Tubs & Pumps

Brief Assembly Guide

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Overview

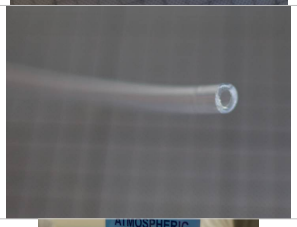
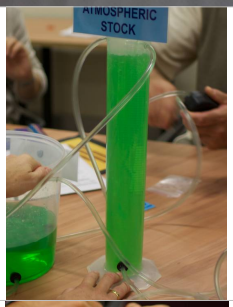
This guide contains the accumulated insights in setting up the Tubs & Pumps activity. It is by no means complete, and suggestions and contributions are encouraged.

This activity is an aid to build understanding of stock-and-flow systems using hands-on materials. This guide is aimed towards an activity about the carbon cycle and has been designed to be a general framework, but could be easily modified for other scenarios.

Equipment

No kits are available at this stage, but there are plans to develop a kit in the future along with suitable support material.

Below is a basic bill of materials:

Item	Cost/Supplier	Notes
	Remote Control (RC) Fuel Pumps $15 eBay/Amazon	Buy a spare - they sometimes jam and it's better to replace one and fix it after the activity. There are bigger pumps around (Jack Rabbit), but these work better, and are cheaper.
	4mm vinyl tube $1/metre aquarium or hose supplies	The tubes that come with the pumps are 3mm, cheap, and pop off easily. Need about 1.5m per pump.
	1 Litre PE measuring cylinder $15-$20 eBay/Amazon	These are great to see the levels gradually rise/fall. 500mL tend to happen too quickly. Plastic drink bottles could work to reduce cost
	5-10 Litre PE tub $3-$5 Discount stores	These need to be big enough so that changes in levels aren't noticed.

Handy things to have:

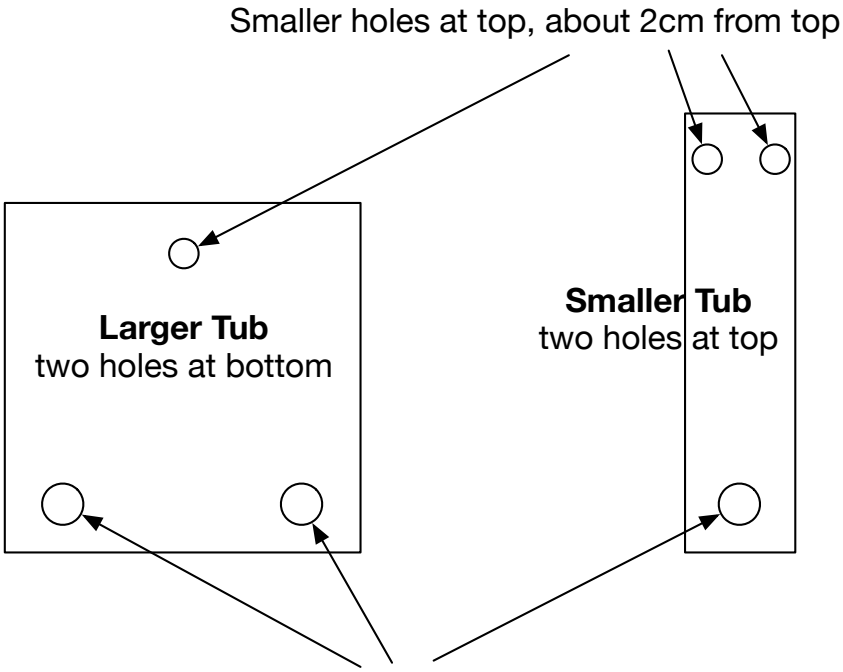
Item	Cost/Supplier	Notes
20 Litre Tub	$5-$10	Handy for setting up and packing up.
	4mm grommets (submerged holes only) $1 aquarium or hose supplies	These are handy if you drill holes into the tubs - they stop leaks! Drilling holes makes the exercise less ‘generic’, as it ‘fixes’ the system structure
	Food colouring $2 supermarket	Choose a cool colour.
	Custom beer mats ~$30 online companies	Print a generic or specific beer mat to help the activity and soak up small amounts of water - it’s usually enough
	Sinkers/Weights Hardware stores	If you don’t want to drill holes in the tubs, it’s handy to use a sinker or some nuts to weigh the pipes down. Drilling holes works better.
Canvas bags	$1, supermarket	To put everything in
An old towel	n/a	Handy for un/intended spills
Activity instructions	n/a	Plan the activity carefully, and provide good instructions

Tools for construction

- cordless drill (low speeds are better for these plastic)
- drill bits (1mm smaller than the outside diameter of pipes/grommets)
- sharp scissors for cutting pipe at an angle
- petroleum jelly or cooking oil - makes putting the pipes into the holes easy
- pliers are handy to pull the pipe through

Assembly Instructions (drilled holes)

Mark out holes on the tub and cylinder. As there are three flows in the Carbon Cycle activity, I use the following pattern:



Tips for drilling holes:

- plot out holes with a marker first - even better, build a card template
- 2 cm is about the right distance from top/bottom. The top holes could be further down to ensure spillage is minimised through over-excited pumping.
- use a low speed drill (cordless low speed)
- drill a pilot hole first
- use blunt drill bits, sharp drill bits can cause cracks in the plastic
- also put the drill in reverse, and take your time to avoid cracks in the plastic

Tips for assembly:

- cut the pipes on an angle to help putting them through the holes
- put cooking oil or petroleum jelly on the pipes to help putting them in
- insert the pipes about an 3 cm into the tubs