STREAM ECOLOGY RESEARCH PROJECT

(Grade Level: 7-12)

STAGE 1—INVITATION

True learning begins with a question or problem in the mind of the learner. In the first stage of the teaching/learning model, the teacher poses a simulated research problem to students. The teacher tips below describe how to get started. See pages 5.9-5.10 for a review of stages of the model.

Teacher Tips

1. Establish "rules" for brainstorming. The focus of brainstorming is to get the students to contribute their ideas and develop their "need to know." The teacher (and a guest scientist, if available) can help elaborate on student suggestions and ask questions to stimulate thinking.

2. Develop an appropriate research problem. The purpose of these classroom and field activities is to help students develop a deeper understanding of major science concepts such as systems and cause and effect. In addition, students will learn a variety of practical field and laboratory skills (determining velocity of stream flow, determining the species of plants in a given area, and using journals); practice traditional science process skills (observation, communication, measuring); and exhibit "scientific habits of mind" (attitudes) such as reliance on data, skepticism, and willingness to modify explanations.

By participating in field/laboratory activities, students add to their content knowledge about the ecology of the shrub-steppe. Equally important is the emphasis on the process used by students to acquire this knowledge. Students participate in a teaching/learning experience that parallels the way scientists uncover knowledge and solve problems.

When developing specific classroom activities, you might want to use the following organizational approach:

a) Initially, brainstorm your desired outcomes: What major science concepts could a river, stream, or terrestrial study help develop (system, cause and effect)? What content/concepts should be learned? What attitudes (relying on data)? What laboratory skills (using a binomial key)? What process skills (data analysis)? How could the study of ecology help develop the learner's problem-solving, logical, and analytical reasoning skills?

Washington EALRS

Science

Standard: The student understands and uses scientific concepts and principles. To meet this standard, the student will:

1.1 use properties to identify, describe, and categorize substances, materials, and objects, and use characteristics to categorize living things.

Standard: The student knows and applies the skills and processes of science and technology. To meet this standard, the student will:

2.1 develop abilities necessary to do scientific inquiry.

2.2 apply scientific knowledge and skills to solve problems or meet challenges.

Standard: The student understands the nature and contexts of science and technology. To meet this standard, the student will:

3.1 understand the nature of scientific inquiry.

Mathematics

Standard: The student uses mathematical reasoning. To meet this standard the student will:

3.1 analyze information.

3.2 predict results and make inferences.

3.3 draw conclusions and verify results.

Standard: The student understands how mathematical ideas connect within mathematics, to other subject areas, and to real-life situations. To meet this standard, the student will:

5.2 relate mathematical concepts and procedures to other disciplines.

5.3 relate mathematical concepts and procedures to real-life situations.

b) Brainstorming continues as you elaborate the list of outcomes by connecting them to questions that might be posed to stimulate inquiry and activities that engage learners in hands-on investigations. Potential activities are assessed for their appropriateness (grade-level, required preknowledge) and feasibility. Next, you develop questions that will be meaningful to learners and will invite their participation. At this point, you may begin to consider questions of scope (too broad? If you are not sure check with a scientist who works in the field), time (do you have a full quarter, three weeks?), and resources needed to conduct the unit.

c) Available resources are a critical component of planning. Not only is there the question of available resources that can be applied to the activity, but whether you have the time and funding to get additional resources.

d) Once outcomes, invitational questions, and resources are identified, the sequence of instruction is organized in an instructional approach that parallels the way practicing scientists uncover knowledge and solve problems.

e) Finally, you need to create a science scenario (story) that provides a meaningful context (ties activities together) to motivate the student investigator. The scenarios that work best with students are "real life" situations, based on actual/simulated

Washington EALRS (contd)

Reading

Standard: The student understands and uses different skills and strategies to read. To meet this standard the student will:

1.5 use features of non-fiction text and computer software.

