SUMMARY OF RESEARCH FINDINGS ON SEPUP

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Extensive research has shown that the SEPUP program has significant positive effects on student learning. SEPUP students are able to gain content knowledge and develop problem-solving, decision-making, and investigation skills. Additionally, SEPUP's approach to learning fosters student interest in science, which has resulted in higher enrollment in advanced science courses for some districts. SEPUP materials also positively impact teachers. They can be a powerful professional development tool because they provide extensive support for good teaching practices.

Over the last fifteen years, various researchers and organizations have conducted studies on SEPUP, using both qualitative and quantitative analysis. Here are a few examples of what others have to say about SEPUP:

- As part of a research project at the University of Arizona, Pogrow (1993) spent three years reviewing and ranking middle school materials, looking for those that were the most "creative, relevant, and rigorous." To be considered exemplary, materials had to: 1) relate science content to issues of concern to students; 2) support a reflective, Socratic approach; 3) develop thinking skills; and 4) present content in a rigorous fashion. In the end, Pogrow identified SEPUP materials as part of this exemplary group.

- In his book *Redesigning Education*, Ken Wilson (1994) calls SEPUP "…one of the best American examples of educational design" (p. 205). Wilson, a Nobel-prize winner in Physics and the former director of Project Discovery (a five-year federally funded project to restructure K-12 mathematics and science in Ohio) has written extensively on school reform, noting that "…the [SEPUP] program develops its [materials] through a small scale version of the redesign process, from tracking basic research in education and testing prototypes in real classrooms to integrating innovations and mentoring teachers…" (p.205).

- Officials from the National Science Foundation's Instructional Materials Development Program used more than 40 specific criteria to review NSF-funded middle level materials (Lewis, 1996). Examples of questions used include whether the materials "pushed teachers to teach differently" or "provide students the opportunity to make conjectures, gather evidence, and develop arguments to support, reject, and revise their explanations for natural phenomena" (Lewis, 1996). In the end, the examining committee recommended both SEPUP modular and full-year comprehensive programs as materials that "meet high content standards."

- SEPUP instructional materials utilize a research-based assessment system that was developed in cooperation with the University of California Graduate School of Education. In *Classroom Assessment and the National Science Education Standards* (National Research Council, 2001), the SEPUP assessment system is provided as a strong example of a system that can be used for both formative and summative assessment. Materials included in a SEPUP Teacher's Guide, such as a scoring guide (or rubric), are reproduced in the book for general use.

Students using the SEPUP curriculum show significant gains.

Research has found that, in classrooms using SEPUP, students showed significant improvements that reflected the goals and objectives of the SEPUP materials (Kelly, 1991). For example, students said

SEPUP materials were helpful in learning about environment, health, industry, the community, and science, all of which are general themes of SEPUP. After using SEPUP, students were more likely to say that people should not make decisions until all the evidence has been collected, that today's scientific knowledge will change in the future, and that people disagree in science because they have different personal beliefs. Among other things, these students also demonstrated increased content knowledge of topics relating to SEPUP, including solution chemistry, acid-base interactions, and risk comparison (Kelly, 1991, Koker 1992b). In fact, one study found significant gains in content knowledge for SEPUP students after only a few weeks of instruction, which is a relatively short amount of time in the educational world (Koker, Thier 1994).

Besides helping students learn science effectively, SEPUP can also encourage students to become more interested in pursuing advanced science courses. For example, in 1995, the Los Angeles Unified School District (LAUSD) started implementing a two-year high school sequence of Integrated/Coordinated Science (ICS) classes largely based on the SEPUP program. Besides significant gains in student performance, LAUSD schools reported higher numbers of students, and in particular underrepresented minority students, enrolling in advanced science courses (Scott, 2000). Additionally, ICS students showed significant gains on the SAT 9 (Stanford Achievement Test) science test (Scott, 2000).

How does SEPUP compare to non-SEPUP programs?

