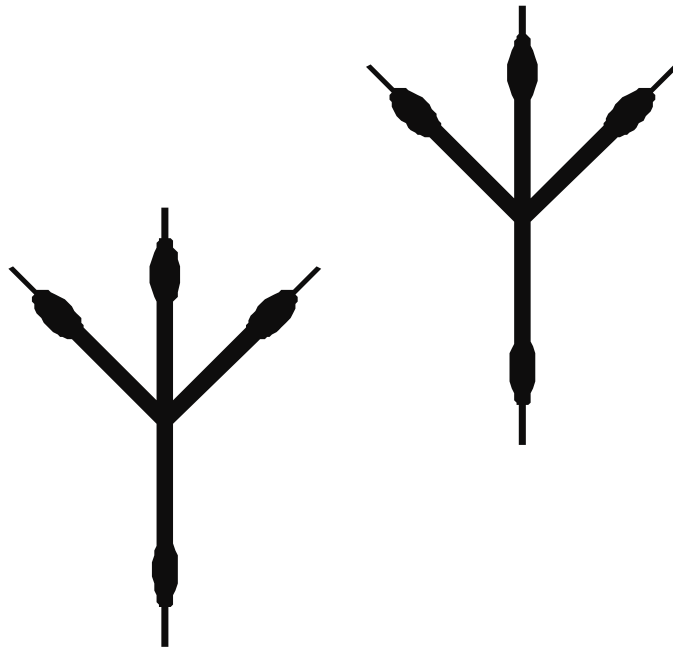

Unit II. Designing Your Program

Every class and teacher operates in a unique environment. This unit is designed to meet your individual needs for a water quality education program.

Sections

1. Utah State Core Curriculum Connections
2. Classroom Instruction Guide
3. Interdisciplinary Study



II-1. Utah State Science Core Curriculum Connections

The *Utah Stream Team* (UST) manual addresses the Utah State 5th - 8th Grade Science Core Curriculum Standards, Objectives and Indicators listed below (only those addressed are listed). Standards and Objectives are addressed to varying degrees:

NOTE:

- Italicized text - UST information and/or activities directly address the Standard, Objective or supporting Indicator.
- Plain text - UST information and/or activities indirectly address this Standard, Objective, or supporting Indicator.

5th Grade

TOPIC: Physical Features of Earth

STANDARD: 3050 – 01- Students will compare and contrast changes in physical features of Earth over time.

OBJECTIVES:

3050-0102

Cite and categorize examples of Earth's natural resources.

- *Describe where natural resources are found and how they are accessed and used.*
- *Research, describe, and map the natural resources in a given area.*

TOPIC: Natural Resources

STANDARD: 3050 - 02 – *Students will evaluate conservation practices in relation to natural resources.*

OBJECTIVES:

3050 - 0201 – *Identify available natural resources*

- *Classify resources as renewable and non-renewable.*
- Describe the role of technology in developing natural resources.
- Describe the relationship between the use of different natural resources and the effect of their use of the environment.

3050 - 0202 – *Analyze conservation practices and pollution problems.*

- *Research conservation practices and pollution problems.*
- Compare and contrast conservation practices in local communities with practices in other communities.

3050 - 0203 – *Based on gathered information, form an opinion regarding human influences on plant and animal survival.*

- *Evaluate the importance of plant and animal species in relation to human survival.*
- *Survey the environmental changes made by people and describe how the changes have affected plants and animals.*
- *Evaluate the cause and effect of changes which have led to the extinction of various plants and animals.*

3050 - 0204 – *Accept the responsibility to become aware of ecological and social issues related to natural resources.*

- *Research an issue related to natural resources.*
- *Research careers that deal with ecological issues.*
- *Communicate with an agency or person dealing with ecological issues.*
- *Justify a position on an issue related to natural resources.*

TOPIC: Natural Resources

STANDARD: 3050 – 03 – *Students will understand the characteristics and management of water.*

