

RESEARCH PROJECT TITLE: ED-STEEP: Education Solutions to Environmental and Economic Problems

INVESTIGATORS: Mark A. Quinn and Catherine A. Perillo, Department of Crop & Soil Sciences, Washington State University

INTERIM OR FINAL REPORT: Final

PROJECT OBJECTIVES:

Objective 1. To develop a series of standards-based lessons, learning activities, and other information, based on the accomplishments and issues addressed by the STEEP Program, which can be incorporated into secondary and post-secondary science classrooms. The education material will continue to focus on biology, environmental sciences, chemistry, physics, and agricultural sciences.

Objective 2. To evaluate the lesson plans, learning activities and education material developed for ED-STEEP.

KEY WORDS: Education Website, Curriculum Development, Science Education, Environmental Education

STATEMENT OF PROBLEM: The benefits of the STEEP Program are significant and known to many within the agricultural community. Cooperation between growers, industry, researchers, and extension personnel continue to have a significant impact toward solving many agriculture-related environmental and economic problems. Unfortunately, the research and benefits of the program are not widely known to educators, students, civic groups, and other members of society. To have a maximum impact, the STEEP program should reach out to educators by providing them with relevant and timely information on the goals and accomplishments of the program. It is the education of students that will lead the drive for more innovative and newer solutions to the environmental and economic problems in the Inland Northwest. The specific problem that we wish to address is the lack of connection between the information being generated through the STEEP Program and educators in secondary and post-secondary school classrooms.

ZONE OF INTEREST: All

ABSTRACT OF RESEARCH FINDINGS: To increase the overall impact of the STEEP program on society, we have developed the website, ED-STEEP: Education Solutions to Environmental and Economic Problems (<http://pnwsteep.wsu.edu/edsteep>), to be incorporated into the STEEP website. We have accomplished the following: 1) identified specific environmental issues being addressed through the STEEP program, 2) catalogued specific results from STEEP research projects, 3) developed a comprehensive set of lesson plans, learning activities, and other education material for secondary and post-secondary science teachers, 4) developed fact sheets, research summaries, and lists of relevant web sites for students, government officials, and others interested in agriculture-related environmental and economic

issues, and 5) have evaluated most of the education material in the classroom. The website has education material on: biodiversity of invertebrates, field burning, global warming and carbon sequestration, organic matter and biodiversity, pesticides chemistry, seed germination, soil bacteria, soil chemistry and physics, soil erosion, and soil organic matter. Other topics will be included in the future.

RESULTS AND INTERPRETATION: Many of the significant environmental and economic issues being addressed through the STEEP program have been identified and include:

- soil erosion from wind and water
- reductions in air quality from field/stubble burning and wind erosion events
- loss in soil organic matter, soil fertility, and soil water holding capacity from repeated tillage
- fallow-field rotations that lead to wind erosion and loss of productivity
- reductions in soil biodiversity because of repeated tillage
- changes in pest population dynamics in no-till fields
- need for alternate crops in continuous cropping systems
- increase in herbicide usage when adopting no-till methods
- reduced profitability of some continuous cropping systems
- release of carbon from soil after tillage, contributing to global warming

Specific research outcomes from STEEP projects that can be incorporated into secondary and post-secondary science curriculum have also be catalogued. This information was compiled from STEEP reports, publications, consultations with researchers, and through the website, [Sustainable Commodity-based Agriculture in the Pacific Northwest](#), developed by Mark Quinn, Bill Pan, and Bob Gillespie.

The education material developed for the website adheres to specific state and national science education standards. State standards have been identified for Idaho, Oregon, and Washington. For example, the Soil Organic Matter and Biodiversity Unit that we developed meets the following Idaho State Standards:

- 648.01-.03 (Unifying Concepts of Science)
- 649 (Concepts of Scientific Inquiry)
- 650.02-.03 (Concepts of Physical Science)
- 652.02 (Interdependence of Organisms and Biological Change)
- 653.01 (Matter, Energy, and Organization in Living Systems)
- 654.02 (Earth and Space Systems)
- 655.01 (Technology)
- 656.01-.04 (Personal and Social Perspectives)
- 658.01-.02 (Interdisciplinary Concepts)

In addition, this unit also adheres to the AAAS Benchmark standards for Diversity of Life, Interdependence of Life, Flow of Matter and Energy, Scientific Inquiry, and The Scientific Enterprise. Specific lessons plans, learning activities, and other education material, based on the outcomes of STEEP research projects, were developed for science educators and included in the

ED-STEER website (See attachments; Figure 1 and Table 1). Figure 1 represents the website's homepage. Table 1, shows the list of education topics developed for the website. The pages can also be accessed at: <http://pnwsteep.wsu.edu/edsteep>. The education material contains lesson plans, fact sheets, student work sheets, links to relevant web sites, and other information on STEEP-related issues and accomplishments. For example, the Organic Matter and Biodiversity Unit contains the following material:

- Summary of STEEP research projects relevant to soil organic matter and biodiversity
- Links to AAAS and state education standards address by the education material
- Choosing a Sample Site and Preparing Soil Samples
- Soil Organic Matter Fact Sheet
- Soil Invertebrate Fact Sheet
- Soil Organism Picture Guide (MS Word file)
- Soil Organism Picture Guide (PowerPoint file)
- Constructing a Berlese Funnel for Collecting Soil Invertebrates
- Simple Soil Analyses
- Scientific Experiments and Lab Report Format
- Constructing Bar and Line Graphs
- Student Handout
- A list of relevant web resources

Much of the education material has been evaluated in the classroom, and refined as needed. Quinn was able to test and evaluate the material while teaching biology and environmental science classes at Paradise Creek Regional High School and Moscow High School (Moscow School District, Idaho), and during a two-week workshop for high school students participating in WSU's Cougar Quest program. The workshops were entitled, "Exploring the Unseen World Under our Feet."

