Unit III. Field Preparation

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III-1. In the Field

Planning is essential to successful field monitoring. Before launching into the "nuts and bolts" of data collection be sure you have clearly identified goals. Knowing *why* you want to monitor will largely determine *where, what, how* and *when* you monitor.

This unit will help you to consider the science and logistics of your study and to avoid common mistakes.

- The "In the Field" guidelines that follow offer general help for organizing your field monitoring. They compliment the specific "Sampling Directions" found in Section IV – Field Investigation. Be sure to consult both sets of guidelines before conducting your tests.

Where to Sample

1. Select a stream

- Involve your students in selecting a stream. This will help foster a sense of ownership for the stream and the program.

- The *Utah Stream Team* is specially designed to monitor flowing water - creeks and streams. Ponds and wetlands offer rewarding monitoring experiences, too, but may require a few modifications in your approach. Refer to "Monitoring a Pond or Wetland" for help monitoring one of these water bodies.

> Visit your field site before you begin monitoring with students. This will help ensure a more successful experience.

- If possible, locate a stream close to your school – walking distance is ideal. Close proximity allows for greater frequency and flexibility in monitoring, and less expense if you have to bus or carpool.

- Local resource management agencies can direct you to interesting sites.

2. Select a sampling site

Here is an opportunity to *revisit your monitoring goals*.

- If you want to represent the water quality of the entire stream, sample a "representative section." This section will have the common forms of vegetation, bank structure and stream shape for that stream.

- If you want to investigate human impacts, such as heavy development, choose a site where you can compare an impacted area with an unaffected area. For example, to isolate the affect of a potential impact, sample upstream of the activity (which will serve as a control site) and just downstream of the impact. You may also want to sample a third site, farther downstream, to determine the range of the impact. A nearby tributary can also serve as a control site.

> STOP If you suspect a point-source of pollution or contaminants in your area, contact the Division of Water Quality, but avoid sampling near the sources of potential pollution. [Refer to the "Resource" appendix for contact information].

- Regardless of your goal, your sampling site should be *accessible* to everyone in your class and *safe*.

3. Document your site

If you are going to sample your site again, or report your findings, be sure to document your location.

- Obtain a topographic map of your area. Detailed 7.5 minute (1:24,000) "quad" maps are recommended. To obtain one, check with a local resource management agency (UT Dept of Natural Resources) or camping supply store. You can also print quad maps through the US Geological Survey's web site - **http://www.water.usgs.gov/.**

- Locate and clearly mark your site on the map. Keep the map with your *Utah Stream Team* manual. It will serve as a valuable teaching tool and also help future groups locate the site.

What to Sample

Utah Steam Team provides the means for sampling seven different measurements of the water itself +and an array of physical and biological components of the stream and riparian area. There are many possibilities for investigating even further. Based on your goals, you may want to include all or just some of these measurements. The questions below will help you decide what to sample.

How much time do you have?

If your field time is short you can limit the scope of your sampling to only a few **parameters**, such as nutrients. Your areas of interest or concern will largely determine which parameters to include.

Do you want to explore aquatic life?

Exploring the **macroinvertebrates** in the stream is exciting for students of all ages, and is an excellent activity for younger students. Macroinvertebrates are an interesting way to introduce the concept of "food chains" and offer great opportunities to study animal behavior.

Do you want to investigate human influences?

You may choose to monitor the effects of a particular land use in your watershed. Consult the "Watersheds – Land Use" section for help identifying and sampling land use impacts.

Do you want to investigate natural influences?

- Research the geology and vegetation around your stream and watershed. Your region may have naturally high levels of certain minerals which affect water quality. Soil types and vegetation affect the physical nature of your stream.

- Your students can look at the variability in water quality that exists within a single site. Compare samples from **riffles**, **eddies**, **backwaters**, shaded areas or exposed areas. You may also find interesting differences above and below a beaver dam.

Much of the soil in Southern and Western Utah is highly alkaline. These soils can cause higher pH in water. Streams that run through these regions may also experience natural bank erosion because of the loose soil and sparse vegetation. How do you think this affects bank structure and turbidity levels?

Do you want to investigate the relationship between different water quality parameters?

Sample several different parameters and determine if or how they relate to each other. For example, turbidity often increases with stream flow while phosphate concentrations may decrease. Sample flow, turbidity and phosphate several times over an extended time period and graph the data together to help illustrate relationships.

