Instrument Construction

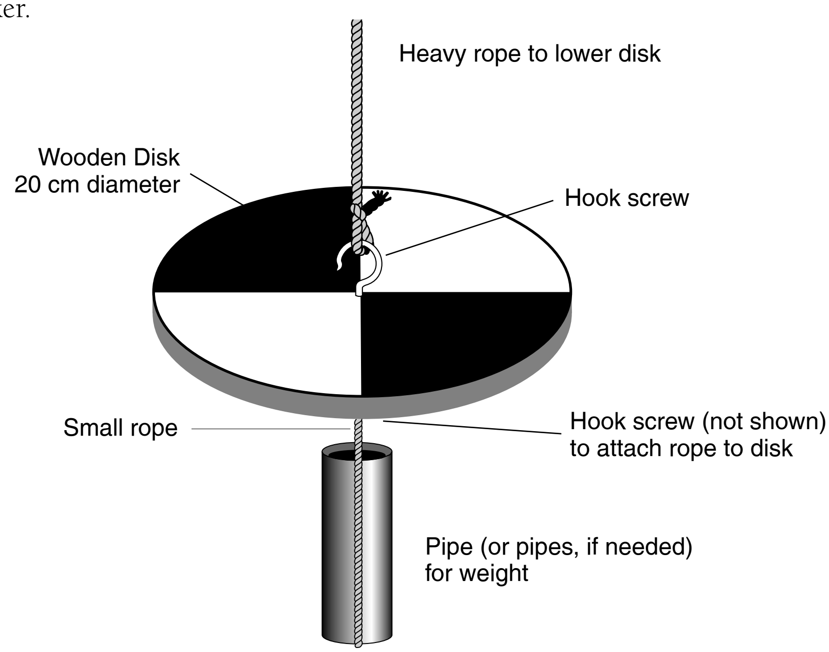
Instructions for Making a Secchi Disk to Measure Water Transparency

Materials

- ❑ Wooden disk (20 cm diameter)
- ❑ Paint (black and white)
- ❑ 2 hook screws (2-3 cm)
- ❑ Pipe(s) for weight
- ❑ 5 meters rope (or more, depending on depth of water)
- ❑ Meter stick
- ❑ Permanent, waterproof markers (black, red, blue)
- ❑ Short piece of rope (approximately 50 cm - 1 m)

Directions for Construction

1. Divide top of wooden disk into four equal quadrants. Draw lightly in pencil 2 lines crossing at a 90 degree angle to identify the quadrants.
2. Paint two opposite quadrants in black and the other two in white.
3. Screw a hook screw into the top center and bottom center of the disk. Tie the 5-m (or longer) rope through the screw in the top of the disk.
4. Tie the short piece of rope through the screw on the bottom of the disk. String the rope through the pipe. Tie a large knot at the bottom of the pipe so that it does not fall off when hanging vertically underneath the disk.
5. Measure and mark the rope above the top part of the disk with a black marker every 10 cm.
6. Measure and mark every 50 cm up from the disk with a blue marker and every meter with a red marker.



Instrument Construction

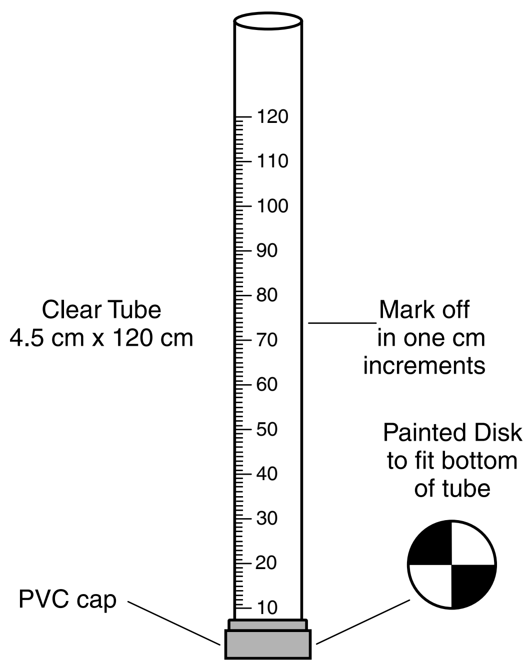
Instructions for Making a Transparency Tube to Measure Water Transparency

Materials

- ❑ Clear tube (approximately 4.5 cm x 120 cm)
- ❑ PVC cap (to fit snugly over one end of tube)
- ❑ Permanent, waterproof black marker
- ❑ Meter stick

Directions for Construction

1. On the bottom of the inside of the PVC cap, draw a Secchi disk pattern (alternating black and white quadrants) with the black marker.
2. Put the PVC cap over one end of the tube. Cap should fit tightly so water cannot leak out.
3. Use the marker and meter stick to draw a scale on the side of the tube. The bottom of the inside of the PVC cap where the Secchi disk pattern is drawn is 0 cm. Mark every cm up from that point.



