Stream Side Science: Tailoring Watershed Education to Meet the Needs of Teachers

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WATER QUALITY

UTAH STATE UNIVERSITY EXTENSION

Water is Life: Quality Matters

Streamside Classrooms…

Materials for K-5

Focus on watershed functions and NPS pollution.

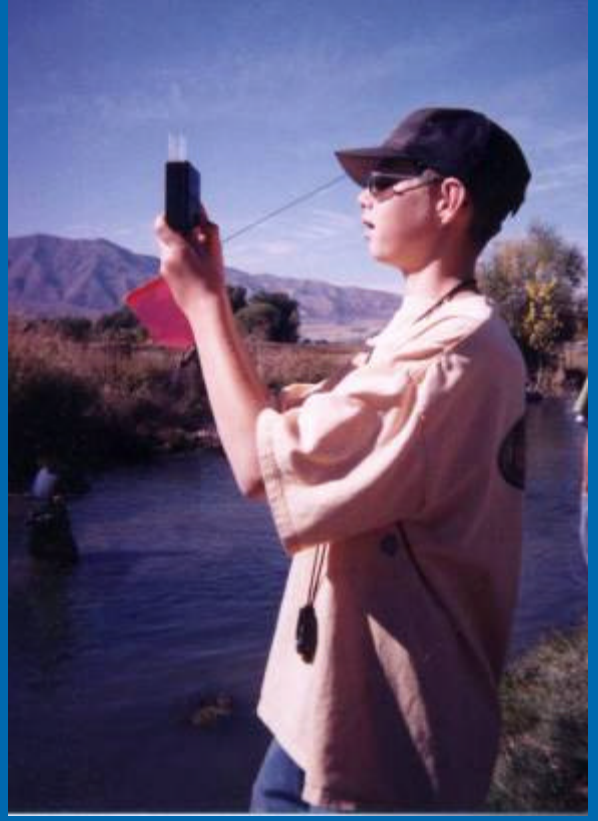
Fewer materials for older students

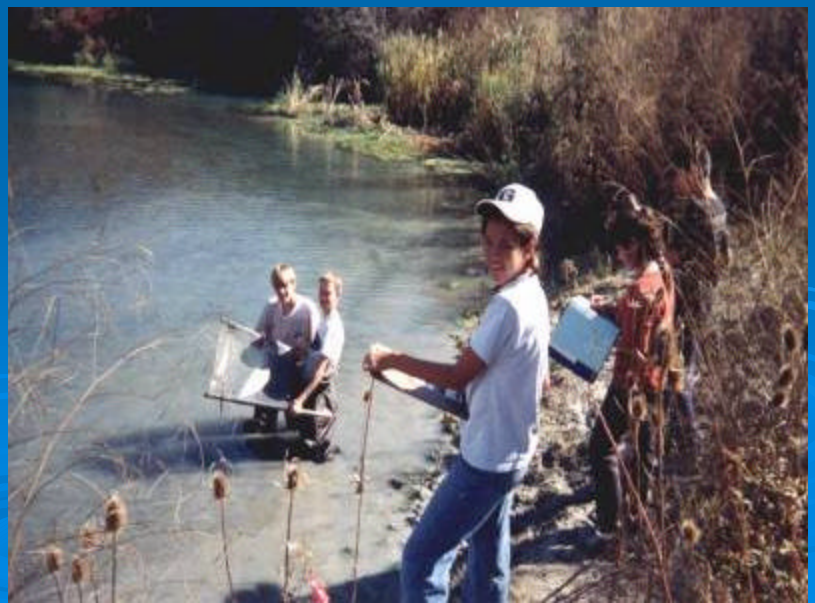
Educational program goals for grades 6-12.

- ✓ Increase awareness about water quality of streams and its relationship to the watershed
- ✓ Learn how to conduct scientific investigations and to collect meaningful data
- ✓ Interdisciplinary, hands-on, easily adaptable
- ✓ Encourage stewardship, community action