Standard: The student reads different materials for a variety of purposes. To meet this standard, the student will:

3.1 read to learn new information.

3.2 read to perform a task.

Writing

Standard: The student writes in a variety of forms for different audiences and purposes. To meet this standard, the student will:

2.1 write for different audiences.

2.2 write for different purposes.

2.3 write in a variety of forms.

Communication

Standard: The student communicates ideas clearly and effectively. To meet this standard, the student will:

2.1 communicate clearly to a range of audiences for different purposes.

2.2 develop content and ideas.

2.3 use effective delivery.

2.4 use effective language and style.

2.5 effectively use action, sound, and/or images to support presentations.

Standard: The student uses communication strategies and skills to work effectively with others. To meet this standard, the student will:

3.1 use language to interact effectively and responsibly with others.

3.2 work cooperatively as member of a group.

3.3 see agreement and solutions through discussion.

research problems. Using this science context, students can apply new-found knowledge and ask questions that could suggest further research.

f) Embedded in this planning is attention to the cognitive, affective, and psychomotor processes of learning. Students need to reflect on the following questions throughout their activity:

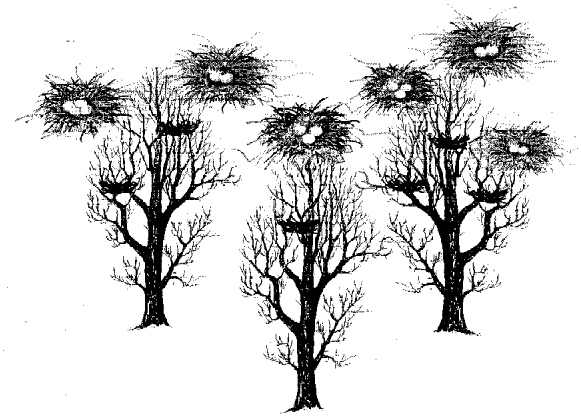
What do I know?

What do I think I know?

What would I like to know?

How do I feel about my experience?

How can what I learned be applied to the problem?



Activity: Defining the Research Problem

Learning Outcomes (things students know and are able to do)

As a result of this activity students will have

- brainstormed what they need to know to address the research problem
- read and understood background information (i.e., basic information on how streams function as a holistic ecosystem)
- defined a scope of work (tasks to be completed) to address the problem.

Materials

- Copies of research scenario description
- Student journal

Simulated Research Scenario

A small town is located along a trout stream popular with local fishermen. Because the town and its water treatment plant contribute various effluents to the river we have been asked by the city council to determine if these effluents are detrimental to the ecology of the stream.

Procedure

1. Share the simulated research problem with the students and ask them to take the role of a research team. Note: Other good research scenarios could look at the impact of construction materials, riparian tree removal, dams, irrigation returns, and differences in insects in local rivers.
2. Guide students (with a biologist/ecologist if available) in a preliminary brainstorming session to determine what the research team needs to know to address this research problem. Is the problem worth considering? What are key or main objectives? What is the team being asked to do? What is most important to do or learn related to the problem?
3. Write all suggestions on a flip chart, overhead projector, or whiteboard. All input is important because each student brings with them a different knowledge base and understanding. Discussion should lead to the "realization" that the team

needs additional information. It's important for students to realize they don't know what they need because they don't (yet) have enough information.

4. After students have participated in the initial brainstorming session, they will want to know more about stream ecology so they can proceed with the research problem. Basically, students have recognized their need to know more information and "accepted" the invitation (or challenge) presented by the scenario.

   At this point, background information on basic stream ecology should be presented. A knowledgeable aquatic ecologist, preferably one with experience in the study of streams and knowledge of insect taxonomy, could present this. Teams can be formed to research specific aspects of stream ecology on the Internet. The information should help acquaint students with how streams function as a holistic ecosystem. This information provides a dialogue for field and laboratory work. (See Attachment 1 for examples of information that could be provided.)

