Science Education for Public Understanding Program (SEPUP)

- Based at the Lawrence Hall of Science, University of California, Berkeley
- Funded by the National Science Foundation (NSF) since 1988
- Published and distributed by LAB-AIDS, Inc.
Science Literacy for All Students...

- SEPUP is a complete program that helps students develop deep understanding of important scientific concepts.
- SEPUP is based on:
  - Decades of research on how students learn and best practices in science teaching
  - Extensive field testing in diverse urban, suburban, and rural classrooms
The SEPUP Approach to Teaching and Learning

- Science content through the context of real-world issues
- Embedded literacy strategies
- A consistent approach to individual and cooperative learning, 4-2-1 Approach
The SEPUP Approach to Teaching and Learning

- Inquiry-based instructional strategies
- An assessment system integrated into the curriculum for both summative and formative evaluation
- Spiraling of key concepts and skills
- Science concepts are developed through a variety of activities, not just based on text, to meet the needs of diverse learners
Inquiry Through Issues

- How do you decide what type (s) of medication, if any, to take when you are ill?
- How might you accidentally introduce a new species into a local ecosystem?
- What can you do to reduce the risk of catching an infectious disease?
Inquiry Through Issues

- Are manufactured diamonds as valuable as mined diamonds?
- What can you do to reduce the risk of catching an infectious disease?
- How can a motor vehicle be made safer?
Inquiry in SEPUP

• Deepens understanding of science content while teaching process skills
• Varies from guided inquiries to more open-ended investigations
• Engages students in the five essential components of inquiry defined in the National Science Education Standards (NSES)
SEPUP Learning Cycle

1. **Collect Scientific Evidence**
   - Gather scientific evidence through inquiry activities and readings.

2. **Challenge**
   - Focus on a specific question. What do we need to know?

3. **Analyze the Evidence**
   - Interpret and/or evaluate the nature of scientific evidence.

4. **Use Evidence**
   - Apply the evidence to address the original issue or problem.

5. **Build Knowledge and Make Connections**
   - Build conceptual understanding of important scientific ideas. Connect new learning to previous ideas.

6. **Motivate**
   - Create a context with an issue or problem.
Issues and Physical Science

- Studying Materials Scientifically
- The Chemistry of Materials
- Water
- Energy
- Force and Motion
Activity 15 - Families of Elements

1. Compare physical and chemical properties of 13 elements and sort them into groups based on common properties.

2. Compare your classifications with groups – or families – of elements as defined by scientists and displayed in the Periodic Table of Elements.

Synthesizing concepts & vocabulary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>Atom</td>
<td>Atomic Mass</td>
</tr>
<tr>
<td>Element</td>
<td>Family (of elements)</td>
</tr>
<tr>
<td>Metal</td>
<td>Periodic Table of the Elements</td>
</tr>
</tbody>
</table>
Families of Elements

**CHALLENGE:** How can elements be grouped based on their physical and chemical properties?

**ASSESSMENT** – Understanding Concepts (UC)

Analysis #5
The element strontium (Sr) is below calcium (Ca) in Column 2 on the periodic table. Design an Element Card that shows the properties you predict for strontium.
Information on Element Card

Element symbol: \( \text{H} \)
Element name: Hydrogen

Physical characteristics:
- non-metal
- gas
- colorless

Chemical characteristics:
- Atomic mass: 1
- Reactivity: high
- Number of bonds to hydrogen: 1
### Periodic Table of the Elements

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
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**Shading Key**
- A. Solid at room temperature
- A. Liquid at room temperature
- A. Gas at room temperature
**Scoring Guide: Understanding Concepts (UC)**

**What to Look For**
Response identifies and describes scientific concepts relevant to a particular problem or issue.

| Level 4 | Above and beyond | Student accomplishes Level 3 AND goes beyond in significant way, such as:
|         |                  | · using relevant information not provided in class to elaborate on your response.
|         |                  | · using a diagram to clarify scientific concepts.
|         |                  | · relating your response to other science concepts.
| Level 3 | Complete and correct | Student accurately and completely explains or uses relevant scientific concepts.
| Level 2 | Almost there | Student explains or uses scientific concepts BUT has some omissions or errors.
| Level 1 | On your way | Student incorrectly explains or uses scientific concepts.
| Level 0 |                   | Student's response is missing, illegible, or irrelevant.
| X |                   | Student had no opportunity to respond. |
The SEPUP Assessment System

- Developed in collaboration with assessment researchers at the University of California, Berkeley
- Assesses a range of learning outcomes, including:
  - Content knowledge
  - Conceptual understanding
  - Inquiry skills
  - Application of scientific information
Assessment in SEPUP
The SEPUP Assessment System has been cited in numerous journal articles and publications, as an exemplary approach to assessing student learning.

