

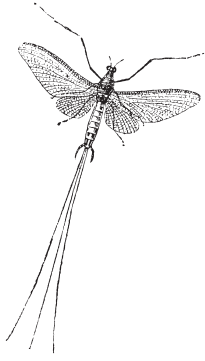
Stream Investigations

Best Practices for Safety, Stewardship, and Care



 **Leaf Pack Network**

STROUD
WATER RESEARCH CENTER



Stream Investigations: Best Practices for Safety, Stewardship, and Care is a guide published by Stroud Water Research Center under the Leaf Pack Network, a Stroud Center initiative that connects educators and learners with freshwater science and stewardship.

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About Stroud Water Research Center

For more than half a century, Stroud Water Research Center has focused on the science of rivers and streams. In its mission to advance knowledge and stewardship of freshwater systems through global research, education, and watershed restoration, the Stroud Center produces the trusted science needed for successful stream and river conservation while fostering people's passion for the water in their lives. The Stroud Center is an independent, 501(c)(3) not-for-profit organization.

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Introduction

Streams and rivers are extraordinary places for learning. They invite curiosity, discovery, and direct engagement with the natural world. A single stream can become an outdoor classroom where students investigate water quality, discover aquatic life, explore ecological relationships, and begin to understand how their own communities are connected to freshwater ecosystems. With that opportunity comes responsibility.

Streams are not simply places where learning happens. They are dynamic, living ecosystems composed of interconnected communities of plants, animals, fungi, microorganisms, water, sediment, rocks, woody material, and streamside forests. The organisms we collect, the rocks we turn over, the banks we walk along, and even the water we temporarily remove for an investigation are all parts of that ecosystem.

For educators, caring for these places is both a stewardship responsibility and an ethical practice. Field investigations should be designed not only around what students can learn from a stream, but also around how we can minimize our impacts on the organisms and habitats that make that learning possible.

This guide brings together best practices developed through the freshwater education work of Stroud Water Research Center and the Leaf Pack Network. It is intended to help educators plan stream experiences that balance three interconnected responsibilities: caring for people, caring for the stream, and caring for the organisms we study.

The recommendations that follow address stream safety, low-impact field practices, and the ethical collection and care of aquatic macroinvertebrates. Throughout the guide, educators will also find examples of practices used in Stroud Center education programs.

When students see educators carefully return a rock to its original position, gently handle an aquatic insect, protect a streambank from unnecessary trampling, or decide not to enter a stream because conditions are unsafe, they learn something larger than a field technique. They learn that scientific exploration carries responsibilities — to ourselves, to one another, and to the living systems that make discovery possible.

Our goal is not simply to help students learn from streams. It is to help cultivate learners who understand, respect, and care for them.

Part 1

Preparing for a Safe Stream Investigation

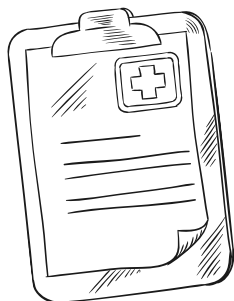
Stream investigations provide memorable, hands-on learning experiences, but they require thoughtful planning and careful decision-making. To ensure safety, assess conditions before entering the water, prepare students, and be willing to modify or postpone an activity when conditions are questionable.

Before You Go

- ☐ Visit the stream in advance whenever possible.
- ☐ Confirm public access or obtain landowner permission.
- ☐ Determine whether permits are required for aquatic macroinvertebrate collection.
- ☐ Identify the nearest road access for emergency responders.
- ☐ Know the location of the nearest hospital or urgent care facility.
- ☐ Share your itinerary and expected return time with another staff member or your organization.

Know Your Site

Become familiar with the stream and its surrounding watershed before bringing students into the field. Consider:



- ☐ Are there safe, stable entry and exit points?
- ☐ Are streambanks stable?
- ☐ Are there nearby roads, stormwater outfalls, agricultural fields, or industrial areas that may influence water quality?
- ☐ Has the stream experienced recent pollution events or advisories?
- ☐ Are there deep pools, undercut banks, or unstable trees, or is there any large woody material that could affect student safety?
- ☐ Is there a history of elevated bacteria levels or harmful algal blooms?

