EQUIPMENT BUILD PLAN

AIR & WATER PRESSURE

Tall Clear Demonstration Tanks

Ordinary aquariums are too short and wide for many demonstrations, so Bruce built his own tanks from clear plastic tubing with a plastic disk epoxied into the bottom and a sturdy wooden base. His four range from 6 inches wide by 20 inches tall to 2 3/4 inches wide by 58 inches tall, and they make density columns and Cartesian divers visible from across the room.

> Written from Bruce's original workshop handout. Bruce's final review of this plan is in progress.

DIFFICULTY	BUILD TIME
Intermediate	2-3 hours plus overnight curing
COST	**SAFETY**
About $40-120, depending on tube size	Adult build / supervision
GOOD FOR	
Teachers, Makers	

What it shows

A five-foot column of rainbow water in the classroom window starts with a plastic tube and a disk of epoxied plastic.

Key ideas: density, buoyancy, water pressure, Cartesian divers

Safety (Adult build / supervision). An adult should cut the plastic and handle the epoxy; wear gloves and safety glasses and work in a ventilated area. A tall tank full of water is heavy and top-heavy: always use a wide base, and never leave a tall tube standing without

it. Bruce lost a 5-foot tube when it fell over.

CONSTRUCTION

Build it

Materials

- [ ] **Clear rigid plastic tubing (acrylic or PVC)** · 1 length per tank
  Sold by the foot; search for rigid plastic tubing. Bruce's sizes: 6 in x 20 in, 6 in x 34 in, 3 in x 46 in, 2 3/4 in x 58 in
- [ ] **Plastic sheet, 1/4 in thick** · enough for one disk per tank
  For the bottoms
- [ ] **Two-part epoxy for plastics** · 1 package
  About a 20-minute working time
- [ ] **Cardboard** · 1 piece
  For making a pattern if the tube is too long to trace inside
- [ ] **Petroleum-based cleaner** · small amount
  For wiping off wet epoxy
- [ ] **Wood for bases** · as needed
  Wide and heavy enough to keep the tank from tipping

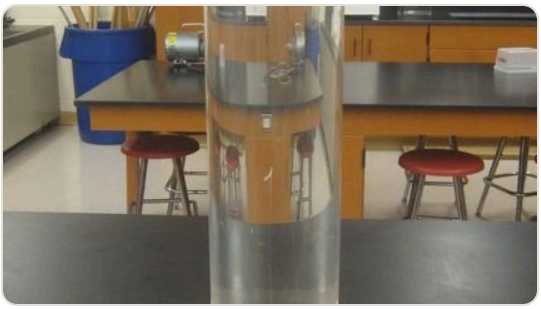
Tools

- Jig saw, scroll saw or band saw
- Marker or scribe
- Mixing stick and disposable surface
- Disposable gloves
- Wax paper
- Sander or sandpaper
- Saw and drill for the wooden base

1

Choose the tubing

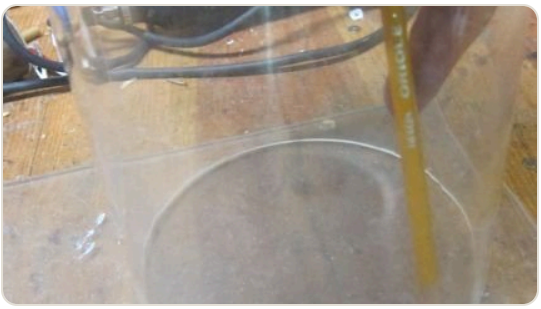
Pick a diameter and height for your demonstrations. Wider tubes suit divers and floating objects; narrow, tall tubes make striking density columns.



2

Trace the bottom disk

If you can reach inside, trace the inside of the tube onto the 1/4 in plastic sheet. If the tube is too long, press its end down hard on cardboard to make an indented circle and use that as a pattern.



3

Cut the disk

Cut out the disk with a jig saw, scroll saw or band saw, staying just outside the line, and sand to the line.

4

Check the fit

The disk should slide snugly into the end of the tube but not be tight. A forced fit can crack the tube.

5

Mix the epoxy

Mix the two-part plastic epoxy on a disposable surface, following the package directions.

6

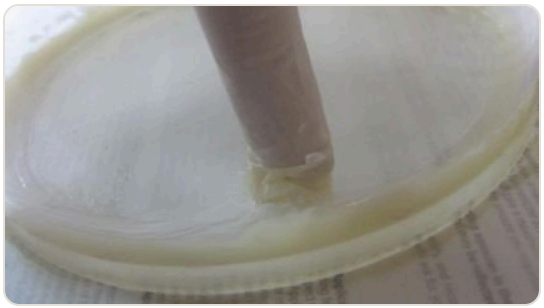
Apply the glue

With a stick, spread most of the epoxy around the inside edge of the tube end, and a little around the edge of the disk.