Stream Monitoring

- **Physical parameters**
- **Chemical parameters**
- **Biological parameters**





Utah Stream Team: Volunteer monitoring program

Detailed manual

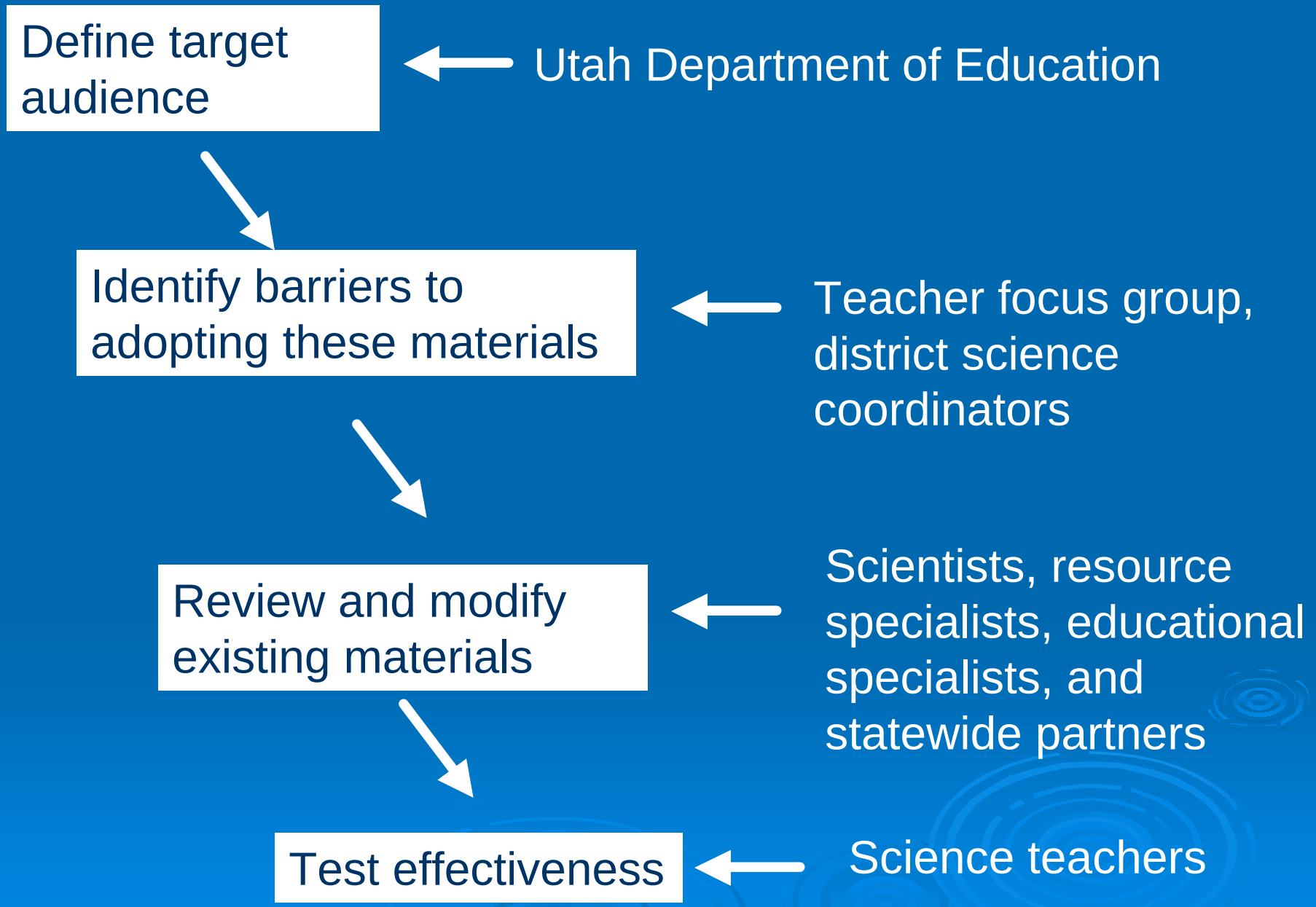
- Background information
- Interpretive information
- Resources, contacts

A River Runs Through Us

Watershed Education Through Stream Monitoring

To identify barriers to wider use of these water quality and watershed educational activities, we worked with:

- Utah Office of Education
- statewide water quality partners
- teachers and curriculum specialists.

