The following pages are select samples from

Issues and Science, Third Edition, Designed for the NGSS

This is a small excerpt from the *Teacher Resources* to be used for evaluation purposes. We encourage the use of all available sample materials in or out of a classroom to properly understand the seamless integration between equipment, student materials, and teacher resources. *Issues and Science* is not a traditional textbook and should not be evaluated as one.

SEPUP®

Issue-Oriented Science

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

ISSUE-ORIENTED APPROACH

Issue-oriented science helps students see how science and engineering are connected to their lives and communities. SEPUP engages and motivates students by using compelling issues related to scientific phenomena. In *Issues and Science*, students investigate a wide range of current and relevant questions, for example:

- How can families reduce their energy usage and costs?
- What is the best way to mitigate the environmental impact of the zebra mussel as an introduced species in the United States?
- How can we design a system to help drivers keep a safe distance behind other cars in different situations?
- What are the trade-offs of using different materials to make a water bottle?

Questions like these provide a focus for students' work and reflection in each SEPUP unit.

DEFINING ISSUES IN SEPUP

SEPUP curricula are based on an instructional model that integrates three-dimensional learning with a thematic approach to applying science and engineering in the context of *issues*—compelling personal, local, societal, and global topics or problems for students to debate, discuss, or explore in order to develop a decision or solution. The issues capture students' interest, focus their investigation into scientific concepts and processes, and enhance students' understanding. Students are then able to apply scientific principles and evidence to make informed decisions. The relevance of science and engineering practices and concepts becomes obvious, eliminating the question, "Why are we learning this?"

Within each SEPUP unit, students investigate a scientific phenomenon (an event, occurrence, or circumstance) and an issue related to the actions, if any, that might be taken in regard to that phenomenon. For example, global climate change is a scientific phenomenon that can be explained with scientific evidence. But when local or global communities develop and debate solutions to address this phenomenon, it becomes an issue. For example, students could apply their scientific understanding of global climate change to suggest a mitigation plan to reduce the impact of human activities at the community level.

This issue-oriented approach is supported by research and *A Framework for K–12 Science Education* (National Research Council, 2012). One of the four criteria for core ideas in the Framework is, "Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge" (p. 31). Appendix J of the NGSS elaborates on the important relationships among science, technology, society, and the environment and their role in standards that "will help today's children prepare for a world in which technological change, and the consequent impact on society and natural resources, will continue to accelerate" (NGSS Lead States, 2013, p. 443).

The activities and investigations in *Issues and Science* require students to apply scientific evidence to and analyze the trade-offs involved in personal and societal decisions or designed solutions to problems. It's important to note that SEPUP curriculum materials do not advocate specific positions on issues, and the units do not promote teachers' or students' acceptance of any position. Instead, the materials aim to provide opportunities for students to build the knowledge, skills, and understanding to help them make their own informed decisions.

When selecting an appropriate issue for each unit, SEPUP uses several criteria:

- The issue requires students to engage in three-dimensional learning.
- It requires students to cite scientific evidence in their explanations and to engage in argumentation to defend their proposed decisions or solutions.
- It is relevant and engaging to diverse groups of students.
- It is complex enough to foster discussion and debate about more than one possible decision or solution.

USING ISSUES TO DRIVE STUDENT LEARNING

In SEPUP, current and relevant issues and problems are the hooks that capture students' interest. Within the first few activities of each unit of *Issues and Science*, an issue that connects closely to the unit's conceptual storyline is introduced.

For example, in the *Geological Processes* unit, students are introduced to the issue of finding a suitable place for the long-term storage of nuclear waste. Students are asked, *What factors must be considered when deciding where to store nuclear waste?* Students then explore the related anchoring phenomenon: *The Earth's surface changes over time*. To make an informed decision about or suggest a solution to this issue, students engage in science and engineering practices as they learn more about changes to Earth's surface and the mechanisms for these changes (the

relevant disciplinary core ideas and crosscutting concepts). Ultimately, students use evidence and scientific reasoning to defend their recommendation for a site to store nuclear waste in the contiguous United States.

Issues give thematic continuity to the scientific investigations in every SEPUP course. If the issues are significant to students' lives, they are motivating and enjoyable additions to the science classroom. By drawing on students' lived experiences, interests, cultural backgrounds, and family and community connections, issues help to provide equitable access to science and engineering? concepts for a diverse student population and to support culturally responsive approaches to teaching. When meaningfully integrated into the curriculum, issues enhance students' understanding of the role of scientific principles and evidence in making informed personal and societal decisions.

During the course of a unit, students are asked to review their initial thinking about the issue and then reflect on how their understanding of the issue and the related science and engineering concepts has grown or changed. This type of deliberate engagement in revising their ideas, together with the engagement that comes from the framework of personal and societal issues, is more likely to result in students gaining understanding and developing their ability to engage in sensemaking when they encounter new concepts and problems.

EVIDENCE AND TRADE-OFFS: A KEY ELEMENT OF DECISION MAKING IN SEPUP

Throughout each SEPUP unit, students apply their understanding of science and engineering concepts to develop and evaluate solutions to the unit issue. Students are provided with support to use evidence and reasoning to analyze the trade-offs involved in the solutions under consideration. In a culminating activity, students construct oral and/or written arguments to defend their positions on the issue, including the use of trade-offs to evaluate competing solutions. This closely relates to the process of *scientific argumentation* as defined by the NGSS, but it is done in the context of a socioscientific issue, rather than argumentation about explanations for natural phenomena.

Students' ability to use evidence and weigh the trade-offs to make a decision related to the unit's issue is supported with the SEPUP Assessment System. The Evidence and Trade-Offs variable and Scoring Guide are uniquely focused on SEPUP's issue-oriented approach to science and engineering. Since students revisit the issue at various times throughout the unit, teachers can use the Scoring Guide to track students' progress in the use of evidence and trade-offs in their

decision making. Students should be able to identify and describe the relevant evidence, how it supports their decision, and the trade-offs of their decision against other possible courses of action.

The Evidence and Trade-Offs Scoring Guide is one of nine Scoring Guides that are part of the complete SEPUP Assessment System. For more on how students' growth over time is assessed in each unit, see **Assessment**.

REFERENCES

National Research Council. (2012). *A Framework for Science Education: Practices, Core Ideas, and Crosscutting Concepts*. Washington, DC: The National Academies Press.

NGSS Lead States. (2013). Appendix J: Science, Technology, Society, and the Environment. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press. Retrieved from https://www.nap.edu/read/18290/chapter/16