Instrument Construction

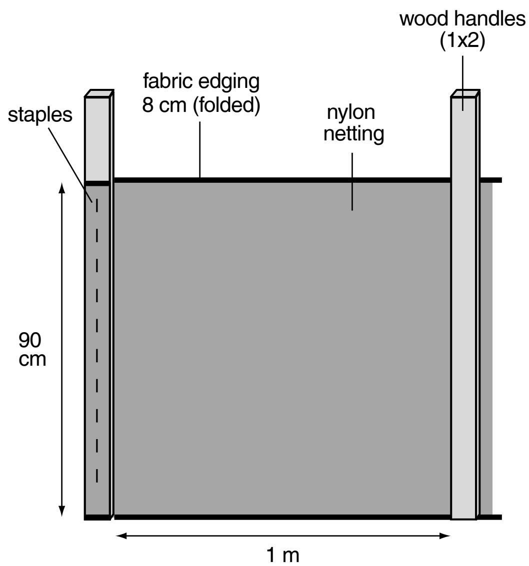
Instructions for Making a Kick-Net to Collect Freshwater Macroinvertebrates

Materials

- ❑ One piece of 95 cm x 132 cm nylon netting (0.5 mm mesh)
- ❑ One piece of 120 cm x 150 cm (or larger) nylon netting (0.5 mm mesh) for a funnel (optional)
- ❑ 2 poles (132 cm long, 4 to 5 cm diameter)
- ❑ Staples
- ❑ 2 pieces of denim or other heavy fabric (8 cm x 132 cm each)
- ❑ Needle and thread or heavy waterproof tape

Directions for Construction

1. Fold each of the 8 x 132 cm strips of heavy fabric over each of the long edges of the 95 cm x 132 cm nylon netting (0.5 mm mesh). Hold in place by sewing or using waterproof tape.
2. Attach the nylon netting and the fabric to the poles with staples. The poles should be even with the netting at the bottom and extend above the netting to form handles at the top.
3. Roll the poles so that the netting wraps around the poles until the width equals 1 m and staple again.
4. Optional: at the center, cut a 30 x 30 cm square to sew a funnel-shaped net. This is not necessary but can be very useful to concentrate organisms and transfer them into a bucket. If you have more 0.5 mm nylon netting, you could also make the whole net into a pouch or a funnel starting at the 90 cm by 100 cm edges and tapering back like a butterfly net.



Instrument Construction

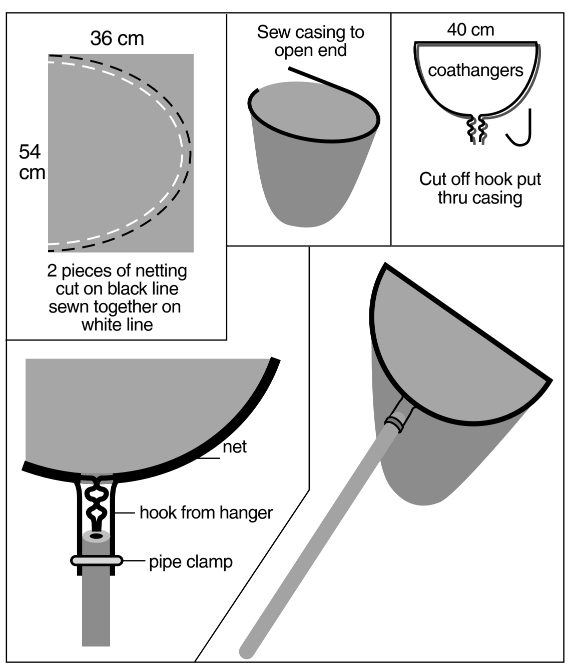
Instructions for Making the D-net to Collect Freshwater Macroinvertebrates

Materials

- ❑ 2 pieces of nylon netting (36 x 53 cm) (0.5 mm mesh)
- ❑ 1 meter of very stiff wire or 3 stiff coat hangers
- ❑ Heavy fabric (8 x 91 cm) (e.g. denim)
- ❑ Needle and thread or heavy waterproof tape
- ❑ 152 cm pole (e.g. broom or rake handle)
- ❑ 4 cm pipe clamp

Directions for Construction

1. Lay the 2 pieces of nylon netting on top of each other. Cut a net shape from the nylon netting pieces (see diagrams) and sew them together.
2. Open the net so that the seam is to the inside. Sew the strip of fabric (8 x 91 cm) on to the edge of the open end of the net, leaving an opening to insert the hangers.
3. Shape the heavy wire into a 'D' shape, with the straight side of the 'D' being about 40 cm long. If you are using hangers, cut the hooks from the hangers and untwist the wires, then shape them into a 'D'.
4. Insert the wire through the fabric casing and twist the ends together at the opening. Use heavy waterproof tape to tape the hangers together.
5. Drill a hole in the tip of the handle large enough to insert the ends of the wires.
6. Attach the net to the pole by inserting the ends of the wire into the hole drilled in the pole end. Loop a short piece of wire over the net frame and clamp the ends to the pole to secure the net to the pole.



