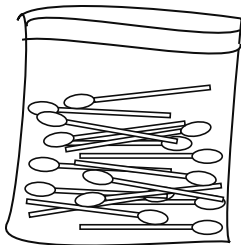
blue food color



yellow or red food color



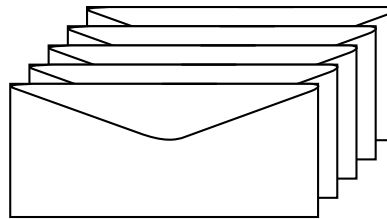
transparencies



cotton swabs



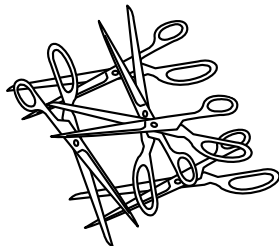
index cards



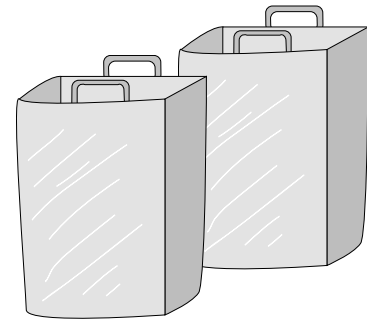
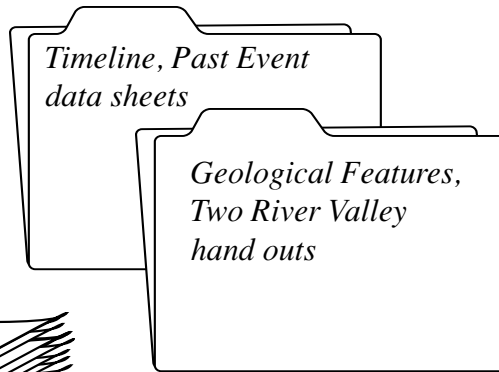
envelopes



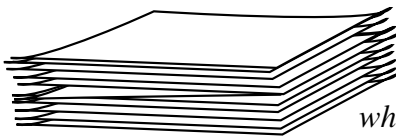
clear plastic straws



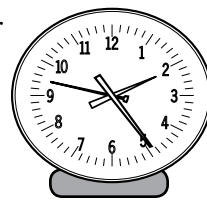
scissors



garbage bags



white paper



clock

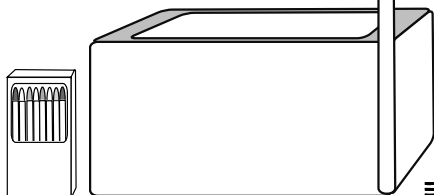


water



paper towels

overhead projector, transparencies, and markers or chalkboard



pencils

Stories in Stone

Non-Consumables

- 1 *Stories in Stone* Teachers Guide
- 9 samples of the following rocks and minerals (plus 1 or 2 extra samples):
 - schist halite granite conglomerate
 - quartz basalt galena
 - slate shale obsidian
- 9 egg cartons
- 32 magnifying lenses
- 1 bottle of white correction fluid, to label rocks
- 1 bottle of clear nail polish, to label rocks
- 2 copies of Rocks and Minerals Key
- 8 trays
- 16 sturdy paper plates
- 1 coffee pot, hot plate, or other source of hot water
- 24 small paper or plastic cups (about 2 oz. capacity)
- 16 clear or black plastic spoons
- 32 stir sticks or additional plastic spoons
- 18 metal spoons (34 spoons is better—one for each student + the teacher)
- 1 measuring spoon, $\frac{1}{4}$ teaspoon size
- 32 pairs of goggles
- 16 clear plastic 8–10 oz. plastic cups
- 1 pitcher with 2–3 qts. of water
- 2 sponges
- 1 large bucket for waste water and soil
- 8 plastic knives for cutting clay
- 8 “mystery rocks”

For information on where to order rocks and minerals, see Sources of Materials, starting on page 149.

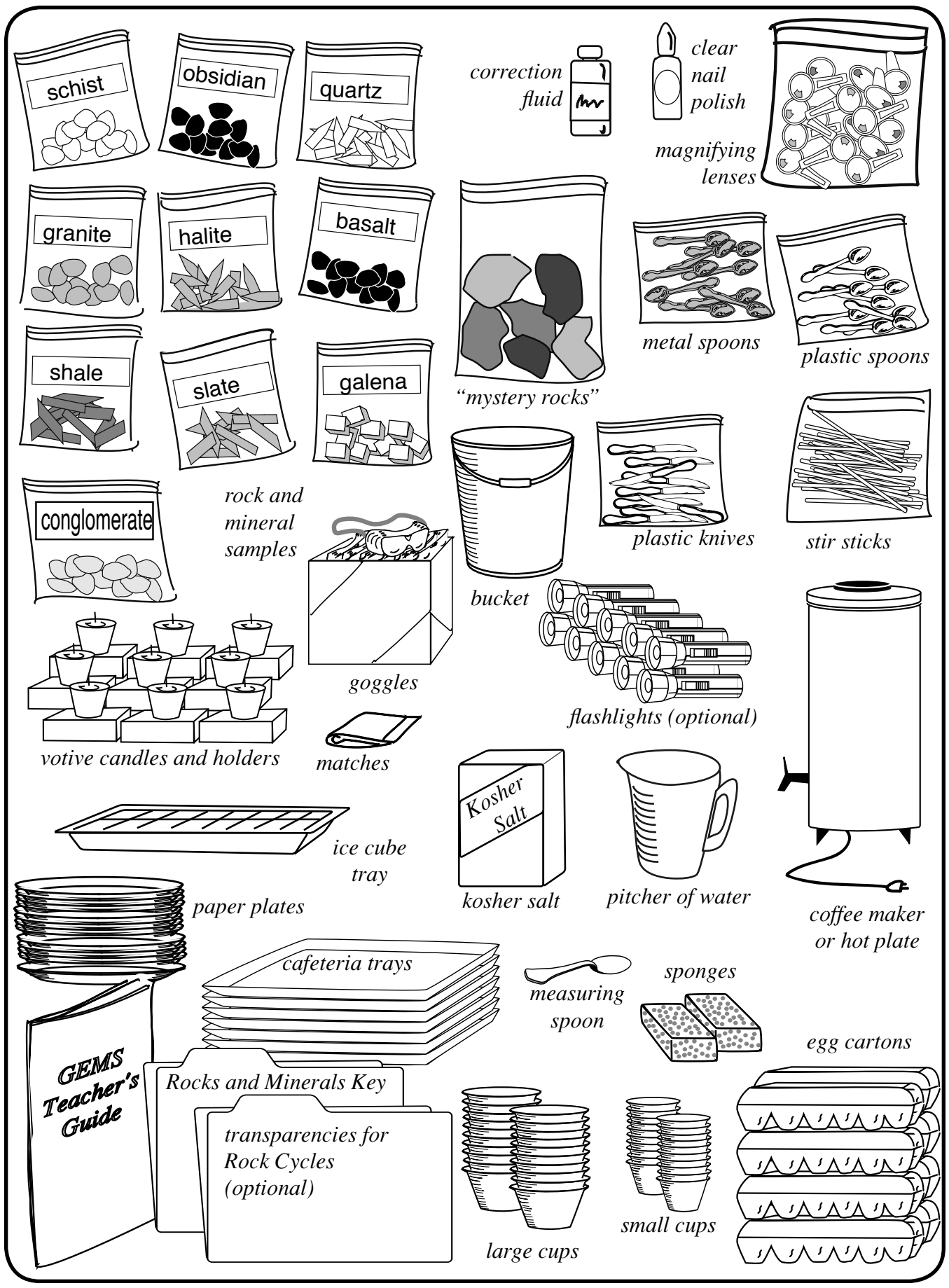
Optional:

- 8 flashlights
- 1 set of transparencies for Rock Cycles

Consumables

- 9 votive candles with holders
- 1 cup of kosher salt (table salt can be substituted)
- 1 book of matches
- 1 tray of ice cubes

List continued on page 130



Stories in Stone

List continued from page 128

Consumables (continued)

- 1 container of salol crystals (2 oz. is adequate for a class)
- 1 pound each of sand, silt, and clay (in plastic bags or jars)
- modeling clay in the following colors:
(note: 8 bars modeling clay = 1 pound)
 - red4 bars green 8 bars
 - yellow4 bars blue.....12 bars

Copies of the following:

- 33 paper model sheets, Cube
- 33 paper model sheets, Hexagonal Prism and Pyramid
- 33 Observing Crystal Formation sheets
- 33 Rock Type Description and Classification sheets
- 33 Observation and Display of Mystery Rock sheets

Optional—copies of the following:

- 33 Minerals at Home information sheets
- 33 paper model sheets, Tetrahedron
- 33 paper model sheets, Dodecahedron
- 33 paper model sheets, Pyritohedron
- 33 paper model sheets, Octahedron
- 33 Rock & Roll Riddles

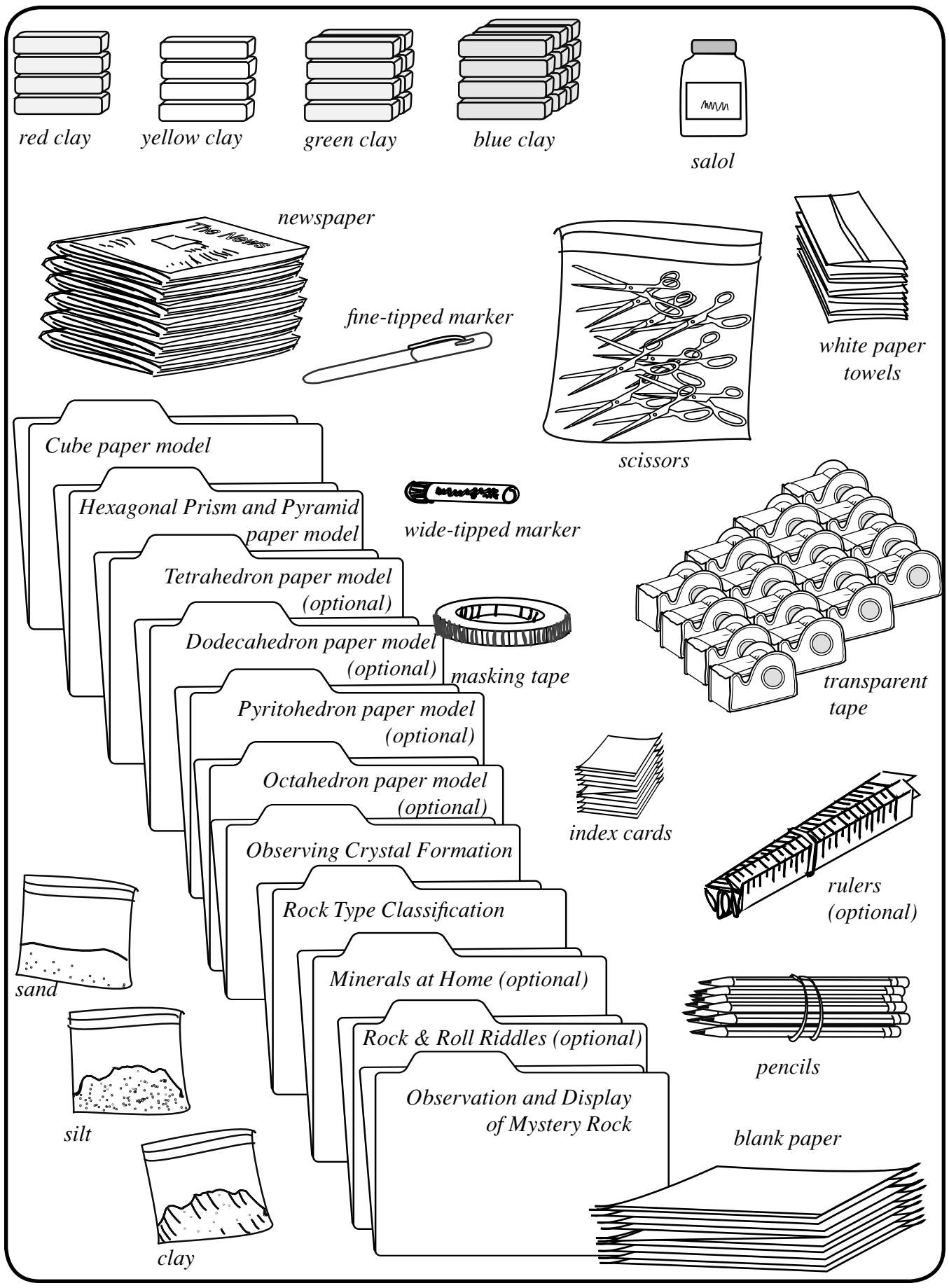
For information on where to order salol, see Sources of Materials, starting on page 149.