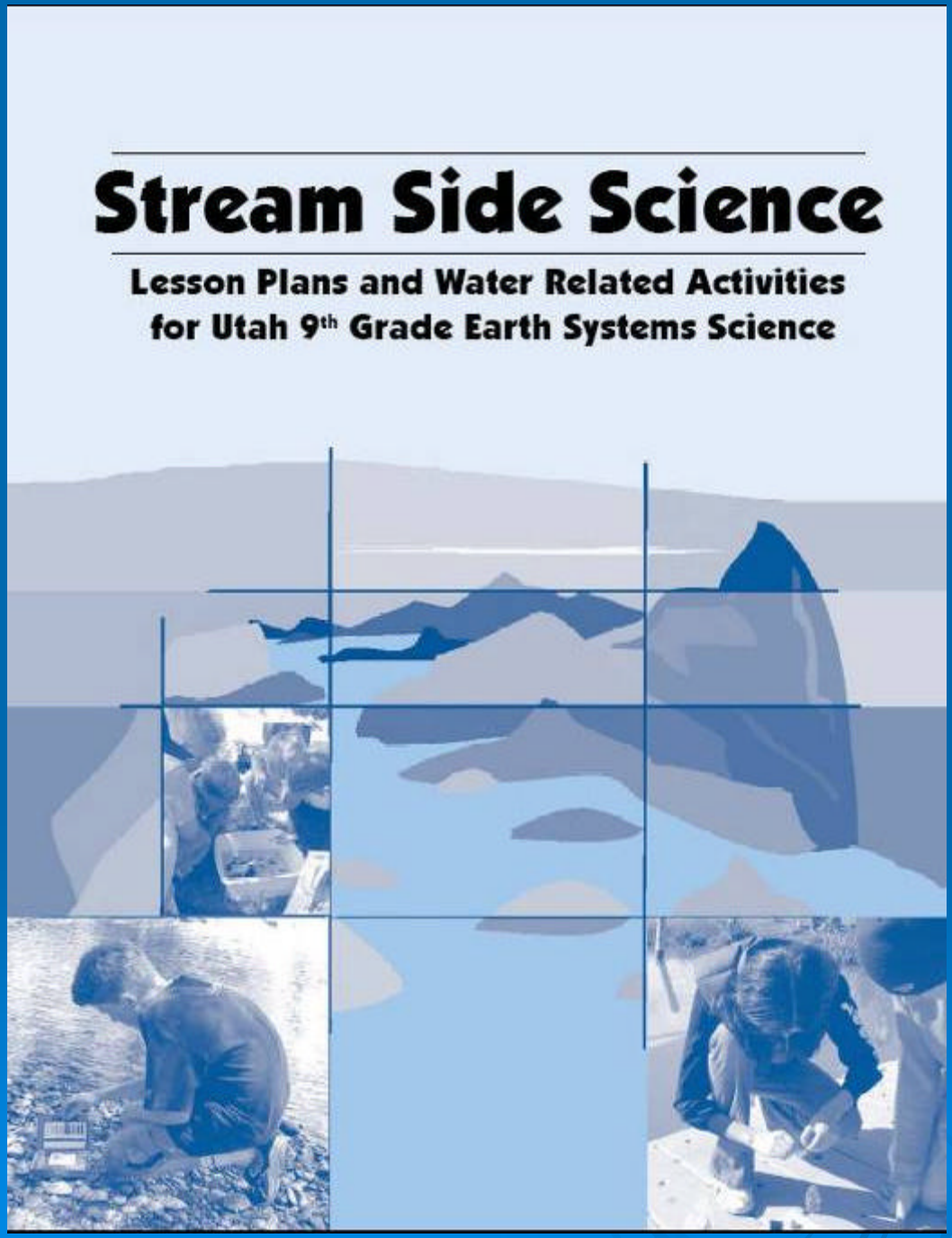

Define target audience
Utah Department of Education
Identify barriers to adopting these materials
Teacher focus group, district science coordinators
Review and modify existing materials
Scientists, resource specialists, educational specialists, and statewide partners
Test effectiveness
Science teachers

Identified barriers to teacher adoption of stream side activities:

- Teachers need to focus on core curriculum standards with end of year testing in mind;
- Teachers want specific lesson plans, not a manual from which they have to pull together their own lessons;
- A majority of teachers are not confident in their knowledge of water quality science;

Other limitations to more widespread use…..

- Teachers may be unwilling to take students to a stream setting because of safety concerns;
- Teachers are financially strapped and may avoid curricula that require additional supplies;
- Teachers may have limited number of field trips each year.



Lesson plans for Utah's 9th Grade Earth Systems Sciences

11 lesson plans based on stream and wetland monitoring and discovery

Biodiversity Debate

Water Management

That's Predictable!

When Things Heat Up

Nitrogen Cycle

Riparian Review

Purpose: To observe and list biotic factors that affect a given ecosystem.

Summary: In this exercise, students will identify and observe biotic factors in a riparian ecosystem, which is the green strip of vegetation alongside a waterbody; they will measure the types of vegetation at the water's edge, the function of plants as ground cover and canopy cover, and observe the wildlife in the area.