Instrument Construction

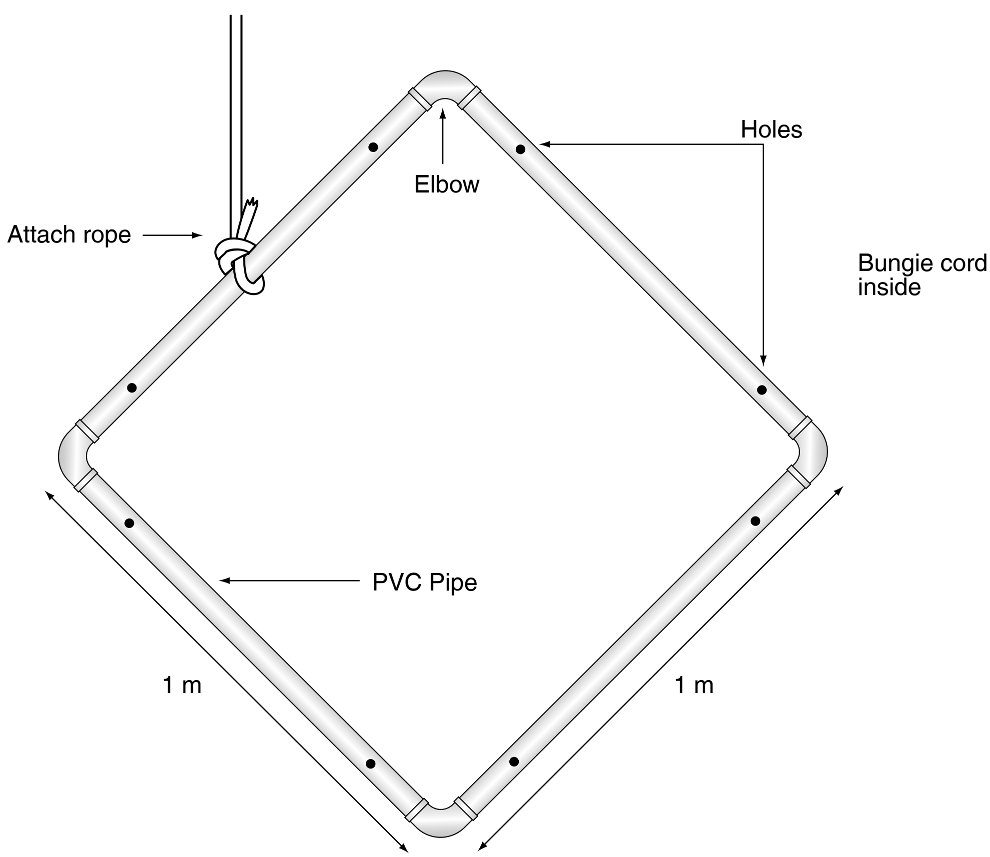
Instructions for Making the Quadrat to Use When Collecting Freshwater Macroinvertebrates

Materials

- ❑ Four poles of PVC pipe (100 cm long)
- ❑ 4 elbows of PVC pipe
- ❑ 3.5 meters of bungie cord
- ❑ 3 meters of rope (longer if needed)

Directions for Construction

1. Assemble the four poles with elbows and adjust to exactly 1 x 1 meter inside the frame.
2. Drill holes in the four poles to allow water to enter and the quadrat to sink.
3. Insert the bungie cord through the four poles and tie the two ends with a knot. The cord will hold the quadrat together in the water and will allow you to collapse the quadrat when not in use.
4. Attach a rope to the quadrat to use for lifting the quadrat out of the water after sampling.



Instrument Construction

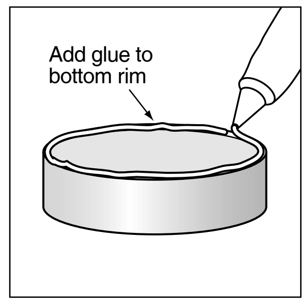
Instructions for Making Sieves to Use When Collecting Freshwater Macroinvertebrates

Materials

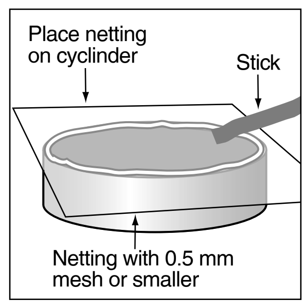
- ❑ One piece of 25 x 25 cm nylon, cotton, or metal netting (0.5 mm mesh or smaller)
- ❑ One rigid plastic or metal cylinder (5 cm high and about 20 cm in diameter, but these dimensions can vary since the sieve is not used to quantify samples)
- ❑ Waterproof glue
- ❑ Stick or spatula
- ❑ Scissors

Directions for Construction

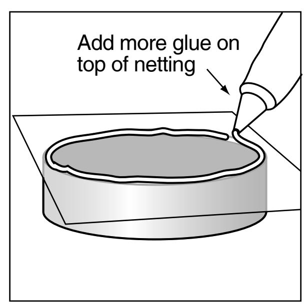
1. The cylinders must be open at both ends. Add glue to the bottom rim of the cylinder.



2. Place the square of netting on top of the glue and use a stick or spatula to press the netting into the glue.

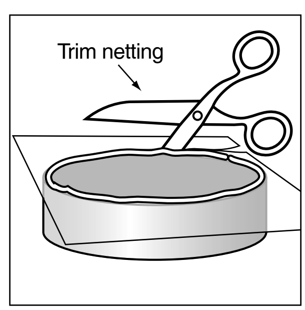


3. Add glue around the same rim but on top of the netting.



4. Allow the glue to dry completely (follow directions on glue package).

5. Once the glue is dry, cut the extra netting around the rim.



Instrument Construction

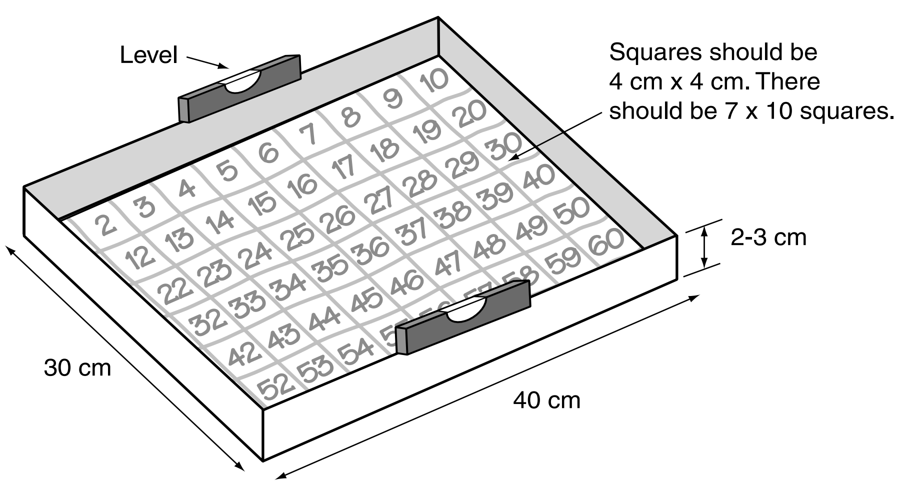
Instructions for Making the Sub-Sampling Grid to Use When Measuring Freshwater Macroinvertebrates

