

# CHAPTER 2: MONITORING WITH ROCK PACKS

## Materials List

Please see each section below for exact quantities and uses of items. Items are listed below to correspond with the Leaf Pack Network kit of tools (e.g. dichotomous key, macroinvertebrate sorting sheet, plastic mesh bags, etc.). See Resources section of Chapter 4 for more information and direct purchase links on the below items.

Plastic mesh bags*
Waterproof bag tags*
White plastic trays*
White plastic spoons*
Sieve*
Macroinvertebrate ID key*
Macroinvertebrate Sorting Sheets*
Scissors*
Thermometer*
Brightly colored nylon string*
Paintbrushes*
Petri dishes*
Steel rebar
Luggage scale
Waterproof marker
Pencil
Metric ruler (in mm)
Buckets
Calipers (optional)
Rocks of sizes 10-60 mm
Data Sheets (Chapter 5)

### Additional Recommended Items for Macroinvertebrate Care:

- ✓ Ice Packs
- ✓ Aerator/Bubbler(s)

\*The Leaf Pack Experiments Stream Ecology Kit provides these materials and can be found on the LaMotte website. For more information, please visit: <https://leafpacknetwork.org/resources/equipment/>.

# Safety

Safety and health are import factors to consider when planning to monitor with leaf packs. Below are tips that will help you to ensure that the experience is enjoyable and safe.

- Follow all school or organization safety rules and guidelines regarding laboratory and outdoor activities.
- Follow state or country regulations for collecting macroinvertebrates. A fishing or collecting license may be required if macroinvertebrates are considered to be fish bait in your state.
- Ensure that the sampling site is on public property or if stream access is on private property make sure that permission is obtained.
- The stream or river site should be wadeable. Do not enter a waterway where the water level is no higher than your knees. When working in streams, take special care to avoid slipping and falling into deep water.
- When working near deep or fast-moving water, wear a personal flotation device.
- On cold or windy days, it is especially important to provide dry clothes or blankets in case someone gets wet.
- Check weather reports and schedule field activities accordingly.
- If lightning is seen or thunder is heard, do not work in or near the water. Go indoors immediately.
- If the water quality is uncertain, wear protective gloves and boots when coming into contact with the water. Wash hands after deploying, collecting and processing the leaf packs.
- Never drink the water.
- Carry a first aid kit and cell phone.
- Tell someone where you are going and when you expect to return.

Additionally, please read the instructions for all procedures *before* beginning the project.

## Defining a Goal

Monitoring with rock packs is a 3-4 week process and takes some time and planning. Before beginning, it is important to determine the question that will be answered and the focus of the project: the goal. Is monitoring being done to establish baseline conditions to understand the health of a stream or river, or will the results be used in a school setting to teach students about experimental design?

You can do both, and this manual is written as such for a teacher to use with students to demonstrate the scientific method process. However, action projects such as monitoring the baseline conditions of a local waterway are certainly possible and simply need to be decided ahead of time.

## Selecting a Waterway to Monitor

Another consideration is to determine which waterway will be monitored or studied and whether the stream has legal access. The ideal waterway would be a small stream where rock packs can be placed in shallow riffle habitats or even runs, but not a stream with deep waters such as pools or larger rivers. A good rule of thumb is to place rock packs in shallow water where the water level is no higher than your knees.

**For help in making decisions about methods, goals, and how to get started, contact the Leaf Pack Network Administrator with Stroud Water Research Center at [leafpacknetwork@stroudcenter.org](mailto:leafpacknetwork@stroudcenter.org).** The Leaf Pack Network also offers in-person 1-2 day workshops, which can be catered to specifically work with rock pack methods.

# Preparing Rock Packs for the Stream

**MATERIALS** (See Resources page, Chapter 4.)

• mesh bags	• string/nylon twine
• luggage scales (or similar scale)	• scissors
• waterproof marker	• waterproof bag tags
• metric ruler with a 2-mm mark	• gravelometer OR calipers - optional (see below procedure for more info)
• Field Data Sheet	• Wentworth grid (see Chapter 3)



## Identifying the Average Gravel Size in Your Stream via the Wentworth Pebble Count

Before making packs, it is recommended you determine what gravel sizes, if applicable, that you have in your stream. The Wentworth pebble count provides a method for quantitatively characterizing the substrate particles in your streambed by determining the percentage of silt, sand, gravel, cobbles and boulders. The optional activity in Chapter 3 (Wentworth Pebble Count) will give you guidance on how to go about this process to discover your average gravel size while also understanding what percentage of the gravel is within the preferred 10mm-60mm range for net-spinning caddisfly colonization!

