

Abstract Title: Encouraging Girls: The Societal Benefits of Physical Science

MSP Project Name: The Power of Physical Science (POPS)

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120 word summary:

The POPS team is investigating ways to encourage middle school girls to study physics and geology to address the problem of under representation of women in these disciplines. The POPS team has developed a pilot study for a hands-on enrichment curriculum focusing on energy. The societal benefits of the physical sciences are emphasized, because the science education research literature indicates that “helping others” is an important consideration for girls in choosing a career. Pre- and post-testing of students in intervention and control groups will be used to determine the impact of this intervention on students’ mastery of science content as well as changes in their science interest, science efficacy, and attitudes about the societal benefits of science.

- **Section 1: Questions for dialogue at the MSP LNC.**

According to data from 2007-08, women earned 57% of the bachelor’s degrees. In biology/biomedical science, women earned 59% of the bachelor’s degrees. However, only 19% of the physics degrees and 41% of the geology degrees were earned by women. What are some possible reasons for this disparity between the biological and physical sciences?

Group work is often encouraged in the sciences. Some past research suggests that the size and composition of student groups impacts girls differently than boys. What “best practices” can we communicate to teachers about this question?

How can college and university faculty help K-12 teachers articulate the relevance of science to their students?

- **Section 2: Conceptual framework**

A successful science student is motivated to explore, confident in her abilities, and proficient in science, with a deep understanding of the physical universe.

Motivation: Student success includes the realization that scientific fields such as physics and geology benefit society. Since research suggests that girls in particular are motivated to prepare for careers that will help others, we maintain that students need to be aware of the critical contributions made by physical scientists in the past and the role that scientists

will have in solving present and future societal problems. The POPS pilot study includes time for reflection on various ways in which physics and geology help others.

Confidence: Students who have demonstrated past successes in science are more likely to continue through the “science-math pipeline”. The POPS pilot study curriculum includes opportunities for students to engage in hands-on activities that reinforce self-efficacy.

Proficiency: Motivated by a desire to benefit others, successful students also need to master the methods of inquiry and the content of science. The POPS pilot study includes a hands-on curriculum addressing several of the 5-8 grade NYS Science Standards for energy, electricity, and transfer of energy.

The intervention group will participate in a seven-lesson enrichment curriculum. Lesson 1 is an introduction to the concept of energy, Lesson 2 is on kinetic energy and potential energy. Students will use rubber-band propelled cars to investigate these concepts. Lesson 3 is on electrical energy. Students will use simple circuits to investigate the flow of electrical charge. Faraday’s Law will also be demonstrated. In Lesson 4 students will assemble an electrical generator and investigate how kinetic energy and gravitational potential energy can be transferred into electrical energy. In Lesson 5, students will discover how the sun is a primary source of both nonrenewable (coal, oil, gas) and renewable (wind power, water power) sources of energy on earth. In Lesson 6 students review several types of energy (heat, light, sound, electrical, chemical) and investigate the transfer of energy. Students construct a wind turbine and use the generator from Lesson 4 to investigate the transfer of energy. Lesson 7 is for evaluation using the post attitude survey and content test. The content test was assembled using questions from the NYS Science assessment, selected by one of our participating teachers.

Each Lesson includes Teacher Notes, PowerPoint presentations, Student Notes Sheets, and Homework Assignments. In addition, the hands-on components (rubber-band cars, circuit kits, Faraday’s Law kits, generators, energy sequence cards, wind turbines) are provided. For five of the Lessons a short video has been produced that emphasizes a way that science is helping people.

Five neighboring rural school districts in Livingston County, New York are K-12 partners on this project. Our evaluation plan includes pre- and post-testing of student content knowledge as well as science interest, science efficacy, and attitudes about the societal benefits of science. Our attitude survey includes questions designed to determine whether the POPS curriculum can increase 5th and 6th grade students’ awareness of the societal benefits of the physical sciences. We project that there will be about 250 students in the intervention group and 250 in the control group.

- **Section 3: Explanatory framework.**

Our current work includes vignettes that highlight how choices about energy sources can impact society. If we determine that participation in this project does in fact correlate

with a positive change in girls' attitudes toward physical science, we will then be in a position to implement other strategies that capitalize on the ways in which girls learn best (considerations in forming working groups, for example). It is our hope that this interactive approach, coupled with an increased emphasis on societal impact and an instructional approach that increases girls' comfort levels in the science classroom, will encourage more young women to explore the areas of physics and geological sciences as a potential college majors.

Through the attitude survey component of our evaluation plan we will learn about how boys and girls respond to statements on science efficacy, the societal benefit of science, and science interest before and after the POPS unit. Another component of the evaluation is pre-and post-responses from a content test that includes questions from past NYS Intermediate Science Exams. These results will be compared with responses from a control group.

Process Issues

Early workshops with teachers emphasized that teacher participation was contingent on our curriculum addressing aspects of the NYS Science Standards. This informed the development of the program.