*Knowing what Students Know

*Classroom Assessment and the National Science Education Standards (National Research Council, 2001)*
Assessment in SEPUP

COMPONENTS OF THE SEPUP ASSESSMENT SYSTEM

VARIABLES (skills to be assessed)
- Designing Investigations (DI)
- Organizing Data (OD)
- Analyzing Data (AD)
- Understanding Concepts (UC)
- Recognizing Evidence (RE)
- Evidence and Trade-Offs (ET)
- Communication Skills (CS)
- Organizing Scientific Ideas (SI)
- Group Interaction (GI)

SCORING GUIDES (rubrics)
- describing
- 4 competency levels
- for each variable

ASSESSMENT QUESTIONS
- for each variable

ASSISTANCE FOR TEACHERS

BLUEPRINTS/OVERVIEWS
- showing where assessment tasks are found throughout course or module

EXEMPLARS
- of student work for each competency level in the Scoring Guide

MODERATION
- collaboration with other teachers for setting criteria in scoring

ITEM BANKS
- for tests and quizzes

QUICK CHECKS
- for informal assessment
Embedded literacy strategies scaffold students’ reading, writing, group discussions, vocabulary acquisition, and synthesis of concepts within the context of science.
<table>
<thead>
<tr>
<th>Literacy Category</th>
<th>Literacy Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supporting Reading Comprehension</td>
<td>Anticipation Guide, Directed Activities Related to Text (DART), Listen, Stop, Write, Reading Scientific Procedures, Three-Level Reading Guide</td>
</tr>
<tr>
<td>Enhancing Student Writing</td>
<td>Keeping a Science Notebook, Writing a Formal Investigation Report, Writing Frame Writing Review, Research Project, Assessment: Communicating Scientific Information</td>
</tr>
<tr>
<td>Synthesizing Concepts and Vocabulary</td>
<td>Categorization Activity, Concept Map, KWL, Talking Drawing, Venn Diagrams</td>
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Diverse Learners

- The SEPUP materials encourage and support differentiated instruction so that all learners have opportunities to succeed.
# Strategies for Diverse Learners

<table>
<thead>
<tr>
<th>Strategy</th>
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<tbody>
<tr>
<td><strong>Students with Learning Disabilities</strong></td>
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<tr>
<td>· Hands-on activities provide concrete experiences.</td>
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<tr>
<td>· Optional student sheets provide step-by-step procedures for open-inquiry labs.</td>
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<tr>
<td>· Literacy strategies support improvement of reading comprehension and writing skills.</td>
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<tr>
<td>· Discussion strategies facilitate communication.</td>
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<tr>
<td>· Scoring guides state clear assessment goals.</td>
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<tr>
<td><strong>English-language Learners</strong></td>
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<tr>
<td>· Vocabulary is introduced with operational definitions that connect concepts to learning experiences.</td>
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<tr>
<td>· 4-2-1 cooperative groupings encourage student interactions in an unthreatening environment.</td>
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<tr>
<td>· Discussion strategies enhance speaking and listening skills.</td>
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<tr>
<td>· Literacy strategies strengthen reading and writing skills.</td>
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<tr>
<td><strong>Academically Gifted Students</strong></td>
<td></td>
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<tr>
<td>· Issues stimulate evaluation of problems in real-world contexts.</td>
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<tr>
<td>· Lab activities encourage students to design complex investigations.</td>
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<tr>
<td>· Scoring guides challenge students to demonstrate their depth of understanding.</td>
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<tr>
<td>· Extension activities encourage in-depth inquiry into related topics.</td>
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