OBJECTIVES:

3050 – 0301 – *Understand the properties of water.*

- *Demonstrate the use of water as a solvent and a chemical reactant.*
- *Discover solids and liquids that dissolve in water.*
- *Demonstrate the capacity of water to absorb, store or release heat.*
- *Demonstrate surface tension.*

3050 – 0302 – *Cite examples of personal, recreational, industrial, and biological uses of water.*

- *Identify the different ways water is used.*
- *Using different media, communicate ways water is used.*

3050 – 0303 – *Estimate amounts of water used daily by individuals, families and communities.*

- *Identify a range of uses of water.*
- *Investigate amounts of water used for different purposes.*
- *Graph comparative amounts of water used for different purposes in the home.*

3050 – 0304 – *Based on gathered information, form an opinion and defend it regarding management of water resources.*

- *Identify issues regarding water usage that impact society or the environment.*
- *Describe, in own words, the impact of technology on the uses of water.*
- *Research an issue of water usage that impacts society or the environment.*
- *Use appropriate supporting evidence to defend a position on an issue concerning water usage.*

6th Grade

TOPIC: Microorganisms

STANDARD: 3060 – 06 - *Students will explain how technology enhances vision and adds to knowledge of the living world.*

OBJECTIVES:

3060 – 0601 – *Explain how scientific development changes knowledge of the living world.*

- *Describe how experiments are used to increase scientific knowledge.*

3060 – 0602 – *Conduct an experiment with microorganisms using methods of science.*

- *Formulate a research question and hypothesis.*
- *Identify variables and describe relationships between them.*
- *Include appropriate controls.*
- *Collect, record and display data.*
- *Analyze data to draw warranted references.*

TOPIC: Microorganisms

STANDARD: 3060 – 07 – *Students will describe the growth, function and significance of microorganisms in the environment.*

OBJECTIVES:

3060 – 0702 – *Describe the interaction of microorganisms within an ecosystem.*

- Plan a balanced aquarium or terrarium.
- *Draw inferences about the roles of microorganisms in a food web, in pond water, or some other environment.*

7th Grade

TOPIC: Structure and Classification

STANDARD: 3200 – 05 – Students will create, use and understand the applications of classification schemes.

OBJECTIVES:

3200 – 0501 – Classify matter based upon observable properties.

- Compare and contrast the states of matter.
- *Relate density and temperature to the states of matter.*
- *Formulate hypotheses about physical properties of water related to changes in states of matter.*
- Conduct experiments to test hypotheses.

3200 - 0502 – Distinguish between living, dead and non-living matter.

- Compare and contrast living and non-living things.
- Identify and describe the needs and characteristics of living things.
- Compare and contrast building blocks of living and non-living things.

3200 – 0504 – *Classify organisms according to taxonomic levels.*

- Identify characteristics of living things within each kingdom.
- *Compare organisms at the same level of taxonomic classification.*
- *Use classification keys to identify organisms.*

8th Grade

TOPIC: Chemical and Physical Changes

STANDARD: 3240 – 02 – Students will observe and describe chemical and physical change.

OBJECTIVES:

3240 – 0101- *Differentiate between common chemical and physical changes.*

- Identify and categorize characteristics of chemical and physical change.
- *Report examples of chemical and physical changes.*
- Identify reactants and products in common chemical and physical changes.
- *Observe and compare chemical reactions involving atmospheric oxygen (e.g., rust, fire, respiration, photosynthesis) .*

3240-0102 - *Analyze factors that influence chemical and physical change.*

- *Hypothesize the effect of variables on chemical reactions.*
- *Experiment with variables affecting the relative rates of chemical and physical changes (e.g., temperature, stirring, crushing, concentration).*
- *Graph variables showing change over time.*
- Demonstrate the effects of chemical change on physical properties of substances.

TOPIC: Chemical and Physical Changes

STANDARD: 3240 – 02 – Students will investigate changes in biological energy.

