

How to Build BabyLegs

A citizen science research trawl for studying marine plastics



Created with baby's tights, soda pop bottles, and other inexpensive and easy to find materials, BabyLegs can be used to skim the surface of water in rivers, streams, and oceans for floating marine microplastics by hand or from a boat. This instrument is called a **surface trawl**.

Plastics in the water pass through the mouth of BabyLegs, and accumulate in the toes. Once sampling is done, you turn the leggings inside out to see what they have caught!

This guide will walk you through how to build and use BabyLegs.

If you have any questions, contact Civic Laboratory for Environmental Action Research through our website, or by emailing our director, Dr. Max Liboiron, at mliwoiron@mun.ca.

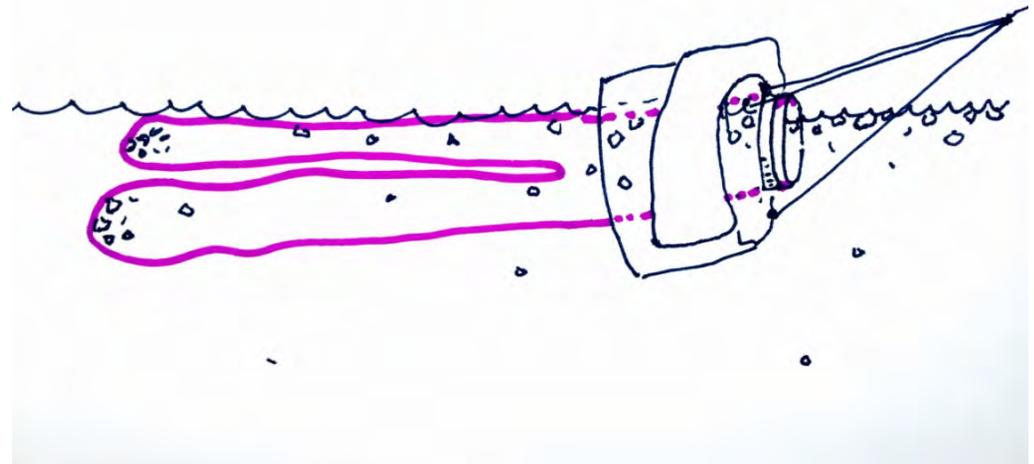
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Getting Started

Materials:

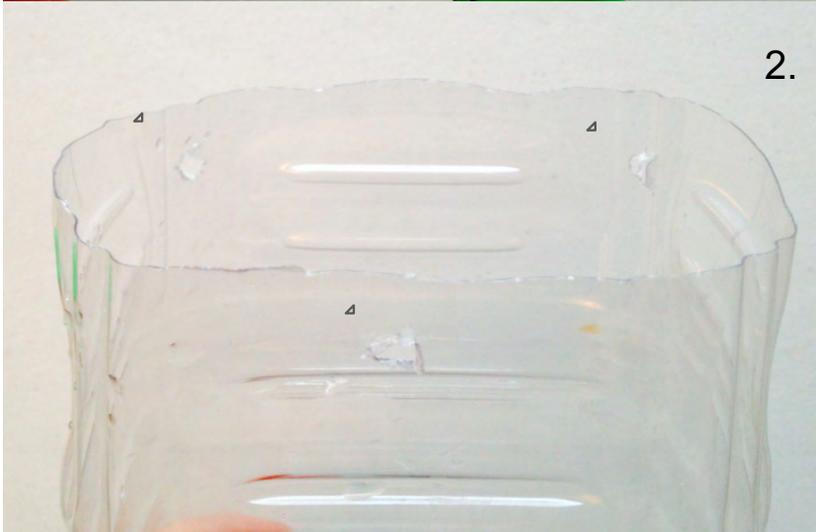
- 1 waterproof container with a mouth at least 6 inches wide. Square or rectangular works best.
- 1 plumber's clamp that will fit around the container (you can always merge two together if they are too short)
- 1 pair of nylon baby or toddler's tights- we recommend pink or red in case fibres contaminate your sample, as they will be easy to pick out. Cotton tights will get too heavy when wet, so ensure tights are nylon.
- 1 rope (~10 meters)- we recommend a bright colour in case threads contaminate your sample
- 1 pair of scissors or utility knife
- 1 nut driver or flathead screwdriver to open and close the plumber's clamp
- 1 drill or grommet punch (optional, but useful)
- 1 file or sandpaper (optional, but useful)



Creating the Body



Step 1: Cut the bottom (and top if not already open, ie: soda bottle) off a waterproof container to use as Baby Leg's body. We recommend containers with openings 6 inches and larger to get adequate samples. Square-mouthed containers will give you a better idea of how much water passes through if you want to calculate the volume of water sampled, but if you are just sampling for the presence of plastics, a round-mouthed container will be fine. Any container will work. We've used bulk ketchup containers, kitty litter containers, small buckets, juice containers, and even a cardboard milk carton. Use what works best in your environment based on what you have available.