Background: Riparian areas are the transition zone between aquatic and terrestrial systems. The plants in this zone depend on high water tables and flooding patterns associated with the aquatic systems. Riparian zones cover a very small area in a watershed, but are extremely important.

Riparian Zone Functions:
- Bank stability to resist erosion
- Habitat for a diversity of plants and animals
- Canopy cover which provides shading
- Organic materials drop from canopy cover into waterbodies
- Soils soak up water from runoff and prevent flooding
- Healthy riparian areas protect the land from flooding, and provide storage for a sustained summer flow

For more background information, see:
- The Riparian Zone section of the Utah Stream Team Manual

Duration:
Classroom 20 minutes
Outdoors 50 min.

Setting:
Classroom
Outdoors

Link to the Utah Core Curriculum:
Earth Systems – 9th grade
Standard II-2b
Standard II-3a

ILO's:
1 a, f, g, k, j
2 b, c, e
3 a, c, d
4 a-e
6 a-d, h

Wetlands versus Stream Macroinvertebrates

Missing Macroinvertebrates

Who Lives in the Water?

What's in the Water?

Where's the Water?

Purpose: To identify the reservoirs of the Earth's water cycle (e.g., ocean, icecaps / glaciers, atmosphere, lakes, rivers, biosphere, ground water) locally and globally and graph or chart relative amounts in global reservoirs.

Summary: Students will use 10 liters (approximately 2.5 gallons) of water to represent all the water on the earth. They will be given the percentage for each water source in relation to the total amount, and asked to divide the 10 liters of water to demonstrate this.

Background: Approximately 72% of the earth is covered with water. Sources of water are the oceans, icecaps and glaciers, groundwater, freshwater lakes, inland seas and salt lakes, the atmosphere and rivers. In this activity, 10 liters of water in a bucket is used to represent all the water on the earth. See the table below for the percentage of each water reservoir in relation to the total amount, and the appropriate measurement for each reservoir.

RESERVIOR	APPROXIMATE % OF THE TOTAL AMOUNT	MEASUREMENT
Oceans	97.25	All water left in bucket
Icecaps / glaciers	2.0	~ 200 ml
Groundwater	0.7	~ 70 ml
Freshwater lakes	0.009	~ 2 ml
Inland seas / salt lakes	0.004	~ 4 drops
Atmosphere	0.001	~ 1 drop
Rivers	0.0001	<1 drop

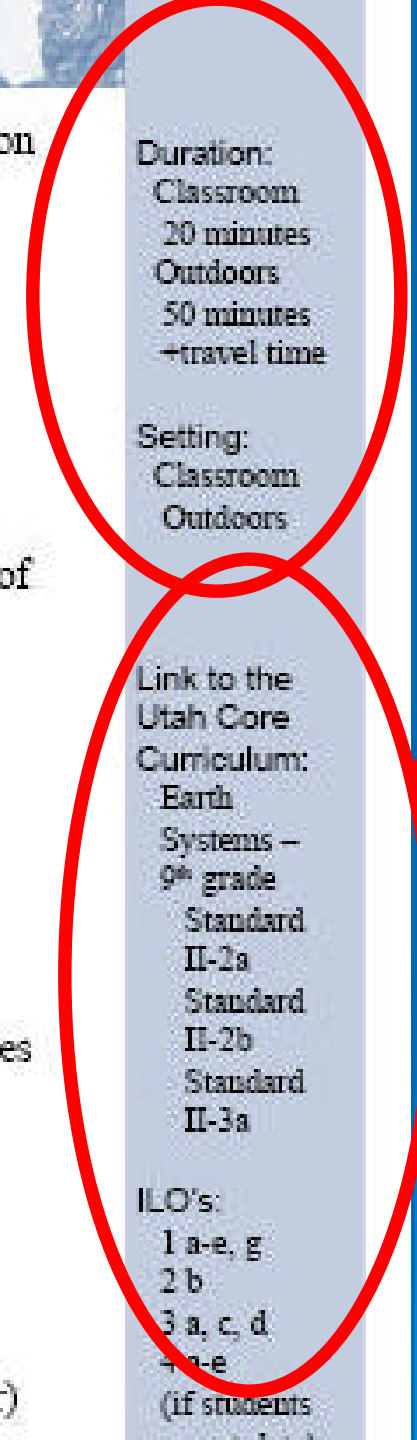
The percentage of usable freshwater is reduced by pollution and contamination. Therefore, the actual amount of water that is usable by humans is very small (approximately 0.00003 percent).