7

Seat the disk

Push the disk into the tube until its bottom is even with the end of the tube. If you can reach, smear the glue around the inside seam to seal it.



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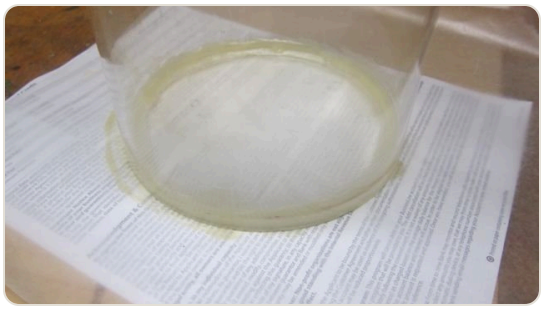
Let it cure flat

Stand the tube on wax paper on a flat surface so the bottom stays even while the glue hardens. Epoxy will not stick to the wax paper.



9

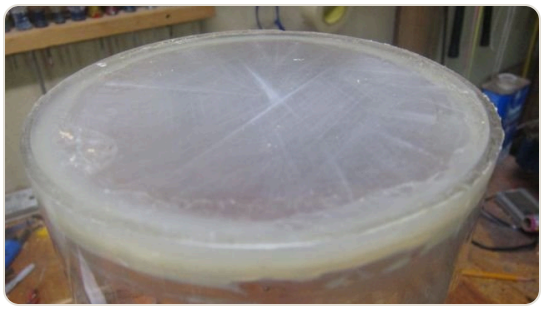
Clean up wet glue

Wipe any stray epoxy off the tube with a petroleum-based cleaner while it is still wet; once it hardens it is much harder to remove.

10

Finish the bottom

When the epoxy is fully hard, sand off any excess on the bottom so the tank sits flat.



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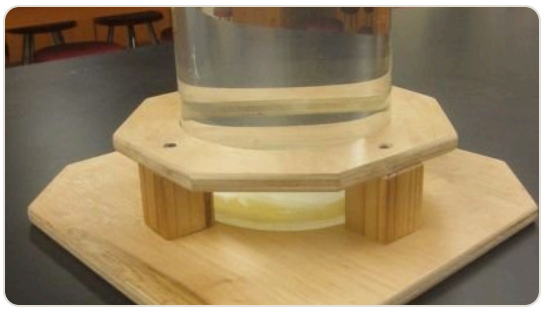
Build a base

Make a wide wooden base with blocks that surround the bottom of the tube, so the tank can be lifted out but cannot tip. Taller tubes need wider, heavier bases.



12

Leak test

Fill the tank with water in a sink or outdoors and let it stand for a day before using it in class.

THE PHYSICS

How it works

A tall, narrow tank stretches layers of different-density liquids into long, easy-to-see bands, so a density column becomes visible from anywhere in the room.

Water pressure increases with depth, about 0.43 pounds per square inch for each foot. A deep tank makes that change large enough to drive a Cartesian diver: as pressure rises, the air bubble inside the diver is squeezed, the diver becomes denser than the water, and it sinks.

The bottom joint must hold the weight of the water and the pressure at the bottom. Plastic-to-plastic epoxy makes a strong, waterproof seal because both parts expand and contract together.

Using it

- Build a rainbow density column in the tallest tube and display it in a sunny window.
- Use a wide tank for Cartesian divers, including large homemade divers and remote-controlled divers.
- Drop objects of different density, such as a grape, an egg or a plastic toy, into a salt-water gradient and watch where they come to rest.
- Have students calculate the water pressure at the bottom of each tank from its height.

GO FURTHER

Variations

- Bruce fitted one tube with a plastic cap at the top, sanded to a funnel-like angle so a rubber stopper seals well, and uses it with a vacuum pump for a coin-and-feather fall demonstration. Vacuum work needs tubing rated for it and eye protection, so it is not covered in these steps.

- Make a short, wide version for a classroom diver tank before attempting a tall one.

IF IT DOESN'T WORK

Troubleshooting

IF THIS HAPPENS	TRY THIS
The tube cracked when the bottom was fitted.	The disk was too tight. Sand the disk until it slides in snugly with no force.
The tube cracked after gluing in a wooden plug.	Never use wood for the bottom. Bruce ruined tubing twice this way: the wood absorbed moisture from the glue, swelled and split the tube. Use plastic only.
The bottom leaks.	Dry the tank, rough up the seam with sandpaper, and run a fresh bead of epoxy around the inside joint.
The tank wobbles in its base.	Add blocks or a deeper socket so the base grips the tube on all sides.

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