Materials

- ❑ Piece of stiff plastic, board or tray (30 x 40 cm) with at least 2-3 cm ridge around the outside OR shallow, white metal or plastic pan (30 x 40 cm) with flat bottom (a white plastic lid with flat bottom from storage boxes or sheet metal dampers can work)
- ❑ White waterproof, nontoxic paint (if your pan or grid sheet is not already white)
- ❑ Ruler
- ❑ Waterproof marker for drawing on sampling grid
- ❑ Graduated cylinder
- ❑ Tube of waterproof silicon caulking compound
- ❑ Two small levels

Directions for Construction

1. If using a flat sheet of plastic or board, cut to the correct size, then paint the sheet white with nontoxic, waterproof white paint. The ridge around the outside of the board should be tall enough to hold 2 – 3 cm of water on the board.
2. Draw a grid on your sheet or in the bottom of your pan. The squares of the grid should be 4 cm x 4 cm.
3. Use the caulking compound to outline each square, building the lines up to about 5 mm in height.
4. Number the squares consecutively.
5. Glue the two small levels onto opposite sides of the grid.
6. Measure the volume of water necessary to cover the whole grid with water so that each square is wet almost all the way up to the 5 mm line. This will contain the live macroinvertebrates in their sub-sampling squares.
7. Record this grid volume and the number of squares onto the *Freshwater Macroinvertebrate Identification Data Sheet.*
8. Practice spreading the grid volume of water evenly over the grid, filling all the squares.



Frequently Asked Questions

1. How much weight do I need on my Secchi disk?

Use enough weight so that the disk will be pulled vertically down under the water.

2. How long should the rope be on the Secchi disk?

The length of the rope will depend on how clear your water is and from where you are measuring. If you are measuring from a dock or bridge, for instance, extra rope may be needed to reach the water surface. If your water tends to be murky and you are measuring from near the surface, you may not need more than a couple of meters of rope.

3. Where do I find a long, clear tube for my transparency tube?

Many hardware stores carry long tubes for protecting fluorescent light bulbs. These are inexpensive and make excellent transparency tubes. If these are not available, any long, clear plastic tube of the appropriate size can be used. Length of tube is more important than diameter.

4. What do I do if my tube leaks around the cap?

If your tube leaks, use waterproof silicone caulk to seal around the cap.

5. Is it acceptable to make a small hole in the transparency tube near the bottom, fill the tube with water, then slowly release water until the disk at the bottom appears?

This method is acceptable as long as the measurement is made very quickly. Particles settle quickly, especially if they are being pulled down by water being released at the bottom. The reading must be made before particles settle and obscure the disk. These tubes should be emptied and rinsed between readings to be sure no particles remain on the bottom to affect the next reading.

6. Can a transparency tube be longer or shorter than 120 cm?

The tube should be within a few centimeters of the 120 cm standard. Some schools might test waters that never have a transparency greater than 20 centimeters, and for them there is no need for the longer tube. Others might have waters that are always >120 cm and need a longer tube to indicate the greater transparency. The standard distance of the eye to the disk (120 cm), however, should be maintained to standardize the measurement.

Site Selection

Ideally, the *Hydrology Study Site* is located within the 15 km x 15 km GLOBE Study Site. Within this area, select a specific site where the hydrology measurements (water temperature, transparency, pH, dissolved oxygen, alkalinity, electrical conductivity or salinity, nitrate, or freshwater macroinvertebrates) can be taken. You may also choose a water body of special interest to you within your GLOBE Study Site. The water bodies that scientists are most interested in are (in order of preference):

1. Stream or river
2. Lake, reservoir, bay, or ocean
3. Pond
4. An irrigation ditch or other water body used because one of the above is not accessible or available within your GLOBE Study Site.

You should collect all water samples from the same place at the *Hydrology Site* each time. This is called the *Sampling Site*.

If the site is a moving body of water, like a stream or a river (*lotic*), locate your *Sampling Site* at a riffle area (a place where the water is turbulent and moving but not too fast) as opposed to still water or rapids. If the site is a still body of water, like a lake or reservoir (*lentic*), find a *Sampling Site* near the outlet area or along the middle of the water body, but avoid taking samples near an inlet. A bridge or a pier are good choices.

If your brackish or salt water body is affected by tides, you will need to know the times of high and low tide at a location as close as possible to your *Hydrology Site*.

Freshwater macroinvertebrate sampling is done at locations near your water quality *Sampling Site*. Since different creatures live in different habitats, sampling sites will depend on the habitat type or types represented near your site. The protocols will direct you in selecting and sampling different habitats.

If others are doing research at your Hydrology Study Site, contact them before your students take measurements to avoid your students potentially interfering with other research. Your students may be able to contribute to ongoing research by taking measurements.

Documenting Your Hydrology Study Site

Information about your GLOBE Hydrology Site is essential for students and scientists to interpret the water data of your school. Students need to keep current and accurate Science Logs, report unusual findings, and attempt to understand the data they are collecting both spatially and temporally. This means understanding what is in their entire watershed and how their area changes over time. Students will find seasonal patterns and they may also find longer-term changes or trends.

You will be asked to provide information on your site in three ways: through written comments, photographs, and a field map.

Written Comments

Students are asked to provide specific information when they define their site, by filling out the *Hydrology Site Definition Sheet*.