Understanding the watershed helps educators make informed decisions about whether stream activities are appropriate.

Check Weather and Stream Conditions

Evaluate weather and stream conditions before every program. If conditions are questionable, modify or postpone activities.

- ☐ Do not enter a stream when thunderstorms or lightning are present or expected. If thunder is heard, move students to a substantial building and follow National Weather Service lightning guidance before returning outdoors.
- ☐ Postpone activities after a heavy rainfall, when rain is occurring or forecast upstream, when flood watches or warnings are in effect, or when water levels are actively rising.
- ☐ Remember that streams can rise rapidly even when it is not raining at the field site.



Flooded creeks are best avoided.

Stroud Center Education Practice

Weather and stream conditions are evaluated before every stream program. If conditions are questionable, educators modify the activity, use a streamside alternative, or postpone the investigation.

Water Quality Considerations

Not every stream is appropriate for educational activities. Consider postponing or relocating an investigation when there is a known or suspected health-risk condition, including:

- ☐ Elevated bacteria or a current public health advisory.
- ☐ Recent sewage overflows or wastewater releases.
- ☐ A reported pesticide, chemical, or other pollution spill.
- ☐ A harmful algal bloom.
- ☐ Unusual color, odor, sheen, foam, or other visible signs of pollution.
- ☐ Recent runoff or other conditions that raise a credible water quality concern.

When available, consult local watershed organizations, conservation districts, health departments, or state environmental agencies for current information.



An algal bloom turns a Pennsylvania stream green.



A stream's conditions in winter differ from those in summer.



Stream data collected by an EnviroDIY Monitoring Station can be viewed on [MonitorMyWatershed.org](https://monitormywatershed.org).

Seasonal and Environmental Conditions

The same stream can present very different conditions throughout the year.

- ☐ Spring may bring high water and cold temperatures.
- ☐ Summer can bring heat, thunderstorms, and low-flow conditions.
- ☐ Autumn may create slippery, leaf-covered rocks.
- ☐ Winter and early spring may include ice or extremely cold water.
- ☐ Check air-quality conditions when smoke, ozone, or other air-pollution concerns may affect outdoor activity.
- ☐ Modify or shorten programs during unusually hot or humid conditions, when shade is limited, or when students show signs of overheating or fatigue.

Evaluate the site and conditions before every program — not just the first visit of the season.

Water Depth, Water Velocity, and Streamgages

- ☐ As a conservative educational practice, keep students in water no deeper than knee height; younger students may require even shallower water.
- ☐ Avoid fast-moving water. If maintaining footing requires significant effort, conditions are not appropriate for a student investigation.
- ☐ Shallow, fast-moving water can be hazardous. If you are uncertain whether conditions are safe, choose an alternative activity.
- ☐ When available, consult nearby [United States Geological Survey \(USGS\) streamgages](https://www.usgs.gov) or local monitoring stations before your visit, such as an [EnviroDIY Monitoring Station](https://monitormywatershed.org). Check which parameters a particular station actually measures. Streamgages commonly report stage (water level) and may provide discharge estimates; other monitoring stations may measure additional parameters depending on installed sensors.
- ☐ Pay particular attention to rising water levels, rapidly increasing streamflow, and recent storm events.

Prepare Students

Before entering the stream, explain the following:

- ☐ Where students may go and the boundaries of the investigation area.
- ☐ How to move slowly and maintain stable footing.
- ☐ Emergency signals and what students should do if they lose footing.
- ☐ Plants or site hazards to avoid, such as poison ivy.
- ☐ That entering the stream is not required for every student.

Consider student balance, mobility, comfort around water, and ability to move through uneven terrain and follow instructions. PFDs may be appropriate for younger children and those with limitations, or whenever site conditions, policies, or regulations call for them.

Clothing and Footwear

Recommended:

- ☐ Closed-toe shoes, old sneakers, or wading boots.
- ☐ Water shoes with enclosed toes and secure heels.
- ☐ Weather-appropriate clothing, sun protection, and hats as needed.

Avoid bare feet, flip-flops, and loose or open footwear without secure heel and toe protection.