General Supplies

- 32 pencils
- 8 sheets of blank paper
- 8 index cards
- 32 pairs of scissors
- 16 rolls of transparent tape
- 1 roll of masking tape
- old newspapers to cover student work areas
- 1 fine-tipped permanent marker, to label rocks
- 1 wide-tipped permanent marker, to label bags of soil
- 16 white paper towels

Optional:

- 32 rulers



Terrarium Habitats

Non-Consumables

- 1 *Terrarium Habitats* Teacher's Guide
- 16 magnifying lenses
- 20 plastic sandwich bags for soil
- 32 plastic spoons
- 1 tray or piece of cardboard for sorting earthworms
- 8 push pins for making holes in terrariums or earthworm container
- small animals collected by students such as garden snails, crickets, beetles, or slugs
- 8 water misters
- 8 small clear plastic storage boxes with lids, or clear plastic salad containers
- enough soil to fill $\frac{1}{3}$ of the containers when mixed with sand
- sand equal to $\frac{1}{4}$ the amount of soil
- 8 measuring cups
- 32 earthworms (redworms or bait worms)
- 64 isopods: 32 pillbugs and 32 sowbugs
- 16 milk carton trays or other small trays with sides
- 32 plastic cups with lids (clear, colorless)

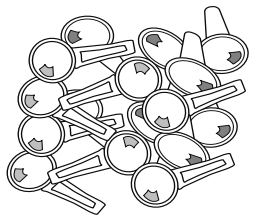
Optional:

- 8 trays to organize team materials
- 16 nightcrawler earthworms
- 16 rulers
- 32 clear plastic vials with lids, 1" (2.5 cm) diameter x 3" (8 cm) high
- 8 cups or sandwich bags for alum

Consumables

- 8 cups of garden soil
- 32 pieces of white scratch paper to use as soil observation mats
- 32 student journals for recording observations
- 16 chunks of raw potato, size of large marble

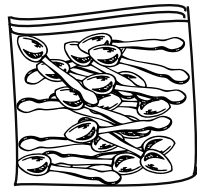
List continued on page 134



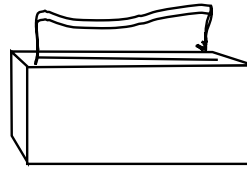
magnifying lenses



push pins



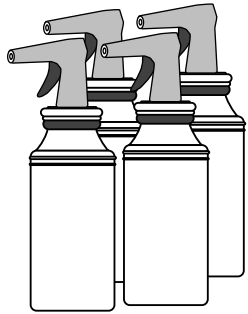
plastic spoons



plastic sandwich bags



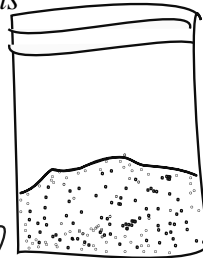
potatoes



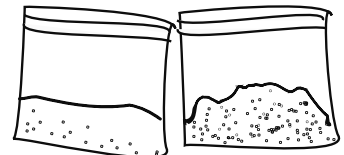
water misters



measuring cups



garden soil



sand

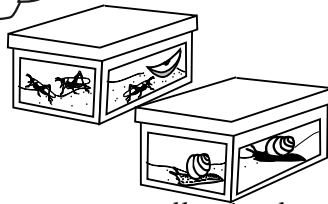
soil



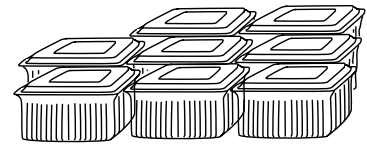
redworms



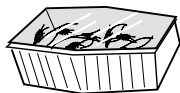
nightcrawler earthworms (optional)



small animals



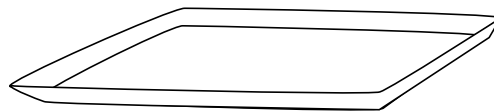
storage boxes with lids



pillbugs



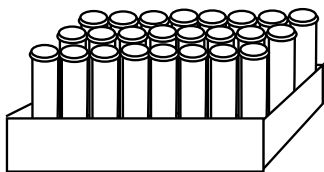
sowbugs



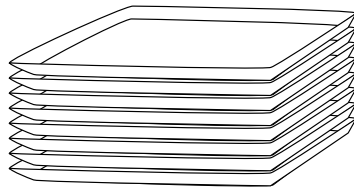
tray for sorting earthworms



plastic cups with lids



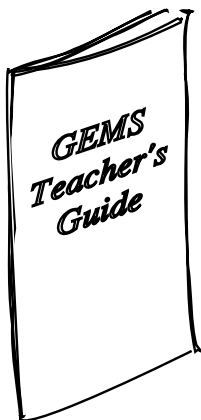
plastic vials with lids (optional)



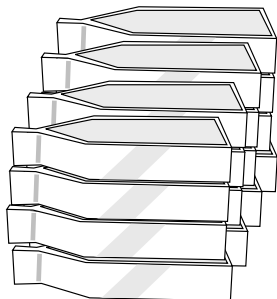
trays for team materials (optional)



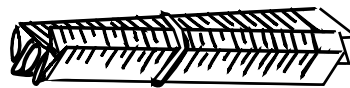
cups for alum (optional)



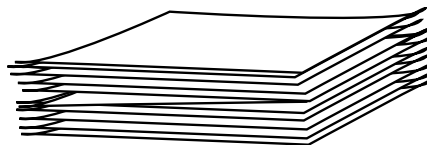
**GEMS
Teacher's
Guide**



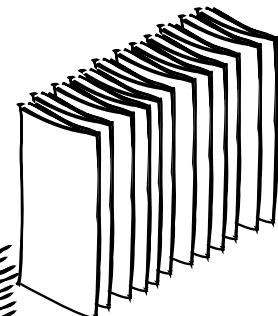
milk carton trays



rulers (optional)



white scratch paper



student journals

Terrarium Habitats

List continued from page 132

Consumables (continued)

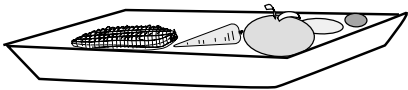
- other food items to add to terrarium such as carrot, apple, corn, eggshells, more leaves, potato, seeds
- other objects brought in by students such as rocks, twigs, shells, bark, weeds, and plants
- 8 teaspoons of birdseed or grass seed
- 8 handfuls of dry leaves from fruit, oak, birch, maple, or other deciduous trees
- 8 small plants such as strawberry, sweet alyssum, violets, or other garden plants
- 8–16 twigs or pieces of bark
- 8 pieces of black construction paper to cover one side of the box
- 8 white adhesive labels or strips of masking tape to stick on piece of black paper
- 16 one-quarter pieces of cardboard roll from toilet paper

Optional:

- 32 Observing Isopods student sheets
- 32 Observing Earthworms student sheets
- 8–16 tablespoons of alum (alum can be purchased at a well-stocked grocery store)

General Supplies

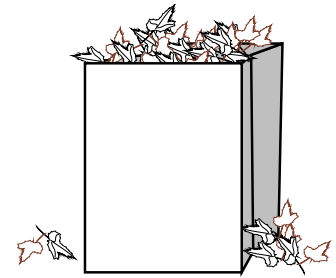
- 2 sponges
- 32 pencils
- old newspapers
- 8 rolls of transparent tape



food items



objects brought by students



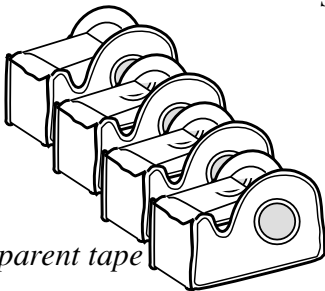
leaves



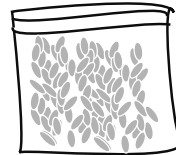
small plants



twigs



transparent tape



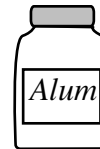
birdseed



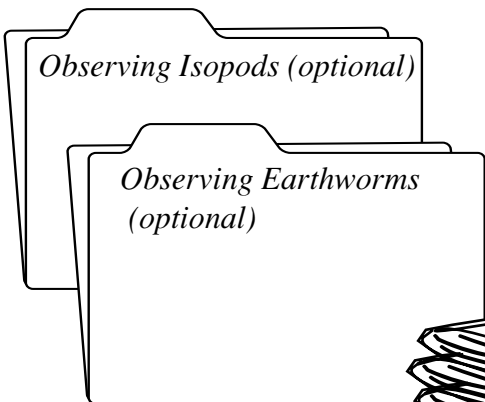
pencils



masking tape

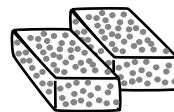


alum (optional)

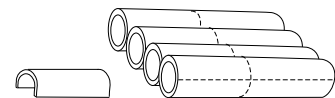


Observing Isopods (optional)

Observing Earthworms (optional)



sponges



*toilet paper rolls
cut into quarters*



newspaper



black construction paper

Tree Homes

Non-Consumables

- 1 *Tree Homes* Teacher's Guide and posters: Parts of a Tree, Raccoon, Owl, Tree Homes
- access to a living tree
- 3 cardboard boxes, with flaps, for tree: one 9" x 11" x 14" (23 cm x 28 cm x 36 cm); one 7" x 8" x 11" (18 cm x 20 cm x 28 cm); one 6" x 6" x 8" (15 cm x 15 cm x 20 cm)
- glue or 8 large brads or 5' of Velcro to attach tree boxes
- 3 cardboard wrapping paper rolls for tree branches, or real tree branches
- 1 utility knife
- 2 large toy bears
- 2 small toy bears
- 1 toy grasshopper or other insect
- 3 large brown paper grocery bags
- several acorns, nuts, or berries
- 1+ blankets
- several toy animals that live in trees
- several large boxes, blankets, or bedspreads
- 1 toy or paper-bag raccoon
- 2 toy or paper owls
- 1 toy or paper mouse
- 1 toy or paper snake
- 1 small plastic toy garbage can with a lid
- pictures of owls
- 1 cafeteria tray
- several feathers
- 1 lunch bag full of small twigs or sticks
- 1 handful of real or paper leaves
- 32 paintbrushes
- 1 of each child-size clothing: sweater, coat, sock, glove, hat, scarf