OBJECTIVES:

3240 – 0201 – *Relate energy requirements of plants and animals to physical and chemical changes.*

- *Compare and contrast how producers and consumers obtain chemical energy.*
- *Diagram how matter is converted from one form to another in living things.*
- *Model how photosynthesis and respiration help maintain biological balance in closed systems (e.g., biosphere, terrarium).*
- *Formulate and test a hypothesis on the effects of temperature or light on plant and animal processes (e.g., growth rates, metabolism, seasonal adaptations).*

3240 – 0202 – *Analyze food webs in terms of energy flow.*

- *Trace the transformation of chemical energy in food from radiant solar energy to mechanical energy in organisms.*

TOPIC: Changes in Force, Motion, and Energy

STANDARD: 3240 – 03 - Students will relate forces and energy to motion.

OBJECTIVES:

3240-0301 - *Demonstrate the results of forces.*

- *Identify forces that result in motion.*
- *Investigate and measure propulsion, friction, gravity, and magnetism.*
- *Demonstrate and explain the effect of balanced and unbalanced forces.*
- *Measure and graph movement of an object to calculate velocity.*

3240-0302 - *Identify the role of energy in motion.*

- *Identify forms and sources of energy (e.g., light, heat, mechanical, nuclear, chemical).*
- *Group examples of energy as either kinetic or potential.*
- *Demonstrate various energy movements (e.g., mechanical, heat, sound, light, electricity, magnetism).*

TOPIC: Earth Changes

STANDARD: 3240 – 05 - Students will investigate changes in Earth's crust and climate.

OBJECTIVES:

3240-0501 - *Model changes in Earth's surface.*

- *Determine the factors involved in changing Earth's surface (e.g., gravity, heat transfer, erosion, weathering, deposition).*
- *Analyze evidence of geological change (e.g., fossils, strata, radioactive decay).*
- *Determine events involved in changing Earth's surface (e.g., earthquakes, volcanoes, floods).*

3240-0502 - *Determine changes on Earth caused by climate variation.*

- *Explain how climatic changes have affected Earth's crust.*

3240-0503 - *Analyze the processes involved in rock formation.*

- *Diagram and explain the rock cycle.*
- *Correlate Earth processes to the rock cycle (e.g., volcanoes, erosion).*
- *Model sedimentation and fossil formation.*

3240-0504 - *Evaluate the relationships between biological processes and Earth's changes.*

II-2. Suggested Instructional Strategies

Defining Your Goals and Objectives

What do you want to accomplish?

The nature of your water quality monitoring program depends on which learning objectives you identify for your program and the plan that supports those objectives. Begin this process by asking yourself and your students, “What do we want to accomplish through water education and water quality monitoring?” To increase their motivation and sense of ownership for the program, include students in the planning process.

Important considerations

The following considerations will help you further define your program plan.

- **Developmental level** – Students of every developmental level can appreciate their surroundings, increase their understanding of science and take action. Developmental level will only influence how you facilitate these processes.
- **Time** – Consider the number of field trips you can take over the course of the school year and the time allotted per trip. These will be important factors when you select a stream site. Remember to account of pre-field preparation and post-field processing.
- **Influences within your watershed** – Familiarize yourself with the land use, soils and vegetation of your watershed. You may want to use monitoring to form an understanding of these processes and how they affect your stream.
- **Interdisciplinary curriculum connections** – Consult the “Interdisciplinary Study” section for help connecting the *Utah Stream Team* program with other teachers and disciplines.
- **Core Standards and Objectives** – Consult the “Utah State Core Curriculum Connections” to identify Core requirements you will meet through your monitoring program.

Learning Principles

The *Utah Stream Team* follows Constructivist learning principles. Included among these principles are Learner-Centered Instruction, Cooperative Learning, and Holistic Learning.