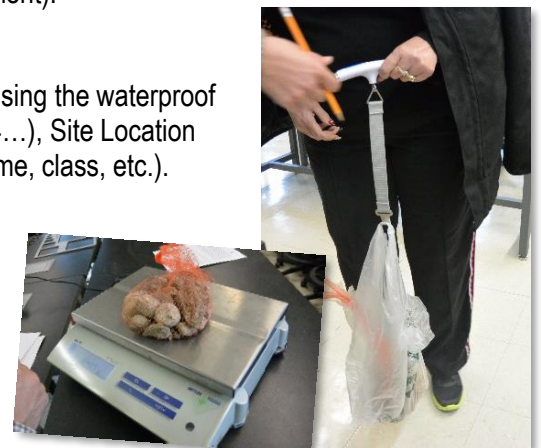
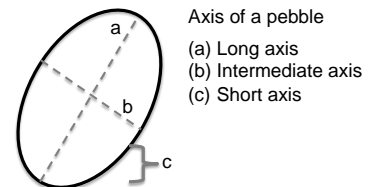
## Collecting Rocks for Your Packs

After completing the Wentworth pebble count, you can grab rocks from your stream or source them elsewhere (e.g., garden or landscape supply store). If taking gravels from your local stream, please take care and caution to not disrupt or degrade the streambed habitat, and return rocks after completing your rock pack experience. Do not remove too many rocks from any one particular area, and when removing rocks, ensure there are no macroinvertebrates removed from their natural habitat. If you find a macroinvertebrate, gently remove the animal and place it on another rock in the same stream.

## PROCEDURE

### Making Rock Packs

1. Collect rocks to fill 3-4 mesh bags per stream site. It is recommended to use a combination of rock sizes between 10-60 millimeter (gravels). Measure along the b-axis (see diagram to right) with a 2-mm metric ruler (easiest option), calipers, OR use a gravelometer or Wentworth grid.
2. With a scale (e.g., luggage scale or other electronic scale; see Resources section), weigh anywhere from 500 grams (minimum suggested) to 1000 grams (maximum suggested) of rocks for each rock pack. Use an average of 750 g grams for consistency between treatments (if not manipulating weights for an experiment).
3. Record your average pack weight on the **Field Data Sheet** (see Chapter 5).
4. Complete a waterproof tag (see Chapter 4 for examples) for each rock pack, using the waterproof marker to record the following information on the tag: Bag # (e.g., 1 of 4, 2 of 4...), Site Location (e.g., stream name), Date, and any other pertinent information (e.g., group name, class, etc.).
5. Place the waterproof tag inside the rock pack bag.
6. Tie each bag closed with one knot.
7. Loop a long length of nylon twine or string through the mesh of each bag so the rock pack can be attached to a rebar post or piece of wood in the stream. See next section for more details on placing packs in the stream!



# Placing Rock Packs in the Stream

**MATERIALS** (See Resources page, Chapter 4.)

• thermometer	• prepared rock packs
• nylon string/twine	• Field Data Sheet
• pencil	• Habitat Data Sheet
• sledgehammer	• Site Map Data Sheet
• steel rebar	• scissors



## PROCEDURE

**NOTE:** If you are determining stream discharge, do so before placing rock packs. Follow procedures found in Chapter 3. Additionally, remember to place rock packs in shallow water where the water level is no higher than your knees, typically in a riffle habitat.

1. One tried and true method is to secure rock packs in the stream using a sledgehammer, reinforcing steel rods or rebar (1 rebar for up to 5 packs), and brightly colored (e.g., neon yellow, pink, or orange) nylon string/twine. First, use the sledgehammer to drive a piece of rebar (tall enough to see above the water level) to secure it into the streambed.
2. Loop the string through the mesh bag of each rock pack and, one at a time, tie each pack directly to the rebar and use the scissors to cut any long strings.