How to Sample

Answer the questions below to determine "how" you will collect your samples.

Are you collecting chemical samples?

- Collect your sample from an area where water is moving at a moderate pace. Avoid backwaters (unless you want to compare flowing and still water).

- Collect your sample from just below the water's surface to avoid floating oils, scums and other materials that may alter your results.

- Test water samples immediately after collecting or your results may change.

> Most chemical tests must be run within 30 minutes of collection. Nitrate and phosphate samples may be brought back to the classroom for testing if analyzed within 24 hours. (Keep samples cool and in a dark place.)

Are you collecting physical or biological samples?

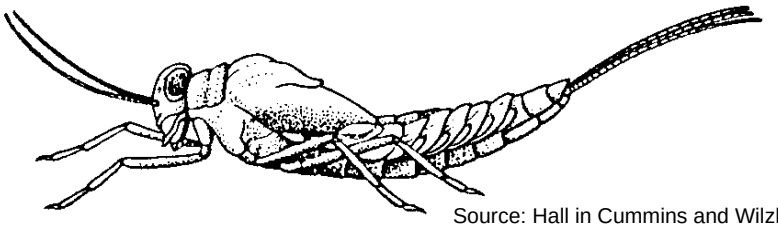
For more diverse biological samples, sample from different parts of a stream, such as slow, pooled areas as well as fast running riffles.

For the most representative flows, sample a straight stretch of stream with fairly even flow. Avoid pools, stagnant areas or stretches where the stream flow has backed up.

Do you want to increase your accuracy and precision?

- Accurate data are representative of the true value. Keep in mind that the tests and measurements used in this program are simplified field methods which will never be as accurate as monitoring with professional equipment and methods. You can increase the confidence in your results, however, by taking several measurements and averaging these.

- The precision of the data represents how well you can repeat the same measurement. Your precision increases when multiple measurements become more consistent and close to each other. To increase precision, have students practice the tests ahead of time, and take care to follow directions carefully and consistently. Be as consistent as possible in how, when, and where you sample to accurately assess trends in water quality. If you stray considerably in these areas, make a note of it on your data collection sheet.



Source: Hall in Cummins and Wilzbach

When to Sample

The only rule for when to sample is: *whenever you can.* Sample as often as you can or when your schedule allows for it. Sampling once a year is far better than not at all. To help you determine when to sample consider how water quality changes in the following ways.

Daily changes

Samples taken at different times of the day may yield different results. Changes in stream flow, air temperature, shading and the photosynthetic activity of aquatic plants affect chemical properties of water.

Compare early morning samples to late afternoon samples to find differences in pH, temperature and dissolved oxygen values. Consult the background information for each parameter in Unit IV to find out why.

Seasonal changes

- Nutrient levels may vary seasonally with changes in the abundance of aquatic plants (plants use up nutrients in the water).

- Spring runoff may increase nitrate levels, stream flow, and turbidity.

- Macroinvertebrate populations also vary in abundance and types across seasons. You'll find the greatest diversity in the spring and fall, and easier collecting in the fall (when water levels are low).

- Sample once each season to see how water quality changes over the course of the year.

Be aware of the added safety issues that accompany high spring streamflows. If high flows are a concern, sample in the late summer and fall when flows are lower.

Special events

- High runoff events, such as spring snowmelt, may offer different results than other times of the year. Look for lower pH levels and higher turbidity.

- If you wish to monitor the effects of human actions on water quality, monitor before, during and after the action. For example, if your class is interested in the effects of a construction project on turbidity in a nearby stream, measure turbidity in the stream before, during, and after the project.

Long-term trends

Long-term trends will provide better insight into the health or functioning of your stream than one-time readings. Choose time(s) of year that is easiest for your group to get to the field. Try to return each consecutive year at that time.

III-2. Organizing Your Group

What factors will influence how you organize your group?

- **What you would like your students to gain from sampling?** In some programs each student samples many different parameters. In other programs students specialize in one or two parameters and then share their findings with the rest of the class.
- **How much stream do you want to study?** If you wish to monitor as much of a stream as possible (and you have enough adult supervisors) spread separate monitoring groups over a longer distance.
- **How much equipment do you have?** More equipment allows you more flexibility. For example, you may choose to create specialized sampling teams, such as a "nutrients team," in which several students, with several test kits, take multiple samples of the same parameter.
- **How prepared is your group?** Proper classroom preparation allows groups more flexibility in the field; students can operate in autonomous groups (with an adult along for safety) and can run more tests in the same amount of time.
- **How large is your group?** If you have few students (about 10 or less) then you may want to work together in a single group. Larger groups will find it more effective to split-up to avoid distractions.