Emergency Preparedness, Communication, and Supervision

- ☐ Carry a first aid kit, drinking water, emergency contact information, and supplies for preventing or treating insect stings and injuries due to site hazards.
- ☐ Student-prescribed emergency medications should be handled according to organizational policy, staff training, and applicable requirements.
- ☐ Whenever possible, have at least one educator trained in CPR and first aid.
- ☐ If an AED is available and appropriate for the site, know its location and how to use it.
- ☐ If cell service is unreliable, consider two-way radios or an appropriate satellite/emergency communication device.
- ☐ Maintain adult-to-youth ratios appropriate to student age, experience, group size, site conditions, and organizational policy. Younger children require close supervision in and around the stream.



Part 2

Caring for the Stream

Healthy streams are living ecosystems. Every rock, leaf pack, patch of gravel, fallen branch, streambank, and streamside plant can provide habitat. Low-impact field methods help protect the places we use for teaching while showing students what responsible environmental stewardship looks like in practice.

Plan for Low-Impact Student Access

Many environmental impacts occur not because of a single student, but because dozens or hundreds of students visit the same stream over time. Careful planning can reduce cumulative disturbance while preserving meaningful learning experiences.

- ☐ Keep groups entering the stream as small as practical.
- ☐ Rotate students through short investigations rather than allowing an entire class to enter at once.
- ☐ Limit the amount of time each group spends in the stream.
- ☐ For large groups, consider collecting aquatic macroinvertebrates in advance rather than having every student enter the stream.
- ☐ Evaluate the size, condition, and sensitivity of the stream when determining group size and visit duration.

Stroud Center Education Practice

At Stroud Water Research Center, education programs use a designated teaching reach in a relatively small third-order stream. In a single day, no more than two groups of about 20 students take turns collecting aquatic macroinvertebrates in the stream. For larger groups (more than 50 students), educators may collect macroinvertebrates in advance using the animal-care practices in part 3 of this guide. These are site-specific practices, not universal thresholds; educators should adapt group size and duration to their own stream and program.

Introduce Stewardship Before Entering

Before students step into the stream, explain that the stream is a living ecosystem and that their individual movements matter. Encourage them to walk gently, move only what is necessary, and leave the stream looking as though no class had visited.

Move Gently Through the Stream

- ☐ Walk slowly and deliberately — think of moving gently enough that you do not cloud the water around your feet.
- ☐ Take short, careful steps and test footing before shifting your full weight.
- ☐ Avoid running, jumping, splashing, and unnecessary movement.
- ☐ Avoid trampling streamside vegetation.
- ☐ Use the same travel corridor whenever practical.
- ☐ Take extra care around large rocks and woody material, which can be slippery or unstable.



Why Use Gentle Movements

Fast or repeated movement can stir fine sediment into the water. Fine sediment can fill spaces between rocks where aquatic insects, fish eggs, and other organisms live. Keeping sediment in place helps protect streambed habitat.

Protect Stream Banks and Access Points

- ☐ Establish a single designated entry and exit point whenever possible.
- ☐ Use existing access points and trails rather than creating new ones.
- ☐ Keep students back from fragile stream edges until it is their turn to enter.
- ☐ Where appropriate, use temporary flags, ropes, or natural barriers to discourage groups from gathering along erodible banks.





Watershed restoration resources are available on the Stroud Center's website.



Protect Stream Habitat

Avoid turning over every rock, digging into banks, kicking through leaf packs, removing large woody material, or building dams. Instead:

- ☐ Lift only the rocks needed for the investigation.
- ☐ Return each moved rock to its original position, submerged under water, and oriented as it was before.
- ☐ Minimize disturbance to leaves, gravel, woody material, and other habitat features.

Protect Streamside Vegetation

Streamside trees and plants make up a riparian buffer that helps stabilize banks, reduce erosion, filter pollutants, provide habitat, and shade streams. Protect vegetation by using established trails and designated access points and by keeping groups away from fragile banks. For further information, see the Stroud Center's [watershed restoration resources](#).