Step 2: Carefully cut, punch, or drill three holes around the edges of the mouth of BabyLegs. These will be for the rope to attach. The mouth should be the side with the smallest opening (otherwise it creates drag). Put holes above where you are going to put the tights. There should be two holes at the top and one at the bottom, as this configuration gives the trawler the most control over maneuvering BabyLegs.

Step 3: Trim, file, melt, or sand the holes so they don't have sharp edges that might snag the tights. Do this for the cut edges at the top and bottom of the container as well. We don't want runs in our tights—it's bad for science because the snags might let samples escape.

Adding the Legs

Step 4a: Open a plumber's clamp wide enough to put over the body. If your clamp isn't big enough, you can screw two clamps together. Put the tights between the container and the clamp. The strongest part of the tights—the waist band—should be where the clamp attaches. **4b:** You may have to crimp the round clamp around a square body if your container is square; bend the edges with your hands so the clamp and the body are the same shape.

4c: If possible, tuck the tights around the clamp for added strength, or double up the tights under the clamp if the clamp is too loose. If you clamp the thinner material, it may create holes.

Step 5: Close the clamp securely, but not too tightly that it stresses the container. If your container is square, you may have to keep crimping the corners so the clamp tightens evenly. Test by tugging on the tights. They should stay firm.

4a.



4b.



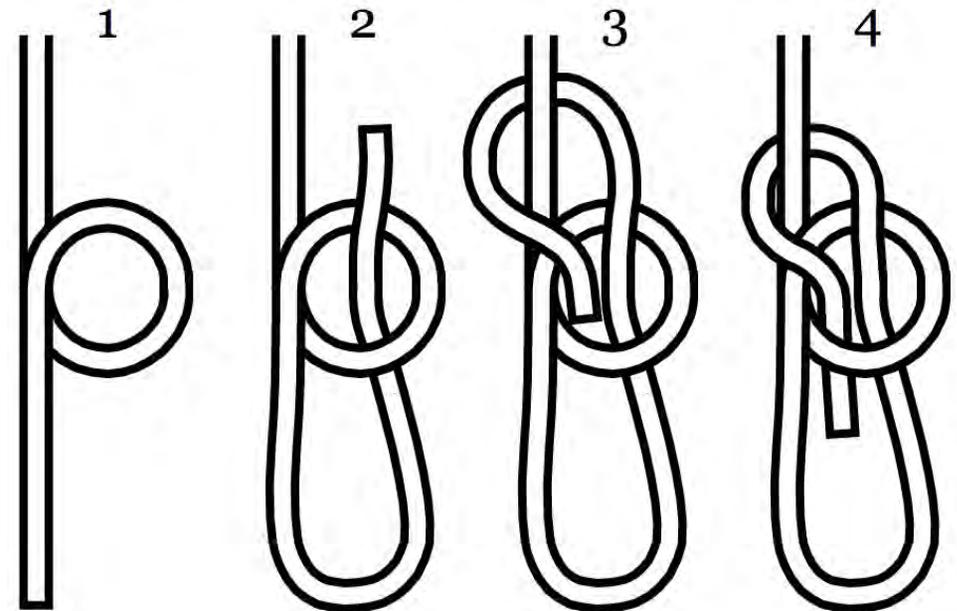
4c.



Attaching the Rope

Step 6: Cut 3 equal sections of rope, and leave a 4th, much longer piece for trawling Baby Legs. Attach each of the 3 pieces of rope to the three holes you've created around the mouth of the trawl. Tie them so that they evenly attach at one central point. If it is uneven, BabyLegs can spin in the water and snag the lines. Melt* or otherwise tie off ends of the rope so threads do not contaminate your sample. If you can't melt them or are concerned that they might contaminate your sample, tie them so the ends are on the outside of the trawl rather than the inside.