How much time? How many students will you need?

These estimates are based on an eighth-grade skill level, assume practice sampling has occurred, and include any time needed to perform calculations on the "Data Collection Sheets."

Activity			Time required (minutes)	# persons required
Physical	Stream flow		45	4
	Stream shape	Channel pattern	2	1
		Substrate type	15	3
		Riffle/run/pool[1]	15	3
	Temperature		2	1
Chemical[2]	Nitrate		15	1
	Ammonia		5	1
	Phosphorous		10	1
	pH		2	1
	Dissolved oxygen		3	1
Biological	Macro-invertebrates	Collect and look	40	2
		EPT	60+	3 or more
		WQ Rating Index	120+	3 or more
	Riparian	Greenline	30	2
		Canopy cover[3]	30	2
		Ground cover	35	2

[1] The riffle/run/pool ratio can be measured at the same time as the pebble count with no additional persons. Estimate 20 minutes to complete both activities if done together.
[2] The chemical tests must sit for various periods of time. Students can perform other activities while waiting.
[3] The canopy cover can be measured at the same time as the greenline with no additional persons. Estimate 40 minutes to complete both activities if done together.

What roles will your students assume?

Below is one example of an organizational plan. This plan divides groups into six-person teams. Each person on the team has a unique role. In this plan, all the Utah Stream Team water chemistry parameters are sampled, as well as stream flow and macroinvertebrates.

Consider the following points, whether you follow this plan or create your own.

- Students should clearly understand their role before reaching the field.
- Students should be held accountable for completing their tasks.
- Give students a choice in the role they assume. This is a great planning exercise and further increases motivation for the program.
- Have students switch roles on each subsequent visit.

Team leader

- Makes sure team members know and accomplish their tasks.
- Makes sure the group stays focused and on schedule.
- Reads sampling directions aloud and makes sure they are followed.
- Conducts a nutrient test.

The 6 plan will take 2 to 3 hours to complete, depending upon your groups' abilities and preparation.

Assistant team leader

- Assists in measuring the length intervals.
- Assists in measuring width of the stream.
- Double-checks all measurements.
- Helps with stream velocity test.

Recorder

- Holds the notebook and records all information on "Data Collection Sheets."
- Makes sure group agrees on all results.
- Conducts temperature tests.
- Helps identify macroinvertebrates.

Wader

- Measures depth of stream to determine cross-sectional area.
- Assists with velocity test.
- Collects Dissolved Oxygen sample.
- Assists with macroinvertebrate sampling and identification.
- Conducts turbidity test.

Timer/measurer

- Carries stopwatch and times velocity test.
- Carries tape measure and measures distances (places flags at designated intervals)
- Assists with measuring width of stream
- Conducts pH test

Equipment keeper

- Helps carry tub with all equipment in it.
- Distributes equipment.
- Returns supplies and equipment to the tub; ensures all equipment is accounted for.
- Conducts two nutrient tests.

III-3. Field Behavior

Volunteer water quality monitoring is a great tool for building appreciation and respect for our natural resources. Consider whether the actions of the entire group – teachers, students, volunteers – work towards this goal. Give careful thought to the following:

How can we help the wildlife and resources of our site?

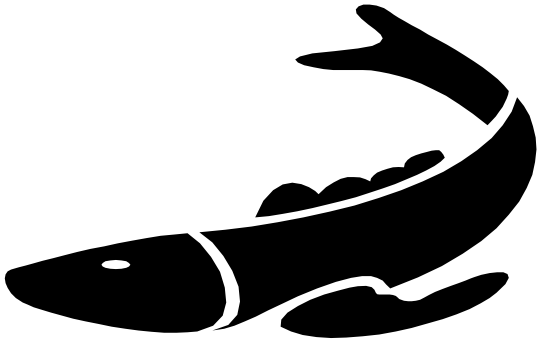
Groups of people, both small and large, have the potential to impact the aquatic and terrestrial environment in a short amount of time. Follow these guidelines to lessen your impact.