Leave Naturally Occurring Woody Material in Place

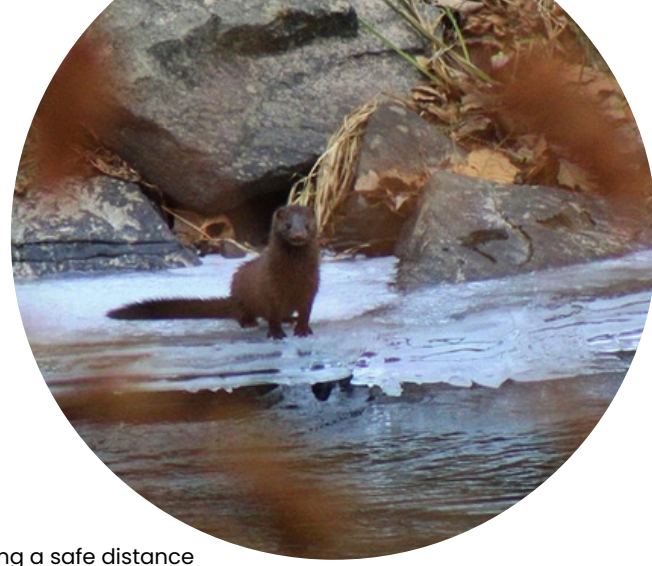
Logs, branches, and other naturally occurring woody material are part of stream habitat. They can slow water, stabilize streambeds, create pools, trap leaves, and provide shelter for fish and aquatic macroinvertebrates. Avoid moving large woody material unless it presents a safety concern for the activity.

Respect Water

Return stream water used during investigations to the stream whenever practical. Stream water contains microscopic organisms, algae, and other components of the aquatic ecosystem; avoid pouring it onto pavement, grass, or dry ground.

Respect Wildlife

- ☐ Observe wildlife quietly from a distance that allows animals to continue their natural behavior.
- ☐ If an animal changes its behavior because of your presence, move farther away and give it space.
- ☐ Avoid repeated approaches to basking, nesting, spawning, or otherwise sensitive wildlife.
- ☐ When collecting aquatic macroinvertebrates for an educational purpose, follow the care and handling practices in part 3.



Keeping a safe distance from this mink reduces the risk of stress on the animal.

A Simple Wildlife Lesson for Students

Give wildlife enough space to continue its normal behavior. If an animal stops feeding, moves away, changes position, becomes alert to you, or otherwise changes its behavior because of your presence, move farther away.



Prevent the Spread of Aquatic Invasive Species (AIS)

Before moving equipment to another water body, follow current local or state guidance to prevent the spread of invasive species and aquatic diseases. At a minimum:

- ☐ Remove mud, plants, algae, and animals from boots, nets, buckets, and sampling equipment.
- ☐ Drain water from equipment.
- ☐ Use approved decontamination procedures when required or recommended.
- ☐ Allow equipment to dry completely whenever possible.



New Zealand mud snails cling to a rock.



Cleaning boots helps prevent the spread of AIS.



Freshly cleaned boots dry in the sun before transport.

Part 3

Caring for Aquatic Macroinvertebrates

Aquatic macroinvertebrates are living animals adapted to the conditions of their streams. Re-create those conditions as closely as practical, minimize stress and handling, and collect only what is needed for learning. Every organism plays a role in the stream ecosystem and deserves care.



What They Need

- ☐ Oxygen-rich stream water.
- ☐ Cool temperatures close to the conditions at collection.
- ☐ Natural leaves or other appropriate habitat material.
- ☐ Places to hide and cling.
- ☐ Minimal disturbance.

What to Avoid

- ☐ Direct sunlight.
- ☐ Chlorinated tap water.
- ☐ Sudden temperature changes.
- ☐ Crowded containers.
- ☐ Long-term captivity.
- ☐ Overhandling.

Collection and Transport

- ☐ Check applicable collection permits before sampling.
- ☐ Avoid collecting during extremely hot weather or unusually low flows, when organisms may already be under environmental stress.
- ☐ Do not use sampling containers or nets with soap residue; residues can harm aquatic organisms.
- ☐ Transport organisms in containers filled with stream water and secured appropriately.
- ☐ Minimize handling.
- ☐ Use aerators during transport. If cooling is needed, place small ice packs around the outside of the container rather than directly in the water, and avoid abrupt temperature changes.
- ☐ Collect only the number and diversity of organisms needed for the lesson.
- ☐ If organisms are held together, separate larger predatory species such as dragonfly nymphs, crayfish, and hellgrammites from smaller macroinvertebrates when needed to reduce predation.
- ☐ Include leaves, small sticks, gravel, or cobble from the stream to provide shelter and places to cling.

