Focus on the Classroom Learning Environment

SEPUP News

Fall 2004

Lawrence Hall of Science

University of California at Berkeley

Classroom Learning Environments in SEPUP

Imagine a classroom in which students' investigations of science lead to discussion and debate about the impact of science on their lives and their communities. Students work individually and in groups to observe scientific phenomena and relate them to larger concepts. The teacher facilitates learning through ongoing interactions that respect students' interests and ideas and encourage them to take the next step in learning.

This is the classroom learning environment SEPUP strives to support through issue-oriented science. In this environment, the connections of science to students' lives and other school subjects are established through discussion of real-world issues.

In *How People Learn: Brain, Mind, Experience, and School* (see complete reference on p. 2), the authors suggest four perspectives to keep in mind when you design a learning environment. You may find it helpful to consider them and how they relate to each other as you plan for your own classroom environment.

Learner-centered environments: The teacher seeks information about what students know and uses this information to build on their existing knowledge in order to foster a learner-centered environment. Classroom activities are planned to elicit students' ideas and interests and incorporate them into instruction.

Knowledge-centered environments: A focus on concepts and inquiry skills important to science helps foster a scientific environment focused on ideas and evidence for the ideas. In this kind of environment students can gain knowledge and understanding of science and the role of scientists in formulating and testing ideas.

Assessment-centered environments: In assessment-centered science classrooms, teachers use formative assessments to inform instruction and to provide students with opportunities for feedback and revision. Summative assessments to determine what students have learned after instruction should be consistent with the classroom learning goals.

Community-centered environments: The classroom itself can be a stimulating learning community when teachers create a safe place for students to express ideas and listen and learn from each other. In addition, the classroom can be connected to the larger community through exploration of community issues and connections to the family and outside experts.

We have found these perspectives helpful in our work at SEPUP and you will see them reflected in some of the articles in this edition of the *SEPUP News*. We hope they will be helpful to you as you make decisions about your own classroom environment.

Using SEPUP in My Classroom

By Andy Coblentz, 6th grade teacher, M.H. Tobias Elementary School, Daly City, California

As a 6th grade elementary school teacher originally trained as a scientist, I have sought to foster a learning environment that integrates science with language arts.

After only a month of field testing *Issues and Earth Science* (IAES), SEPUP's course for 6th grade, I have seen that science inquiry and language arts skills go hand in hand.

Andy Coblentz's students work on mapping soils during the field test of SEPUP's earth science course for 6th grade.

At the beginning of each activity, I ask my students to read the introduction and the challenge. Then they write the title and purpose, prompting them to anticipate what they will be doing next.

I write key vocabulary words on the board and on index cards which are placed in a pocket chart. I encourage students to use these words in their discussions and written responses. They must also use this vocabulary to accurately describe their observations and conclusions.

All too often students use non-scientific terms instead of the appropriate vocabulary, but reminding them of the key words on the board or in the pocket chart has helped. I believe students are more successful in their use of appropriate vocabulary because SEPUP introduces terms only on an as-needed basis within a relevant context.

Continued on page 7

Director's Corner: New Projects for SEPUP

This fall, SEPUP begins work on two exciting new projects for the high school, as part of an overall plan to expand our work at that level.

The first project, *Science in Global Issues*, **is funded by the National Science Foundation. It involves the revision of our current year-long high school science course,** *Science and Sustainability*, **and preparation of an additional year of instructional materials, resulting in a complete two-year integrated high school sequence. The new materials will be available as either two full-year programs or as eight individual megamodules. Each megamodule will provide approximately 10 weeks of instructional material that will be appropriate for either integrated or subject-oriented science courses. The new materials will reflect SEPUP's approach to issue-oriented science, with an emphasis on the role of science in addressing the needs of modern society. In addition, the new materials will include a greater focus on the use of technology in advancing scientific knowledge.**