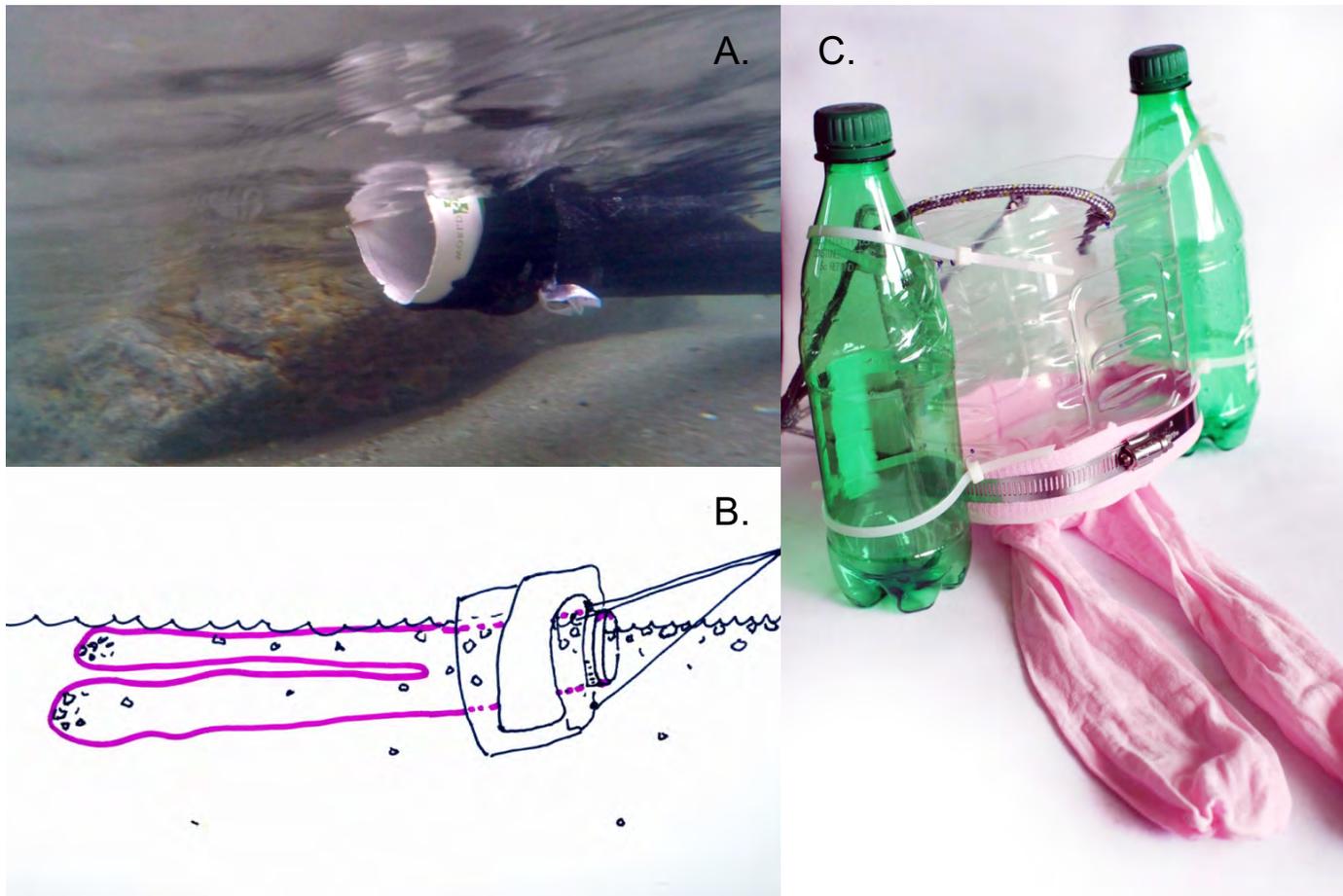
*Adults may need to assist with this step, if children are participating in building BabyLegs.



You can tie any kind of knot, but a bowline is a strong knot and is illustrated here.

Amendments and hacks

Since these are do-it-yourself tools, often people will use them in ways and conditions that we don't cover here. That's great, and is what advancing knowledge is all about! There are other additions to can add to BabyLegs depending on the type of water and vessel you are using. You can add "water wings," soda pop bottle pontoons, manta wings, and other stabilization or flotation devices for very calm and slow water, or choppy water.



- A. BabyLegs with a cardboard body and black tights, used by hand instead of pulled by a rope.
- B. BabyLegs design with a "water wing," or floatation device to keep the mouth of the container at the water's surface in rivers.
- C. BabyLegs with pontoons to stabilize her in rough and choppy waters.

