That's Predictable - Stream Side Science

Summary

In this exercise, students will be asked to research and report on ecosystem changes that occur as a result of changes in an aquatic environment.

Materials

Access to the library and other reference materials
Access to the internet
- The Utah Stream Team Manual
Other reference sources (see a list on the Teacher Resource page (pdf))
Results from the Stream Side Science Activities (optional):
  - What's in the Water?
  - Riparian Review
  - Who Lives in the Water?

Background for Teachers

Purpose:
To predict how an ecosystem will change as a result of major changes in the abiotic and/or biotic factors.
Background:
For background information, see:

The Teacher Resource page (pdf) provided which includes a table showing the changes to an aquatic ecosystem and the ecosystem response.
The Chemical Properties section (pdf) of the Utah Stream Team Manual which discusses abiotic factors in an aquatic ecosystems including how each chemical property changes due to natural and human influences, and why the factor is important in aquatic ecosystems.
The Biological Properties section (pdf) of the Utah Stream Team Manual which discusses macroinvertebrates and riparian vegetation in an aquatic ecosystem.
The Physical Properties Section (pdf) of the Utah Stream Team Manual which discusses stream flow and stream structure and how those are affected by human activities.

Intended Learning Outcomes

Use Science Process and Thinking Skills

Observe objects, events and patterns and record both qualitative and quantitative information.
Use comparisons to help understand observations and phenomena.
Evaluate, sort, and sequence data according to given criteria.
Plan and conduct experiments in which students may:

Identify a problem.
Formulate research questions and hypotheses.
Predict results of investigations based upon prior data.
Identify variables and describe the relationships between them.
Plan procedures to control independent variables.
Collect data on the dependent variable(s).
Select the appropriate format (e.g., graph, chart, diagram) and use it to summarize the data obtained.
Analyze data, check it for accuracy and construct reasonable conclusions.

Prepare written and oral reports of investigations.
Distinguish between factual statements and inferences.

Manifest Scientific Attitudes and Interests
Voluntarily read and study books and other materials about science.
Raise questions about objects, events and processes that can be answered through scientific investigation.
Evaluate scientifically related claims against available evidence.

Demonstrate Understanding of Science Concepts, Principles and Systems
Apply principles and concepts of science to explain various phenomena.

Communicate Effectively Using Science Language and Reasoning
Provide relevant data to support their inferences and conclusions.
Use precise scientific language in oral and written communication.
Use proper English in oral and written reports.
Use reference sources to obtain information and cite the sources.

Demonstrate Awareness of Social and Historical Aspects of Science
Cite examples of how science affects human life.

Instructional Procedures

Classroom Activity:

Ask the students to review all the abiotic and biotic factors in an aquatic ecosystem. Optional: Refer to the activities, What's in the Water?, Who lives in the Water? and Riparian Review.
Discuss the role that these factors play in the environment. Have the students discuss how a change in abiotic or biotic factors would affect the aquatic ecosystem.
Explain to the students that they will choose a change in abiotic or biotic factors in an aquatic ecosystem and explore it further in the form of a written paper, presentation or other format of the teacher's choice. For ideas, see the Teacher Resource page.
To help the students get started, choose a topic and with the class, form a hypothesis of what might happen to the ecosystem as a result of the abiotic or biotic change. With the class, develop a list of sources where they will be able to find more information.

Suggested points that students may include:

Geographic scale of problem -- e.g., watershed scale vs.backyard scale.
Magnitude of problem -- e.g., slumping of entire hill slopes vs. loss of banks in small sections.
Reversibility of changes -- e.g., loss of topsoil from a major avalanche vs. loss of vegetation in an avalanche.
Driving factors for changes -- e.g., erosion from a construction site.
Natural forces -- e.g., floods, tornadoes, droughts, global warming.
Economics -- e.g., developers of housing developments or logging/mining interests.
Politics or regulations -- e.g., requirements by law.
Cost/benefits -- i.e., who or what will benefit, who will pay (consider costs and benefits to society, to individuals, to ecosystem functions or to different components of ecosystems).
Have the students research further on their topic for changes that have occurred in their area.

Applying the Information:

Use the information in the student's papers to hold a debate for or against each of the changes in abiotic or biotic factors.
Have the students take action in their community on one of the topics they researched. For example:
Work with local agencies to restore a section of a stream.
Service project such as a "stream clean-up"
Make a web site

Educate the public about the issue at a public forum or through educational materials at a public location such as a park or mall

Participate in volunteer monitoring through USU Water Quality Extension

Further Discussion:

1. Do you think that ecosystems will always be changed if there are small changes in abiotic or biotic factors?

- *Change is a natural part of ecosystems, and all healthy ecosystems are to some extent "self-correcting." For example, an early snowstorm may cause many trees or branches to fall, but in a healthy riparian system or healthy forest the trees will eventually regrow and any openings in the forest canopy will fill again. In fact, many ecosystems depend on some degree of disturbance. For example, sprouting young cottonwoods in riparian areas often depend on a flood event.*
- *Some disturbances in ecosystems are more important than others. For example, the accidental introduction of a tiny mussel into the Great Lakes has led to extremely clear waters from these efficient filter feeders, but also to changes in food availability for other organisms, and economic impacts when huge mats of these mussels attach to intake pipes, docks and boats.*

2. What could be done to protect aquatic ecosystems from these changes?

Protecting through laws and regulations: Some potential problems are so severe that we regulate them with laws. A few examples are:

- *"Point source" water pollution: EPA and Utah's Division of Water Quality regulate how much and what kind of pollutants can be dumped into our lakes and rivers from factories, municipal treatment plants, and large animal feeding operations. All point sources must have a "discharge permit" in Utah.*
- *Modification of a stream channel: No one in Utah can modify a stream channel (e.g., take gravel from the channel or channelize the stream banks) without a permit from the state Division of Water Rights. Protecting through voluntary approaches: In many cases, rather than regulating behavior with laws, we depend on people making the right decisions on how to best manage their own lands and activities. These are often called "Best Management Practices." Because these practices are voluntary, it becomes especially important that citizens are well educated on how their activities affect the environment and why.*

For aquatic systems, some Best Management Practices include:

- *Healthy riparian areas and buffer strips along streams and canals that shade the water, protect the banks from erosion, and filter runoff of pollutants.*
- *Grassy swales or retention basins that slow the flow of urban runoff and promote infiltration rather than surface runoff.*
- *Lawn care practices that avoid over fertilizing lawns and gardens and watering lawns only when needed.*
- *Cleaning up pet waste so it is not washed into streams.*

Bibliography

Lesson plan authors: Andree Walker and Nancy Mesner (Utah State University Water Quality Extension)

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Additional resources can be found on the USU Stream Side Science 9th Grade Curriculum web page.

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