In the second project, *HyTEC*, **which is funded by the U.S.Department of Energy, SEPUP is leading an exciting partnership of energy researchers, transportation experts, and educators to develop modular materials on hydrogen and fuel cell technology in the context of energy use and resources. Our partners include the Schatz Energy Research Center at Humboldt State University, our local Alameda-Contra Costa Transit District, the Chabot Space and Science Center in Oakland, the National Hydrogen Association, and school districts in the San Francisco Bay Area and throughout the nation. The partnership will develop materials that focus on the research and development needed to create technological solutions for problems such as safe, environmentally responsible transportation. The materials will support National Science Education Standards in Physical Science, Science and Technology, and Science in Personal and Societal Perspectives.**

The staff is excited by the opportunities afforded by these projects. *Science in Global Issues* **will result in the completion of a SEPUP Grade 6–10 sequence, while** *HyTEC* **will produce SEPUP modular materials specifically tailored for the high school. As a former high school science teacher, I'm looking forward to working again with high school teachers and students and contributing to materials that facilitate students' transition from middle to high school science.**

Dr. Barbara Nagle, Director

Selected Bibliography on Classroom Learning Environments and SEPUP

Bransford , J.D., Brown, A.L. & Cocking, R. (Eds.), (1999). *How people learn : Brain, mind, experience, and school*. **Washington, D.C.: National Academy Press.**

DiRanna, K., & Siegel, M.A. (2004). *Facilitating Learning: The Role of the Teacher*: **Elementary Science Teacher Leadership (ESTL) 2. Berkeley, CA: SEPUP, Lawrence Hall of Science, University of California, Berkeley. Available free of charge at** *www.sepuplhs.org/profdev/educators/estlguides.html*.

Fetters, M. K., Czerniak, C. M., Fish, L., & Shawberry, J. (2002). Confronting, challenging, and changing teachers' beliefs: Implications from a local systemic change professional development program. *Journal of Science Teacher Education*, **12(2), 101–130.**

National Research Council. *Inquiry and the National Science Education Standards: A Guide for Teaching and Learning*. **(2000) Washington, D.C.: National Academy Press.**

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SEPUP Materials

SEPUP instructional materials include student books or pages, teacher's guides, and kits. The following are currently available:

Science and Sustainability: high school

Issues, Evidence and You: middle school (available both as year-long course and megamodules)

Science and Life Issues: middle school (available both as year-long course and megamodules)

12 SEPUP Modules: secondary school (kit includes CD-ROM and transparencies)

CHEM-2: Grades 4–6 (Spanish student pages also available)

In field test, commercially available late 2005:
Issues and Earth Science: middle school

All SEPUP materials are produced and distributed solely by Lab-Aids®, Inc. (800) 381-8003
www.sepup.com

SEPUP Issues in the News: Using Current Events to Foster Successful Learning Environments

Research has shown that classroom learning environments play an important role in determining student success. Current issues, especially those that involve recent scientific discoveries that can affect local and global communities, are ideal for promoting knowledge-centered classroom environments in which knowledge is connected to personal and societal issues. The issues, and the scientific knowledge associated with them, can help motivate students, provide evidence to dispel common misconceptions, provide survey topics to involve parents and community members, increase content knowledge, and provide opportunities for students to apply their current understandings to new situations, including assessment tasks. Several examples are provided below.

Carpets: America's New Energy Source?

Each year, 25 million tons of old carpets are put into landfills and account for 2% of all landfill waste. Shaw Industries, a carpet manufacturer based in Dalton, Georgia, in cooperation with Siemens Building Technologies, has developed a "carpet-to-energy" process. They are building a plant, to begin operating in late 2005, that will convert 16,000 tons of carpet waste into a gas that will fuel a boiler, producing steam. Shaw Industries will then use the steam to run its carpet manufacturing plant, and thus contribute to reducing the amount of carpets in landfills.