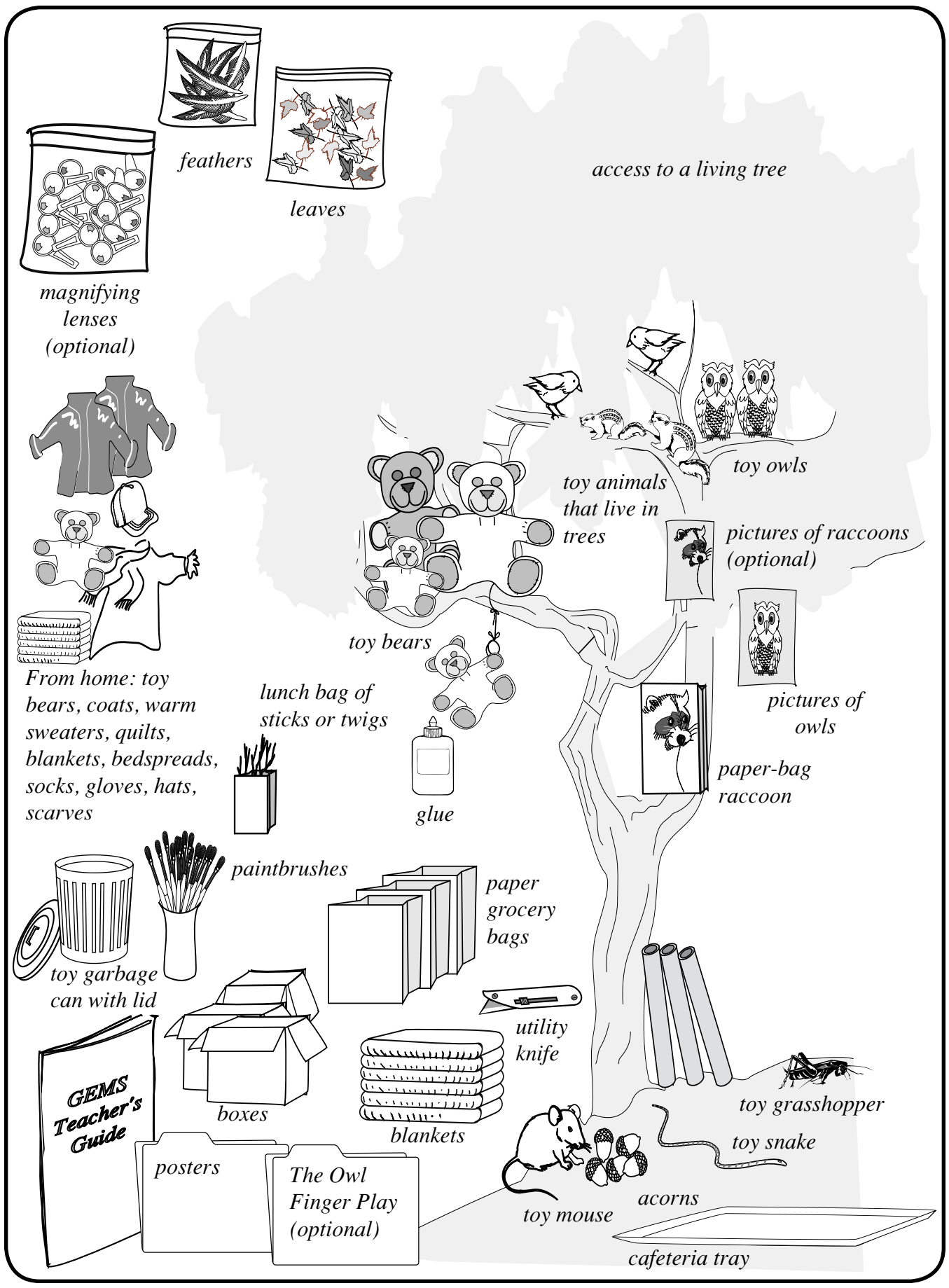
Students bring from home:

- toy bear for each child (have extras in the kit)
- coat for each child
- several warm adult-size sweaters, small quilts, bath towels, or blankets

Optional:

- several magnifying lenses
- pictures of raccoons
- 1 copy of *The Owl Finger Play*

List continued on page 138



feathers

leaves

access to a living tree

magnifying lenses (optional)

toy animals that live in trees

toy owls

pictures of raccoons (optional)

toy bears

pictures of owls

From home: toy bears, coats, warm sweaters, quilts, blankets, bedspreads, socks, gloves, hats, scarves

lunch bag of sticks or twigs

glue

paper-bag raccoon

paintbrushes

paper grocery bags

toy garbage can with lid

utility knife

toy grasshopper

boxes

blankets

toy snake

GEMS Teacher's Guide

posters

The Owl Finger Play (optional)

toy mouse

acorns

cafeteria tray

Tree Homes

List continued from page 136

Consumables

- several branches or cuttings from living trees or bushes
- 1 container brown poster paint
- 1 piece each of 9" x 12" (24 cm x 30 cm) white, black, brown, green, yellow, red, and orange construction paper
- 33 pieces of 12" x 18" (30 cm x 45 cm) brown construction paper
- 132 brown paper lunch bags
- 33 handfuls of brown yarn cut into 1"-3" (3-8 cm) pieces
- 64 $\frac{3}{4}$ " diam. yellow round adhesive dots, or hole reinforcements for eyes **or** 1 piece of 9" x 12" (24 cm x 30 cm) yellow construction paper to make paper eyes for class
- several berries, apple slices, nuts, and cooked spaghetti noodles

Copies of the following:

- 1 Tree Hole/Raccoon Patterns sheet
- 1 Owl Patterns sheet 1
- 1 Owl Patterns sheet 2

Optional:

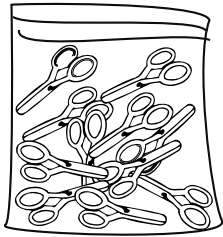
- several feathers

General Supplies

- pencils
- black crayon or marker
- white glue or paste
- old newspapers
- 1 large pair of scissors
- 1 roll of double-stick tape
- 1 roll of masking tape

Optional:

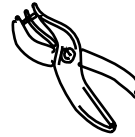
- 32 scissors
- 1 piece of paper, at least 12" x 18" (30 cm x 45 cm)
- watercolor markers or crayons in different colors
- 1 roll of transparent tape



scissors
(optional)



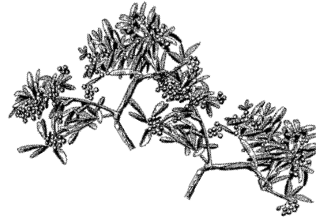
glue



single-hole paper punch
(optional)



scissors

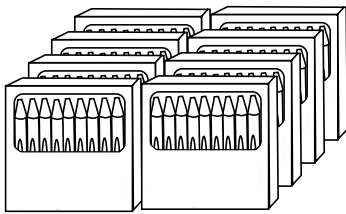


branches from living trees

feathers



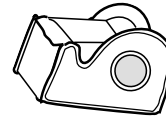
pencils



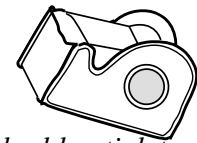
markers or crayons (optional)



masking tape



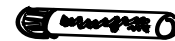
transparent tape
(optional)



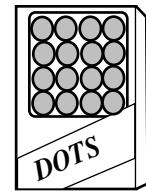
double-stick tape



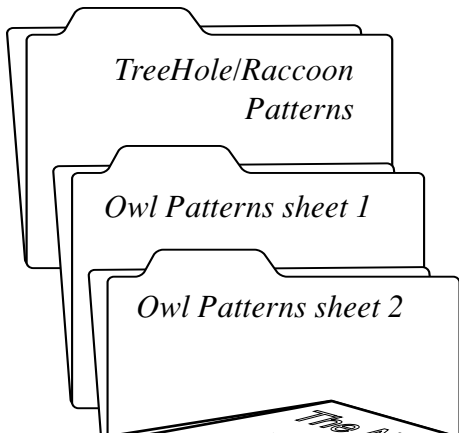
brown poster paint



black marker



adhesive dots



TreeHole/Raccoon
Patterns

Owl Patterns sheet 1

Owl Patterns sheet 2



berries



apple
slices



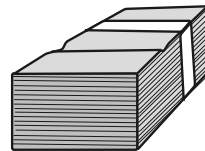
nuts



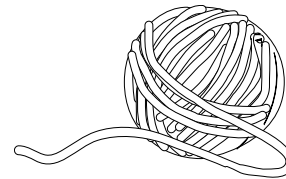
cooked
spaghetti
noodles



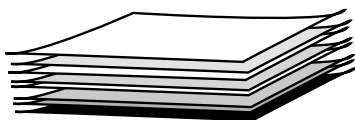
newspaper



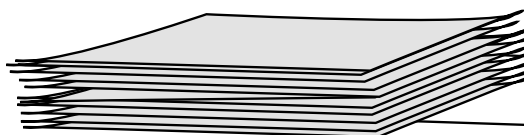
paper lunch bags



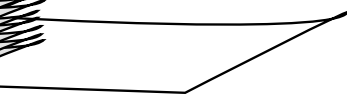
brown yarn



white, black, brown, green, yellow,
red, and orange construction paper



brown construction paper



large paper (optional)

Vitamin C Testing

Non-Consumables

- 1 *Vitamin C Testing* Teacher's Guide
- 8 cafeteria trays
- 100 wide-mouthed plastic cups (8–12 oz. clear, colorless, flexible)
- 75 medicine droppers
- 8 wide-mouthed plastic containers (yogurt type, 16 oz. capacity or larger) for use as waste buckets at student tables
- 32 clear graduated cylinders for measuring 10 ml quantities
- 32 clear, colorless, plastic vials (15–25 ml capacity)
- 32 medium plastic squeeze bottles with lids, 8–12 oz. (150–300 ml)
- 1 medium container with lid to contain vitamin C solution (1 qt./1 liter capacity)
- 1 large container with lid to contain indophenol solution (1 gallon/4 liters capacity)
- enough containers or pitchers to make and contain the 4–7 fruit juices you test (some of the juices will come in their own containers)
- 2 plastic containers with lids for storing orange juice (2 cup/500 ml capacity)
- 1 measuring cup (4 cup capacity)
- 1 funnel
- 1 orange squeezer
- 32 plastic stir sticks

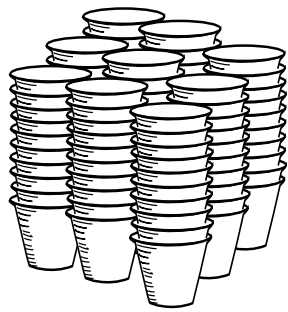
Optional:

- 1 mortar and pestle

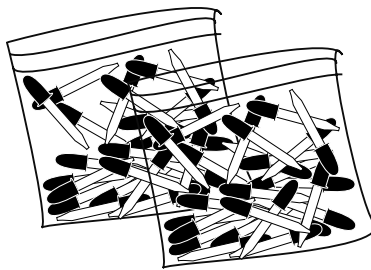
Consumables

- 1 small bottle of di-chloro-indophenol powder (1–5 g)
- 1 flat wooden toothpick
- 12 oranges
- 4 grams of ascorbic acid (vitamin C) powder or tablets (powder is best)
- water
- 2–3 cups (500–750 ml) of each of 4–7 kinds of fruit drinks

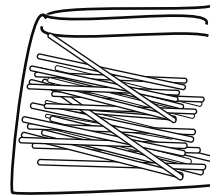
List continued on page 142



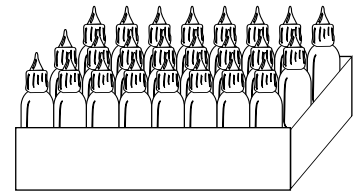
wide-mouthed plastic cups



medicine droppers



stir sticks

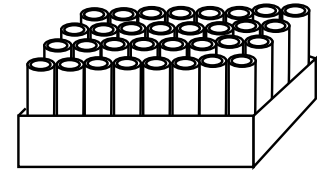


squeeze bottles

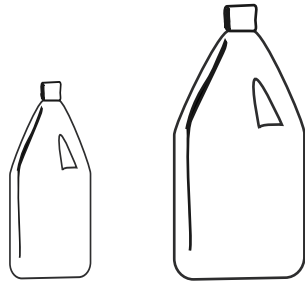


wide-mouthed plastic containers

flat wooden toothpick



plastic vials

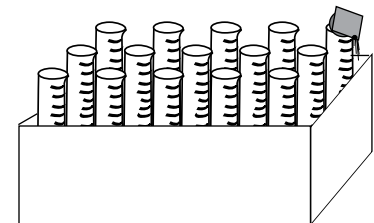


medium container

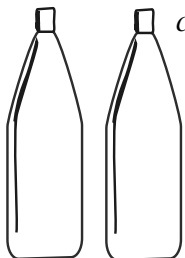
large container



different fruit juices



graduated cylinders



containers for storing orange juice



ascorbic acid (vitamin C)



di-chloro-indophenol powder (1-5 g)



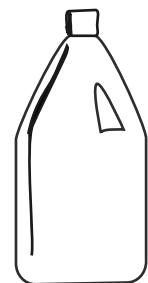
mortar and pestle (optional)