Using BabyLegs

Research trawls are essentially fancy butterfly nets for catching surface plastics. You can use BabyLegs anywhere where there is water and you can get the water to flow through the device. Here are some of the ways people have deployed BabyLegs:

A. Behind a human-powered boat like a canoe or skiff.



B. From a motorized boat, which requires an arm keeping the device out of the wake.



C. By hand in flowing water.



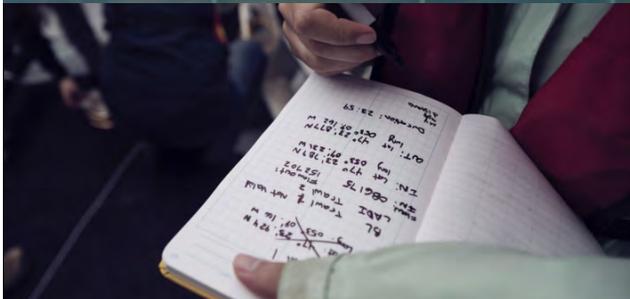
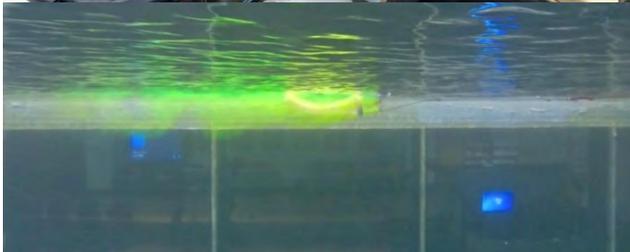
D. Tied off to a wharf with fast flowing water.



E. Tied off from a bridge with fast flowing water beneath.



Proper comportment



No matter where you use BabyLegs, the main issue is to make sure the mouth of the container stays at the surface of the water at all times, so most of the mouth is underwater, and a small amount is above water. This ensures the surface of the water, where most buoyant plastics are, is always entering the container.

Keep BabyLegs out of wake, turbulence, or disrupted water flow. Turbulence “down wells” plastic, pushing them deeper in the water column. If you’re tying BabyLegs to a wharf or bridge, ensure she doesn’t bump against anything or end up in an eddy. From a boat, keep BabyLegs out of the wake. We recommend using an extending arm to pull her alongside a vessel rather than behind it. This shows a make-shift arm we made for a research trawl.

Water should always be running through BabyLegs, not “choking up” or flowing out again. Otherwise you’ll lose plastics. This is especially important when you are taking BabyLegs out of the water or changing direction (if you are in a boat or doing things by hand). This image shows dye moving through BabyLegs without flowing back out of the mouth.

Timing will vary, though we do not recommend trawling for less than half an hour if you want to get a good sample. If the water is particularly swampy or full of debris, we do not recommend sampling with a trawl at all, as it will be extremely time consuming to separate plastics from organics.

Removing the Sample

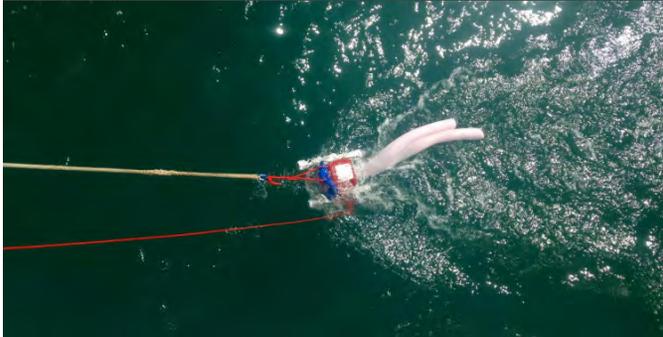
When you have trawled for a set amount of time, pull BabyLegs up and let the water drain out of her toes. There are two methods for removing the accumulated sample:

a) If you have a hose: Leaving the clamped to the body, slowly turn the tights inside out, one leg at a time, and rinse everything captured into a sieve (if you don't have a scientific sieve, you can use a fine mesh spaghetti strainer used in kitchens—the smaller the holes, the better). Repeat with the other leg. You can then transfer the items from the sieve into a jar. Add a capful of hydrogen peroxide (from a drug store) to the jar to keep the sample from smelling.

b) If you do not have a hose or a sieve, or if you are in a rush: Unclamp the tights, squeeze the water out, bundle the tights up, and put them in a sample bag or jar, and put on a new pair of tights if you want to sample again. You will process the tights afterwards in a sink. You will need many spare pairs of tights for this method. Add a capful of hydrogen peroxide to the jar/bag to keep the sample from smelling.