SEPUP Knowledge Connection: Integrated waste management includes options such as re-use and source reduction. Students using the "Materials" unit of **Issues, Evidence and You** or the module **Waste Disposal: Computers and the Environment** consider these options in the context of plastics and metals. This news story provides a unique opportunity to discuss another strategy—waste-to-energy—and its application to other products.

Genetically-Modified Genes Travel Far

A 2004 study completed by the U.S. Environmental Protection Agency finds that genetically-modified (GM) genes can be found in plants up to 21 kilometers (km) away from fields growing the GM plants. The researchers monitored a large field growing creeping bentgrass that had been genetically modified to be resistant to a specific herbicide. This plant grows wild through much of the United States. The researchers placed more than 100 unmodified plants at various distances from the test field. After the pollination season ended, they found many genetically-modified genes in seeds within a 2-km radius, some in wild seeds up to 14 km from the test field, and some downwind 21 km away.

SEPUP Knowledge Connection: The "Feeding the World" unit of **Science and Sustainability** looks at the science behind genetically-modified foods. This study provides new evidence for discussions of the contamination of wild plants by modified genes and other trade-offs of genetic modification.

Aggressive Music Can Lead to Accidents

At the Intel International Science and Engineering Fair in May 2004, Rebecca Wilder, a high school senior from Mentor, Ohio, shared her results on driving and music. She used a driving simulation video game to collect data from 50 teenage volunteers to see if the kind of music they listened to while driving affected their chances of causing a car crash. Her results suggested that aggressive music might be the most dangerous. Players "crashed" an average of 10.7 times in 3 minutes while listening to aggressive music. They averaged 6.1 crashes during a sad country song, and 8.4 crashes when there was no music at all.

SEPUP Knowledge Connection: Many young people make choices based on little knowledge of actual risk. In the **Decision-Making: Probability and Risk Assessment** module, students investigate and compare risks. These students can discuss whether a test based on a small sample could convince them to change their behavior.

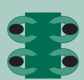
Household Chemicals Affect Algae

During the past few years, many anti-bacterial products have become available—soaps, toothpaste, household cleaners. However, new research suggests that the chemicals we use to clean and disinfect our bodies and homes are causing damage to the algae at the bottom of the aquatic food chain. Environmental scientists at the University of Kansas collected algae from a local stream. They then treated the algae with three common household chemicals in concentrations similar to those often found in streams. The number of species and overall growth of algae dropped in these samples. The researchers also found that even small amounts of chemicals could have a significant effect on the algae population.

SEPUP Knowledge Connection: The "Micro-life" unit of **Science and Life Issues** investigates the role of antibiotics, vaccines, and hand-washing in preventing disease. Current science raises questions about the environmental impact of personal and household hygiene products.

SEPUP's 4-2-1 Cooperative Learning System

Current educational research suggests teachers should be aware of different aspects of their classroom environments. For example, students in the "community-centered classroom" are encouraged to learn from each other, articulating their own ideas, acknowledging mistakes, and joining together to solve problems. Group work is a powerful method of providing these opportunities, and SEPUP's 4-2-1 system fosters group work while ensuring individual accountability.

	4	A group of four students shares materials, including dropper bottles and some specialty items. Groups of four students also often work together in activities such as discussion of open-ended questions, research, and presentation of projects.
	2	Each pair performs the procedure. In many cases, pairs share and discuss data and observations within the group of four; on occasion, students continue to work in pairs to respond to specified questions.
	1	Each student is expected to have access to a copy of the Student Book and to keep an individual science notebook of classroom experiences, such as data, observations, and written responses to selected questions.

Check out the video clip of 4-2-1 in action at sepuplhs.org/teachers/modules/4-2-1.html

The 4-2-1 dynamic models scientific peer review: before "publication" to the teacher, students have a chance to teach and learn from each other. Confirmations can be made, mistakes may be found, or students may discover that neither group is sure of its results.

