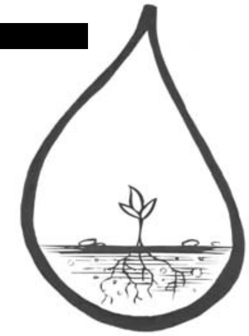

TOPIC:
Background research

OBJECTIVES:
- Students will develop and test hypotheses through collecting and recording water quality data.

LENGTH:
2 to 3 hours

ENVIRONMENT:
Outdoors in a location with safe stream access for students.

MATERIALS:
- Access to a water resource professional
- Transparency Tube
- Water quality monitoring kit w/ dissolved oxygen and pH tests
- Oranges and 10' lengths of string for each group
- 2 pairs of wading boots for each student group
- A clipboard for each student
- Copies of the data forms for all students
- Maps and pictures of test sites and streams
- Access to a van or other means of transporting students to monitoring sites.

Testing the Water

Background:
Scientific processes are central to identifying, researching, planning and completing environmental service-learning projects. In this activity, students explore the scientific method observing, hypothesizing and testing water quality at various locations along a safe stream. They develop a valuable understanding of parameters associated with water quality. Through this activity, students may also realize that threats to stream environments may be more complex than previously predicted.

Activity Outline:
Selecting Monitoring Sites:
Identify a water resource professional to work with the team before and during the activity. Due to the technical nature of water quality monitoring, it is essential that students learn from someone familiar with techniques and equipment. Professionals will also provide valuable advice concerning sampling locations and dates. Contact representatives from organizations like Soil and Water Conservation Departments, Natural Resource Conservation Services, University Extension Service, Department of Natural Resources, etc. for help identifying appropriate personnel. It may be worthwhile to connect this activity with either *Expert Advice* or the *Observation and Adventure Trip* activities.

Select locations for stream testing at least 2 to 4 weeks before the activity date. Either multiple locations along a single stream or different streams that exemplify different characteristics relevant to the service project (i.e., flat vs. steep, muddy vs. clear water, etc.) may be selected. In any case, monitoring sites should allow students safe access to water from the stream bank. Good sites will have shallow sturdy banks that go right to water's edge. Water should be reachable from a crouched position and no deeper than the tops of wading boots.

Cut a 10' length of string, and gather one orange for each group of students to use for measurement of water velocity. Transparency tubes and water quality monitoring kits also need to be secured in sufficient numbers for students to work in groups of 5 or less. Water resource professionals may have access to these materials. Otherwise, leaders should purchase from a scientific supply catalogue. Because accuracy is not overly important to the objectives of this activity, inexpensive test kits will suffice.

Permission and Preparation:
Follow facility guidelines and timelines for securing transportation to the site. Before departing on the trip, make sure that all participants also have a permission slip signed by a legal guardian. This form should conform to any safety needs expressed by trip leaders. It should 1) clearly

communicate all risks associated with the activity, and 2) solicit any health conditions that might bar a participant from safely participating.

Students need to dress for the weather forecasted on the trip dates. Prepare a packing list, including items to bring and those to leave at home. Cover trip specifics like where bathrooms and phones will be located, what the landscape will be like, etc. Make sure that all students have this information at least two-weeks prior to the trip. Pre-trip meetings are a good means of disseminating and discussing this information. Water resource professionals should be contacted 1-week prior to the arrival date to confirm procedures, times, concerns, etc.

In addition, assemble clipboards and copies of the data forms for all student groups. Make sure students are prepared with pencils for recording data. Prepare maps and pictures of test sites for group scrutiny.

Testing the Waters—In Class Exercise:
Students gather for the activity. Take a moment to review the objectives. In order to better understand water quality and how it is measured, students will plan an experiment, collect and interpret water quality data. Ask students to define and detail steps of the scientific process—observation, formulation of hypothesis, experimental design, data collection, interpretation, conclusion. Discuss each of these, and answer any questions. Then, brainstorm a list of threats to water quality in local streams. Ask students to link these with potential stressors. For instance, they might suggest loss of underwater plant life as a threat caused in part by increased stream turbidity. It might be useful to complete *Remedial Action* before tackling this part of the activity.

Describe each of the water quality parameters students will test. Note how these parameters relate to stressors identified previously by students. Background information is available in the *Understanding* section of the Duluth Streams website www.duluthstreams.org.

