QUICK START TO *ISSUES AND SCIENCE*

SEPUP (Science Education for Public Understanding Program) is a science and engineering program of the Lawrence Hall of Science at the University of California, Berkeley. SEPUP's innovative instructional materials and approaches support the vision for science education outlined in the Next Generation Science Standards (NGSS) and *A Framework for Science Education*.

The Quick Start aims to orient teachers to the classroom materials and resources provided in SEPUP's *Issues and Science* units. For a complete program description and to learn more about SEPUP's research-based and field-tested instructional approach, please see the *Teacher Resources*.

SEPUP'S INSTRUCTIONAL MATERIALS

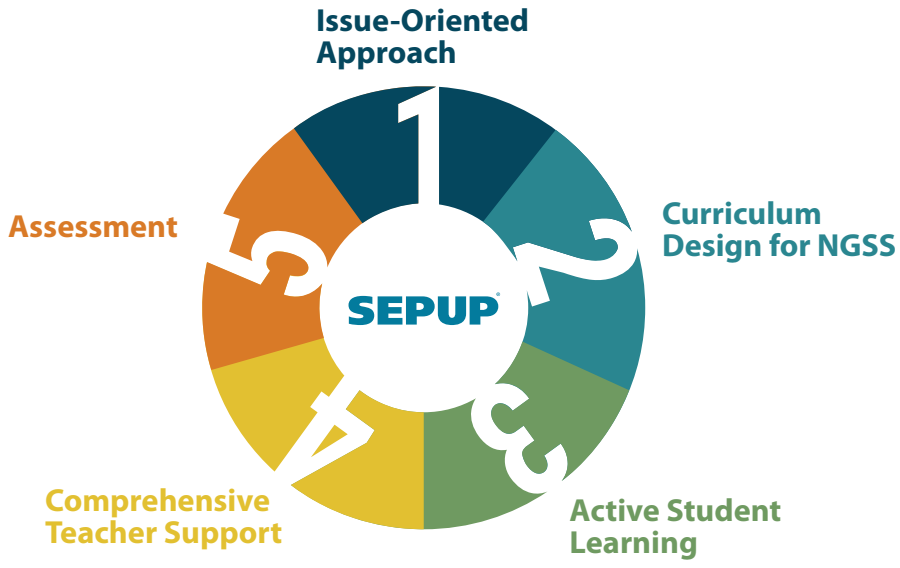
Issues and Science: Third Edition Redesigned for the NGSS includes interconnected instructional pieces for students and teachers. There are five essential items:

- Teacher Resources
- Teacher Edition
- Student Book
- Equipment kit
- Online resources

Each is described in more detail on the following pages. For those who are new to the SEPUP program, or who are not familiar with the Third Edition, "Planning for First-Time Users" can be found at the end of this guide.

TEACHER RESOURCES

The *Teacher Resources* **Issues and Science Program Overview** section provides an in-depth look at the five interrelated components of SEPUP's *Issues and Science* program:



Quick Checks

Icons in the margin of the Teaching Steps in the Teacher Edition guide users to the corresponding SEPUP component section in the *Teacher Resources*, where more detailed information can be found. The highlighted portion in the icon refers to the specific component, and the text below the icon refers to the relevant subtopic found in the Table of Contents for that component. For the example shown on the right, the icon directs users to more information about Quick Checks within the **5 - Assessment** tab of the *Teacher Resources*. Icons appear only when a new component, or a new subtopic of a component, is introduced in the Teacher Edition.

The *Teacher Resources* **Additional Resources** section includes a number of teaching supports such as the NGSS Overviews for all units, Scoring Guide Exemplar Responses (Levels 1-4), and Lab Safety. The last tab, "Additional Unit Support," includes items that may be helpful in planning each unit:

- Information and Resources for Parents
- Open House/Science Night
- Unit Enhancements
- Substitute Teacher Ideas
- Master Glossary
- References

For a comprehensive list of additional resources available, see the Table of Contents in each tabbed section of the *Teacher Resources*.