Classroom experience and educational research confirm the benefits of group work: peer to peer discussions in which even the quietest student participates; revelation of misconceptions by students who might not otherwise speak up in class; hands-on activities that fully engage all students.

The role of the teacher as a facilitator is critical, particularly when groups ask for help. Instead of telling the students what to do, teachers need to remember to ask the students guiding questions: "What did you do on the last step?" "Do you have a suggestion for what to do next?" "What does the book say?" Studies recommend looking for questions that direct the students back to their materials and to each other. Every question is also an opportunity for assessment—your chance to determine what your students know and to observe how well they work together.

Clearly group work, like all good teaching, must be planned to maximize the beneficial aspects and minimize the pitfalls.

> Good group lessons are hard work for the teacher: I always knew I had a good day when my feet ached at the end of the day. But the rewards were worth it: I knew I had made it around to all students, assisted their collaboration, had a good sense of what the class learned and missed, and that the students had enjoyed and learned from the activity.
>
> Lee Amosslee, former high school teacher and new SEPUP developer

Make It Stop Growing!

CHALLENGE

What chemical(s) can be used to inhibit the growth of microorganisms, such as yeast?

Safety Note: Follow all classroom safety rules. Wash your hands when you finish the investigation.

PROCEDURE

1. With your group, design an experiment to test the ability of chemicals to inhibit the growth of yeast. When designing your experiment, think about the purpose of your experiment, the one variable that you will investigate, and the type of data you will collect.

   Hint: Before you can inhibit the growth of yeast, the yeast must first have everything it needs to grow. Think about what yeast needs to grow as you design your experiment.

2. Obtain your teacher's approval of your planned experiment.
3. Record your hypothesis and your planned experimental procedure in your science notebook.
4. Make a data table that has space for all the data you need to record. You will fill it in during your experiment.
5. Work with your partner to conduct your experiment and record your results.
6. While waiting to record additional observations, look at the tray of another group. Compare their experiment and results to your own. Record these observations in your science notebook.

ANALYSIS

Group

1. Based on your experimental results, did the chemical(s) you tested inhibit the growth of yeast?
2. a. According to the class results, which chemical(s) are effective at inhibiting the growth of yeast?

   b. According to the class results, which chemical(s) are *not* effective at inhibiting the growth of yeast?

Individual

3. What effect did the chemical(s) you tested have on the growth of yeast? Support your answer with evidence from your experiment.
4. Explain whether your results supported or disproved your initial predictions.
5. Which of the chemicals tested by the class would be the best food preservative? Support your answer with evidence from the investigation and identify the trade-offs of your decision.

SEPUP (2003) Investigating Food Safety. Ronkonkoma, NY: Lab-Aids, Inc.

Different Questions—Different Goals

What kinds of questions do you ask in an average class period? What kinds of questions do your students ask you and each other? By paying attention to the questions and the nature of their answers, you can reflect on whether your approach to questioning is consistent with the type of learning environment you hope to create in your classroom.

Straight-forward questions to check on students' knowledge of basic facts, vocabulary, and procedures are almost certainly part of your daily questioning. When you ask these questions, you are looking for specific responses.

But if you are a SEPUP teacher, chances are you are also asking more open-ended questions to learn what your students are thinking, to help them build conceptual understanding, and to help them relate what they have learned to new situations.

By asking these questions, allowing students adequate time to respond, and encouraging them to reflect and elaborate on each others' answers, you send important signals to your students. They will learn that science is more than memorization of facts, that you think their ideas are important, and that they can learn from each other.

Effective questioning results from a combination of advance planning and flexibility to respond to students' comments and answers. Most SEPUP activities include suggestions for questions that you can ask at different stages of an activity. Once their discussion begins, your skills at questioning and guiding discussion come into play.

In the opening section of most activities, questions are used to elicit students' ideas and to get them thinking about the specific topic of the lesson. This helps you create an environment that is both knowledge- and learner-centered. If you use the information to guide your instruction in the days ahead, the questions also contribute to formative assessment.