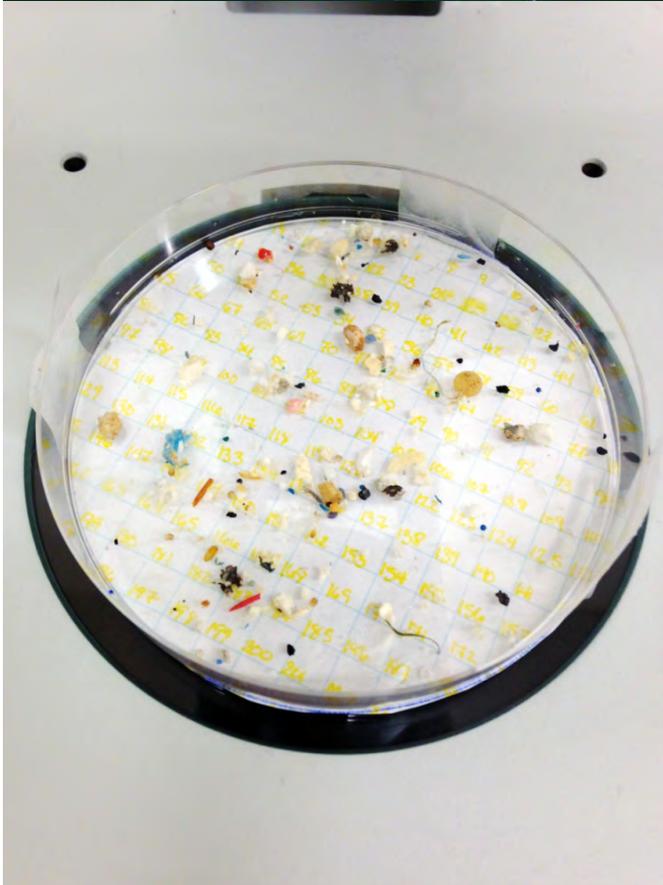


Capacities



Speed: We have found that BabyLegs (Ketchup Container version) can easily handle up to 5 knots of speed in semi-choppy waves for over an hour. In high speeds, attach a “leash” to BabyLegs-- an extra line that does not take any pressure and is tied to the boat directly (red line in the image). If your pole breaks or the main line malfunctions, you can use the leash to keep the device from being lost at sea, or being sucked under the boat.

Type of data collected: BabyLegs can collect samples of marine plastics so that you can see the types and sizes of plastics in an areas. You can also see the ratios of different kinds of plastics: are there more fishing line threads than foam? Or is it mostly foam and fragments? This can tell you about the type and sometimes even the sources of plastics in your area. You can also tell if there are “hot spots” or areas of high density of plastics, such as at sewage outfalls or in certain bays.



However, the data collected by BabyLegs will not hold up in scientific publications because of two reasons: 1) the faster BabyLegs goes and the older she gets, the more the tights stretch and the holes change size slightly. This means that you cannot be sure of the minimum size collected consistently. 2) At different speeds and in different amounts of chop, BabyLegs can bob above or below the surface of the water, especially with different designs, meaning that the behaviour isn’t exactly consistent across or between uses. In rigorous science, you need exactness and consistency to make robust claims about precisely how many plastics are in an area. If you need this kind of data, we recommend using our LADI trawl (see our website). But if you don’t need this kind of precision, BabyLegs is just fine. The image to the left is a sample from BabyLegs in the Hudson River.

FAQs

Q: What if the trawl skips along the water and isn't always sampling?

A: If you're just curious about what's in the water, this doesn't matter. If you want to understand the density of plastics in the water, or you want to have a representative sample, then the trawl mouth has to always be in the water for the sample to be valid. Slow down, let out more line, or wait for less choppy water.

Q: Can I use cotton tights instead of nylon tights?

A: Nope. They will sink when they get heavy with water.

Q: I don't have a hose or other way to process the sample on my boat. What do I do?

A: Bring lots of pairs of tights, and switch them out whenever you want to do a new sample. Store each one in a ziplock or other watertight bag that will not contaminate the sample.

Q: Can I change out any part of the trawl, or change the design?

A: Of course! The only thing you have to make sure of is that the mouth of the trawl is always half in the water and half out. It cannot dive or skip over the water. Also beware of any materials that might put more plastic into the ocean or into the sample (plastic 3D printing, fleece, and plastic thread are particularly bad for this).

Q: I can't tell what is plastic and what is not!

A: Yeah, it's really hard. There is a spotters guide and an analysis workbook to help with that. The more time you spend with a series of samples and body of water, the better you will get at knowing the types of plastics and plastic-look-alikes in your area.

Q: The trawl keeps diving under the water!

A: Go slower, fix your ropes so the top rope is slightly shorter, and/or put pontoons on the outside so that BabyLegs has floaties.

Q: Can I do this from my paddle board?

A: Yes, please!

Q: The trawl keeps spinning when it's in the water.

A: This means that one side is pulling more than the other. Use a square container rather than a round one if you aren't already. Ensure your ropes are the same length. Make sure the holes for the ropes are evenly spaced.