Constructivism

Constructivist learning theory recognizes that each of us constructs our own, unique understandings of the world by synthesizing new information with previous understandings. Real learning (internalizing and applying new information) will occur only when the student finds meaning and relevance for the new information. Old methods of lecture and recitation can help students pass tests by memory, but they often fail to support long-term learning. Several techniques for promoting constructivism (learner-centered instruction, cooperative learning, and holistic learning) follow.

Interdisciplinary Instruction and Service Learning (Stewardship) represent additional Constructivist Learning Principles. These are discussed in chapters II-3 and V-3, respectively.

Learner-centered instruction

Learning improves when the students:

- Take responsibility for learning.
- Examine new material in ways that interest and inspire them.
- Express their points of view while valuing those of others.
- Develop autonomy.

These learner-centered techniques help students build the attitude, confidence and skills necessary for life-long learning.

The *Utah Stream Team* offers many opportunities to apply learner-centered instruction, such as:

- Allow students to identify water quality issues in their community that are of concern or interest.
- Help students to determine what courses of action should to take on an issue.
- Guide students through a research design process based on the identified issue(s).
- Work with students to develop a stewardship project based on their findings.

The National Science Teachers Association has called for reform in schools that includes "hands-on" experimentation and learner-generated questions, investigations, hypotheses and models.

Cooperative learning

Through cooperative learning experiences, students appreciate diversity in knowledge and opinions. Cooperative learning also increases achievement, provides peer support while reducing social and academic anxiety, and fosters the skills and attitudes required for collaborative work in all disciplines. The *Utah Stream Team* provides an excellent format for cooperative learning. Classes can work as a single group to identify topics of interest, plan a stewardship project and assess their program. Small groups are well suited for monitoring individual stream sections and sharing findings with peers. "Organizing Your Group," section III-2, will help you plan a cooperative learning experience in the field.

Holistic learning

Presenting discrete bits of information without context does little to foster critical thinking skills and conceptual understanding. Use the *Utah Stream Team* materials to help your students gain a holistic understanding of water quality by presenting information under the umbrella of larger, unifying concepts. Students should see the common threads that connect water and water quality concepts with all aspects of the natural world and our everyday lives.

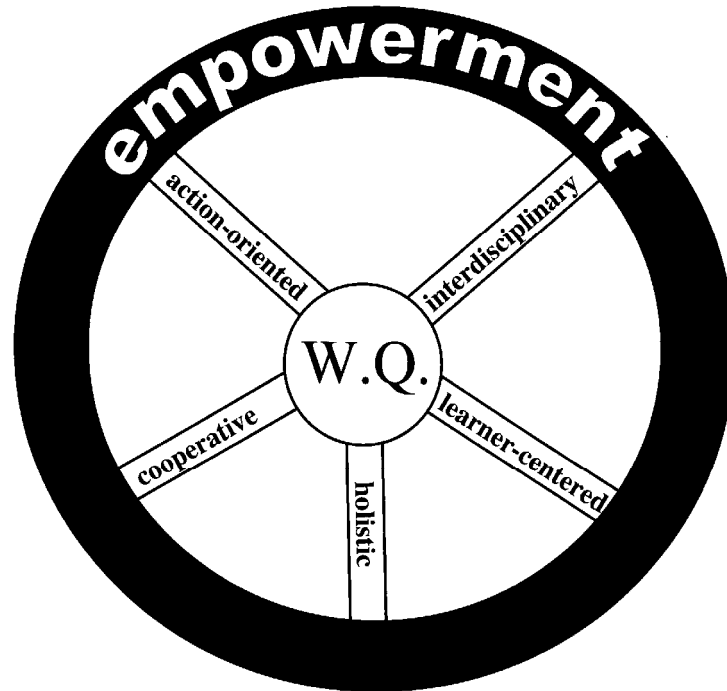
Action-orientation

Helping students to positively affect their surroundings increases their motivation for learning, sense of personal responsibility, likelihood of participating in future environmentally responsible behavior. Read more about taking action in the Stewardship section, V-3.