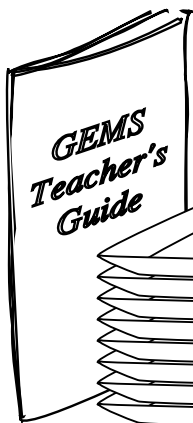
orange squeezer



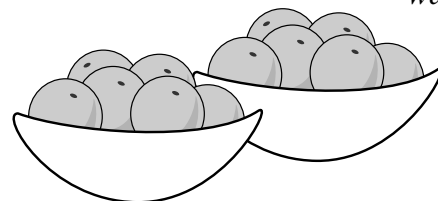
funnel



water



cafeteria trays



oranges

Vitamin C Testing

List continued from page 142

Consumables (continued)

Copies of the following:

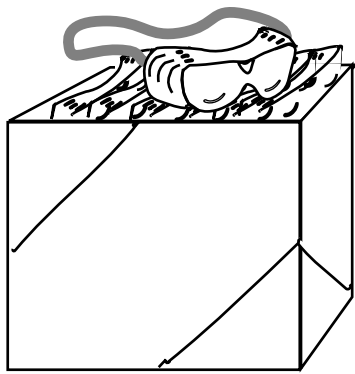
- 96 Vitamin C Testing data sheet
- 64 Graphing Sheet

General Supplies

- 32 pencils
- 100 pieces of white scratch paper to use as a background
- 1 fine-tipped permanent marker
- 1 knife for cutting oranges
- 1 large, flat, non-aluminum baking pan
- several sponges
- paper towels
- 1 roll of masking tape
- butcher paper and markers (if no chalkboard is available)
- 2 buckets and squeeze bottles of water (if no sink is available)
- 16 sets of colored pencils, colored pens, or crayons

Optional:

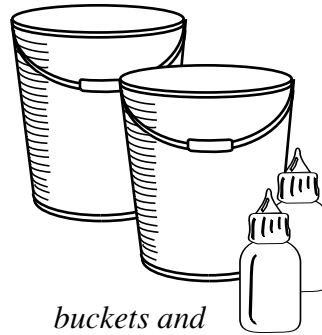
- 32 pairs of safety goggles
- 1 overhead projector
- overhead transparencies of the following:
 - Vitamin C Testing data sheet
 - Vitamin C Testing graphing sheet
- 1+ calculators
- 1 blender



goggles



*blender
(optional)*



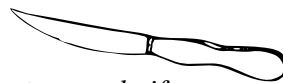
*buckets and
squeeze bottles
of water or sink*



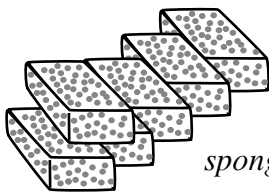
*butcher paper and markers
or chalkboard*



non-aluminum baking pan



knife



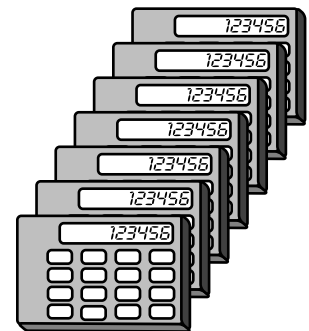
sponges



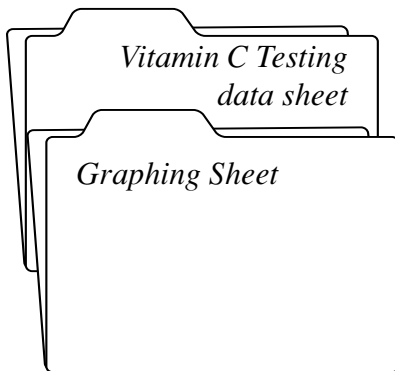
paper towels



masking tape



*calculators
(optional)*



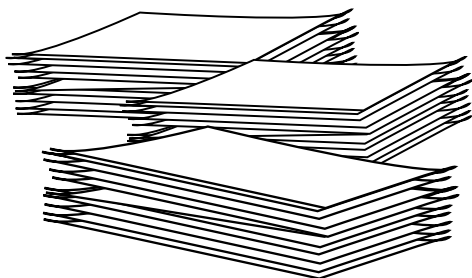
pencils



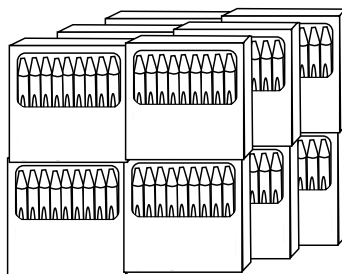
fine-tipped marker



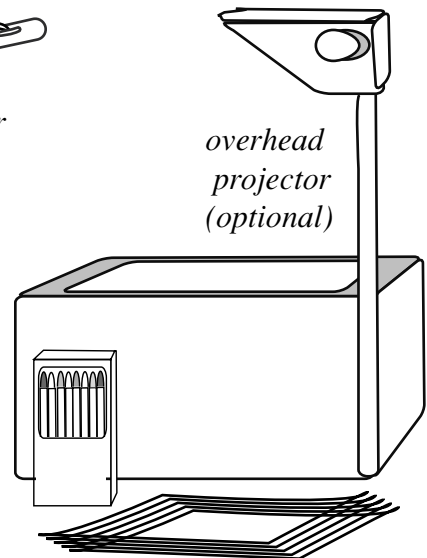
*overhead
projector
(optional)*



white scratch paper



crayons or colored pencils



*overhead pens and
transparencies (optional)*

III. The ABC's of Making and Maintaining GEMS Kits

This section presents practical suggestions to facilitate a successful kit-building process, whether you are working alone, with a partner, with the PTA, or part of a large coordinated district effort. If you have additional suggestions for this section, please write to:

University of California, Berkeley
GEMS
Lawrence Hall of Science # 5200
Berkeley, CA 94720-5200

Creative Ways to Get Money for Science and Math Kits

One way or another, kits cost. This is true whether you buy commercially-made kits, buy the materials that will go in them, or spend lots of time scrounging materials or writing funding requests. There are many creative ways to get the funds to purchase what you will need and strategies to stretch funds by getting donated and/or reused materials, engaging in bulk purchasing for teams of teachers at several schools, and mobilizing volunteers (besides yourself!) to help in these efforts.

Your particular situation will determine what resources are most available to you and how you might proceed. The scope of your endeavor will dramatically affect how much effort, time, and money will be needed—whether you are one teacher assembling kits for several GEMS guides or a district science or math coordinator assembling ten kits for ten GEMS units. Whatever your situation, you need to decide whether you have more money at your disposal or more time (labor). That will help you decide on the best approach for you to take.

Here are some possible sources of funds:

- Many districts have been able to fund kits through their instructional materials budget, even though these funds are becoming more scarce.

- State, federal, or private funds can be obtained for curricular improvement projects and used to purchase materials and pay for labor costs.
- Some local math and science organizations offer mini-grants to individuals or teams of teachers who wish to purchase instructional materials.
- Experienced kit-builders have garnered considerable support from individuals, businesses, and industries in their communities. (See “Interviews with Kit Builders,” page 155.) More and more, companies and local businesses are interested in supporting their communities—they directly benefit from students who graduate with mathematical and scientific literacy and then enter the local work force.
- Many parent organizations are supplementing school budgets through the provision of funds for teaching supplies.

Labor—The Real Kit Builders

There are two kinds of labor—paid and unpaid. Teachers are so used to donating their own unpaid time, that we sometimes forget the other possible sources of volunteers. And, of course, there isn't always enough advance time to delegate tasks that need to be done quickly. Yet, if you can take the time to organize tasks in advance, kit-building is an ideal project for parents who are willing to support a school, but do not have time available during the day. A parent may be happy to take a little time one evening at home to label that class set of plastic cups or cut all those four-inch squares of waxed paper you need. In addition to parent volunteers, you could enlist older students, senior citizens, and workers from business and industry who wish to donate time to support their local schools.

Small Scale Kit Assembly

In addition to getting someone to volunteer as a “room parent,” consider also getting a “kit parent” who has the task of rounding up materials

from your list. With appropriate introduction and consultation as needed, the illustrated lists in this handbook can be handed to a volunteer.

Large Scale Kit Assembly

If you are undertaking a large kit assembly project, it is helpful to appoint one person as the leader. This can be a parent, a secretary, a mentor teacher, or a curriculum coordinator. The leader can duplicate the materials lists from this handbook and create shopping lists. Next, she can organize the crew to conduct the various necessary tasks: purchase kit materials and storage containers, assemble and label storage containers, assemble kit materials in containers, distribute materials to school sites, etc.

You may want to organize a “Kit Construction Day” on a weekday or weekend, or a Science Workday during the summer. Publicize the event well in advance—in and beyond the school community. Post sign-up lists at PTA meetings, Back-To-School Night, Open House events, and at school fund-raisers. Contact the local newspaper to cover the kit-building project. You will assemble a larger crew if you provide child care. High school students and instructional aides often can provide this service at a reasonable fee.

Groups of volunteers can meet at the school or district office on evenings and weekends to assemble the kits. It is essential to provide the construction crew with written directions, particularly if the crew leader will not be present. A nice touch is to write a note of appreciation to the crew when the project is done.

Getting Materials

When kit-making is a small scale enterprise (one kit for one classroom), there are many ways to acquire materials fairly easily—some even are free!

- Some materials are available
 - ✍ around the classroom,
 - ✍ around the school,
 - ✍ around the home (e.g., straws, aluminum foil, empty yogurt containers).

- Donations of new or reused materials may be easier to get than you think. Veteran teachers know that if they tell people and businesses the donation will be used for teaching, it’s easy to get.

- ✍ butchers to donate a class set of liver container lids,
- ✍ ice cream stores to provide dry ice,
- ✍ local swimming pools to donate phenol red and diatomaceous earth, and so on! See the interviews starting on page 155 for more great examples.

The few items that must be purchased can be made into a shopping list. Notes can be sent home with students, asking for donations of materials.

In large-scale kit building efforts, it is usually necessary to purchase materials. Since most GEMS materials are available locally, the leader can provide volunteers with shopping lists to purchase materials. The materials lists in this handbook can be used as shopping lists. It is helpful to separate the items into several categories, for example:

- materials that are stored in district office warehouses (e.g., scissors, card stock)
- materials that are available from local hardware, grocery, and office supply stores (e.g., corn starch, food color, metal washers)
- materials that must be ordered in advance from special distributors (e.g., magnifiers, live ladybugs)

Some GEMS guides are packaged with special materials (e.g., slides, filters, posters). A very few special items are available from GEMS Headquarters at the Lawrence Hall of Science in Berkeley (lenses, color filters, sets of slides, and Spanish language data sheets).

As this handbook announces, under an exclusive, authorized arrangement, VWR/Sargent-Welch will be producing materials kits for the GEMS series. Specialized materials are also available from other vendors whose names and addresses are listed in the Sources of Materials section of this handbook (page 149).

Plan ahead so that you can purchase large quantities in bulk. This can result in great savings.

If you have a crew of shoppers, set a deadline to complete the purchasing and have the crew leader check in with purchasers to be sure they understand their assignment and make timely progress.

Putting Kits Together

There are several options for packaging science and math kits. It is *ideal* to get boxes that are uniform in size and shape to make it easier to stack and store them. Think about where kits will be stored and how they will be transported. Many of the GEMS units need materials that can be stored inside only one box, but quite a few require two boxes, and some need three.

It can be easier, especially for very large kit-building projects, to purchase standard boxes. Cardboard banker's boxes are relatively inexpensive, fairly sturdy, uniform in size and shape, and have convenient carrying handles. They stack very nicely so you can easily put them in a closet or corner of your room, or in storage for the summer.

Another option is to purchase large plastic storage boxes with hinged or removable lids. These have the advantage of being more sturdy and waterproof, but are usually a bit more expensive. Both banker's boxes and plastic storage boxes are frequently available at discount warehouses for very reasonable rates, or perhaps can be donated by local businesses.

Schools that are severely limited in funds can obtain free cardboard boxes from supermarkets, grocery stores, and other places. Remember that copier paper comes in cardboard boxes with lids, too!

Once you have acquired the boxes, prepare large, easy-to-read labels on at least two sides and the top of the box, describing what is inside. The label should include the name of the GEMS unit, and perhaps the location where it will be stored. If there are two boxes for one kit, you might write "Box 1 of 2" and "Box 2 of 2" on the labels so that

other users will know when they have everything. It's especially easy to apply self-adhesive labels, but you can also attach the paper labels with wide clear packaging tape. Alternatively, you can write directly on the boxes with a wide-tipped, permanent marker and cover the writing with clear packing tape.

