

HYDROVILLE CURRICULUM OVERVIEW

Background

In September 2000, the National Institute of Environmental Health Sciences (NIEHS) awarded a seven-year grant to the Environmental Health Sciences Center at Oregon State University. This grant, entitled “Learning Through Environmental Health Scenarios,” was used to create the Hydroville Curriculum Project. The Hydroville Curriculum Project seeks to improve high school students’ academic performance and to provide experience in problem solving, environmental health science, decision making, team work and social responsibility. The curricula use environmental health topics to enhance connections between science, language arts, mathematics, social studies, health and technology.

Introduction

The project has developed three curricula, each dealing with a real-life problem using real-life data. The town of Hydroville, which could be a town anywhere in America, is experiencing one of three environmental health problems: a pesticide spill, an indoor air quality problem, and a water quality problem.

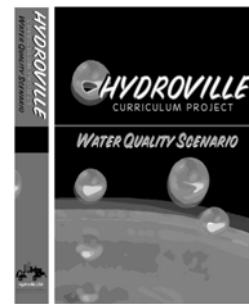
Pesticide Spill



Indoor Air Quality



Water Quality



Students participate in a series of background activities to develop specific concepts and skills. Students then assume the roles of experts on a team brought in to solve the environmental health problem. As a team, they must develop and formally present a solution based on data collected through laboratory experiments, interviews, and research. The curricula are structured to help students understand the complexity of environmental health issues and to emphasize that many real-world issues have many acceptable answers.

Meeting National Educational Standards

The Hydroville Curricula integrate environmental health science themes of toxicology, risk, and decision analysis with concepts in science, language arts, social studies, mathematics, technology, and health. Emphasized skills common for all these disciplines are problem solving, reading, evaluating, analyzing, calculating, writing, graphing, communicating, and teamwork. The principal standard that is covered in depth by these curricula is the science standard *Science as Inquiry*.

Science as Inquiry Standard

The Hydroville Curricula use real-life problems to help students master the seven abilities necessary to do science inquiry (NCR 1996). Research results have shown that through their emersion in the Hydroville problems, students begin to think more like scientists. They formulate hypotheses, use data from investigations to support or modify those hypotheses, and develop skills in communicating their findings to diverse audiences. Students take more responsibility for their own learning and have used these inquiry skills to design and continue research on local problems related to the Hydroville topic. Teachers using the curricula repeatedly cite the development of inquiry skills as one of the major strengths and advantages of teaching the quarter-long Hydroville Curricula.

Abilities Necessary to do Scientific Inquiry*

1. Identify questions and concepts that guide scientific investigations
2. Design and conduct scientific investigations
3. Use technology and mathematics to improve investigations and communications
4. Formulate and revise scientific explanations and models using logic and evidence
5. Recognize and analyze alternative explanations and models
6. Communicate and defend a scientific argument
7. Understandings about scientific inquiry

*National Science Education Standards. National, National Research Council, 1996

Hydroville Curriculum Framework

The Hydroville Curricula have been developed around a carefully designed learning framework that reflects how scientists and experts solve real-world problems. This framework models the scientific method and widely used problem-based learning models (Table 1).

1. **Define the Problem:** Students are introduced to an environmental health problem in Hydroville by watching a video which provides facts and background information.
2. **Collect Data:** Students complete background activities to learn the concepts necessary to understand the problem and develop skills that environmental health experts use in the real world.
3. **Analyze Data and Develop Hypothesis(es):** Students form teams of experts to investigate the problem, test, analyze data and propose and test hypotheses.
4. **Synthesize Data and Generate Solutions:** Student experts share data, revise their hypotheses, and develop an action plan to address the problem.
5. **Present Solutions:** Student teams develop presentations within the context of the scenario and present their findings to the problem's stakeholders.

Table 1. A Comparison of the Hydroville Curriculum Framework

Step	Hydroville Curriculum Framework	Problem-Based Learning Model ¹	Scientific Method ²
1	<ul style="list-style-type: none"> Define the problem 	<ul style="list-style-type: none"> Meet the problem 	<ul style="list-style-type: none"> Define problem
2	<ul style="list-style-type: none"> Collect data Develop hypothesis(es) 	<ul style="list-style-type: none"> KNK (know, need to know) Define problem statement 	<ul style="list-style-type: none"> Derive hypothesis(es) Review the literature
3	<ul style="list-style-type: none"> Analyze data to test hypothesis(es) 	<ul style="list-style-type: none"> Gather and share information 	<ul style="list-style-type: none"> Test hypothesis Decide on a procedure Develop methodology Data collection and analysis
4	<ul style="list-style-type: none"> Synthesize data Generate solutions 	<ul style="list-style-type: none"> Generate possible solutions Evaluate fit of solutions 	<ul style="list-style-type: none"> Derive conclusion Interpret results
5	<ul style="list-style-type: none"> Present solutions 	<ul style="list-style-type: none"> Present findings 	<ul style="list-style-type: none"> Disseminate findings

¹ Problem-based learning model. Center for Problem-Based Learning, Illinois Mathematics and Science Academy, 1998-2001. <http://www.imsa.edu/team/cpbl/whatis/model.html>

² Scientific method. <http://www2.selu.edu/Academics/Education/EDF600/Mod3/sld001.htm>