IMPACTS OF RESEARCH: The Impact of the ED-STEER website will increase in time as teachers, students, and others access the website for information. The main goal of the project is to expand greatly the impact of the STEEP program by developing a working connection between STEEP researchers and the education community. The education material developed for ED-STEER will be used directly by:

- educators in the classroom as part of their curriculum
- students in the classroom working on specific education topics and units
- government officials seeking information on the accomplishments of the STEEP program
- civic groups interested in agriculture-related environmental issues
- growers seeking specific information on agricultural issues (e.g., organic matter, carbon sequestration)

The beneficial impact of ED-STEER will come through the dissemination of STEEP research results and information to a wide audience comprised of students, educators, government officials, and civic groups. A single lesson plan derived from a STEEP research project and used by a single teacher has the potential of reaching hundreds of students at one time. The ED-

STEEP education material will target those people responsible for developing innovative solutions to the environmental and economic problems of the future.

INTERACTIONS (COOPERATION) WITH OTHER SCIENTISTS CONDUCTING RELATED ACTIVITY: Numerous STEEP researchers have supplied information for the website (see STEEP Research Reports).

PUBLICATIONS AND PRESENTATIONS: ED-STEEP: Education Solutions to Environmental and Economic Problems (<http://pnwsteep.wsu.edu/edsteep>). The website will continue to be developed as more curriculum material becomes available.

Pacific Northwest Conservation Tillage Systems Information Source
ED-STEEP: Education Solutions to Environmental and Economic Problems



About ED-STEEP

For Teachers –
 Lessons and Activities

Education Material

- STEEP Projects
- Grower Case Studies
- Research Reports
- PNW Tillage Handbook



About ED-STEEP

Information about the education program sponsored by the STEEP project, tips on how to use the website and educational material, and information on the authors and support.



Lessons and Activities

A list of standards-based lesson plans and activities for science teachers. The lesson plans include support material for teachers, student work sheets, background information, and links to relevant education sites.



Education Material

A list of fact sheets, other education material, and web sites. Education material is sorted by topic and linked to relevant lesson plans and STEEP research projects.



STEEP Projects

A list of STEEP research projects, reports, and grower case studies.

Contact us: [Mark Quinn: quinnm@wsu.edu](mailto:quinnm@wsu.edu) 509-335-2263 | [Accessibility](#) | [Copyright](#) | [Policies](#)
 Dept. of Crop and Soil Sciences, PO Box 646420, [Washington State University](#), Pullman, WA 99164-6420 USA
 Maintained by [Debbie Marsh](#), Dept. of Crop & Soil Sciences, WSU

Fig. 1. ED-STEEP homepage

Table 1. Education Units for teachers showing a list of STEEP-related topics.

Biodiversity of Ground-dwelling Arthropods	In this lesson, students collect ground-dwelling arthropods to compare the biodiversity of different habitats. The lesson allows them to explore the importance of biodiversity, arthropod communities, terrestrial ecology, and classification.
Biodiversity of Soil Invertebrates	Soils are extremely complex and fascinating ecosystems. In this lesson, students extract and identify invertebrates from different soils. It's an excellent lesson in biodiversity, invertebrates, ecology, behavior, and science methodology.
Field Burning	Field burning is a controversial issue in the Inland Northwest. This lesson allows students to debate the pros and cons of field burning
Global Warming and Carbon Sequestration	This lesson allows students to develop and experiment with possible solutions to the global warming problem, with an emphasis on carbon sequestration in soils. It provides background material on the causes and consequences of global warming and examines the role of agriculture in mitigating its effect.
Organic Matter and Biodiversity	This is a comprehensive, experiential-based lesson that lets students explore the relationship between habitat type, soil organic matter, and biodiversity of soil invertebrates. It includes information on constructing Berlese funnels, conducting experiments, and writing lab reports.
Pesticide Chemistry	In this lesson, students conduct internet-based research on the structure, mode of action, uses, and environmental problems associated with common pesticides used in the Inland Northwest.
Seed Germination	In this lesson, students develop and conduct simple experiments to determine the effects of biotic and abiotic factors on seed germination. It's an excellent lesson on scientific methodology and the preparation of lab reports.
Soil Bacteria	Soil bacteria are primarily responsible for the decomposition of organic matter and are essential to ecosystem functions. In this lesson, students use a dilution plate technique to count the number of bacteria found in 1 g of soil.
Soil Chemistry and Physics	This is a series of experiments that allows students to explore the chemistry and physics of soils, including pH, soil charge, movement of chemicals in soil, water holding capacity, texture, composition, moisture, and percolation. Soils are an excellent medium for teaching applied chemistry and physics.
Soil Erosion	Soil erosion is a significant global and regional problem, contributing to the loss of fertile soil and numerous other health and environmental problems. In this lesson, students will explore the causes and consequences of soil erosion and its impact on regional agriculture
Soil Organic Matter	Organic matter is the key to nutrient recycling and plant growth in terrestrial ecosystems. In this lesson, students measure the organic matter content of different soils, and discuss the importance of soil organic matter. The lesson can also be combined with the lesson on Global Warming and Carbon Sequestration.