**NOTE:** Please remember to dispose of your waste (e.g., strings) responsibly and remove the rebar when your monitoring is completed.

3. Position rock packs (facing upstream) so that as much surface area of the bag is facing the current as possible. Make sure all rock packs are submerged and securely tied. To further secure the rock packs, consider slightly anchoring one end of the pack with an external heavy rock found in the stream; this should NOT cover your rock pack entirely, but instead provide additional security during high flows or flooding. **NOTE:** Rock packs that move with the current are not properly placed.
4. Record appropriate information on the **Field Data Sheet**.
5. Sketch a site map on the back of the **Site Map Data Sheet** that shows the position of each rock pack in the stream and gives some guidance on how to find them as rock packs may become covered with sediment and algae making them hard to locate weeks later. **NOTE:** It may be useful to place markers along the bank of the stream to help you find your packs again. However, these markers may draw attention to your rock pack and possibly incite vandalism.
6. Complete the **Habitat Data Sheet**. Refer to glossary for definitions.
7. Keep the rock packs in the stream for 3-4 weeks. If possible, check the packs periodically to see that they remain submerged, especially noting if any storms occur and amounts of rainfall.





# Collecting Rock Packs from the Stream

**MATERIALS** (See Resources page, Chapter 4.)

• thermometer	• bucket(s) (>1 gallon)
• scissors	• Field and Site Map Data Sheets
• pencil	• sieve (optional but helpful)



## PROCEDURE

**NOTE:** If conducting an experiment with your students (e.g., comparing different rock pack grain sizes, habitat locations, etc.), be sure to keep packs separate as you collect them from the stream (e.g., in separate buckets) to ensure macroinvertebrates do not travel to other packs and cause data errors! Otherwise, multiple packs may be added to the same bucket.

1. Complete the remaining information on the **Field Data Sheet**. (e.g., time, air and water temperature, number of packs, date removed, precipitation/storm information)

**NOTE:** Refer to the **Site Map Data Sheet** to identify the location of each pack. Be sure to collect packs starting with the one furthest downstream, then work your way upstream so that you are not disturbing downstream packs as you go.

2. Fill bucket(s) three-quarters full with stream water from the source – enough to cover the surface of your rock packs.
3. Collect additional stream water in another bucket to be used during macroinvertebrate sorting! Keep the water cool. Tap water may be used. **NOTE:** Chlorinated tap water must sit for three days before use to allow the chlorine to dissipate. Chlorine will kill the macroinvertebrates.
4. In the stream, locate your packs and one by one, cut or untie the nylon string/twine attaching a rock pack to the rebar, responsibly disposing of the string waste.
5. When retrieving a rock pack from the stream, position your bucket just downstream of your pack and bring the rock pack into the bucket quickly and gently. Some of the insects are very quick and will try to escape.
6. Repeat Steps 4-5 for each rock pack.
7. If processing rock packs indoors or storing rock packs overnight for next-day sorting, place a cooler pack and aerator/bubbler in the bucket(s). Some invertebrates are very sensitive to changes in temperature and dissolved oxygen. Therefore, try to keep the water consistently cool. Reduce stress by adding some rocks and leaves as habitat.

EXAMPLE		APRIL 2020						EXAMPLE
SUN	MON	TUE	WED	THU	FRI	SAT		
			1	2 <i>Place Packs</i>	3	4		
5	6	7	8	9	10	11		
12	13	14	15	16	17	18		
19	20	21	22	23	24	25 <i>Collect Packs</i>		
26	27	28	29	30				

Mark your calendars for collecting your packs!

## TIP! HOW DO I SAFELY MAINTAIN MACROINVERTEBRATES OVERNIGHT?

1. Place rock packs of macroinvertebrates in a cooler with stream water from the source (the same site at which the animals were collected). Leave outdoors if cool (<15°C), keeping out of direct sunlight. Alternatively, store cooler indoors with freezer packs inside.
2. Use an insulated bucket (bait bucket) and add an air-stone. These items can be found inexpensively at local outdoor recreation / fishing stores or pet stores.
3. Store bags in a refrigerator.