In addition to supplying this information, you must also carefully observe and report other things that may affect the water at your site. For example, you may observe migratory waterfowl in the pond, a large storm may have caused trees to fall into the stream or a new bridge is being built slightly up the stream from where you are sampling. You may be collecting other GLOBE data such as precipitation, soil pH, or land cover that might affect the water. Teachers can support these efforts by helping students find other resources to use such as maps, reports from other monitoring groups or government agencies, local experts, and other people who may have special insight into the history of the community.

As requested on the *Hydrology Site Definition Sheet,* please provide the manufacturer and model name for the test kits. If you change the type of kit, please update the site definition information.

All observations should be documented in Science Logs. They should also be reported in the *Hydrology Site Definition Sheet*, under *Comments,* and reported to GLOBE.

Photographs

Once each year, take photographs of your Hydrology Study Site and send them to GLOBE. Take four photographs, one in each cardinal direction (north, south, east, and west) while standing where you normally stand to collect your water sample. Have two sets of pictures printed, one for your records and one for GLOBE. Label each photograph with your school's name and address, the Hydrology Study Site name, and cardinal direction. Submit labeled copies of the photographs to GLOBE by mailing them to the address given in the *Implementation Guide*.

Field Map

Draw and submit a field map of your Hydrology Site each year following the guidelines in the *Mapping Your Hydrology Site Field Guide*. The field map will help you become familiar with your site and identify micro habitats as well as surrounding land cover that may affect the water.

Teacher Support

Each time you establish a new Hydrology Study Site, your students should fill out a new *Hydrology Site Definition Sheet,* take photographs of the site, and make a map following the *Documenting Your Hydrology Study Site* and *Mapping Your Hydrology Study Site Field Guides*. After the initial site description, you should update your site definition information, as well as take new pictures, create a new map, and submit them to GLOBE once a year. Ideally, this should be done at the beginning of the school year. If you are using a new group of students to take Hydrology measurements, use this opportunity to introduce them to your existing Hydrology Study Site. If you are using the same group of students, use this opportunity to explore and document any changes that may have occurred since the previous year. Maintaining your site definition information, providing current photographs and site maps of your Hydrology Study Site once a year, are essential for the interpretation of your Hydrology data by your students, other GLOBE students, and scientists alike.

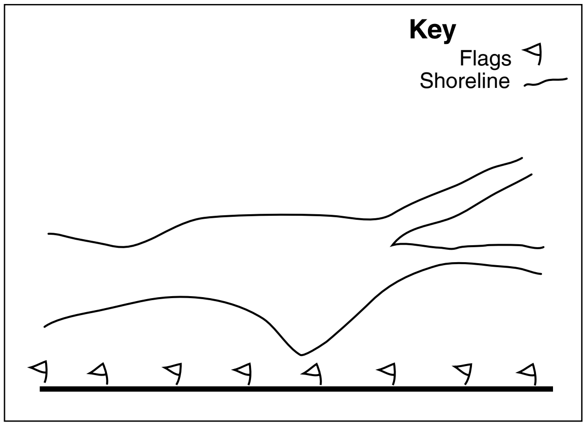
When you create the map of your Hydrology Study Site select a stretch of at least 50 meters along the bank that contains the site where you collect your Hydrology measurements as well a variety of habitats. The *Mapping Your Hydrology Study Site Field Guide* asks students to walk along the 50-m stretch they are mapping. Students should do this only if it is safe for them to do so. If your site is a river or stream, the likely habitats you may find are,

- run areas - where water flows freely and there is no turbulence;
- pool areas - where water is standing or still; finest sediments will deposit here;
- riffle areas - where there are rocky obstructions in the river bed resulting in turbulence; rocks deposit here;
- gravel bars – deposits of gravel within the stream, above the normal level of the water; and
- sand bars - deposits of sand within stream, above the normal level of the water.

If your study site is a lake, pond, reservoir, bay, ocean or other, likely habitats you will find are,

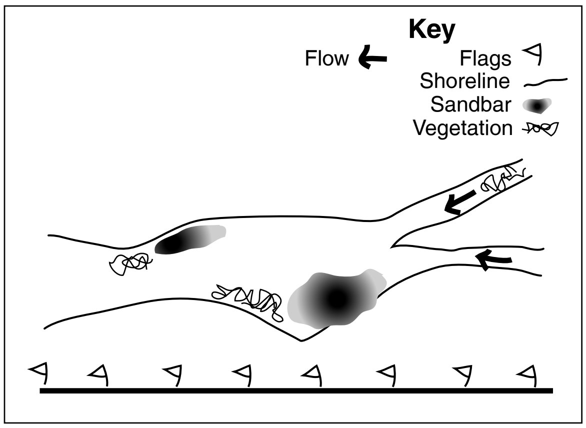
- vegetated banks: areas where vegetation grows into or hangs into the water;
- logs or snags: areas where partly or wholly submerged logs, branches, or other vegetation form habitat areas;
- aquatic vegetation: areas where submersed plants grow; and
- gravel, sand or silt: areas with no plants or debris.

The following is an illustrated example of creating a field map of a Hydrology Study Site.



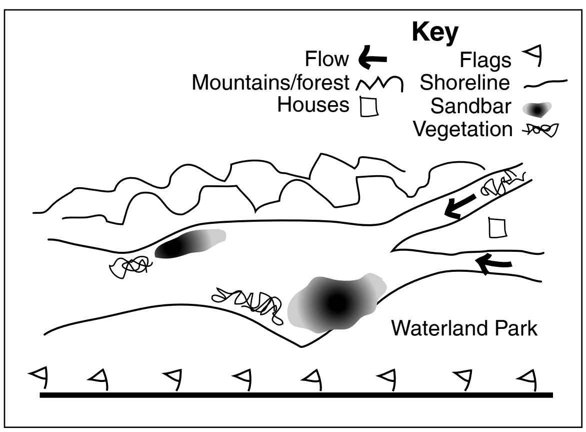
Begin by laying out a transect and marking it every 3 meters with flags. Each square on your paper will represent the area between two flags.