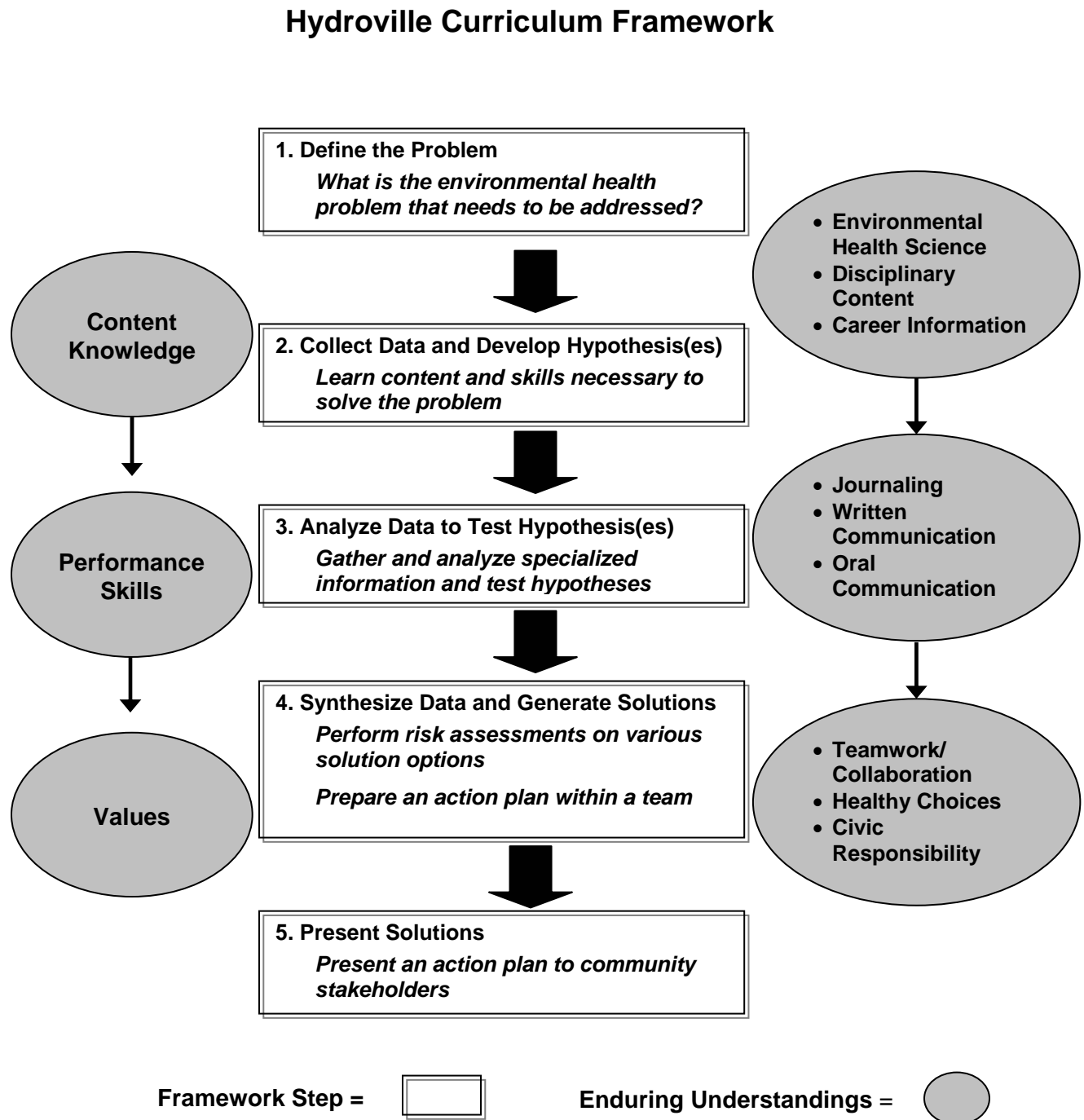
Strengths of Hydroville Curricula

Research results from quantitative and qualitative data collected during field testing, show that Hydroville Curricula:

- Teach science inquiry as a process rather than a subject to be learned, resulting in students that think more like scientist when approaching a problem.
- Develop higher-order and critical problem-solving skills.
- Teach group process and team-building skills
- Create an environment where students take responsibility and become self-directed learners which requires teachers to be a facilitator of learning.
- Stress written and oral communication.
- Include final solutions that are open-ended with no one right answer and require students to use decision-making skills to develop an action plan that is supported by data collected and is responsive to the stakeholders involved.

Embedded in the Hydroville curricular framework are content knowledge and skill development that create enduring understandings that students translate to other courses and their personal lives (Figure 1).

Figure 1. Hydroville Curriculum Framework and Enduring Understandings



Curricula Logistics

Grade Levels

The Hydroville Curricula are designed primarily for students in the 9th and 10th grades. They are also appropriate for use in alternative or charter schools; for 11th and 12th grade electives in biology, chemistry, and environmental science; or in programs for at-risk or gifted students. Additionally, many of the activities can be modified for advanced middle school students. The Pesticide Spill and Water Quality problems are recommended for 9th grade integrated or physical science classes. The Indoor Air Quality Scenario is recommended for 10th grade biology.

Teaching Teams

Ideally, these curricula should be taught collaboratively by a team of teachers in science, language arts, social studies, math, and health who are interested in integrating across disciplines. Working in teams allows teachers to share in the preparation and implementation. However, a science teacher can use the Hydroville Curricula independently.

Time Requirements

The Hydroville Curricula were developed on the belief that students cannot be successful if they are thrust into a problem-based learning situation without sufficient preparation. Therefore, they require nine weeks to complete. Specific time requirements are given in the Scope and Sequence section of each curriculum. The background activities can be used alone or integrated into existing lesson plans or state-mandated curricula.