Duration:
Classroom 40 minutes

Setting:
Classroom

Link to the Utah Core Curriculum:
Earth Systems – 9th grade
Standard IV-1a

ILO's:
1 h, i
4 a



Quick access information: Time of activity, classroom and outdoor settings

Correlations to core curriculum and integrated learning objectives

Easy to follow format

Brief description

Brief background information

List of all materials; information on where to easily obtain materials

Purpose: To investigate the diversity in a specific area through and charting.

Summary: In this exercise, students will collect and observe macroinvertebrates in an aquatic system. They will summarize their findings.

Background: For background information see the macroinvertebra the Utah Stream Team Manual for information about macroinvertebrates and natural and human influence macroinvertebrate populations.

Materials:

- Kick nets
- Plastic pans
- Transfer pipettes
- Magnifying glasses
- Copies of student worksheet
- Macroinvertebrate keys and photos
- Copies of macroinvertebrate sampling instr
- Bucke
- Penci
- Clipb
- Plasti
- Wade

* For information on equipment for loan or for purchase, contact USU Water Quality Extension at (435) 797-2580 or www.extension.usu.edu/waterquality

Simple to follow instructions in the classroom and in the field

Classroom Activity:

1. Ask the students to list differences between a stream biome and a wetland biome (e.g., water velocity, temperature, depth, width, vegetation, sediment, inhabitants). Tell them that for this activity they will compare the diversity of macroinvertebrates found in a stream to those found in a wetland.

2. Explain to the students that they will be using their data from the activity Who Lives in the Water? to compare with the new data they collect from a wetland biome.

3. Ask the student about the differences they expect to see in the macroinvertebrates from the two types of biomes. Why would there be differences?

4. Be sure the students are familiar with the macroinvertebrate keys they will be using in the field and also the sampling procedures. If you would like a larger, laminated version of the key provided, please contact USU Water Quality Extension at (435) 797-2580.

Field Activity:

1. Set up stations for sampling macroinvertebrates. These areas should be easily accessible and safe to enter. Each station should include:

- Wetland sampling instruction sheets (it helps to laminate these!)
- Waders
- Collection net
- Plastic pan
- Transfer pipettes
- Magnifying glasses

Safety First!
Always consider safety factors when working near water.

Further Discussion:

1. What habitats had the greatest diversity? What habitats had the lowest diversity? Why?

More diverse aquatic habitats provide more niches or microhabitats that specialized organisms may inhabit. Therefore, cobble bottomed streams may have more types of organisms living in them than a silt bottomed backwater. Keep in mind, however, that many other factors may affect the diversity you observe. The absence or presence of predators can greatly affect diversity and food availability may restrict certain types of organisms. In addition, many aquatic organisms are susceptible to water pollutants or even to increases in water temperature. In these situations, so-called "pollution tolerant" species may be all you will see. Refer to the Missing Macroinvertebrates lesson plan for more specifics on pollution tolerance.