5. Lead a second brainstorming session. As a group, try to define and refine the student research team's scope of work based on the research scenario. Return to the list developed from the first brainstorming session. Look at the research problem again. What is the student research team being asked to do? What is most important to do or learn related to the problem? What did students learn from the background information that would help them pose additional questions or suggestions? Given the time, money, and number of people participating in the project, what can the student research team realistically accomplish? The goal is for students to determine that they need to conduct a study of the stream/river that focuses on the physical, chemical, and biological aspects of the stream/river.

The discussion should yield answers to the following questions:

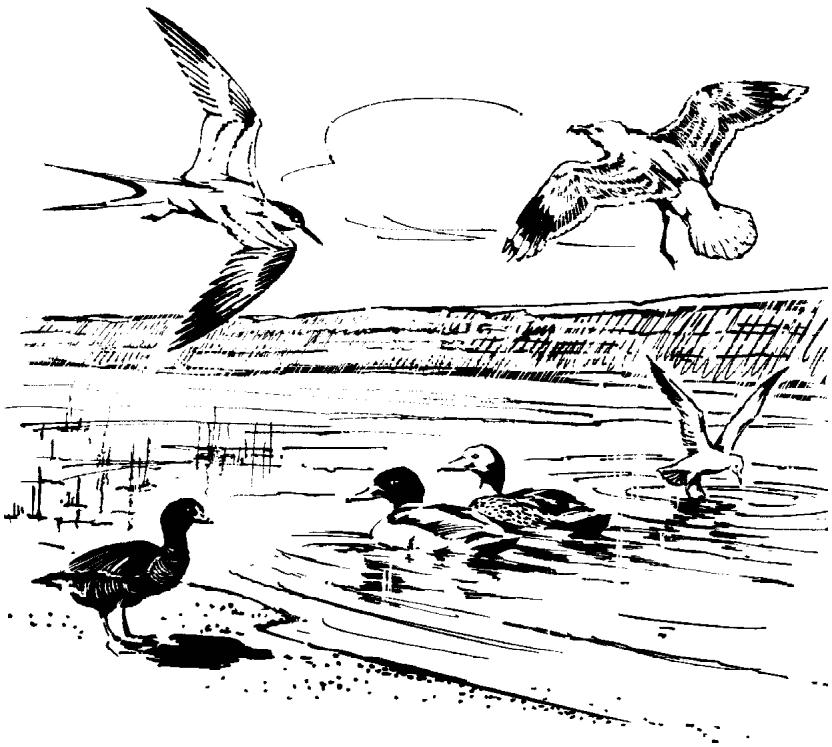
Question : What information do you need to know about the stream being studied?

Answer : Information on the

- geological nature of the basin [composition of rocks (soluble/insoluble)]
- light penetration to the streambed
- human activities in the area
- biological characteristics of the stream
- physical and chemical characteristics of the stream.

Question : What field/laboratory work should be conducted to gather data to evaluate the ecological characteristics of the stream being studied?

Answer : Conduct biological, physical, and chemical assessments of the stream. The biological assessment should consist of field collection and laboratory analysis of invertebrates. The physical assessment should include field measurement of stream width, depth, velocity, volume, and substratum size. The chemical assessment should include field measurements of alkalinity, dissolved oxygen, pH, and temperature.

This information is important because it helps determine the number and type of organisms that live in a stream. For example, water temperature can influence the rates of photosynthesis of instream plants, metabolism of organisms, growth, and decomposition of organic matter. The water current (velocity) shapes the habitat, carries food and nutrients to the organisms, and carries away their metabolic wastes, which, in turn, becomes a part of downstream communities. Aquatic insects are key indicators of the health of a stream.

6. The outcomes of the brainstorming session are that the student research team determines that their scope of work will include measuring the physical and chemical characteristics of the river and obtaining quantitative and qualitative studies of the invertebrate population (biological characteristics).