Inside the lid of the kit box, attach an inventory list of everything that should be in the box. The materials lists in this guide were designed so they

could also be used as inventory checklists. For kits which have more than one box, you could tape a list to the inside of *each* box lid and highlight those items from the list which are contained in the box. Or you could tape the list inside of Box #1 and indicate the box number where each item is stored.

It is also helpful to include a list of general supplies required for that unit.

Whatever system of boxes and labels you choose, we cannot overemphasize how valuable boxes are for keeping the materials organized. Materials on open shelves can get lost more easily. Items in drawers get buried and forgotten. In a few cases, you may need to store objects that are unusual in size or shape (like the wallpaper trays for *Crime Lab Chemistry*) outside of the box. However, if most of the materials are stored in boxes, these unusual items will not be difficult to locate.

Packing Tips

Organizing the inside of each box is an art form unto itself. Small containers within the boxes help to organize small materials so they don't end up loose at the bottom of the box. Some commercially prepared containers have built-in dividers that are perfect for organizing items, or you can make your own "divider" system out of smaller cardboard or plastic boxes, trays, buckets, or baskets. Covers really help to prevent spillage in case the box is accidentally tipped over. Other organizing devices include freezer containers (such as Tupperware), ziplock bags, large paper clamps, and rubber bands. And don't forget about food containers, preferably

Some schools put a GEMS guide in the kit along with a three-ring binder. Teachers who use that GEMS unit add copies of modifications, extensions, and other resources to the binder.

with lids: plastic cottage cheese and yogurt containers, tin cans, and jars.

In general, it is a good idea to pack heavier things in the bottom of the box and lighter things towards the top of the box. Definitely do not put fragile items on the bottom!

There is always a trade-off in how full to pack each container. If the container is completely full, the contents will tend to stay in place when the container is jostled. But if the container is packed too tightly, it might be very difficult to repack each time it is used. As a rule, it's best to pack containers as full as possible and still have the lid fit on easily. This also allows for easier stacking during storage.

It is important that the organization of each box be clear so that when a teacher takes everything out of the box, it is not a struggle to fit everything back in, or a puzzle to figure out where things go. If your box has dividers, label the sections where each item should be placed. A packing diagram on the lid of the box can be a lifesaver to a teacher who would otherwise be frustrated trying to fit all the materials back inside the container.

If you are designing a large-scale kit project, spend some extra time making a prototype organization for each box before you decide on the best system for "mass-production."

Distributing Kits

Many GEMS teachers start out making their own personal kits, and then as their colleagues get "turned on" to GEMS, the advantages of sharing supplies becomes obvious. While each teacher might like to have all the kits that they need right in their own classroom, the realities of limited classroom storage space, and more importantly cost, force teachers to share kits.

Schools can have their own set of kits, or district kits can be kept in a centralized place. In the case of school-based kits, some schools have designated a single person from each

grade-level as "kit-master" for the kits at that grade level. A centralized system is easier for a district kit-master to check and maintain, but is less convenient to the teachers using the kits, unless the kit-master can manage to deliver kits to teachers as needed or according to a scheduled curriculum. Some districts have such transport systems in place.

The size and demographics of your school and school district will help determine what situation would work best for you.

Storing Kits

Closely related to the distribution issue is the problem of storage. Consider this factor especially if you decide to embark on a large-scale kit development project. In overcrowded schools, there often is no space available to store large, bulky quantities of materials for activity-based learning. The following suggestions may be helpful:

- Create "home" classrooms for each kit and list the room number on the label of the box or container. Each grade level teacher can store one or two kits, and, if necessary, be responsible for maintenance and restocking. Have teachers return the kit to the designated room after each use.



- Allocate space in the staff room or library as a teacher resource section.
- Find a space at the district office to store science kits.
- Convince a local company to designate a portion of its warehouse for kit storage, or to donate funds for a storage shed or portable classroom on school grounds. Or, include funds in your budget to purchase a portable storage unit.

Maintaining Kits

Teachers, schools, and districts have instituted a variety of systems for restocking. Following are some elements of these systems:

- Use the materials lists to check inventory. This can be done before or after the kit is used, by the classroom teacher or the school or district kit-master.
- Have a plan for checking consumable materials and restocking them. This can be done by each teacher who uses the kit, so it is ready for the next teacher. It can be done by a “middle person” who receives the kit after it is used and then readies it for the next use. Some teachers are asked to check consumable materials after they have used the kit so that there is an adequate supply for the next teacher when the kit is returned. The teacher then submits a written list to inform the kit-master which items should be restocked.
- Kits are stocked with an entire year’s supply of consumable items and replenished annually.
- Designate shelves or floor space to hold restock items. Having a central area that maintains cups, straws, and liquid detergent, for example, will make for a speedy restocking of kits.

No matter what strategies you adopt to maintain your kits, we recommend that the responsibility of maintaining kits be assigned. The designated person can be a parent volunteer, a district kit coordinator, a mentor teacher, a teacher at each grade level, or a small group of teachers. When kits are shared, there needs to be someone specifically assigned to making sure the kits are kept in good shape.

Environmental Considerations

There are a number of ways that you can be kind to our planet in your choices for materials in GEMS activities. Here are a couple of examples:

1. Plastic cups and plasticware are reusable. Often, items that most people think of as “throwaway” items can be easily washed and reused.
2. When do you use a sponge as opposed to paper towels? Most people have not given much thought to this question. For many people it is almost instinctive to reach for the paper towels whenever there is any sort of spill or mess. Probably 90% of all such spills or messes are best cleaned up with sponges, and 100% in cases of spills of water. The main reasons are that (a) a big sponge is far more efficient at sopping up wet stuff than paper towels are, (b) the sponge is washable and reusable, and (c) every time you use a paper towel, you create more demand for cutting down trees. So when would you use paper towels? If the mess is of a particularly gooey and nasty sort that would completely mess up your sponges, go ahead and use the paper towels.

Liquid Explorations

- 20 jars
- 1 pitcher
- 1 spoon
- 16 stir sticks
- 52 tall plastic cups

**Store in district office
Box 1 of 2**

Example of box label

IV Sources of Materials (Individual Items)

Acetate

Art supply stores

Animals (live)

Alameda County Home Composting
Bassett Cricket Ranch
Berkshire Scientific
Carolina Biological Supply Co.
Connecticut Valley Biological Supply Co.
Delta Education, Inc.
Fisher Scientific Co.
Insect Lore Products
McKilligan Supply Corporation
Nasco
Rainbow Mealworms, Inc.
Science Kit & Boreal Laboratories
Ward's Natural Science Establishment
Western Scientific Co.

Bandanas (black)

Campmor

Bee stuff

Bee Associations
Beekeeping supply stores

Bottles (small plastic; squeeze)

Cole Parmer
Consolidated Plastics
Frey Scientific Co.
Nasco
Science Kit & Boreal Laboratories
Ward's Natural Science Establishment

Bromothymol blue solution

Flinn Scientific
Nasco
Ward's Natural Science Establishment

Buttons

Creative Publications
Cuisenaire Company
Lakeshore Learning Materials

Cafeteria trays

Consolidated Plastics
Restaurant supply stores

Calcium chloride flakes

Flinn Scientific
Nasco
Ward's Natural Science Establishment

Diatomaceous earth

Pool supply stores

Dice

Lakeshore Learning Materials
Creative Publications
The Math Learning Center

Dust masks

Hardware stores

Eyedroppers

see "Medicine droppers"

Frogs and toads, plastic, large

Discovery Corner

Glycerin

Pharmacies

Graduated cylinder

Cole Parmer
Flinn Scientific
Nasco
Sargent-Welch Scientific Company
Ward's Natural Science Establishment

Grease pencils

Art supply stores

Honey in the comb

Health food stores

Indophenol powder

Flinn Scientific, Inc.
Ward's Natural Science Establishment

Ladybugs (live)

Nurseries
Insect Lore Products

Lenses (Magnifying glasses)

J. P. Manufacturing
AOtec Inc.

Medicine droppers

Flinn Scientific
Nasco
Ward's Natural Science Establishment

Mirrors

The Math Learning Center

Paper

(Construction, Blue mural, butcher)

Nasco
Art supply stores
Teacher supply stores
Craft stores

Pattern block paper shapes

Teaching Resource Center

Pattern blocks

Didax Educational Resources
Lakeshore Learning Materials
The Math Learning Center
Teaching Resource Center

Pattern blocks (Rainbow)

Creative Publications

Petri dishes

Cole Parmer
Flinn Scientific
Frey
Nasco
Science Kit & Boreal Laboratories
Ward's Natural Science Establishment

pH paper

Nasco
Sargent-Welch Scientific Company
Ward's Natural Science Establishment

Phenol red powder or concentrate

Pool supply stores
Flinn Scientific, Inc.
Nasco
Ward's Natural Science Establishment

Polydrons

Activity Resource Company
Dale Seymour
Polydron USA Incorporated

Polystyrene balls

Science Kit and Boreal Laboratories
Molecular Model Enterprises, Inc.

Rock samples

Ward's Natural Science Establishment

Rockets: "Estes Viking" model rocket kit

Estes Industries, Inc.

Salol

Ward's Natural Science Establishment

Sentence strips

Teachers supply stores
Lakeshore Learning Materials

Small plastic frogs

Concepts to Go
Kindel and Graham

Sulfuric acid

Flinn Scientific
Nasco
Sargent-Welch Scientific Company
Ward's Natural Science Establishment

Tangrams

(small plastic ones and giant floor tiles)

Didax Educational Resources

Tongue depressors (craft sticks)

Nasco
Craft Stores

Universal indicator

Flinn Scientific
Ward's Natural Science Establishment

Universal indicator color charts

Flinn Scientific

Vials (Plastic)

Cole Parmer
Flinn Scientific
Frey Scientific Co.
Nasco
Science Kit & Boreal Laboratories
VWR Scientific
Ward's Natural Science Establishment

Sources of Materials (Suppliers)

Activity Resource Company

20655 Hathaway Ave.
P.O. Box 4875
Hayward, CA 94541 (for
street address)
94540 (for P.O. Box address)
(510) 782-1300

**Alameda County Home Com-
posting**

7977 Capwell Dr.
Oakland, CA 94621
(510) 635-6275

AOtec Inc.

(508) 765-2203

Bassett Cricket Ranch

535 North Lover's Ln.
Visalia, CA 93291
(209) 732-2738

Berkshire Scientific

P.O. Box 404
Florence, MA 01060
(413) 586-6149

Campmor

P.O. Box 700
Saddle River, NJ 07458

Carolina Biological Supply Co.

2700 York Rd.
Burlington, NC 27215
(919) 584-0381

Cole Parmer

7425 North Oak Park Ave.
Chicago, IL 60648
(800) 323-4340

Concepts to Go

Box 10043
Berkeley, CA 94709
(510) 848-3233

**Connecticut Valley Biological
Supply Co.**

82 Valley Rd.
P.O. Box 326
Southampton, MA 01073
(800) 638-7748

Consolidated Plastics

8181 Darrow Rd.
Twinsburg, OH 44087
(216) 425-3900

Creative Publications

50400 West 11th St.
Oak Lawn, IL 60453
(800) 624-0822

Cuisenaire Company

12 Church St.
New Rochelle, NY 10802
(800) 237-3142

Dale Seymour

P.O. Box 10888
Palo Alto, CA 94303-0879

Delta Education, Inc.

P.O. Box 915
Hudson, NH 03051-0915
(800) 258-1302

Didax Educational Resources

395 Main St.
Rowley, MA 01969
(800) 458-0024

Discovery Corner

Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200
(510) 642-1929

Estes Industries, Inc.

1295 H St.
Penrose, CO 81240
(800) 525-7561

Fisher Science Education

485 South Frontage Rd.
Burr Ridge, IL 60521
(800) 621-4769

Flinn Scientific

P.O. Box 219
131 Flinn St.
Batavia, IL 60510
(708) 879-6900

Frey Scientific Co.