Finally, recall attention to the scientific process outlined earlier. Lest team members just go through the motions of testing parameters, it is imperative that they observe the sites, make some predictions about their tests, develop some hypotheses, and design experiments before heading out into the field. Split students into test groups of 4-5 that will work together in the field. Provide each group with pictures and maps of the sites as well as their data collection forms. Ask them to explore these pieces, consider the weather, etc., and predict values for each of the sites. Once all have finished, ask students to discuss and explain their predictions. Develop hypotheses based on group predictions. For instance, the group might hypothesize that turbidity will be lower at test site #1 than test site #2.

Collect data forms for safe-keeping. Remind students to dress for the weather and turn in any required permission forms.

Testing the Waters—Field Exercise:
Upon arrival at the first test site, provide students a few minutes to explore and get used to their surroundings. Once the novelty of the setting has diminished, ask students to gather for directions. Briefly discuss rules and expectations. Take a few moments to introduce the water resource expert who will help with the activity. Allow time for the specialist to describe his or her interests, background and job responsibilities. Then, review the agenda, safety protocols and answer questions.

Remind the team of hypotheses generated earlier. Preview in detail how students can test these hypotheses using monitoring kits, oranges and string. Follow directions for kit tests and transparency tubes. To test water velocity, two students from each group should pull taught the ends of their 10' length of string at a point up- to downstream. Drop the orange in the water at the upstream edge of the string, and count the number of seconds it takes to reach the downstream edge. Divide the count by 10, which provides an approximate velocity in feet per second. Answer questions. Then, provide groups with their data forms, suggest they spread out along the stream, and allow them time to test the water. The resource expert may float around helping groups and discussing results.

Repeat the novelty reduction and testing process at each site.

Conclusion:
Students gather after recording data at the final site. Review again the objectives of the activity. Remind them of the scientific process, and hypotheses generated prior to the tests. Then, ask each group to share 1) their results, 2) how these compare with their predictions made in class, and 3) how their results compare with hypotheses. As a team, consider and discuss any lessons learned through the process. For instance, groups may discover in many instances that water quality is much more uniform in and across streams than expected. Have students apply these lessons to their service project. Does this have any effect on our action planning or research? Provide the resource expert time to interpret the results for students.

Afterward, refer often to the experience, asking students to recall lessons learned and expert interpretation of their results. Students should often explicitly apply these lessons to the team service-learning effort.

Water Quality Data Form

Test Site #1:

Describe the Site: What does the water look like? What does the land around the water look like? What might some problems in this part of the stream be? Describe in as much detail is you can. You can write your description, draw a picture, or whatever makes the most sense to you.	
Temperature Predicted Value: ____ °C Actual Value: _____ °C	**pH** Predicted Value: ____ Actual Value: _____
Dissolved Oxygen Predicted Value: ____ ppm (parts per million) Actual Value: ___ ppm	**Velocity:** Predicted Value: ____ fps (feet per second) Actual Value: ___ fps
Turbidity Predicted Value: ____ cm Actual Value: _____ cm	**Comments:**

Test Site #2:

Describe the Site: (Same Directions as First Test site)	
Temperature Predicted Value: ____ °C Actual Value: _____ °C	**pH** Predicted Value: ____ Actual Value: _____
Dissolved Oxygen Predicted Value: ____ ppm (parts per million) Actual Value: ___ ppm	**Velocity:** Predicted Value: ____ fps (feet per second) Actual Value: ___ fps
Turbidity Predicted Value: ____ cm Actual Value: _____ cm	**Comments:**

Test Site #3:

Describe the Site: (Same Directions as First Test site)	
Temperature Predicted Value: ____ °C Actual Value: ____ °C	**pH** Predicted Value: ____ Actual Value: ____
Dissolved Oxygen Predicted Value: ____ ppm (parts per million) Actual Value: ___ ppm	**Velocity:** Predicted Value: ____ fps (feet per second) Actual Value: ___ fps
Turbidity Predicted Value: ____ cm Actual Value: ____ cm	**Comments:**

Test Site #4:

Describe the Site: (Same Directions as First Test site)	
Temperature Predicted Value: ____ °C Actual Value: ____ °C	**pH** Predicted Value: ____ Actual Value: ____
Dissolved Oxygen Predicted Value: ____ ppm (parts per million) Actual Value: ___ ppm	**Velocity:** Predicted Value: ____ fps (feet per second) Actual Value: ___ fps
Turbidity Predicted Value: ____ cm Actual Value: ____ cm	**Comments:**