Interdisciplinary learning

When students integrate disciplines in the study of water quality, they see that water quality and science in general is relevant to all aspects of their lives. This helps decrease much of the abstractness that science holds for many students. Read more about Interdisciplinary Learning in Section II-3.

The combined benefits of constructivist teaching reach far beyond the topic of water quality. If facilitated properly, students stand to gain a process for life-long learning: they are more likely to identify issues of importance to themselves, their community and the environment; they will possess the knowledge and skills needed to investigate those issues; and, they will have greater motivation to act on their findings. This process for life-long learning transcends the topic of water quality: it *empowers* students to positively affect themselves and their community.



Resources for Further Investigation

Project Integration and Visualization Tool (PIViT) – This software program, available on the web, will help you to graphically design concept maps. Available free at <http://www.umich.edu/~pbsgrough/PIViT.html>

“Mapping for Understanding: Using Concept Maps as Windows to Student’s Minds,” by Donna Dorough and James Rye. The Science Teacher. January, 1997. pp. 37-41. Provides practical information on how to create and evaluate student concept maps.

“Clarify with Concept Maps,” by Joseph Novak. The Science Teacher. October, 1991. pp. 45-49. Details much of the learning theory behind concept maps.

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II-3. Interdisciplinary Study

Through interdisciplinary study, the *Utah Stream Team* program can help students understand the significance of water in all aspects of life and the many ways to investigate it. Interdisciplinary study carries many added rewards.

Students:

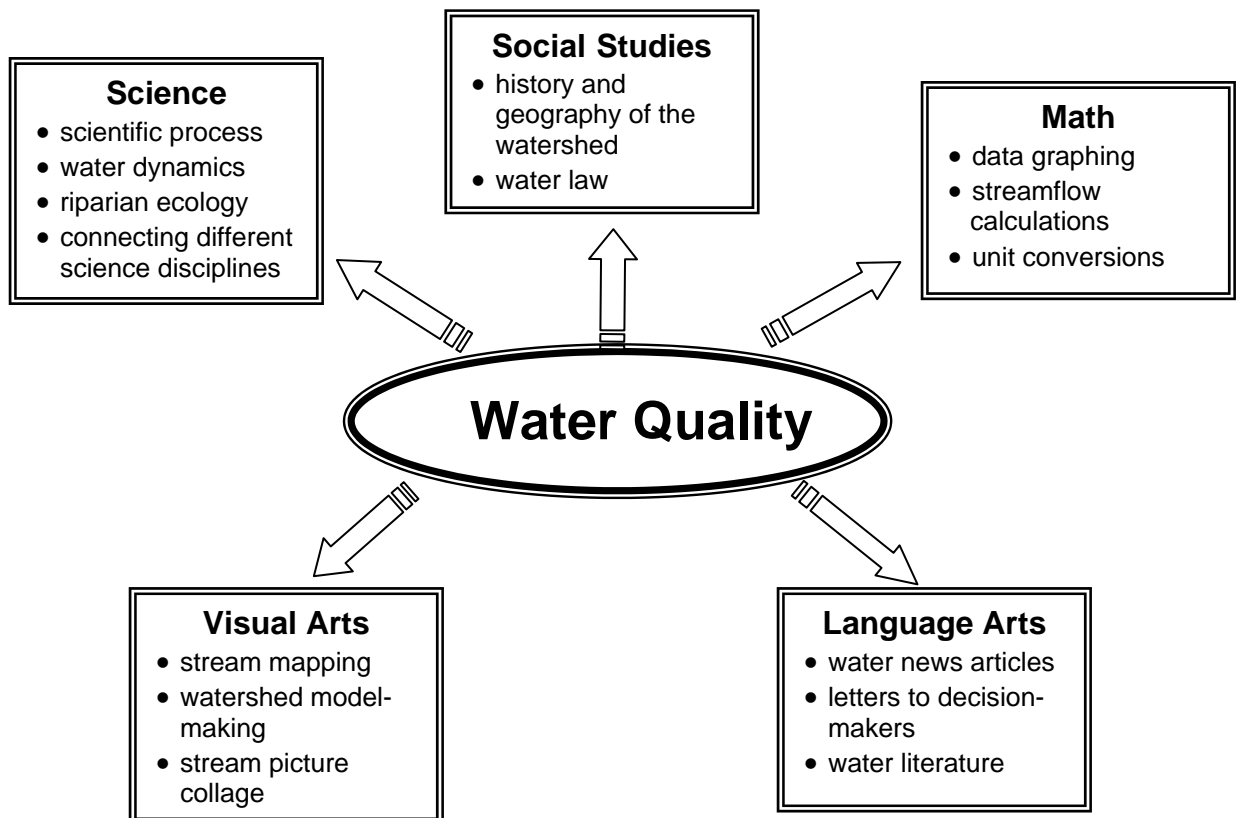
- understand the relevance of subjects that often seem abstract;
- see how different subject areas fit together;
- gain enthusiasm for school-related work; and
- increase their level of achievement.