# Processing Rock Packs from the Stream (streamside or indoors)

## MATERIALS

• Biotic Index Data Sheet (optional)	• Net-Spinning Caddisfly ID Guide	• white trays
• sieve (optional)	• spoons	• squirt bottle (optional)
• hand lenses	• brushes	• measuring cup
• petri dishes (optional)	• scissors	• sorting sheet (optional)
• identification keys	• buckets	• small trash bag for string

## PROCEDURES PART I: PREPARING TO SORT ROCK PACKS

### NOTES:

- You may simply identify ONLY net-spinning caddisflies, coming up with a total count per pack or across all packs. Alternatively, you may count and identify ALL macroinvertebrates, using the Biotic Index Data Sheet (Chapter 5) to determine a Pollution Tolerance Index score and rating (poor, fair, good, excellent).
- Streamside processing is preferable over indoor processing to minimize stress on the macroinvertebrates. If processing the packs indoors, keep the packs in a cooler with ice packs or in a refrigerator until they are processed.
- Prior to processing rock packs, it is highly recommended that teachers complete the Digital Detectives Activity (Chapter 3) with students and explore the macroinvertebrate identification resources found in Chapter 4.

1. Fill white trays with 1-inch of cool stream water (Collecting Rock Packs, Step 3). Teachers may opt to divide white trays among different student groups (e.g., students conducting an experiment on different grain sizes).
2. Untie or carefully cut open mesh bags and empty contents into the bucket of stream water. Be sure to look over the mesh bag, your hands, and clothes to remove macroinvertebrates that may still be hanging on!
3. Carefully remove rocks from the bucket(s), gently placing rocks in the white tray(s) of stream water. No worries if a macroinvertebrate has hitchhiked from a rock to the tray; we will be sorting through the trays soon!
4. Once all rocks are removed from the bucket(s), carefully pour contents of the bucket(s) (e.g., stream water with any macroinvertebrates or leaf litter) through a sieve into another bucket. Add second bucket of sieved content to tray(s) for sorting. **NOTE:** *This process is most easily done with 2-3 individuals. Additionally, it may be helpful to use a squirt/squeeze bottle to squirt water through the back of the sieve and into the white trays to dislodge more macroinvertebrates. Check the second bucket for any missed macroinvertebrates!*
5. Repeat Steps 3-4 for each rock pack. Make sure to keep rock packs separate and properly labeled so that the data you collect directly corresponds to each particular rock pack.



## PROCEDURES PART II: SORTING ROCK PACKS AND SHARING YOUR DATA IN THE PORTAL

**Optional:** If identifying all macroinvertebrates (not only net-spinning caddisfly larvae) using the **Biotic Index Data Sheet**, it is useful to organize all individuals with the Leaf Pack Network sorting sheets (See Chapter 4 for purchase links). If using this, place a petri dish with stream water on each circle of the sorting sheet.

6. Using a clean paintbrush or plastic spoon (white recommended), place all macroinvertebrates that look alike in the same petri dish, sorting “like with like.” Use hand lenses to check for the special characteristics of each macroinvertebrate. Use identification keys as needed.
7. Count the total number of individual net-spinning caddisfly larvae from all packs and record in the **Field Data Sheet**. Additionally, you can record all macroinvertebrate types on the optional **Biotic Index Data Sheet**, calculating the Pollution Tolerance Value and Rating as well as % Net-Spinning Caddisflies of the Total Macroinvertebrates recorded on the Field Data Sheet.
8. Data can be entered into the Monitor My Watershed data portal; go to [www.wikiwatershed.org/help/leaf-pack-help](http://www.wikiwatershed.org/help/leaf-pack-help) for detailed instructions. Most data fields are mirrored in the database; if you only collected data on net-spinning caddisfly abundance (NOT on all macroinvertebrates), you may enter those specific data into the database.

## PROCEDURES PART III: CLEAN-UP

9. Wash and dry all lab equipment before putting away.
10. Return macroinvertebrates alive to the section of stream they were collected from as soon as possible.
11. Any macroinvertebrates that die can be preserved for future educational uses in a reference collection if placed in 70% ethyl alcohol (can be purchased inexpensively from your local pharmacy).