905 Hickory Ln.
Mansfield, OH 44905
(800) 225-3739

Guy's Teachers Supply

4327 Jacuzzi St.
Richmond, CA 94804
(510) 527-0566

Insect Lore Products

P.O. Box 1535
1325 Beech
Shafter, CA 93263
orders: (800) LIVE BUG
customer service: (805) 746-
6047

J. P. Manufacturing, Inc.

13 Lovely St.
Southbridge, MA 01550
(508) 764-2538

Kindel and Graham

1147 Howard St.
San Francisco, CA 94103
(415) 863-6667

Lakeshore Learning Materials

2695 E. Dominguez St.
P.O. Box 6261
Carson, CA 90749
(800) 421-5354

The Math Learning Center

P.O. Box 3226
Salem, OR 97302
(503) 370-8130
fax (503) 370-7961

**McKilligan Supply Corpora-
tion**

435 Main St.
Johnson City, NY 13790
(607) 729-6511

**Molecular Model Enterprises,
Inc.**

116 Swift St.
P.O. Box 250
Edgerton, WI 53534
(608) 884-9877

Nasco

901 Janesville Ave.
Fort Atkinson, WI 53538
(800) 558-9595

Polydron USA Incorporated

2750 South Harbor Blvd.,
Suite C
Santa Ana, CA 92704
(800) 452-9978

Rainbow Mealworms, Inc.

P.O. Box 4907
Compton, CA 90224
(800) 777-9676
(310) 635-1494
FAX (310) 635-1004

**Sargent-Welch Scientific
Company**

911 Commerce Court
Buffalo Grove, IL 60089-2375
(800) 727-4368

**Science Kit & Boreal
Laboratories**

777 East Park Dr.
Tonawanda, NY 14150
(716) 874-6020

Teaching Resource Center

14023 Catalina St.
P.O. Box 1509
San Leandro, CA 94577
(800) 833-3389

VWR Scientific

3745 Bayshore Blvd.
Brisbane, CA 94005
(415) 468-7150

**Ward's Natural Science
Establishment**

P.O. Box 92912
Rochester, NY 14692-9012
(800) 962-2660

Western Scientific Co.

P.O. Box 681
West Sacramento, CA 95691
(916) 371-2705

Sources of Materials (General Supplies)

Here is a list of all “General Supplies” needed for presentation of many GEMS activities. You can consider the list a partial inventory of a super deluxe, well stocked school supply room.

- Cafeteria trays
- Acetate (*overhead transparency stock*)
- Calculators
- Chalk—*white and colored*
- Clipboards
(*or other hard writing surfaces*)
- Crayons
complete sets of crayons
class sets of extra yellow, white
- Detergent
- Drop cloth
- Glue
rubber cement
white glue (large container —for filling
smaller bottles or putting in dishes/cups for
use with cotton swab or scrap cardboard strip
applicators)
- Glue sticks
- Goggles
- Grocery bags (*large, paper*)
- Index cards (*3" x 5"*)
- Manila folders
- Markers (*wide-, medium-, and fine-tipped*)
- Meter sticks
- Newspapers
- Overhead projector and markers
- Paper
butcher paper
construction paper (variety of colors)
graph paper
heavy card stock
lined paper
scratch paper
white paper (many reams)
- Paper clips
- Paper cutter
- Paper fasteners (*sometimes called paper brads*)
- Paper punch (*single hole*)
- Paper towels
- Pencils
- Pitchers
- Plastic bags
large trash bags
sandwich bags
ziplock bags (in different sizes)
- Rulers (*class set*)
- Scissors
class set of student-type scissors
one or more adult-type scissors
- Sink with water or buckets and squeeze
bottles of water
- Slide projector
- Soap
- Sponges
- String
- Tape—*masking and clear*
- Utility knife
- White projection screen—*white wall is fine, or*
large white cloth or paper, at least 4' x 6'
(1½ meters x 2 meters)
- Yarn in a variety of colors



V Interviews with Kit Builders

Why reinvent the wheel! Mistakes are often valuable experiences that help us create excellent products. Read these interviews to find out what worked well for these kit builders—the pitfalls to avoid and what they have learned, in retrospect, after years of kit building. Let their hindsight become your foresight!

An Interview with...

Steve Gair

Pittsburg Unified School District

Pittsburg, California

Steve Gair, as Curriculum Coordinator for the Pittsburg Unified School District, has helped the district create a hands-on science program in Grades K–5. Fourteen GEMS units are part of the core program, with certain ones designated for each grade level. Teachers are required to teach a minimum of four units per year, and to include at least one unit from Physical, Life, and Earth sciences. All seven elementary schools have a collection of fourteen GEMS kits, and each teacher has copies of those guides designated for her particular grade level. As you can imagine, kit building in Pittsburg is no small task, as indicated in the following interview.

GEMS: You’ve been using GEMS kits for five years now. What were the first steps you took to embark on such a large-scale project?

Steve: We didn’t start with fourteen kits. In our first year, we eliminated the science textbook and created four kits for Grade 4 and Grade 5. During the second year, we added Grades 2 and 3. Kindergarten and Grade 1 kits were developed for Year 3 of the program. Now, we’re in our second cycle, and we’ve returned to Grade 4 and 5 and added new units. Each year, we’ll focus on two grade levels. All kits are piloted by a task force of

teachers from every elementary school at each grade level. They continue to advise us as to what needs to be in the kits.

GEMS: How do you maintain and store the kits?

Steve: We keep all of our kit supplies in the Science Resource Center, a portable building with ample storage and space for assembly, restocking, and training. I worked to create the kits with my secretary and a mentor teacher, with supply lists from the Lawrence Hall of Science. We started with banker’s boxes, but they didn’t work well because they were too collapsible. Now we use big plastic boxes that cost about \$10 each at Wal-Mart. Each guide needs one to two boxes. Within the kit, we separate consumable and non-consumable materials into two boxes.

In May of each year, teachers return the consumable box with a list of the number of teachers who will use the kit the following year. We replenish the supplies during the summer and return the kits in September.

We include enough supplies for all teachers to use the kit at their school, and include some overage. We also include a binder in each kit so that teachers can add modifications and extra activities, management tips, practical ideas, and student work. However, we find that few teachers use the binder. I think that the district needs to provide extra time for teachers to add to the binder, because they’re too busy doing the units to write anything down!

Start small; move slowly and provide good teacher training on how to use the kits.

GEMS: How did you fund this project?

Steve: We tapped into local resources from business and industry. GWF Power Systems gave us \$15,000 in seed money to create the first cycle of kits. We currently receive \$40,000 a year from Dow Chemical Company to replenish the materials. The local companies were impressed with the fact that we were committed to the project. It was in their self-interest to assure that scientifically literate students

graduate from their local community and enter the work force.

GEMS: In retrospect, what advice do you have for novice kit builders?

Steve: Start small; move slowly and provide good teacher training on how to use the kits. In our district, we use Eisenhower funds to pay for staff development. We want our teachers to use integrated themes in their classrooms, with science as a cornerstone. So, they receive training in all of the GEMS units at their grade level. Then, they can select the units that mesh with particular themes, as well as their teaching style.

GEMS: In your estimate, is the GEMS kit project a success?

Steve: Definitely. Currently, all of our elementary teachers use GEMS units as a large part of their science program. I'd guess that if we didn't provide the kits directly at the school site, only 5% to 10% of the teachers would use the GEMS guides. That's a success!

An Interview with...

Gail Paulin

Tucson Unified School District

Tucson Arizona

Gail Paulin is a Project Specialist at the Science Resource Center in the Tucson Unified School District. Teachers in the district's 74 elementary schools use no science textbooks. Instead, the science curriculum consists of two core units from FOSS, an assortment of GEMS guides, and AIMS activities. In 1990–91, the district started a GEMS training program for Grades K–3, with Gail at the helm. She has created multiple kits for three GEMS guides which are heavily used by Tucson's 74 elementary schools. Gail, a former high school teacher, says that kit building is one of her favorite aspects of her job!

GEMS: You're the first person who's told us that she

loves to build kits! Can you explain?

Gail: Putting together kits is one of the most enjoyable things I've ever done. It's inspiring to be able to facilitate what people are going to teach in their classroom. I love shopping and enjoy the opportunity to locate the materials for the kits. I've taught science for 23 years and I know how to find things. Sometimes, I find things in unusual places.

GEMS: Unusual places?

Gail: Sure! Local museums and organizations are a great source for materials. When I put together the *Animal Defenses* kit, I contacted the International Wildlife Museum and the Fish and Game Department. They donated animal artifacts—antlers, horns, hooves, skulls and eland (an African antelope) hide. The hide is so large that a whole class of kindergartners can sit around it. Then, they add actual antlers and the hooves for defenses! It's very engaging.

Recently, I was planning a workshop on *Buzzing A Hive* and I wanted the teachers to make hives from large egg cartons. I knew that not many people buy eggs in such large quantities, so I contacted a local restaurant and they saved me several hundred egg cartons. They even made a special shelf in the kitchen for my boxes! When the teachers left the workshop, they had enough cartons to make hives with their students. This made the unit come alive.

Fast food places and grocery stores have also been quite helpful. A local fast food restaurant donated portion cups with lids to store the salt for *Liquid Explorations*. In the "deli" department of our grocery store, they donate Styrofoam trays that can be used for experiments. The manager arranges for volume discounts by purchasing my supplies along with their large orders from big distributors. This has saved the district a lot of money.

GEMS: How did you gather so much local support?

Gail: It's really important to let everyone in the community know what you are doing, regardless of whether you see them as a potential helper. Go beyond what you'd think of as ordinary science supply places. We told every possible person

that we were building hands-on science kits. We found that resources turned up from the most unexpected places. For example, someone knew a surgeon at the local hospital. He noticed that the hospital discarded a large number of unused sterile containers from lab packs. Once the pack was open, they couldn't use the leftover containers. So, he saved the containers for us for our kits.

Also, remember to take the time to thank the people who contribute to the kit program. Businesses and individuals love to support their local schools, and a note of appreciation reminds them of their positive contributions to education.

GEMS: It sounds like you really make an effort to enhance your kits!

Gail: We try to create an in-depth experience for teachers and students. The kits contain all the supplies necessary to teach the units, but we also include other resources, such as trade books and other materials that will help children relate to the content of the guide. For example, we include bee and skunk puppets in the *Buzzing A Hive* kit. That kit also has a bee keeper's hat as well as a public service tape on Bee Safety. The video is particularly relevant because we have Africanized bees in Arizona, and students are aware of their presence in the community. We also include a book called *Following the Bloom*, by Douglas Whynott, who followed itinerant bee keepers around the country. This is an adult book, but we prepared a guide to highlight the relevant parts, such as photographs, for young students. These resources really enrich the GEMS guides.

Go beyond what you'd think of as ordinary science supply places. We told every possible person that we were building hands-on science kits. We found that resources turned up from the most unexpected places.

In addition, each kit contains an on-going notebook filled with extension ideas for the guide. For *Animal Defenses*, we include a recipe for cookies and a set of dinosaur cookie cutters so that the children can add cookie dough defenses! With *Hide A Butterfly*, we have a recipe for stained glass butterfly cookies that have life savers in their wings.

Also, did you know that you can make a really cute butterfly pin from the little metal chute in salt boxes?

GEMS: What support do you provide for teachers to use GEMS guides that don't have kits?

Gail: For many other guides, we don't have complete kits, but we do provide the necessary materials that wouldn't ordinarily be found in classrooms—ladybugs, magnifying lenses, chemicals like indophenol for *Vitamin C Testing*. We also contracted a commercial developer to make a kit for *Liquid Explorations* and to provide replacement items. We now have sixty big plastic tubs for that guide because it's used as part of the core curriculum for Kindergarten teachers. It's our heaviest kit because of all the seltzer water. In addition to science, the kit is a great weight-lifting experience!

An Interview with...
Scott Stowell, Kit Builder
Spokane School District
Spokane, Washington

Scott Stowell is Grade K–12 Science Coordinator for the Spokane School district. The district's entire science program is kit-based and GEMS is a strong component. In 1992, the National Science Foundation funded a 5-year science implementation grant for Spokane's elementary schools. The district has enhanced and expanded several GEMS units so that they are part of five-to-eight-week curriculum modules. The modules include comprehensive kits to accompany the guides. In addition, Spokane is about to launch major restructuring and revision of the secondary school program, and some GEMS guides will be developed into more substantial core modules.