Draw the bank or coastline by measuring from the transect to the shore. If the far shore is too far away to fit on your map, indicate this with an arrow and the approximate distance.

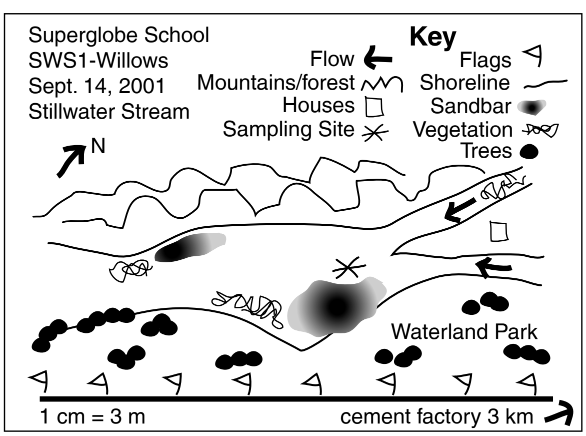


Add features to your water site. Show areas of different habitats, snags, dams or bridges, sand bars, etc. Use a different symbol in the Key to represent each feature.

Indicate the direction of water flow or inlet and outlets if known.



Add features from the surrounding area such as residential areas, trees, forests or grasslands, agricultural or recreational areas, parking lots, etc.



Add other features along the water site that might help identify your site or interpret your data such as cliffs, big trees, docks, limestone outcrops, clay deposits, etc.

Important features not shown on the map, such as industry or dams upstream, can be indicated with an arrow and approximate distance.

Add your school and site name, name of the water body, scale, north arrow, and date.

Documenting Your Hydrology Study Site

Field Guide

Task

Describe and locate your Hydrology Study Site.

What You Need

- ❑ *Hydrology Site Definition Sheet*
- ❑ *GPS Protocol Field Guide*
- ❑ Pencil or pen
- ❑ Compass
- ❑ GPS Receiver
- ❑ Camera
- ❑ GLOBE Science Log

In the Field

1. Fill in the information on the top of your *Hydrology Site Definition Sheet.*
2. Name your site by creating a unique name that describes the location of your site.
3. Locate your Hydrology Study Site following the *GPS Protocol Field Guide.*
4. Record the name of the water body you are sampling, using the name commonly used in maps. If your water body does not have a common name, then provide the name of the water body your water site comes from or flows into or both. For example, Unnamed Stream, Tributary to Green River; Unnamed Stream, Outlet from Whiterock Lake; Unnamed Stream, Outlet from Bear Lake, Tributary to Black Creek.
5. Record whether the water is salt water or fresh water.
6. If your water site is moving water, record whether it is a stream, river, or other and its approximate width in meters.
7. If your water site is standing water, record whether it is a pond, lake, reservoir, bay, ditch, ocean or other and whether it is smaller than, larger than, or about equal to a 50 m x 100 m area. If known, indicate the approximate area (km^2) and depth (meters).
8. Record whether your sample location is an outlet, bank, bridge, boat, inlet or pier.
9. Record whether you can see the bottom.
10. Record the material from which the bank or channel is made.
11. Record the type of bedrock, if known.
12. Record the manufacturer and model number for each chemical test kit you are using, if any.

13. Record in the *Comments* section any information that may be important for understanding the water at your site. Some possible observations might be:

    a. Any upstream discharge into your body of water

    b. Whether the flow (streams) or water level (lakes) is regulated or is natural (for example, flow is regulated downstream of dams).

    c. Types of plants and animals observed

    d. Amount of vegetation in the stream

    e. Human uses of the water: fishing, swimming, boating, drinking water, irrigation, etc.

    f. Other information about why this specific site was selected.

14. Standing where you will be collecting your water sample, take four photographs of your sampling area, one in each cardinal direction (N, S, E, W). Use a compass to determine the direction.

15. Print two sets of photographs and label each photo with your school's name and address, your Hydrology Study Site name, and cardinal direction. Keep one set for your records.

16. Submit the other set to GLOBE by mailing them to the address given in the *Implementation Guide*.

Mapping Your Hydrology Study Site

Field Guide

Task

Make a scaled field map of your Hydrology Site.

Materials

- ❑ *Hydrology Site Mapping Sheet* (1 cm grid paper)
- ❑ Measuring tape (50 m)
- ❑ Compass
- ❑ Flags (18)
- ❑ Pencil/eraser

In the Field

1. Select a section of the bank at least 50 meters long as your study area, if possible. You may consider the entire water body as your study area if it is small enough. The area should contain the sampling site where you collect your water measurements as well as a variety of habitats.
2. Use the measuring tape to measure a straight transect, at least 50 meters long, parallel to the shoreline, and within 10 meters of the bank. The transect will be varying distances from the water if the bank is not straight.
3. Place flags at the two ends and at every 2 meters along the transect.
4. Start drawing your map using the flags to help keep it to scale.

   Note: Using the *Mapping Field Sheet* or graph paper with 1 cm squares, each square should represent 2 meters. Put the scale on your graph.
5. Mark the transect and flag positions on the map.
6. Draw the waterline or bank by measuring from each flag directly to the water, placing a small dot on the map to show the waterline, then connect the dots with a dotted line to indicate the bank.
7. Put in the opposite bank or indicate the approximate distance to the opposite bank if known.
8. Use an arrow to indicate the direction of water flow or the inlet and outlet of your water body.
9. Create a key with symbols for special features found at your site. Use these symbols to indicate where special features are located on the map. Suggested features to include:
   - Within the sampling area: riffle areas, pools, vegetated areas, logs, rocky areas, gravel bars, sand bars, bridges, docks, jetties, dams, etc.