TEACHER EDITION

The Teacher Edition is designed to support teachers in fostering student learning over the entire unit. Some of the information provided pertains to day-to-day practical instructional management: how to prepare the classroom and set up the equipment, what materials are needed, sample student responses, and how to modify materials for diverse learners. Some information is more "big picture": explanations about how the disciplinary core ideas (DCIs) and science and engineering practices (SEPs) unfold over time, opportunities to connect crosscutting concepts (CCCs), and approaches to facilitate student sensemaking.

Teacher support in each activity is divided into several sections:

- The **activity title** identifies the type of activity (e.g., Investigation, Reading, Role Play) and the estimated number of 40- to 50-minute class sessions required to complete the activity.

- **NGSS Connections** describes the activity in the context of the NGSS, while **NGSS Correlations** lists the performance expectations, DCIs, SEPs, CCCs, and Common Core State Standards (CCSS) in English Language Arts (ELA) and Mathematics associated with the activity.
- **Investigative Phenomena and Sensemaking** identifies phenomena that students explore in the activity and the relation to the unit's core societal issue. It also describes the primary sensemaking opportunities in the activity, potential knowledge gaps that will be addressed, and how students' sensemaking will proceed as they move forward in the unit.
- **What Students Do** gives a straightforward description of what goes on in the activity from the students' perspective.
- **Materials and Advance Preparation** lists what materials are needed for the activity, how they should be distributed, and any pre-planning or organization that is required. Items marked with an asterisk are *not* supplied in the equipment kit (see more on this in the Equipment kit section of this Quick Start.)
- Detailed **Safety Notes** are provided for those activities in which they are needed. (These also appear in the Student Book.)
- A **Teaching Summary** provides an overview of the upcoming teaching steps in outline form.
- The **Teaching Steps** give specific suggestions on how to accomplish the goals of the activity. Every activity is broken down into three major steps: Get Started, Do the Activity, and Build Understanding. These steps correspond to the teacher's role in conducting the activity. Within each step, there are specific suggestions on how to run the activity, including possible discussion prompts, sample student responses, how to use an embedded instructional strategy, and/or how to assess students' work.
- If an activity includes an **Extension**, pertinent information is provided after the Teaching Steps.
- **Strategies for Teaching Diverse Learners** includes activity-specific suggestions for students with learning disabilities, English learners, and academically gifted students.
- **Sample Responses to Analysis** provides exemplar student responses. For summative assessment items that have a corresponding Scoring Guide, a Level 4 "Complete and correct" exemplar is shown.

- **Revisit the Guiding Question** provides information and suggestions on how to bring the class back to the original focus of the lesson—the guiding question.
- **Key Vocabulary** appears in the Activity Resources section that follows the Teaching Steps. The bolded words in this list are defined in the activity; non-bolded words in the list were previously defined.
- The **Background Information** (if applicable) is not intended for students; rather, it provides a conceptual framework and can help teachers better prepare for questions that may arise in class.
- Any data or studies cited in the activity are listed in **References**.
- **Student sheets**, if any, are included at the end of the activity along with **visual aids** and **sample student responses**.

Additional teacher supports are provided in the Teacher Edition to show different aspects of the unit progression as a whole. For example:

- **Driving Questions Board cards** and directions for implementation are located in a front pouch of the printed Teacher Edition. Online users can find these as a download on the Teacher Portal. Driving questions are a common instructional sensemaking approach used throughout *Issues and Science*. Cards listing the unit issue, the anchoring phenomenon, and the driving questions are provided for each unit. Opportunities to revisit the driving questions are mentioned throughout the Teaching Steps.
- The **NGSS Overview** shows how the NGSS three dimensions—DCIs, SEPs, and CCCs—and the CCSS for both ELA and Mathematics are integrated throughout the unit. The assessments for performance expectations are identified by activity.
- **Phenomena, Driving Questions, and SEPUP Storyline** identifies the scientific phenomena that students investigate and how they relate to the issue being addressed or the problem being solved across the unit.
- The **Unit Overview** describes what students do in each activity, what topics are covered, which activities include embedded literacy and sensemaking strategies and mathematics connections, what advance preparation and materials are needed, the locations and types of assessments, and the recommended number of teaching periods.
- **Materials Provided In Kit, Materials Not Provided In Kit**, and **Solutions Preparation** help teachers plan the materials management of the unit.