Several studies have compared SEPUP students to non-SEPUP students. One study that investigated SEPUP's *Issues, Evidence and You* curriculum found that while both SEPUP and non-SEPUP students showed educational gains after one year, only SEPUP students were found to make statistically significant improvements (Wilson et al, 1995). In another study, significant gains in content knowledge were found for SEPUP students after only a few weeks of instruction (Koker, Thier 1994). No such improvements were found with various other science programs after such limited instruction (Bredderman 1982,1983).

Besides greater gains in content knowledge, several studies suggest that SEPUP students also improve more than comparison non-SEPUP students in a variety of specific skills. For example, Koker (1996) examined students' decision-making skills and found differences in student responses that generally favored SEPUP students over non-SEPUP students. He also found that SEPUP students were more likely to approach problems with empirical methods (i.e. doing tests, gathering evidence, etc.) rather than non-empirical ones (i.e. using "conventional wisdom" or rhetoric). Additionally, Samson and Wilson (1996) found that compared to non-SEPUP students, SEPUP students not only performed higher in problem-solving situations that called for scientific evidence but also believed that science was more relevant to their lives. This suggests that SEPUP students are better than non-SEPUP students at applying and using scientific methods to solve problems. These SEPUP approaches can help students in future scientific as well as non-scientific contexts.

The SEPUP assessment system is central to improvements in student performance. This system provides credible evidence about student learning in key process areas such as the ability to design an experiment, interpret data, explain a scientific concept, or use scientific evidence to make a decision (Wilson & Sloane, 2000). Research has shown that gains for students using the assessment system were 3.46 times greater than those for non-SEPUP groups and a SEPUP group not using the SEPUP assessment system (Wilson & Sloane, 2000).

SEPUP has a positive effect on teachers, too.

Use of the SEPUP system impacts teachers in positive ways. For example, SEPUP use is strongly associated with an increase in the use of more positive teaching strategies and professional behaviors (Kelly 1991, Koker 1992a, 1992b). Such behaviors include cooperating with other teachers, working with

college science and science education faculty, participating in professional organizations, such as the National Science Teachers Association, and collaborating with outside groups related to industry, environmental, or community concerns. SEPUP instructional materials, assessment rubrics, and moderation activities are also powerful professional development tools. Several studies have found that they improve teachers' ability to assess learning as well as improve teaching practices such as clarifying learning goals and establishing fair standards (Roberts, Sloane, & Wilson, 1996; Roberts & Wilson, 1998).

Based on this type of evidence, some organizations have used the SEPUP materials as the basis for professional development workshops for teachers. In 2001, the University of North Carolina, Chapel Hill used activities adapted from SEPUP to create a professional development program. Environmental Resource Program Educator Michele Kloda, who developed and led the workshop, commented, "Our goal was to help teachers give students real-life, meaningful experiences to show them that there are things we can all do every day to help maintain a healthy environment. It is an opportunity to help teachers, and ultimately students, understand that the work taking place [in research labs] has a direct application to our lives."

SEPUP continues to research and evaluate its materials.

Current efforts to assess student learning are focused on *Science and Life Issues (SALI)*, an issue-oriented course for the middle school published in 2001. The course has been adopted in Arkansas, Kentucky, Louisiana, Oklahoma, South Carolina, and West Virginia. *SALI* includes an embedded assessment system adapted from the system of an earlier SEPUP course *Issues, Evidence and You*. However, there are additional items, including multiple choice and short answer problems correlated to the course and to the National Science Education (NSE) content standards for middle level life science. This will provide evidence about student content learning related to NSE standards in addition to the evidence of deeper understanding provided by the SEPUP assessment system. Results from the 2003–2004 school year are currently being scored and analyzed. In addition, several school districts, most notably Charleston, SC, are conducting their own studies on the effectiveness of SALI. They will be looking at students' progress on state exams and other tests such as the PASS test developed by WestEd.

For more information on SEPUP, visit the SEPUP website at www.sepuplhs.org

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