- Around the sampling area: land cover (or MUC codes), geological features such as cliffs or rocky outcrops, man-made features such as houses, parks, parking lots, factories, roads, dumps or debris, etc.

10. Show the location of your Hydrology Sampling Site.
11. Include the following information on the map:
    - Name of site
    - Name of water body
    - North arrow
    - Date
    - Scale (e.g., 1 cm = 3 m)
    - Key to all symbols used on the map
12. Photocopy your map and keep the original for your records.
13. Submit a copy to GLOBE by mailing it to the address given in the *Implementation Guide.*

    Note: Make sure to include your school's name and address, as well as the name of your Hydrology Study Site.

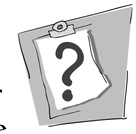
Frequently Asked Questions

1. Is it acceptable to use a man-made site, e.g. a pond built near the school?
Although natural sites are first in the order of preference, man-made sites may be used. Many lakes and ponds are man-made

2. My coastline curves. Is this an appropriate site?
You will seldom find a perfectly straight coastline. Try to pick as straight a stretch of coast as possible or an area of coast representative of the water body.

3. There are agricultural fields to the north of my site. How should I indicate them?
In the *Comments* section, note anything within your watershed that you think might affect the water. On the field map, note direction and approximate distance to major land cover features of the surrounding area.

4. My beach has both rocky and sandy shores. Should I choose a mix or try to find a site with just one type of habitat?
Try and find a site with just one type of habitat. The sampling procedures for different types of coast are different.



5. We live fairly near to a river, but my class can't go that far for sampling every week. Should we choose a less preferable, but closer site?
Try to sample water bodies that are significant to your area, even if you have to use a less frequent sampling strategy. Sites closer to the school, that can be sampled weekly, can also be chosen as a second sampling site. This often makes for interesting comparisons between the sites.

6. Can I choose a site that is sometimes dry?
Water sites may sometimes dry up, be frozen, or become flooded so that data cannot be collected. If one of these situations occurs, check 'dry', 'frozen' or 'flooded' on the data entry page for each week that you cannot collect a water sample. This will indicate to researchers that the site is still being monitored even though water data cannot be collected.

7. Can I have more than one site on a river or lake?
Multiple sites along a watershed are desirable. Significant differences might be found at sites with different depths, near different land cover, or in tributaries of a larger river or body of water.

Sampling Procedures

Quality Assurance and Quality Control

A quality assurance and quality control (QA/QC) plan is necessary to ensure that test results are as accurate and precise as possible. Accuracy refers to how close a measurement is to its true value. Precision means the ability to obtain consistent results. Accurate and precise measurements are achieved by,

- practicing the measurement techniques of the protocols;
- collecting the water sample or invertebrate sample as directed;
- performing tests immediately after collecting the water sample;
- carefully calibrating, using and maintaining testing equipment;
- following the directions of a protocol exactly as described;
- repeating measurements to check their accuracy and to determine any sources of error;
- minimizing contamination of stock chemicals and testing equipment ;
- checking to be sure the numbers submitted to the GLOBE Student Data Server are the same as those recorded on the *Hydrology Data Sheets;* and
- examining your data for reasonableness and anomalies.

Calibration

Calibration is a procedure to check the accuracy of testing equipment. For example, to ensure that the pH instruments are functioning properly, a solution of known value is tested. Calibration procedures vary among the measurements and are detailed in each protocol. Certain calibrations must be done in the field just before the measurement is taken. Other calibration procedures are done in the classroom.

Collecting the Water Sample

If students are able to SAFELY reach the water body (within arms' reach), then water temperature, pH, dissolved oxygen, and electrical conductivity measurements can be taken on site (*in situ)* directly at the water's edge. However, the measurements of alkalinity, salinity, and nitrate require a sample to be taken with a bucket using the bucket sampling procedure. For electrical conductivity, if the temperature of the water sample is outside the range of 20-30˚C, then allow the sample to adjust to the temperature within that range before conducting the measurement.

Important: The sequence in which the measurements are performed is critical to their accuracy and precision. Transparency measurements should be taken first, followed immediately by the water temperature measurements, the dissolved oxygen test, then electrical conductivity or salinity, pH, alkalinity, and finally nitrate.

If taking water measurements when students are collecting freshwater macroinvertebrates, collect water quality measurements first.

Testing for transparency, temperature, and dissolved oxygen must be done on site (*in situ*) immediately after collecting the water sample. Do not let the bucket of water sit for more than 10 minutes (preferably less) before taking the measurements and keep the water sample out of the sun. Take a new sample after 10 minutes.

A sample of surface water can be used with the transparency tube. The Secchi disk measurement is only appropriate for deeper water and measurements are generally taken from a bridge or pier, away from the water's edge.

The dissolved oxygen test may be started in the field and completed within 2 hours in the classroom. To do this, the sample is first fixed in the field (see the directions in your dissolved oxygen kit for fixing the sample).

Important: Dissolved oxygen measurements have limited value unless the temperature of the water is known. Measure dissolved oxygen only if you are able to measure water temperature. If your site has salty or brackish water you must also measure salinity in order to interpret the dissolved oxygen measurements.