- The **Sensemaking and Literacy Strategies** and **Opportunities for Eliciting and Addressing Students' Ideas** tables summarize where each of these teaching strategies appear throughout the unit.
- The **Assessment Blueprint** indicates where assessments are embedded in the unit. Having an overview of all opportunities to measure student growth throughout the unit is a convenient planning tool for teachers.
- Additional assessment tools include the **SEPUP Scoring Guide**s used in the unit and an **Item Bank** and **Item Bank Answer Key** of questions for pre- and post-assessment of the unit content. The **Item Bank NGSS Correlations** table correlates the Item Bank items to the activities and the NGSS.

STUDENT BOOK

Each unit requires students to interact with specific DCIs, SEPs, and CCCs through various learning experiences. SEPUP uses a variety of activity approaches to support student learning. Activity types include:

- Computer Simulation
- Design
- Field Study
- Investigation
- Laboratory
- Modeling
- Problem Solving
- Project
- Reading
- Role Play
- Talking It Over
- View and Reflect

Regardless of the activity type, the Student Book has a deliberate structure that provides support for student learning, as shown on the following pages.

Following the last activity, a **Unit Summary** reviews the unit's essential ideas and scientific terms. It is followed by a list of Appendices and a Glossary.

A number of additional resources to support students' use of the SEPUP materials are included in the Appendices. Teachers may find it helpful to review these sections and subsections ahead of time to figure out which ones students should use throughout the unit:

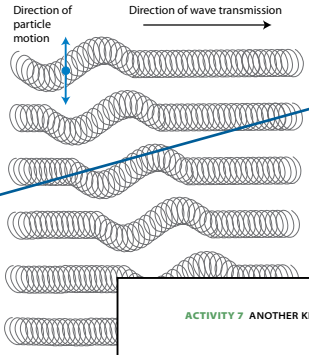
- Appendix A: Science and Engineering
- Appendix B: Science Safety
- Appendix C: Science Skills
- Appendix D: The International System of Units
- Appendix E: Literacy Strategies
- Appendix F: Media Literacy
- Appendix G: Crosscutting Concepts

7 Another Kind Of Wave

INVESTIGATION

Sound is one of many kinds of waves. Other common waves include those on the surface of water, light waves, radio waves, and seismic waves. Digital sound transmission, as described in the last activity, involves more than one kind of wave. For example, a sound wave could be transformed into a microwave for transmission. When it arrives at its destination, the digital information encoded on the microwave is reconstructed back into the sound wave.

All waves share some of the same characteristics, but they also differ in certain ways. A good example of this becomes apparent when comparing sound and light. As with all waves, sound and light both carry energy. Like sound, light is an integral part of our everyday life. However, there are important differences. One difference is that light travels over 800,000 times faster in air than does sound. Another difference is that light is not a longitudinal wave like sound but, instead, behaves as a transverse wave. A **transverse** wave consists of vibrations that are perpendicular to the direction that the energy travels. A transverse wave may travel through a medium, such as secondary waves (s-waves) in an earthquake, or without a medium, such as light through a vacuum. This means that a transverse wave does not have compressions and rarefactions like sound. In this activity, you will model the characteristics of transverse waves using a long metal spring.



Transverse wave

GUIDING QUESTION

What are the characteristics of a transverse wave?

Every activity begins with an **introduction** that sets the stage for the activity, often referring or relating to experiences in the previous activities. In some cases, this section formally defines a term that was previously introduced as a concept.

A **guiding question** helps students focus on the purpose of the activity.

MATERIALS

For each group of four students
- 1 long metal spring

For each student
- 1 pair of safety goggles
- 1 sheet of graph paper

The **Materials** list shows what materials are to be distributed to groups of four, to pairs, or to individual students.

SAFETY

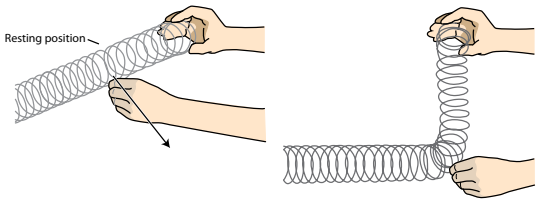
Handle the springs with care and never let go suddenly when the spring is under tension. If released when tension is being applied, the spring can move rapidly and unpredictably and could scratch someone. Wear safety goggles to protect your eyes from such an event.

