

EQUIPMENT BUILD PLAN MATTER

Rainbow Density Column

Six solutions with different amounts of salt are colored with food coloring and layered from saltiest to fresh. Because each layer is a little less dense than the one beneath it, the colors stay separate, making a bright, simple demonstration of density. Bruce's recipe comes in metric and kitchen measures.

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



DIFFICULTY	BUILD TIME
Beginner	30-45 minutes
COST	SAFETY
About \$5	Everyday care
GOOD FOR	
Teachers, Families	

What it shows

Six cups of colored salt water, poured carefully, stack themselves into a rainbow that holds its stripes.

Key ideas: density, solutions, concentration, layering of fluids

Safety (Everyday care). Uses only water, table salt and food coloring. Food coloring stains clothing and counters, so cover the work area.

CONSTRUCTION

Build it

Materials

- ☐ **Water** · 600 ml (or 3 cups)
100 ml or 1/2 cup per jar
- ☐ **Table salt** · about 66 g (or about 13 teaspoons)
- ☐ **Food coloring: blue, red, green, yellow** · 1 set
- ☐ **Tall clear container** · 1
Narrow is best; a tall tank or a 600 ml cylinder works well

Tools

Six cups or jars

Kitchen scale (grams) or measuring spoons

Graduated cylinder or measuring cup

Stirring spoon

Spoon, turkey baster or large syringe for layering

1

Measure the water

Put 100 ml of water (or 1/2 cup) into each of six jars and number them 1 to 6.

2

Add the salt

Add salt and stir until it dissolves: jar 1, 20 g (4 teaspoons); jar 2, 16.6 g (3.3 teaspoons); jar 3, 14 g (2.5 teaspoons); jar 4, 10.6 g (2 teaspoons); jar 5, 5 g (1 teaspoon); jar 6, no salt.

3

Add the color

Jar 1: 2 drops blue and 1 red (purple). Jar 2: 2 drops blue. Jar 3: 2 drops green. Jar 4: 2 drops yellow. Jar 5: 1 drop yellow and 1 red (orange). Jar 6: 3 drops red.

4

Pour the bottom layer

Pour jar 1, the saltiest, into the bottom of the tall container.

5

Layer the rest gently

Add each jar in order, 2 through 6, very slowly, letting the liquid run down the inside wall or over the back of a spoon held just above the surface. A turkey baster or large syringe gives even more control.

6

Let it settle

Set the column where it will not be bumped and observe the six bands from purple at the bottom to red at the top.



THE PHYSICS

How it works

Dissolving salt adds mass to the water while increasing its volume only slightly, so salt water is denser than fresh water. The more salt, the denser the solution.

A less dense liquid floats on a denser one. Poured gently, each new layer rests on the layer below instead of mixing into it.

The layers are not permanent. Over hours and days, salt slowly diffuses from the saltier layers into the fresher ones and the sharp bands blur into a smooth gradient.

Using it

- Show the finished column and ask how six clear-looking liquids can stack in stripes.
- Give students the jars out of order and have them figure out the correct pouring order by testing small samples.
- Drop in a grape, a small piece of potato or a plastic bead and watch it float at a particular layer.
- Check the column the next day and the day after to see diffusion blur the boundaries.
- Measure the mass of 100 ml of each solution to calculate its density.

GO FURTHER

Variations

- Build the column in one of Bruce's tall tanks for a classroom-sized display; multiply the recipe to fill the tube, keeping the same salt-to-water ratios.
- Use sugar instead of salt, or layer different liquids such as honey, dish soap, water and oil.

IF IT DOESN'T WORK

Troubleshooting

IF THIS HAPPENS

The colors mix into one muddy layer.

TRY THIS

Pour more slowly and against the wall or a spoon, and do not skip a jar in the order.

IF THIS HAPPENS

Some salt will not dissolve.

TRY THIS

Use warm water and stir longer, then let the solution cool to room temperature before layering.

IF THIS HAPPENS

Two neighboring layers blend together.

TRY THIS

Their densities are close; add a little more salt to the lower one.