Samples may be bottled (see *Bottling a Water Sample for Classroom Testing Field Guide*) and tested for pH, alkalinity, nitrate, and salinity or electrical conductivity after returning to the classroom. Measurement of pH and nitrate should be completed within two hours of collecting the sample. Alkalinity, electrical conductivity or salinity may be conducted within 24 hours. However, it is necessary to measure electrical conductivity before measuring pH to make sure the electrical conductivity is high enough to measure pH accurately. See *pH Protocol*.

Safety

Consult the Material Safety Data Sheets (MSDS) that come with test kits and buffer solutions. Also consult your local school district's safety procedure guidelines. If you are testing potentially contaminated water or using kits with chemicals, latex gloves and safety goggles are strongly recommended.

Disposal of Liquid Waste

After tests have been conducted, all resulting solutions or liquids (except for the ones produced by the nitrate analysis and salinity titration) should be collected in a wide-mouthed screw top plastic waste container and disposed of in a school sink or utility sink while flushing with excess water. Or, they should be disposed of according to your local school district's safety procedure guidelines. The wastes from the nitrate analysis and the salinity titration (which typically contain cadmium and chromate) should be collected in separate containers and disposed of according to your local school district's safety procedure guidelines.

Measurements (in the order to be taken)	**Maximum time allowed between collecting the water sample and taking the measurements**
Transparency (Secchi disk)	Testing always made *in situ*
Transparency (tube)	10 minutes
Water Temperature	10 minutes
Dissolved Oxygen	10 minutes at site or within 2 hours after sample is fixed
pH (using paper)	10 minutes on site or 2 hours after sample is bottled
pH (using meter)	10 minutes on site or 2 hours after sample is bottled
Conductivity	10 minutes on site or 24 hours after sample is bottled
Salinity (hydrometer)	10 minutes on site or 24 hours after sample is bottled
Salinity (titration kit)	10 minutes on site or 24 hours after sample is bottled
Alkalinity	10 minutes on site or 24 hours after sample is bottled
Nitrate	10 minutes on site or 2 hours after sample is bottled

Collecting a Water Sample in a Bucket
Field Guide

Task

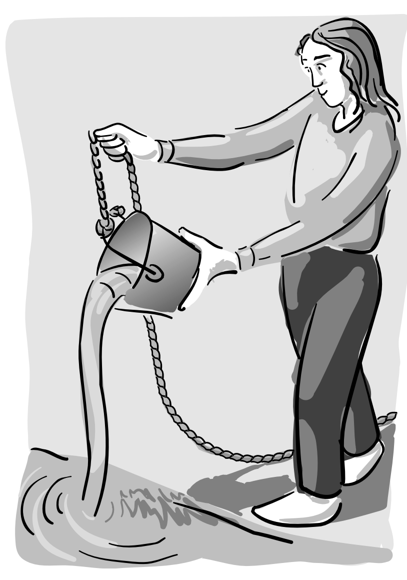
Collect a water sample in a bucket for testing.

What You Need

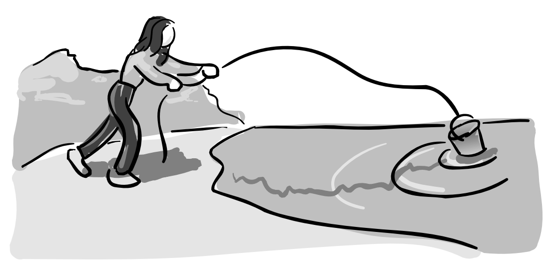
- ❑ Bucket with rope tied securely to handle
- ❑ Latex gloves (recommended)

In the Field

1. Rinse the bucket with sample water from the site. To avoid contamination, do not pour the rinse water back into the sampling area. Be careful not to disturb the bottom sediment. Do not use distilled water to rinse the bucket or use the bucket for any other purpose.
2. Hold tightly onto the rope. If your sampling site is a stream, throw the bucket out to a well-mixed area (a riffle), a little distance from the shore. Ideally, the water should be flowing at least slightly. If you are sampling from a lake, bay, or the ocean, stand on the shore and throw the bucket as far out as possible to collect your sample.
3. If the bucket floats, jostle the rope until some water enters the bucket. You should always take a sample from the top surface water. Be careful not to let the bucket sink to the bottom or stir up bottom sediment.
4. Allow the bucket to fill about 2/3 to 3/4 full and pull it back in with the rope.
5. Immediately begin testing procedures or bottle the sample (see *Bottling a Water Sample for Classroom Testing Field Guide*).



Rinsing the water bucket.



Casting the bucket.

Bottling a Water Sample for Classroom Testing

Field Guide

Task

Bottle a water sample to take back to the classroom for testing pH, conductivity or salinity, alkalinity, and nitrate.

What You Need

- ❑ 500-mL polyethylene bottle with lid
- ❑ Permanent marker
- ❑ Masking tape
- ❑ Latex gloves

In the Field

1. Label a 500-mL polyethylene bottle with your school's name, the teacher's name, the site name, the date and time of collection.
2. Rinse the bottle and cap with sample water 3 times.
3. Fill the bottle with sample water until the water forms a dome shape at the top of the bottle so that, when the cap is put on, no air is trapped inside.
4. Put on the cap and seal the cap of the bottle with masking tape.

   Note: Tape serves as a label, and an indicator of whether the bottle has been opened. Tape should NOT be in contact with the water sample itself.
5. Store these samples in a refrigerator at about 4˚ C until they can be tested (within 2 hours for pH and nitrate and within 24 hours for alkalinity and salinity or electrical conductivity).
6. Once the seal is broken, first do the test for salinity or electrical conductivity, then pH, then nitrate test, and then alkalinity. The sample will need to reach 20˚ - 27º C before testing for electrical conductivity. Ideally, all the measurements should be performed during the same