If appropriate, **Safety** information is included for students to review before they begin the activity.

PROCEDURE

Part A: Wave Pulses

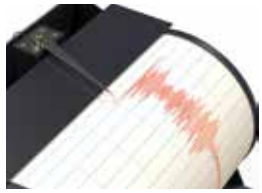
1. Put the spring on the floor or a long table, holding the ends about 2 m apart.
2. Near one end of the spring, pull a coil away from its resting position toward one side of the spring, as shown below. When everyone is ready, release the coil to make a wave pulse.



3. All group members should observe the pulse as it travels down the spring.
4. Record the group's observations in your science notebook.
5. Create additional pulses by pulling and releasing more coils. Each time, observe and record what happens as the pulse travels down the spring.

The **Procedure** provides step-by-step directions, often supplemented by illustrations, that will support the majority of students in performing activities with minimal assistance from the teacher.

and create maps showing regions at risk of earthquakes. All of these examples illustrate ways in which people have invented devices that use wave energy to measure things we would not ordinarily see or hear.



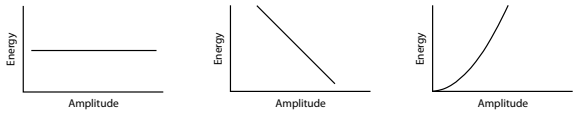
Seismograph

STOP TO THINK 5

What is another example of a device that uses sound waves?

ANALYSIS

1. If you started the motor of a boat in the middle of a lake, who would detect the sound of the motor first: a friend sitting on the shore of the lake or a friend snorkeling just below the surface of the water at the same distance from the boat? Explain your answer.
2. Lightning and thunder occur at the same time, yet we see the flash of lightning before we hear the clap of thunder. What does this indicate about the speed of light compared with the speed of sound?
3. Whales communicate with other whales by making low-frequency sounds. They navigate by making high-frequency sounds that echo back to them. Military sonar systems on ships produce sounds as loud as 200 dB, and these sounds travel great distances across oceans. Describe how such systems might affect whales.
4. Look at the following graphs that show the relationship between the amplitude and energy for a wave. Which one was supported by the patterns you observed in the reading?



Graph A *Graph B* *Graph C*

Analysis items probe students' understanding of the concepts and ideas of an activity as they relate to the phenomena and issues of the unit. Depending on the class, Analysis items may be best answered by an individual student, a pair of students, a group of four students, or the full class. Analysis items are used as both formative and summative assessments of students' learning.

5. If you want to increase the amount of energy a wave transfers over time, will it be most effective to double the frequency or double the amplitude? Explain using the graphs in the Reading and provide an example.
6. A student stands 100 m in front of a large smooth wall and claps loudly. Another student figures out the time for the sound to travel to the wall and back. If the sound takes 0.58 s for the sound to leave and return, what is the speed of the sound?

EXTENSION

Find through research an example of a technology not found in the Reading that uses sound to extend the way we measure, explore, model, and compute during scientific investigation. Explain how the technology uses sound.

Some activities include an **Extension** that is related to the Procedure and/or provides an opportunity for additional analysis. Extensions appear before or after Analysis items.

EQUIPMENT KIT

The SEPUP program includes hands-on, interactive activities for students to safely engage in science practices as they investigate phenomena in cooperative learning groups. The equipment kit provides the materials and specialty items students need for the experiences that are central to this instruction. Some of the equipment is specially designed and developed in collaboration with Lab-Aids, Inc. Refills for kit items may be ordered directly from Lab-Aids (by phone at 800/381-8003 or online at **www.lab-aids.com/refills**).

The equipment kit is designed for a typical setting of 32 students (eight groups of 4) per class. Enough materials for at least five classes are provided for each unit.

The equipment kit does not usually require a full laboratory setting. Although it is convenient for some units to have an available source of running water and a sink, it is not assumed that students have access to running water.