2. How might water pollution affect the diversity you observed?

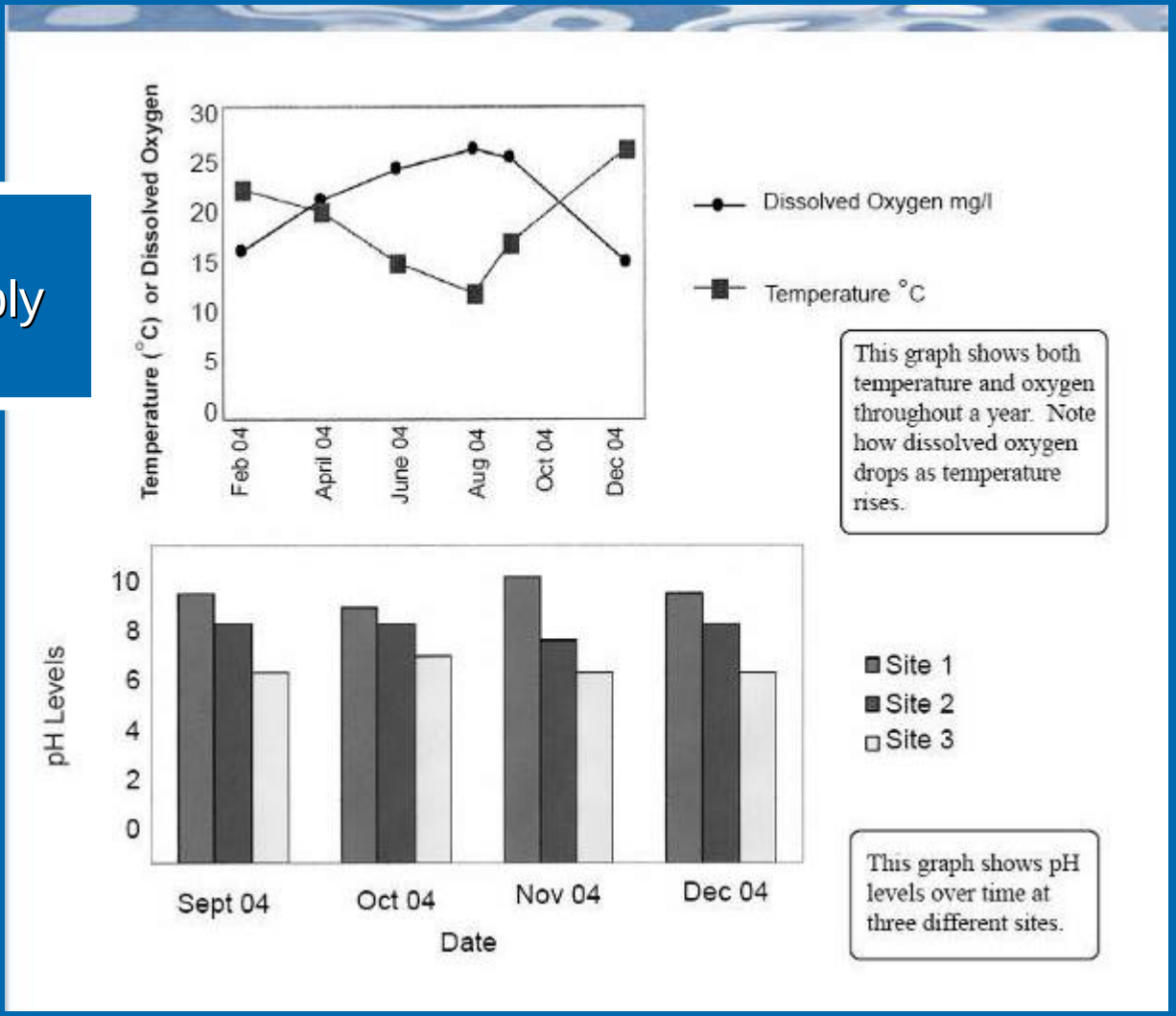
Typically, in polluted water, many sensitive species will disappear. Often these systems will still have a high abundance of organisms, and may even have higher total abundance of organisms than "pristine" systems, but the number of different types of species is greatly reduced.

3. How do adaptations of the insects allow them to inhabit different niches in an aquatic ecosystem?

The organisms you collect display an array of adaptations to their unique environment. For example, most organisms you collect in fast moving water either have clawed feet for holding on, have a very streamlined body, or may have some means of attaching to the rocks. Organisms found in soft silt in quiet waters may experience low oxygen conditions. You may find "blood worms," which are dipteran fly larvae. The red color is from hemoglobin, which helps these organisms trap oxygen when there isn't much around.

Discussion questions to help teacher's understanding of watershed and water quality issues