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GEMS: What have you learned through your kit-building experience?

Scott: First, it is important to develop one materials list for the entire guide. In GEMS earlier editions, the materials often are not listed in one place, so you'll need to consolidate. You also need to distinguish between things that you'd consider putting in a kit and others that classroom teachers could gather on their own.

At first, we tried to put everything in the kits including general classroom supplies such as pencils

Since we get most items in bulk from vendors, we need to be very specific as to whether we'll consider substitute items. Send your specifications to various companies for approximate costs. On a large scale, this will save money.

and scissors. Then, we received feedback that we didn't need to put in the "ordinary" things. However, an item such as crayons is ordinary for a primary grade teacher but may be rare for a high school teacher. So, you need to create the kit with the user in mind.

Be sure to think through your plans very clearly, particularly when you deal with vendors. If you're ordering materials for a kit, describe each given item very clearly, by size, quantity, and composition. Since we get most items in bulk from vendors, we need to be very specific as to whether we'll consider substitute items. For example, a Solo cup is more flexible than a rigid cup, and that makes a difference in terms of how long it will last. Send your specifications to various companies for approximate costs. On a large scale, this will save money.

Sometimes, it is important to test various brands of a particular item. For example, there are certain water soluble markers that are perfect for *Crime Lab Chemistry*, while others are not. Don't buy large quantities until you're sure they're right.

GEMS: How have the teachers responded to the kits?

Scott: The teachers are very satisfied with the units because they include everything that is needed to

implement the activities. When they pick up a kit, they can be assured that they don't have to hunt all over the place for materials. What isn't in the kit is readily available in their classrooms. If teachers were only given a GEMS guide, it's likely that only the more committed and dedicated teachers would implement the activities.

GEMS: Do you have any other advice for potential kit builders?

Scott: A few years ago, Jacquy Barber from GEMS asked me if I thought it would be worthwhile to hire a vendor to construct the kits. At the time, I anticipated that it would be easier for us to make our own kits, but I didn't have much experience with the process. Now, I would still make the same decision. If you hire a company, their prices will include the labor that it takes to create the kits, as well as the packaging that they'll have to design to make it marketable. It's far more cost effective to do it on your own, especially if you know the sources for special items. The Association of Science Materials Centers (ASMC) in Mesa, Arizona, is an excellent resource for kit builders. They've been a great support to us.

An Interview with...

Anne Kennedy, Kit Builder

ESD 112

Vancouver, Washington

Anne Kennedy is Coordinator of Math and Science Programs for Educational Service District 112 in Vancouver, Washington. She works with 30 school districts, each with a different science program. The GEMS series is used primarily in Grades K-6, and recently has begun to expand into the middle schools. Anne coordinates the staff development, production, and distribution of kits to accompany the GEMS guides.

GEMS: Why did you decide to create GEMS kits, and how did you get started?

Anne: Since Washington does not have a statewide curriculum in science, GEMS is one way for our

districts to develop a common language. When we first began, we received two grants from Hewlett Packard to build kits for eight guides for Grades K–6. Each year, we added more kits. By the fall of 1996, we will have created kits for a total of 18 guides.

GEMS: What process do you use to create and distribute the kits?

Each kit was developed by a team of three people—a

Throughout the process, there was on-going communication between the kit builder and the potential user.

teacher who knew the guide, a support staff person who would actually build the kit, and myself. Through-out the process, there was on-going communication between the kit builder and the potential user.

We build in time to re-

visit and replenish the kits after they are used by teachers.

We also provide training for teachers on how to use the guides and the kits. We have workshops for schools and districts and three yearly conferences presented by GEMS leaders. A portion of our workshop fee goes back into the kit program to make it self supporting.

We use a courier service to distribute and return the kits to the schools. Once they have been trained to use a particular guide, teachers can check out the kits for three to four weeks and then send them back to us. We include an evaluation in each kit which has the teachers identify the condition of the kit; items that were missing or need to be replaced; and also what other kits need to be built. We're currently revising the kits to include copies of related literature connections.

GEMS: What helpful hints do you have to offer for future kit builders?

Anne: The most important thing is to have a good inventory list, not only for what is in the GEMS guide, but also for what it implies that you'll need. For example, most teachers have scissors and crayons in their classrooms, but if you use the kit for inservice, there may not be scissors and crayons

available in the room. We also include materials that are listed as optional in the guide.

Our secretary compiled incredible inventories for each guide. She created one large list for the entire guide, with symbols that are cross-referenced to show what material goes with each session. Items 2A, 2B, and 2C are all used in the second session of the guide. With this method, we have one comprehensive list but the teachers also know which items connect with particular activities.

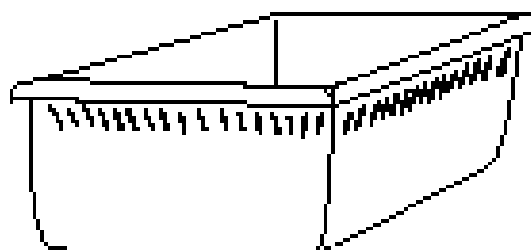
GEMS: Did you encounter any obstacles during your kit-building experience?

Anne: We discovered that some guides do not make as good a kit as other guides, particularly if you use a courier service! For example, *River Cutters* was a tough kit for us to make because the kit had many tubs and a lot of earth. Because the covers stayed on the tubs during shipping, many teachers discovered that the earth was moldy by the time they unpacked it. This is particularly a problem in humid climates like ours in the Pacific Northwest! We tried adding a chlorine/water mix to the earth, but it didn't help.

A positive thing that happened was that local fish stores donated tubs for us to use in the kits. These tubs look like plastic shoe boxes and are the perfect size and price for GEMS kits!

GEMS: Do you think that the GEMS Kit Builder's Handbook will be a helpful tool for people who want to use GEMS for activity-based science?

Anne: This handbook is greatly needed. In fact, our own kits have become models for schools throughout our service area. They check out our kits; copy our lists, format, and packing instructions; and then create their own kits. We also trade ideas with Hewlett Packard. They use kits for parent training and classroom visitations. It's part of an ongoing project.



An Interview with...

Bob Box

West Mesa Public Schools

Mesa, Arizona

Bob Box is a Social Science Resource Specialist for the West Mesa Public Schools. The district has used an activity-based approach to science curriculum for almost 20 years. Their entire elementary school science budget is used to deliver materials kits to the classroom; no textbooks are purchased. Although GEMS units are a relatively recent addition to their program, Bob and his colleagues have built science kits for almost two decades! Bob is also the originator of the concise and complimentary phrase, for which we are duly grateful: “GEMS truly live up to their name!”

GEMS: What are the components of your science kits?

Bob: Each kit has a copy of the guide or the teacher’s edition for the program.

We use a courier service to distribute and return the kits to the schools.

We also include student booklets or data sheets; some are part of the program and some are developed at the district. The student booklets help to individualize instruction and are useful when you demonstrate an activity. The booklets can

be used for diagrams, pictures, record keeping, embedded assessments, and summaries for portfolio assessment. The kits also contain all materials necessary for effective implementation of the unit.

GEMS: What advice do you have for potential kit builders?

Bob: First, try to organize materials in a user friendly manner. They need to be ready for the teacher to use immediately. In our district, we sort the materials by activity in a large plastic bag, with smaller bags of the components for the activity.

Also, if you are a large district or a science resource

center, take advantage of bulk buying. Designate a space to store large quantities of commonly used items and restock the kits.

Third, recycle the unit—be sure that there are enough materials so it can be used multiple times. Develop a clear procedure to circulate the kit. Have teachers bring it back to a central location after they use it, so that it can be ready for the next user.

GEMS: What has been most helpful for you in large-scale kit building?

Bob: As a science resource center, we are members of the Association of Science Materials Centers (ASMC). This organization is a rapidly growing network of science material distribution centers. Our purpose is to network ideas, share resources, and provide advice on how to implement hands-on science curriculum, particularly the materials end of it. The ASMC newsletter includes a column on “Tips from The Miser” which presents challenges faced by kit builders and possible solutions. A Next Step Institute is held each year for districts and consortiums that are already involved in systemic support for science education. Participants attend the conference to upgrade their skills and keep current in the latest reform efforts.

GEMS: What has been the impact of your kit-based science curriculum?

Bob: Two nationwide trends are clear in science education. First, students learn best when science is interactive and hands-on. Second, districts must develop a support system for teachers so they can implement activity-based science. For many years, the collective wisdom of our department and the quality of our kit-based science program have met both of these objectives. We believe that we have become a model program for the nation.

For general questions about ASMC, contact: ASMC c/o Susan Sprague, Science Resource Center, Mesa Public Schools, 143 South Alma School Road, Mesa, AZ 85210-1096. Phone (602) 898-7815.

An Interview with...

Gaylene Suganuma, Parent

Buena Vista Elementary School

Walnut Creek, California

Gaylene Suganuma is a parent at Buena Vista Elementary School in Walnut Creek, California. A regular volunteer in school activities, Gaylene coordinated an all-day Bubble Festival for the first grade classes. The extremely successful festival was the first of its kind at the school.

GEMS: Festival coordination is a big task! How did you know where to begin?

Gaylene: All I had was the *Bubble Festival* guide! I read it and followed the directions. I improvised when I had to. I set up five stations in the morning and three in the afternoon. I learned a lot in the process.

GEMS: What did you learn?

Gaylene: I learned that I made too much bubble solution. I made 120 gallons and we only used sixty! I guess I overestimated the amount of spillage that might occur. I also realized that cottage cheese containers don't work too well for the body bubbles because they're too small for children's hands. I used 2-quart ice cream tubs instead. And, some students are too big to stand on ordinary plastic milk crates; be sure to get VERY strong ones!

I also learned that it really helps to increase the humidity in the room where the bubble festival will occur. I moisturized the multipurpose room the night before the festival. I had a swamp cooler that my dad had given me a long time ago. When we installed air conditioning at home, we didn't need the cooler anymore, but I decided to keep it just in case there was a use for it in the future. It certainly came in handy at the festival! That night, I set up the swamp cooler in the multipurpose room and the next day, teachers noticed how humid the room had become. It worked! We also put big signs on the doors to the room that said: Keep Doors Closed, Bubbles Do Not Like Wind.

GEMS: It sounds like you did a lot of advance planning.

Gaylene: It was a lot of planning. The GEMS guide was very helpful. I covered the entire floor with newspaper. Each station was equipped with all the necessary materials and I also included cleanup stuff. Under each table was a 5-gallon bucket of bubble solution, a spray bottle with the vinegar and water mix, a roll of paper towels, a rag, and a squeegee. There was also an empty bucket for foam. Then, station monitors could clean up throughout the day.

GEMS: Did you follow the GEMS guide exactly?

I made some adjustments to the *Bubble Festival* guide. For example, the book suggested two volunteers per station. Sometimes I had three or four helpers and I noticed that the festival ran smoother when I did. Also, the vinegar solution is great for cleaning tables, but the smell is terrible! When you're done cleaning, it's not like you're ready to have a salad bar in that very room. You have to wait a while before you can use the room for eating.

GEMS: Was it difficult to get materials?

Gaylene: I set up the festival on a very low budget—under \$100. I wrote a lot of letters asking for help, and I borrowed a lot of equipment. We got dishpan buckets from the science lab and our household had four bedpans from times that we had been hospitalized. The custodian lent us squirt bottles and squeegees. One parent, who works for a research firm, discovered that they were throwing out 5-gallon buckets with covers. He grabbed them out of the trash can and donated them to the festival. I found some inflatable swimming pools that were four feet in diameter and were perfect for the festival.

GEMS: Did you create a bubble festival kit for future use?

Gaylene: No. We don't need a kit. I did save the 5-gallon buckets, the swimming pools and, of course, the swamp cooler. But, when we do our next festival, we'll gather the materials together again. We'll be experienced next time.

Note: Some other teachers keep a kit of materials for this festival.

GEMS: I noticed that you said, “when WE plan the next festival . . .” Will you coordinate the event?

Gaylene: I won’t coordinate it, but I will help out! It was a great success. Even though it looked like the kids were just exploring the bubbles, they actually learned a lot. For example, many first graders thought that a star-shaped bubble would result from a star-shaped bubble blower. They were surprised to see that the bubble was round! At their level, they learned about surface tension and didn’t even realize it!