As the activity continues, the questions may relate specifically to the investigations students are conducting. They often focus on building students' knowledge, and may again help determine how you lead the discussion after the investigation.

Toward the end of the activity, you will find a variety of questions that facilitate students' progress in forming conclusions from their investigations and connecting their new ideas to previous knowledge. Questions that ask students to relate what they have learned to personal and societal issues or to make a decision about an issue are central to the design of the SEPUP learning environment.

Tips for Organizing Student Ideas

☞ Use chart paper in the classroom to keep track of changes in student thinking. Write down the ideas you brainstorm in an opening activity, so students realize they don't have all the answers. This creates a "need to know" for upcoming activities. As students collect evidence and weigh their ideas, they modify what is on the chart.

☞ Have students set up an appendix in the back of their science journals. Every time you come to a key skill that they will need to use during the year, they can put guidelines or samples in their appendix so they can find them easily. For example, they could include pages with sample graphs and tables, the format for a complete lab report, and the components of a "good experimental design."

Earth Science Field Test Moves Into Second Year

This past July, 30 teachers from 8 field test centers joined the SEPUP staff at the Lawrence Hall of Science in Berkeley for a week of preparation for their role in the second year field test of **Issues and Earth Science**, *SEPUP's new year-long course for 6th grade.* *(See the article on one teacher's experience on p. 1.)*

New Staff at SEPUP

Lee Amosslee,
Instructional Materials Developer

Lee has a B.S. in physical science and has taught high school science in urban schools in the San Francisco Bay Area for 10 years. He has taught technology to both students and teachers, and is a frequent contributor to several science educator e-mail lists. Lee helped pilot a unit from *Science and Sustainability* while he was a teacher at Berkeley High School.

Kate Haber,
Instructional Materials Developer

Kate has a B.A. in microbiology and immunology. She has taught high school chemistry and biology in both public and private schools in Berkeley, California since 1986. Before that she did viral research for the State Public Health Laboratory. She joins SEPUP this year after developing a customized laboratory biology program for Berkeley High School.

Managing a Learner-Centered Classroom

Science teachers need to create a rich environment to facilitate student learning. SEPUP materials kits can aid in the incorporation of inquiry into the curriculum and have the potential to foster some of the fundamental changes in teachers' and students' perspectives that is needed to establish environments that enhance student learning outcomes.

All SEPUP courses and modules include kits containing most materials and equipment necessary to perform the activities in 3–5 classrooms. By eliminating many of the mundane and time-consuming lab management tasks, the kits give the teacher time to focus on designing and implementing effective learning environments that meet the needs of diverse learners.

The small scale of the equipment lends itself to work in pairs and groups of four students at their desks and encourages cooperation and discussion of results.

SEPUP kits provide the flexibility to create a more varied landscape in the classroom. Investigations may be done by the class as a whole or in smaller groups working on different activities simultaneously. The classroom environment may be restructured into a wet-lab area, a reading corner, a review corner equipped with single set-ups of previous labs for students who were absent, small and large "board rooms" for group discussions, and an extensions center for the fast-working students.

Tips for Managing Materials

☞ Use permanent markers or nail polish to color code dropper bottles with their tops.

☞ Use wide colorless packaging tape to wrap around the labels of the dropper bottles to prevent them from getting wet and worn.

☞ If you first put together the materials for one group, assembling the class set is a snap, because you've already thought through what you need.

A Word from Lab-Aids

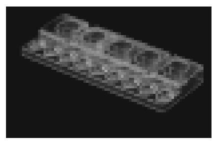
Belinda Fox, National Sales Manager and John Weatherby, Director of Sales and Marketing

SEPUP Signature Items

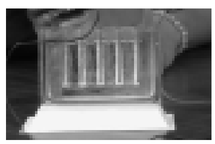
Lab-Aids is committed to providing durable, functional, and economical equipment to facilitate SEPUP's 4-2-1 instructional model. With this in mind, we have designed all SEPUP materials packages to aid the teacher with activity preparation and provide students the opportunity to explore science by doing.