During Observations

- ☐ Keep water close to the stream temperature at the time of collection.
- ☐ Use an aerator to maintain oxygenated conditions.
- ☐ Keep aquatic organisms submerged in stream water. Avoid holding delicate organisms directly in your hands.
- ☐ Keep containers shaded and out of direct sunlight.
- ☐ Refresh stream water during extended programs when needed.
- ☐ Handle organisms gently with spoons, soft paintbrushes, or appropriate plastic transfer tools. Avoid forceps whenever possible. Pipettes may be appropriate for very small organisms when used carefully.
- ☐ Keep observation time as short as practical for the learning objective.





From left: Mayfly and stonefly.

Returning Macroinvertebrates to the Stream

- ☐ Return organisms gently to the same stream where they were collected.
- ☐ Whenever practical, release them near the original collection location and among appropriate leaves, rocks, or woody material where they can find shelter.
- ☐ After release, check nets, trays, containers, and instructional supplies for organisms that may still be clinging to surfaces.
- ☐ Return organisms as promptly as practical after observations.

Guiding Principles

Many aquatic macroinvertebrates — especially mayflies, stoneflies, and caddisflies — are adapted to cool, well-oxygenated streams. Warm water holds less dissolved oxygen while simultaneously increasing the organisms' metabolic demands, making them more vulnerable to stress. By maintaining cool, oxygen-rich conditions and minimizing handling, you'll help ensure healthier organisms, more natural observations, and a more meaningful learning experience for your students.



Good Stewardship Is Good Science

Careful collection, observation, and release practices protect stream life while modeling ethical scientific practice. Students learn that scientific investigations should be conducted with respect for the living organisms that make discovery possible.

Before You Leave the Stream

Use one final check to care for both students and the site:

- ☐ Account for all students.
- ☐ Return collected aquatic organisms to their source stream and check equipment for lingering organisms.
- ☐ Return stream water used for investigations to the stream whenever practical.
- ☐ Return moved rocks and habitat materials to their original positions as closely as practical.
- ☐ Inspect equipment and remove visible mud, plants, algae, and organisms before visiting another waterbody.
- ☐ Check students for ticks and other field concerns appropriate to the site.
- ☐ Wash hands with soap and clean water as soon as practical; if that is not immediately available, follow your organization's hygiene procedures and ensure hands are cleaned before eating.
- ☐ Pack out all trash and pick up litter when practical and safe.
- ☐ Leave trails, banks, vegetation, and the stream as you found them, and safely remove any litter you brought or encountered.



Guiding Principles for Ethical Freshwater Education

Every stream investigation involves choices: where we enter, how many students enter at once, what we move, what we collect, how we handle organisms, how long we stay, and when conditions tell us that we should not enter at all. Individually, these choices may seem small. Collectively, they shape both the health of the stream and the lessons students take away from their experience.



Protect people. Plan carefully, evaluate conditions, understand student needs, and be willing to modify or postpone an investigation when conditions are not appropriate.



Respect living organisms. Observe before collecting, collect only what is needed for learning, minimize handling and stress, and return organisms carefully to their habitat.



Protect habitat. Walk gently, minimize disturbance, protect streambanks and streamside vegetation, leave woody material in place, and return moved habitat features as they were found.

Notes

Plan a Better Stream Investigation

A stream is both a place to investigate and a living ecosystem to protect. Whether you're leading students into the field or conducting your own stream study, knowing how to work safely and minimize your impact is an important part of the experience.

Drawing on Stroud Water Research Center's decades of freshwater research and education, *Stream Investigations: Best Practices for Safety, Stewardship, and Care* offers practical guidance for before, during, and after a stream investigation. Learn how to assess a site and prepare for field conditions, minimize disturbance to the stream and its habitat, and properly collect, handle, and return aquatic macroinvertebrates.

Use it to help make every trip to the stream safe for participants, respectful of the ecosystem, and rewarding for everyone involved.



Leaf Pack Network

