What Are GEMS® Sequences?

GEMS Sequences combine the vitality and excellence of GEMS Teacher's Guides with greater coherence, more scientific and educational depth, systematic assessments, informational readings, and new learning technologies. The purpose of a GEMS Sequence is to provide an effective and time-efficient way to teach the key concepts of a particular subject area and to give students the opportunity to be scientists as they, in turn, learn how scientists inquire about the real world. The goal of each sequence is to focus strategically and effectively on the *core science concepts* that students need to understand within a scientific discipline. Sequences provide numerous opportunities for students to develop *inquiry skills and abilities.* The sessions have been designed in accordance with the latest research on human learning. A significant number and range of national, state, and district standards and benchmarks are addressed in depth throughout each sequence; they are described in more detail in the introduction to the unit. Sequences have been classroom tested by teachers across the United States in a wide variety of classroom settings.

Nine Key Features of GEMS Sequences

Flexibility of Use of the Curriculum. A sequence is composed of three or four units, each lasting between four and twelve sessions. Each unit builds upon knowledge from previous units. Although a sequence is carefully designed with an overall learning progression in mind, each unit is also designed to be effective when inserted into a different curricular context. A sequence can be used in different ways, depending on standards and curriculum requirements. Some educators may sequence units *horizontally*, implementing all the units in a single grade during one school year. Others may sequence units *vertically*, teaching individual units in consecutive grades over two or three years. Still others may use only one or two units to meet specific goals and/or to integrate with other instructional materials. If you choose to use one unit independently from the other units in a sequence, the Teacher's Guide provides information about prerequisite concepts.

Strong Support for Teachers. The Teacher's Guide describes how to present the sequence and serves as a source of teacher professional development. The Introduction describes how to use the materials and provides scientific and pedagogical information. In the main body of the Teacher's Guide, the step-by-step lesson plan is on the left-hand page of each two-page spread. On the right-hand page of each two-page spread are Teacher Considerations, which provide teachers with insight and advice related to the lesson and to broader pedagogical issues, including:

Assessments: Quick Checks for Understanding, Critical Junctures, and Embedded Assessments offer ways to monitor students' progress toward key learning goals.
English Language Learners: optional accommodations increase English language learners' access to the activities.
Instructional Rationale: provides goals for specific activities and reasoning behind suggested procedures.
Instructional Routines: notes about repeated procedures and routines that will become familiar to teachers and students, and which facilitate ease of instruction.
Instructional Suggestions: alternative presentation options and tips on leading discussions and other activities.
Providing More Experience: optional activities to prepare students for an activity, reinforce key science ideas, or extend students' learning.
Science Notes: scientific information and common alternative conceptions.

Assessment System. GEMS Sequences use a multileveled, systematic approach to assessments. The assessment system is designed to gauge students' learning and inform teachers on how and when to adjust instruction to ensure students understand the content and gain needed skills. The assessment system includes the following types of assessments:

Quick Checks for Understanding: opportunities to briefly evaluate students' understanding and/or abilities. These are highlighted opportunities for assessment within the activities, focusing on science inquiry skills (such as using models and making evidence-based explanations) as well as on science content understandings.
Critical Junctures: points at which the teacher may assess a particular understanding or skill that is crucial to students' success in subsequent activities. At these junctures, there are suggestions (Providing More Experience notes) for students who may benefit from additional activities to improve their understanding.
Embedded Assessments: opportunities for teachers to assess students' written work based on a scoring guide. Typically, a unit in a sequence includes one central formative assessment that students take during the first session of the unit, revisit at key points during the unit, and take again at the end of the unit.

Summative Assessments: Some sequences include summative assessments intended to be used in a pretest/posttest fashion and to provide a measure of student learning over an entire unit.

Key Concepts and the Concept Wall. The ideas that are most important for students to understand were derived from the National Research Council *National Science Education Standards*, state/district frameworks, and experts in the science domain and in education. Each sequence emphasizes important ideas that research indicates are commonly misunderstood and are developmentally appropriate for the age range. In addition to developing science content knowledge, special attention is placed on student understanding of scientific habits of mind and the processes of scientific inquiry. These understandings and abilities are interwoven through activities, student readings, and assessments. As key concepts are introduced, they are explicitly shared with students in appropriate language and posted on classroom *concept walls.* As a unit or sequence builds, these key concepts form a framework—or concept map—for students' increased familiarity with and understanding of these essential ideas. The clear delineation of key concepts aligns with research that supports making learning goals explicit to students. The key concepts are highlighted on the first left-hand page of each session and are listed in the At-a-Glance Charts for each unit.

Engaging in Investigations. Students work collaboratively to engage in firsthand investigations. They do what scientists do—observe, ask questions, measure, record, discuss, compare, use models, analyze data, and gather evidence—which leads to deeper understanding. Through their classroom investigations, students develop inquiry skills and an understanding of the nature of science.

Meaning-Making Discussions and Writing. For deep learning of key concepts, students need opportunities to grapple with intriguing and challenging ideas. Students are then able to decide whether the available evidence supports those ideas. Understanding is often best achieved through reflection and thoughtful discussions during which students are exposed to new concepts and confronted with evidence that may make them reconsider their previous ideas. Students need much guidance and practice in developing the skills of evidence-based argumentation. Sequences include small-group, structured discussions designed to deepen learning and foster the language of scientific argumentation. There are also less-structured discussions; partner discussions; and large-group, teacher-moderated discussions. Writing assignments provide further opportunities to review concepts and practice evidence-based argumentation.

Student Readings. A few student readings in each unit extend and deepen student learning and directly reinforce science concepts addressed in the units. Each reading provides a real-life historical example of the ongoing story of scientific exploration or a specific explanation or description related to core science content. In many readings, emphasis is placed on how an investigation helped advance understanding by gathering evidence. Some readings are integrated into the sessions; other readings are optional. Most readings have core information on the first page and more details or complexity on the second page. This allows for natural scaffolding for students with varied reading abilities.

Vocabulary Development. Key vocabulary words for each unit—targeted for the development of conceptual understanding—are listed in the margin of each right-hand page of the Teacher's Guide. The vocabulary words are chosen carefully to support the key conceptual learning goals of each unit and are used strategically in the presentation of sessions and readings. They are also used as reminders for the teacher to incorporate this vocabulary into classroom discussion and teaching as often as possible. Vocabulary words highlighted in bold type are those that are used in that session. A glossary includes short, student-friendly definitions for teachers to use as necessary when clarifying definitions for students.

Technology Component. Images and short videos are included with each sequence. Some of the components are an integral part of the class sessions. Other components are optional and can be used as a supplement to the curriculum.

Student Investigation Notebook. Investigation Notebooks are available for students to record data and ideas; student readings are also included. If you purchase the Materials Kit, one printed Investigation Notebook is provided for each of the three units, and you can make the appropriate number of copies for your class. Alternatively, you can either purchase additional Investigation Notebooks through Carolina Biological Supply Company or download each unit's Investigation Notebook from the files that are included. Using an Investigation Notebook rather than distributing individual student sheets has several advantages: students are more motivated to do careful work; they refer back to their work more often; teacher preparation time is significantly reduced; paper management is simplified; and, student work is simpler to monitor and assess.