An Interview with...

Winnifred G. Bolinsky, Teacher

Fogelsville Elementary School

Allentown, Pennsylvania

Winnifred Bolinsky has taught fifth grade for three years at Fogelsville Elementary School in Allentown, Pennsylvania. She has used ten different GEMS units in her science and math programs and is a regular contributor to the *GEMS Network News*.

GEMS: How do you prepare for your GEMS units?

Winnifred: I’m not what you’d call a bona fide kit builder. I have a box or container for each guide I use. Whenever possible, I try to use something that is part of the unit for a storage medium. For example, with *Bubble Festival*, I use the wallpaper containers to store a lot of the materials. Cardboard boxes don’t typically hold up as well as plastic, particularly if you have to store dishwashing soap bottles or other materials that are wet and drippy.

GEMS: Where do you get your containers?

Winnifred: Bakeries and restaurants are great sources for containers. They buy fillings for pies and pastries in 5-gallon containers. You can fill these buckets with materials, like the geometric shapes for *Bubble Festival*. When it’s time to set up the

festival, dump out the shapes and use the buckets to mix large quantities of bubble solutions.

GEMS: Where do you store the containers?

Winnifred: I keep certain kits in the classroom. Flat containers with lids stack nicely, underneath tables, underneath your desk, in a closet, on a shelf, in your basement or garage. Be sure to get containers with lids, because they stack nicely in a corner; you can just stash them away!

GEMS: What items do you put in the kits?

Winnifred: I put whatever special materials are necessary. For *River Cutters*, I keep furring strips of varying slopes in an under-the-bed storage box. I also include and reuse the plastic tumblers, food coloring, coffee stirrers, wires to insert in the drippers, and sealed bags of diatomaceous earth. The box also has the drip systems that worked well in prior units and are still working. I replenish items whenever I run out, so that the kit is ready to go whenever I need it.

If you think ahead, you can save a lot of money. I buy items at the end of the season, at discount rates.

GEMS: Why is it preferable to replenish the items as soon as you complete a unit?

Winnifred: You never know when you’ll be called upon to do a special class during the year at a time you hadn’t planned. Or, sometimes the students are interested in a particular topic, and you decide to explore it with a GEMS guide, on very short notice. The items you need may be out of season. For example, in Pennsylvania, it’s very hard to find diatomaceous earth in the middle of the winter. You don’t have to worry about locating an item if it’s already there!

GEMS: How did you finance your kits?

Winnifred: I had to be creative! As I said before, local businesses are great sources for materials. For example, coffee stirrers are free at restaurants. I’ve also found some great containers at inservices and other school functions where lunch is provided. I’m not afraid to reuse containers that people would ordinarily throw out. Yard sales are a great source

for ordinarily expensive items, such as swimming pools. If you think ahead, you can save a lot of money. I buy items at the end of the season, at discount rates.

Also, teaching is my second career. I used to work in design engineering, in scheduling and planning. This background has come in handy. I have the type of mind that figures out how to use materials in unique and unusual ways.

GEMS: Unique and unusual ways?

Winnifred: Sure! Think about the white glue bottles that you get in school. Many people throw them out when the glue dries up or runs out. I recycle them and fill them with the colored water for *River Cutters*. This eliminates the mess that can occur. Never assume that a container has only its intended use!

GEMS: Do you have any other advice for other teachers who will use GEMS materials?

Winnifred: If you haven't used a unit before, make a checklist that includes what you will need. At first, the checklist will be very valuable. Then, after a while, you probably won't need it. Also, try to design a kit that best meets the needs of your classroom. For example, instead of one large kit for *Crime Lab Chemistry*, I created individual portable crime labs for each of my students. In each bag, I include a pencil, strips with holes punched in them to use with chromatography tests, and testing samples. I decorated each bag with a label that said "Portable Crime Lab." At the end of the unit, I refill the bags and store them in a larger bag or manila envelope. Then, they're ready for next year!



An Interview with...

Andrea Ambrose

GEMS Center Director

Deputy Director for Programs

and Visitor Services

Sunrise Museum

Charleston, West Virginia

Andrea Ambrose first encountered GEMS when she helped launch the GEMS Center in Fresno, California. After moving on to the Sunrise Museum in Charleston, West Virginia, she and other GEMS Associates there quickly found funding to establish a GEMS Center. They have established a very successful and far-reaching program, with plans for future expansion. Among many initiatives, their kit building efforts have been exemplary. They have worked hard to create real "gems" of kits for a large number of GEMS guides.

GEMS: When and why did you start making GEMS kits? How many guides are represented?

Andrea: We began making GEMS kits in 1995 when we received word that we would be taking on an ambitious program of training for teachers from our region. We began by making kits to augment those used by the Lawrence Hall trainers on their visits. We developed more when we initiated our first five-day workshop for educators—which explored eighteen curriculum guides. We now have roughly twenty-five kits and continue to put them together as we take on new guides.

GEMS: How are the kits used?

Andrea: Kits are used by our on-staff presenters for two purposes:

- 1) Teacher's workshops on-and off-site, and
- 2) for museum programs on weekends and for special events.

GEMS: Do you have a lending system for kits for teachers in the area?

Andrea: We have talked about seeking grant money in order to create a lending library of kits (right now we have a lending library of guides only)—we think it would be a great idea. However, until we are able to take on such a labor intensive (and expensive) project, we have made it our policy NOT to lend kits. We need to have kits available at all times for training and for museum programs.

GEMS: How do you fund the project?

Andrea: Funds for our kits have come from a variety of sources. The museum has worked in cooperation with the West Virginia Graduate College and with our local county school district to develop GEMS programming. Funds from both partners have been used to purchase the reusable and consumable supplies contained in the kits. We have also received significant funding from three regional foundations and local corporate donors to fund a broad spectrum of teacher education programs at the museum.

GEMS: How do you maintain and store kits?

Andrea: Our kits are stored in a space dedicated to Museum program supplies. Each kit is contained in a stackable Rubbermaid container (the biggest ones available). We also have additional storage containers filled with “general supplies” (markers, scissors, glue, rulers, calculators, pencils, paper, etc.) which are needed for all GEMS guides. The containers are labeled and all the pieces can be quickly assembled for a workshop. We also find that these containers fit easily into a car and can be carried with relative ease.

GEMS: Are there any special tips you’d pass on to other GEMS kit builders/other sites and centers? Any key consideration for specific guides?

Andrea: It was worth it to us to purchase good quality containers (in a variety of sizes) for our kits and supplies. They have enabled us to transport them easily and they have helped us to stay organized (considering that a variety of different people on staff use them for a variety of purposes).

I would strongly recommend that kit builders plan ahead when assembling a kit. Some kits (e.g.,



Fingerprinting, Oobleck, Color Analyzers) are readily (and inexpensively) assembled. Others require that items be special ordered—sometimes these are costly; other times, they are simply hard to find. Still other kits require diligent collecting, duplicating, lamination and assembly. With sufficient time a kit can be assembled to perfection and can be used with ease.

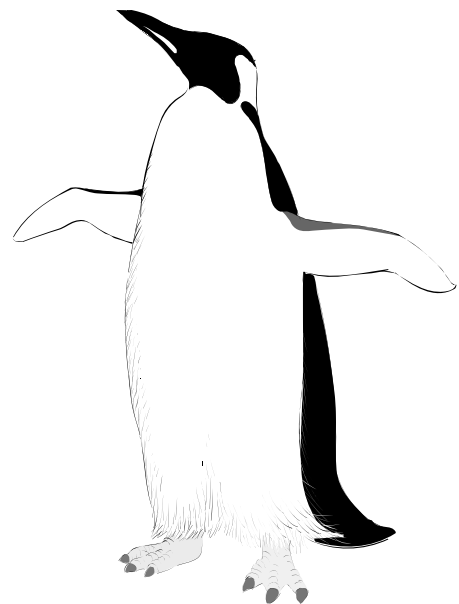
We're lucky because we can order items from a variety of sources, not just science and education catalogs but through the multitude of wholesalers with which our Museum Shop does business. Because we use our kits for public programs, we have made it our goal that we spend what it takes to make and/or purchase "bullet proof" objects. We have high standards for our public programs and we have tried to observe these same high standards in our kit building endeavors.

I know that teachers are in a bind both for time and money, so even though our own materials may sometimes be adapted for durability, we also go to great lengths to show and/or explain simpler, less costly or more readily made approaches to putting kits together. Ultimately, issues of longevity, appearance, and appropriateness must be determined for each kit builder relative to their expected use and storage of each kit.

If we had our way, each of our kits would be fully self-contained. In other words, if a guide calls for rulers, calculators, pencils and paper (general supplies in our book) in addition to manipulatives and other purchased items, we'd like to include them in the container for ready use. Needless to say, the cost of purchasing duplicates of everything seemed excessive to us and our "general supply bins" have served us well. However, there are instances where it pays to buy more than one item if it is needed in more than one kit. For example, we have two sets of tape measures—one for *Penguins And Their Young* and one for *Bubble Festival*—it just makes more sense. (The bubble ones get soapy!) Speaking of penguins, I might add that we've also learned some lessons about regional availability. For example, us former Californians thought it

would be a snap to find large corks for *Penguins* in West Virginia. HA! It has been quite a challenge and we have generally had to settle for very small ones (not good for tiny hands). It's obvious that certain objects are easier to obtain in one region than in another. Also, many of the things that we've ordered come through the Museum Shop we haven't been able to find anywhere else (in more readily available teacher-type catalogs). We often order things for teachers when they run up against a wall. We're of course fortunate to have the resources available to museums (graphic artists, lots of neat computer software and hardware, a variety of supplies and resources that are less restrictive than those available to teachers).

We always get asked where we find things and how we find the time and money to put together/purchase items that we use. We go to great lengths to explain the variety of approaches that can be taken to assembling kits, emphasizing that time, planning, and care are the most important factors beyond all else. As creative as many teachers are, when they get outside of their area of experience—such as assembling display signs for a festival-style guide—they can feel overwhelmed. I'd like to think that some of our teachers have been inspired to get even more creative with their kit assembly after they see our approach to assembling them. ■



A Resourceful Note in Closing

Please note that the list of suppliers starting on page 151 is not meant to be exhaustive. Far from it! There are many other companies and distributors who may carry items needed to conduct GEMS activities.

To connect to information on the Internet about GEMS Kits, see lhsgems.org/gemskits.html

The National Science Teacher's Association (NSTA) is of course an outstanding general resource. The purpose of NSTA is to stimulate, improve, and coordinate science teaching and learning. **Every year, NSTA publishes a revised Science Education Suppliers supplement** to their regular publications *Science and Children* (Elementary School), *Science Scope* (Middle School), and *The Science Teacher* (High School). Members receive the supplement automatically. For more information, contact NSTA at 1840 Wilson Blvd., Arlington, VA 22201-3000, or call (703) 243-7100. Their fax is: (703) 243-7177 and you can visit their web page at <http://www.nsta.org/>

The Association of Science Materials Centers (ASMC) is a growing network of science material distribution centers. ASMC's purpose is to network ideas, share resources and provide advice on how to implement hands-on science curriculum, particularly relating to materials.

The ASMC newsletter includes a column, "Tips from The Miser," on challenges faced by kit builders and possible solutions. A Next Step Institute is held each year. ASMC meets annually on Saturday morning at the National Science Teacher's Association's national conference. The organization has over 300 members representing more than 80 centers in 31 states and 1 Canadian province.

For more information, contact: Susan Sprague, Science Resource Center, Mesa Public Schools, 143 South Alma School Road, Mesa, AZ 85210-1096, or call (602) 898-7815.

There are quite a large number of other helpful educational organizations and kit creators who may be helpful in your own efforts. Many of these are regional, often connected to a school district or other component of the public educational system. School districts that have adopted GEMS units within their curricula have often found excellent ways to create kits for teachers.

As the GEMS national—and international—network grows (there are now over 60 GEMS Network Sites or Centers) many of these sites and centers have created outstanding GEMS kits for use by teachers in their region.

*Thanks
for your interest in
and support of
GEMS!*