Most chemicals are dispensed as dilute liquids from small bottles which makes them safe and also reduces lab waste, disposal concerns, and the need for large quantities of replacement chemicals. The labeled cart drawers make clean up fast and greatly reduce the time it takes to distribute, collect and store materials.

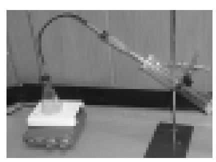
Lab-Aids has worked closely with SEPUP curriculum developers to design unique materials that best fit the needs of specific inquiry activities. Here are a few of these SEPUP signature items:



The SEPUP tray is used in many activities. Made of durable, chemical-resistant plastic resins, the tray takes the place of five small beakers and nine small test tubes. It rinses easily and dries quickly, and helps make any classroom a science classroom.



The wet cell apparatus for "Chemical Batteries" in the Issues, Evidence and You energy unit allows students to investigate how batteries work. They vary electrode composition and placement in an open-ended investigation, and can also explore solution composition and concentration.



The distillation tube, a plastic condenser apparatus that does not require running water, was designed for the purpose of distillation in Science and Sustainability.

For more information, visit us online at www.sepup.com, or call us at 800.381.8003.

SEPUP Classroom *continued from page 1*

Several activities in the unit titled "Studying Soil Scientifically" provide tables and other formats that students can use to graphically organize the information in the text they read. This use of graphic organizers has helped students construct concise written and oral responses to questions posed in the activities.

In addition to bolstering my students' vocabulary and writing skills, IAES has stimulated their thinking skills and engaged them in problem solving. As part of an investigation into the failure of plants to grow in a school garden, the class recently concluded a reading activity about plant nutrition and the advantages and disadvantages of chemical and natural fertilizers.

At the conclusion of the activity, several students insisted that we had to test the soil to determine whether it required fertilizer. They were so engaged in solving the "garden problem" that they had, unbeknownst to them, correctly predicted the subsequent activity—testing the soil for organic matter.

My experience teaching IAES so far has satisfied my goal of teaching language arts skills through science content. My challenges remain largely in making the curriculum more accessible to English learners and students with learning differences. I hope to achieve this objective as I proceed through the remainder of the IAES program this year.

I have found that having enough materials for students to conduct investigations in pairs does wonders toward empowering all students to take an active role throughout the experimental process.

Kate Haber, former high school teacher and new SEPUP developer

SEPUP News

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Fall 2004

Calendar

Selected SEPUP Workshops

October 14–16	California Science Teachers Association “Motivating with Mixtures,” Janet Bellantoni, SEPUP developer. Saturday, October 16, 8:00–9:00 a.m.	San Jose, CA

Look for other SEPUP workshops this fall at the following meetings and events:

October 12–13	New Jersey Science Teachers Association	Somerset, NJ
October 14–16	California Science Teachers Association	San Jose, CA
October 14–16	Florida Science Teachers Association	Orlando, FL
October 14–16	Alaska Math/Science Conference	Fairbanks, AK
October 21	Iowa Science Teachers Association	Des Moines, IO
October 23	Metropolitan Detroit Science Teachers Association	Southfield, MI
October 28–30	Alabama Science Teachers Association	Hoover, AL
November 3–5	South Carolina Science Council	Charleston, SC
November 4–5	Arkansas Conference on Teaching	Little Rock, AR
November 4–6	Conference for the Advancement of Science Teaching	Corpus Christi, TX
November 10–12	North Carolina Science Teachers Association	Greensboro, NC
November 18–19	Colorado Science Convention	Denver, CO
November 18–19	Kentucky Science Teachers Association	Lexington, KY
December 2–3	Pennsylvania Science Teachers Association	Hershey, PA