Although the equipment kit includes the majority of the supplies needed for each activity, some materials are not included because they are common to most classrooms, they can be easily obtained locally, or they are too perishable to be packed with the kit. In the Student Book, all materials needed in an activity—those included in the kit and those not included—are listed without distinction. However, the Teacher Edition for each activity identifies those that are and are not provided in the kit.

ONLINE RESOURCES

Online resources for *Issues and Science* are available for both teachers and students. Information related to the unit content can generally be found on the SEPUP website (**www.sepuplhs.org**), for example:

- Additional resources, Extensions, simulations, and embedded videos for activities
- NGSS Learning Pathways for all 17 *Issues and Science* units
- Activity corrections

Information related to overall portal implementation and the physical materials can found on the Lab-Aids website (**www.lab-aids.com/portal-faq**). The student portal provides the following resources:

- Online access to the Student Book (with notetaking and highlighting features)
- Downloadable PDF version of the Student Book for read-aloud capabilities with Adobe Reader or possible read-aloud features through the student portal
- Access to all student sheets

- Spanish translations of Student Books and student sheets
- "LABsent" videos and files that allow students who miss class to see the experiment, record the data, and complete the activity
- Embedded links to external resources like extensions, videos, and simulations

The extensive teacher portal includes the student resources plus the following resources:

- Access to the complete *Teacher Resources*
- Access to the Teacher Edition, including all student sheets and visual aids
- Spanish translations of visual aids, sample student sheet responses, item banks, and Scoring Guides
- Homework assignments and assessments, with scoring and feedback capabilities
- PowerPoint slides for classroom instruction
- Download packages that includes all student sheets, visual aids, and PowerPoint slides
- Professional development videos
- Additional embedded links just for the teacher such as the NGSS Learning Pathways

FURTHER SUPPORT

Many resources are available to support both new and master SEPUP teachers. As teachers become more comfortable with the third edition of *Issues and Science*, our hope is that they will use more of the program resources and materials to further enrich their classrooms. Please reach out to the Lab-Aids team (by phone at 800/381-8003 or online at **www.lab-aids.com**) with any feedback, questions, or requests for support.

PLANNING FOR FIRST TIME USERS can be found on the following page.

PLANNING FOR FIRST-TIME USERS

For those who are new to the SEPUP program or who are not familiar with the many design features of the third edition of *Issues and Science*, the following steps can help you begin:

1. Gather the *Teacher Resources*, Teacher Edition, Student Book, and equipment kit, and locate the online resources.
2. If this is the first SEPUP unit you are teaching, read the **1 – Issue Oriented Approach** tabbed section in the *Teacher Resources*. For tips or ideas on how to make unit issues even more meaningful in the classroom, refer to the "Unit Issue Tips" page under the **Additional Unit Support** tab in the *Teacher Resources*.
3. Review the content and progression of the unit by reading through the following:
   - The Unit Overview and the NGSS Overview (in the Teacher Edition)
   - The NGSS Pathways for the unit (**www.sepuplhs.org/pathways.html**)
   - The Phenomena, Driving Questions, and SEPUP Storyline (in the Teacher Edition)
   - The Student Book Introductions, Procedures and Analysis items
4. Open the equipment kit, and become familiar with the materials by reviewing the following:
   - Materials Provided In Kit and Materials Not Provided In Kit (in the Teacher Edition)
   - Materials and Advance Preparation (in each activity in the Teacher Edition and on the Unit Overview)
   - Driving Questions Board cards and instructions (in the front pouch of the printed Teacher Edition or downloaded from the Teacher Portal "Tools and Resources" page)
5. Plan how you will assess students' work by getting familiar with the following:
   - The SEPUP Assessment System (under **5 – Assessment** in the *Teacher Resources*)
   - The Assessment Blueprint (in the Teacher Edition)
   - Item Bank questions for pre- and post-assessment (in the Teacher Edition)
   - Read over the "Tips from the Field" page (under **5 – Assessment** in the *Teacher Resources*)
6. Establish your classroom organization, routines, and management plans. If you're looking for tips or ideas, refer to the "Classroom Management Tips" page under the **Additional Unit Support** tab in the *Teacher Resources*.