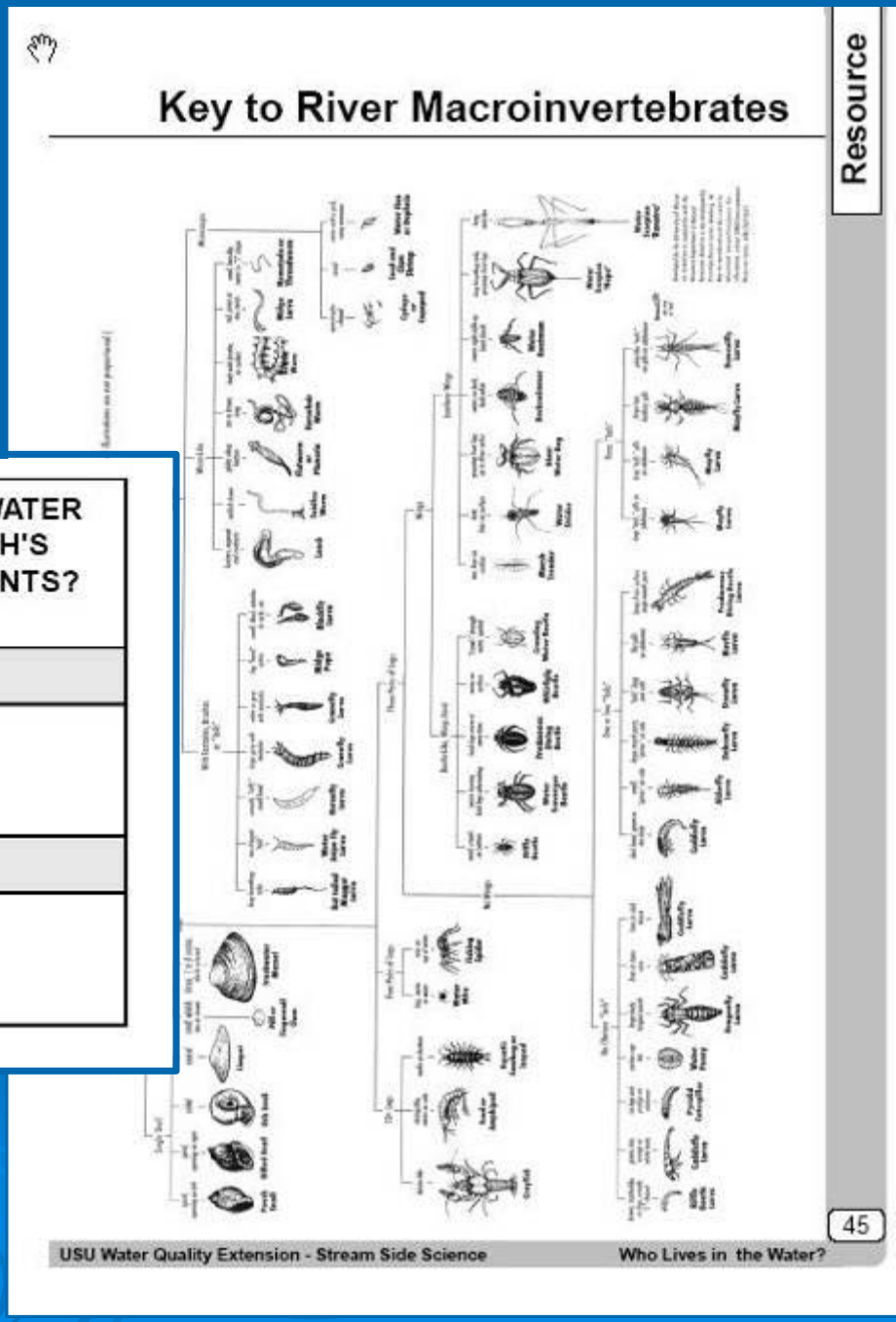
Suggestions on how to summarize, graph and apply the data.



Activities also include:

- field sheets,
- data sheets,
- keys,
- additional handouts

YOUR RESULTS	COMPARE YOUR RESULTS TO ALLOWABLE RANGE IN UTAH	DOES THE WATER MEET UTAH'S REQUIREMENTS? (Y/N)
Dissolved Oxygen		
ppm (mg/l)	Minimum of 6.5 mg/l for cold water fisheries and 5.5 mg/l for warm water fisheries.	
Temperature		
°C	Maximum of 27 °C for warm water fisheries and 20 °C for cold water fisheries.	



Endorsed by Utah's Governor Walker as part of her Statewide Watershed Initiative

STATE OF UTAH

OLENE S. WALKER
GOVERNOR

OFFICE OF THE GOVERNOR
SALT LAKE CITY
84114-0601

GAYLE F. MCKEACHNIE
LIEUTENANT GOVERNOR

July 12, 2004

Dear Teachers:

I am pleased to introduce Stream Side Science, a new curriculum that offers 9th grade students important information about our environment. The lessons and hands on activities are designed to instill in students an appreciation for our water resources. All of us should be more mindful of how we may sometimes waste this precious resource.

Stream Side Science was created for my Governor's Watershed Initiative by Utah State University Extension, in partnership with the Utah State Office of Education and the Utah Departments of Agriculture and Foods, Environmental Quality and Natural Resources.

The lessons and activities help fulfill core curriculum objectives for Earth Systems Science. In addition, they increase student awareness of watersheds, water quality, and water resources. I am excited about this new teaching tool that will expand young minds and challenge our youth to conserve and protect our watersheds.