This section facilitates an interdisciplinary study of water quality. The chart below shows how various exercises can integrate the topic. Next, you will find two strategies for organizing an interdisciplinary field program. Consult the “Resources for Further Investigation” to find more information on interdisciplinary study.

“The concept of water may be one of the most integral of all concepts related to life and the earth and thus is critical to achieving an understanding of the complexity and interrelatedness of earth systems. Without water, life as we know it would not exist. If education is to move into an integrated and holistic mode, we must seek clear examples of concepts that can be used to bridge the so-called traditional disciplines such as biology, chemistry, social studies, mathematics and art. Water provides such an example.”

- M. Brody, “Development of a Framework for Water Education,” 1995.

Making the Connections



Adapted from: M.T. Denecour, *Interactive Lake Ecology*

How can I interconnect disciplines in the field?

1) Split Science - form a cooperative learning environment between different science disciplines. With this approach each science discipline in your school, such as biology, chemistry, earth science, and physics, focuses on water quality as it relates to their discipline. For example, biology students investigate macroinvertebrates and chemistry students sample nutrients. The classes take turns teaching each other and emphasize the role each science discipline plays in forming a complete water quality picture.

2) Rotation Station – multiple classes visit the field together and rotate through stations. Classes separate along a stream stretch and teachers rotate between classes and conduct lessons from their own disciplines. For example a math teacher may work with groups to calculate stream flow while a fine arts teacher may lead a mapping exercise.



Read all about it!

Produce a newspaper about your local stream and its water quality - the "Willow Creek Times" - as a way to bring together separate investigations. The exercise will strengthen writing and graphic arts skills and provide an excellent cooperative learning experience.

Resources for Further Investigation

Project WET - This curriculum and activity guide is an education program for educators and young people, grades K-12. It facilitates and promotes awareness, appreciation, knowledge and stewardship of water resources through lessons that incorporate a variety of disciplines and environments, whole-body activities, laboratory investigations, discussion of local and global topics, and involvement in community service projects. The guide is available to formal and informal educators through workshops. Contact: Project WET, 201 Culbertson Hall, Montana State University, Bozeman, MT 59717-0570, (406) 994-5392, fax: (406) 994-1919,

Sourcebook for Watershed Education – The GREEN watershed education program is unique from other water quality monitoring programs because it emphasizes action-oriented and problem-solving approaches based on an interdisciplinary education. The Sourcebook provides practical techniques and tools for planning, implementing, and assessing a program. You'll also find dozens of lesson plans and a great reference list divided by discipline. Contact: Cole-Misch, Sally, Larry Price, and David Schmidt. Sourcebook for Watershed Education. Global Rivers Environmental Education Network. Ann Arbor, MI. 1996.

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