- Choose a site with well-vegetated banks. Avoid bare or unstable banks to minimize erosion.
- Avoid monitoring during particularly wet weather. Wet soils and plants are easily disturbed.
- In the summer, if the water is low, the stream bed may be the best route for walking. The vegetation on the banks will thank you for it!
- Replace rocks and logs that have been overturned – these are homes for many critters.
- Handle organisms gently. They'll appreciate being returned quickly to their homes.
- Place aquatic organisms directly into water-filled containers for study. Keep the containers shaded so the sun doesn't heat the water to harmful levels.
- Look for fish spawning areas – **redds**. Redds are round or elliptical areas of clean gravel about 1-3 feet long. They provide great opportunities for discussion but avoid walking near them.

What should we know about collecting live samples?

Consider the impact of collecting (permanently removing) macroinvertebrates or other animals and plants from the site. Removal of a few items may have a minimal effect on the environment. However, students learn from the respect leaders show for each individual creature. Discuss the following aspects of collecting with students.

- Disturb animals as little as possible. The best place to learn about them is in their natural environments.
- Encourage your students to investigate freely but collect only with a purpose. Collecting should support instruction or other meaningful activities.
- Ask students to help decide whether and what to collect.
- Collect only specimens that are abundant. Talk with your local Utah Division of Wildlife Resources office (contact information in "Resources" Appendix) to find out if there are any rare or endangered species in or near your stream.



III-4. Sampling Safety

Kids and water are a natural combination. To ensure the two mix well, consider the following guidelines before going to the stream site.

How do I manage my group in the field?

- Have an adult supervisor accompany each separate group, with six students or less per adult.
- Keep a good line of communication between groups at all times (e.g., stay within hearing distance).
- Be aware of medical considerations.
- Make sure each group has ready access to first aid.
- Know which students are allergic to bee stings and how to handle a reaction.
- Know the causes and early warning signs of hypothermia and heat exhaustion.

What are potentially hazardous conditions?

- Be aware of steep, slippery banks. Holes, vertical banks and other hazards can be especially difficult to see when the banks are very heavily vegetated.
- Scout the area for dangerous trash such as broken glass, rusted wire or metal scraps. Flag areas to avoid, if necessary.
- Scout the area for poison ivy, poison oak and stinging nettles. Make sure everyone in the group can identify these plants.

When is it unsafe to enter the stream?

- Moving water is deceptively dangerous. Don't let students enter water over their knees or water that is moving very fast (more than 1 foot per second).
- If you suspect your stream is seriously polluted, contact your local County Health Department or local Division of Water Quality office to determine if your stream is safe for student monitoring.
- Never sample during a lightning storm and beware of sudden storms higher in the watershed which could produce flash floods.
- Students should not enter the stream without proper clothing (waders, or good wading shoes and a change of clothing).
- Never let students enter water if enough adult supervisors are not present.

What are the chemical safety guidelines?

- Avoid contact between chemicals and eyes, nose and mouth. When opening the chemical packets, always use the scissors provided or tear the packets. NEVER open the packets with teeth.
- You may wish to wear latex gloves and goggles when conducting chemical tests. Gloves and goggles are included in your supply tub. Cover test tubes with stoppers, not fingers, when mixing.
- After handling chemicals, wash hands thoroughly. Use lots of water, and avoid no-water cleaners.
- Deposit all sample solutions in designated plastic, screw-top waste bottles (you will find these in your monitoring kit). Flush this waste down the school sink or any sink that drains to a municipal waste water treatment facility. NOTE: The solutions remaining from the tests can be mixed together without the risk of explosion or the forming of toxic gases.

III-5. Before You Go…

Connecting with other groups

Consider the advantages of working with groups involved in water quality management, wildlife (especially fish), agriculture or other natural resource issues in your area.

- If these groups are conducting their own monitoring, you may be able to join in their efforts and increase the information for that stream.
- The data collected by these groups provide a means for checking the accuracy of your own data.
- Even if none of these groups monitors your stream they may still be able to provide you with valuable information on the stream or watershed, such as potential threats to the stream. Water Quality Specialists can work with your students to design appropriate ways to monitor these threats.
- The internet is a great place to learn about other monitoring efforts. Groups to contact include:
    - Federal Resource Management Agencies (Environmental Protection Agency, U.S. Forest Service)
    - State Resource Management Agencies (Utah Division Water Quality, Utah Dept. of Water Resources)
    - Non-government organizations (Audubon Society, Trout Unlimited)
    - Your local university or Utah State University Cooperative Extension agent.
- Many of these groups look for opportunities to send speakers out into the community. Ask if a specialist can come talk with your class.
- A list of Utah groups, with their contact information, can be found in the "Resources" Appendix.