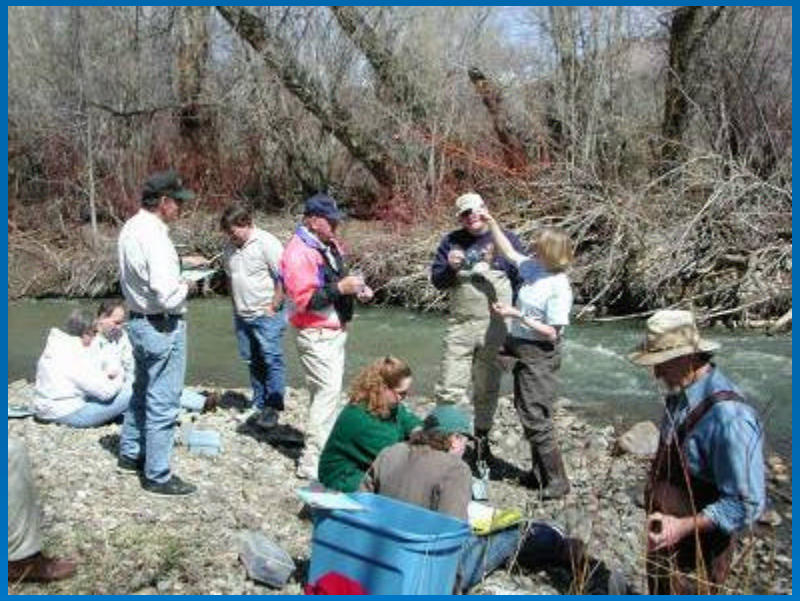
Sincerely,

Olene S. Walker

Olene S. Walker
Governor

Distributed by the Office of Education to each 9th grade Earth Science Teacher in Utah

Teacher training – a key element



Other support provided:

* Monitoring equipment available at all county Extension offices

* Additional equipment can be obtained through USU Water Quality Extension

* Curriculum available by request and on web

* Mini grants to get equipment or travel to site or training

Successes and results:

> 500 copies of Stream Side Science distributed in Utah and region

> 200 educators currently using Stream Side Science materials

Teacher Responses to Curriculum

> in 2005, - 100 teachers attended trainings on Stream Side Science

“I am going to apply all of this to my class next year!”

“The curriculum reinforced concepts, builds on previous understanding of watersheds, and modeled how I can present to students”

“best workshop I have been to in 20 years!”

Evaluation:

Pre and post testing of 1100 students who have been taught Stream Side Science activities.

Tests developed in coordination with office of education

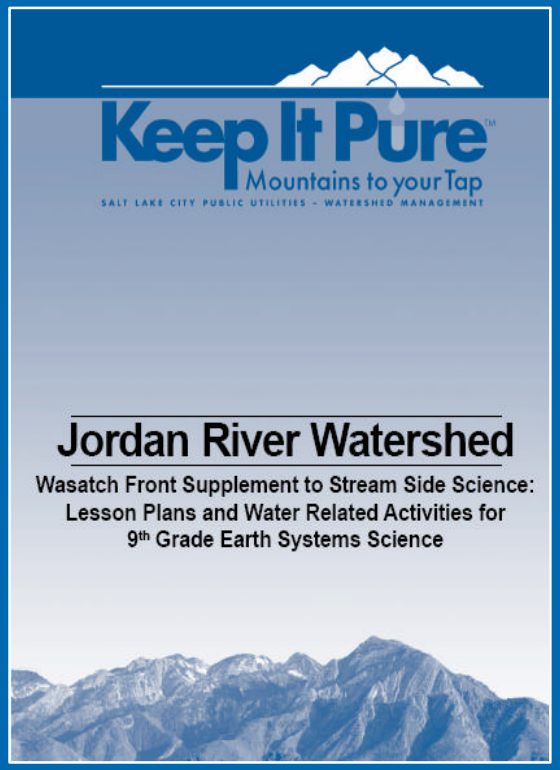
- Evaluate knowledge gain
- Identify additional problems of clarity, appropriateness, usefulness of materials

Test scores of students also used to evaluate teachers:

- prior knowledge or background in water quality science;
- interest water quality;
- attendance in a Stream Side Science training workshop.

The Future:

- Watershed Specific Supplements
- Web CT course offered at MSU
- Linking GIS/GPS teacher training with watershed science.



Mountains & Minds
MONTANA STATE UNIVERSITY
WebCT

learn more at:
www.extension.usu.edu/waterquality

Special thanks to:

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