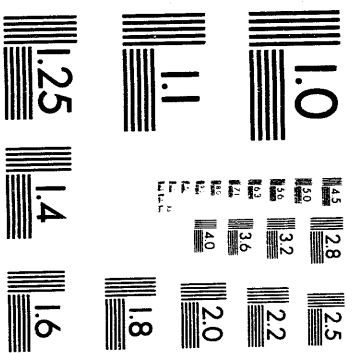
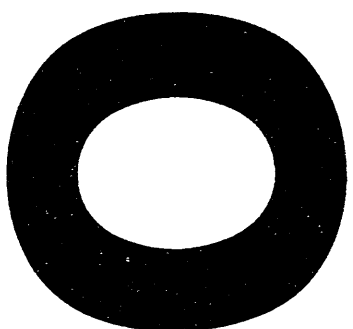






OPTIONS FOR SYSTEMIC CHANGE IN MATHEMATICS,
SCIENCE, AND TECHNOLOGY EDUCATION: SCIENTIST/
TEACHER PARTNERSHIPS

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**OPTIONS for Systemic Change in Mathematics, Science, and
Technology Education: Scientist/Teacher Partnerships**

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I. INTRODUCTION

OPTIONS is a U.S. Department of Energy/Pacific Northwest Laboratory (DOE/PNL) project whose goal is to assist Washington and Oregon middle schools having high percentages of students historically underrepresented in mathematics, science, and technology. The goal is to ensure that all students receive high-quality mathematics, science, and technology education throughout their middle school years.

Teams of scientists work with teams of teachers from participating OPTIONS schools to initiate significant change in the manner in which science, mathematics, and technology are taught. As part of this effort, PNL scientists team up with teachers to develop curricula. Louise Fayette, a middle school science teacher at Toppenish Middle School, and Cliff Glantz, a research scientist with the Earth and Environmental Sciences Center at PNL are two of the participants in the OPTIONS project. Beginning in mid-1993, Louise and Cliff began working together to develop a Global Climate Change curriculum for Louise's 8th grade science classes. Other OPTIONS team members working at the Toppenish Middle School include PNL scientists Jeff Dagle, Dave Geist, and Hipolito Velez and teachers Kathye Pabisz, Nolan Alcorn, and Tony Martinez. This paper discusses OPTIONS, the reasons for developing the global change curriculum, resources used to develop it, and expected results.

II. OPTIONS FOR SYSTEMIC CHANGE IN MATHEMATICS, SCIENCE, AND TECHNOLOGY EDUCATION

The purpose of the DOE/PNL OPTIONS project is to help build the capacity of Washington and Oregon middle schools to deliver high-quality mathematics, science, and technology instruction for all students. The project is designed to integrate or connect the three disciplines and is articulated through the middle grade levels. The project also helps students see that these disciplines are important, can be fun to learn, and offer a wide range of career opportunities. Through OPTIONS, participating middle schools are working toward aligning mathematics, science, and technology education programs with state and national curricular standards and frameworks.

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III. THE METEOROLOGY AND GLOBAL CLIMATE CHANGE UNITS

As part of the 8th-grade science curriculum at Toppenish Middle School, Louise Fayette has focused on three specific science units: space sciences, geology, and meteorology. Meteorology, traditionally, has received the least amount of Louise's time because her confessed lack of knowledge about meteorology makes it difficult for her to get excited about the subject and develop interesting activities for students. When Louise allocates time between fields of study she tends to devote more time to the subjects she feels most comfortable with and can make more interesting for students. In 8th-grade science, she spends significantly more time on the space sciences unit than on the earth sciences unit. As both an atmospheric scientist, and a former astronomy major, Cliff can be objective about Louise's approach; however, in today's world, Cliff and Louise both appreciate the importance of the students' understanding of meteorology, climate, and climate change.

The evolution of Louise's space sciences program is interesting, in the late-1980's Louise and PNL scientist Ed Coombs developed a lunar settlement curriculum project that engages students in the scientific investigations and engineering design problems associated with building a lunar colony. These hands-on activities were very popular with students; they used the classroom knowledge they had acquired, formed connections, and created something as a team.

In developing a unit on global change, Louise's and Cliff's objectives are to:

- "steal" a few weeks from the space sciences program, without significantly reducing the effectiveness of this unit
- modify the content of the meteorology unit to make it more interesting, relevant, and informative
- increase Louise's content knowledge in meteorology, and as a result, help her feel more comfortable teaching this material
- develop a global climate change unit that could be used to connect the space science, geology, geography, oceanography, and meteorology units the students were exposed to over the course of their 7th- and 8th-grade studies.

Modifying the Meteorology Unit

As this paper is being prepared, Louise and Cliff are in the middle of their work on redesigning the meteorology unit. Louise is restructuring the presentation of material (based in part on conversations with Cliff) and is doing "homework" to improve her knowledge (and comfort level) with the subject matter. Cliff's homework assignments include exploring ways for using Weather Channel educational products in the classroom and providing students with access to computer-based weather products (through INTERNET or other network service). The objective of this effort is to allow students to access real-

time weather maps and satellite photos in the classroom, prepare their own weather forecasts for national (and possibly international locations), and evaluate their forecast efforts. Work in this area provides interdisciplinary connections to geography, mathematics, and computer sciences. In addition, Cliff and Louise are working together on ways to introduce the concept of climate into the meteorology curriculum. The plan is for Cliff to visit Louise's classes for at least 2 days during the school year to provide students with instruction on forecasting and to demonstrate meteorological instrumentation.

Objectives/Resources for Developing a Global Climate Change Unit

Several educational objectives have been developed for the global change curriculum, including 1) enhancing the students' concept of climate and climatic differences; 2) understanding the interrelationships between different fields of science--in particular, the connections between "outer space" (e.g., solar radiation, planetary orbits, rotational axes), the oceans, and the atmosphere; 3) understanding the concept of planetary change (climatic variation, geologic change, biological evolution) and realizing their world is a non-static, dynamic place; and 4) understanding human impacts on the earth's environment. These objectives are worthwhile, but achieving them in 4 weeks in the spring is pretty ambitious.

The resources we are using include:

- an EPA draft document presenting integrated science education activities for the study of global climate and climate change (Henderson et al. 1993)
- NOAA's Student Activities in Meteorology Handbook (Meier and Passereli 1992)
- various documents, including the weather channel's workbook (Moore 1992).

In addition to developing curriculum material, Cliff and Louise are working to identify and develop classroom experiments that can demonstrate some of the climatic principles that they are difficult to grasp.

On the downside, potential political problems exist in the community that may be encountered with the global change unit. In many communities the subject of instruction in global change may be controversial. Many people reject the premise that the emission of greenhouse gases could potentially have major effects on the global climate. In addition, some families and teachers reject the more basic concept of planetary change--not only biological evolution but geologic change. Time will tell how well our new curriculum is accepted--not only by the students but also by the broader community.

IV. REFERENCES

Henderson, S., S. R. Holman, and L. L. Mortenson. 1993. Global Climates - Past, Present, and Future. Draft EPA Document, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C.

Meier, B. and E., Passereli. 1992. Student Activities in Meteorology. Draft NOAA Environmental Research Laboratories, U.S. Department of Commerce, Washington, D.C.

Moore, K. W. 1992. The Weather Classroom. The Weather Channel, Atlanta Georgia.

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