> If your sampling site is located on public land (e.g., U.S. Forest Service, Bureau of Land Management) notify the appropriate management agency. Agencies can provide you with important information, such as the latest conditions of your site or other interesting sites to monitor. They many also be able to send a ranger or biologist to speak with your group.

If monitoring on private property,

- Always obtain permission from the landowner ahead of time.
- Let the owner know when you will be on their land and what your group will be doing. The owner may be interested in joining your activities.
- After monitoring, follow up with a thank you phone call or note from the class. The landowner may be interested in receiving a copy of the data your class collected.

Developing community support for your program

Community exposure can be an important part of your program.

- It increases awareness of the need to protect our water resources.
- It may help to strengthen administrative support for your program.
- It may assist you in locating and obtaining funding for your monitoring program.

Contact your local newspaper and radio station a week before you head for the field. You may also want to create interest in your program through newsletters, a web site, or by posting announcements at the library or other public meeting places.

III-6. *Utah Stream Team* Monitoring Kit

Obtaining Your Kit

The *Utah Stream Team* monitoring kits contain the supplies required to conduct all the tests and measurements covered in this manual. You can borrow a *Utah Stream Team* monitoring kit from Utah State University Cooperative Extension. Some schools and organizations in your area may already have kits and be willing to share. Check with your local school district office and the monitoring organizations listed in the "Resources" Appendix. Many of these materials are inexpensive and easily obtained. You may wish to purchase some of these supplies to allow greater flexibility in your monitoring program. Refer to the "Purchasing Supplies" Appendix for approximate prices and purchasing information.

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Materials required for any monitoring:

1 Utah Stream Team notebook
1 calculator
1 stopwatch (or watch with second hand)
1 pair of chest waders (optional)
2 garbage bags

Additional materials required for physical stream monitoring

1 tape measure
2 ping pong balls
4 survey flags

Additional materials required for water chemistry monitoring

water collection bottles
chemical waste bottles
latex gloves
safety glasses
field thermometer
pH strips
1 pair small scissors (Phosphate, Nitrate, Ammonia only)
turbidity tube
Dissolved Oxygen Test Kit
Phosphate Test Kit
Nitrate Test Kit
Ammonia Test Kit

Biological (Macroinvertebrate) Monitoring

1 kick net
1 plastic pan
4 transfer pipettes
4 magnifying glasses
4 plastic petri dishes

Be sure to check the contents of your kit before heading to the field and after you return. Note missing items here. Please report them when you return the kit.

Monitoring Kit Check List:

	Before	After		Before	After
General Kit Supplies:					
1 Utah Stream Team notebook			**Biological Monitoring Supplies:**		
1 pair chest waders			1 kick net		
1 calculator			1 plastic pan		
2 garbage bags			4 magnifying glasses		
			4 transfer pipettes		
Physical Monitoring Supplies:			4 plastic petri dishes		
1 tape measure					
2 ping pong balls					
4 survey flags					
Water Chemistry Supplies:					
1 turbidity tube			4 latex gloves		
1 box pH strips			1 pair safety glasses		
1 field thermometer			2 collection bottles		
1 pair small scissors			2 waste bottles (solid and liquid)		
1 Dissolved Oxygen Kit, containing:			**1 Nitrate-nitrogen Kit, containing:**		
Box of ampoules			Color comparator (black box)		
Sample cup			Pink color disk		
Color standards (for comparison)			Two viewing tubes		
			Two plastic stoppers		
1 Phosphate Kit, containing:			NitraVer6 reagent packets (step 1)		
Color comparator (black box)			NitraVer3 reagent packets (step 2)		
Blue color disk					
Long path viewing adaptor			**1 Ammonia Kit, containing:**		
Two viewing tubes (test tubes)			1 color comparator (black box)		
1 Square mixing bottle			1 yellow color disk		
1 Blue stoppers			Two viewing tubes		
PhosVer3 Reagent packets			Two plastic stoppers		
			1 bottle Nessler Reagent		
			1 eye dropper		