



the Liquid Rainbow



Challenge:
Can you create a rainbow pattern of colors in a test tube?

General Description:

Visitors are given a series of colored ethanol/water solutions, each with a different density. By mixing the solutions together, they determine the order of density. By adding the solutions in order of density, they create a rainbow effect in a test tube.

Objectives:

To show that liquids vary in density, and to develop a systematic approach to solving a problem.

Materials:

For 5 stations (1 child per station)

- 50 6 mm culture tubes or 10 mm test tubes (The large number eliminates the need to constantly wash and replace test tubes.)
- 25 60 ml plastic dropping bottles
- 5 plastic cups for discarded mixtures of solutions
- 5 simple test tube holders
- Water
- 95% Ethanol
- Food coloring (red, blue, yellow, green)
- Rack for pipettes
- Paper towels for spills
- A container of clean water
- A safe container to dump solutions into and seal (waste container)



Activity Preparation (approx. 15 min.):

1) Mix up the five ethanol/water solutions in pint bottles as follows:

- Water (dyed red with food coloring),
- Mixture with 25 ml ethyl alcohol and 75 ml water (dyed yellow with food coloring)
- Mixture with 50 ml ethyl alcohol and 50 ml water (dyed green with food coloring).
- Mixture with 75 ml ethyl alcohol and 25 ml water (dyed blue with food coloring).
- Ethyl alcohol (colorless or purple)

2) Each station includes:

- 5 plastic dropping bottles (each filled with a different colored solution)
- A small test tube rack (A 96-well plate can be used as a test tube holder for 6 mm tubes; 10 mm test tubes need a plastic rack.)
- A cup for discarded solutions

Directions:

Have visitors do the following:

1. Participant **must** wear a pair of safety goggles before beginning!
- 2) Add 3-5 drops of solution from any dropping bottle to a culture tube.
- 3) Slowly add 3-5 drops from a different dropping bottle into the same tube.
- 4) If the colors layer, then the solution on bottom is denser than the solution on the top. If the colors mix or don't create a distinct layer, then the added solution was denser than the solution in the tube.
- 5) Try combinations until the correct density order is discovered
- 6) Add the solutions in the correct order to make the complete layered rainbow!

Clean Up (approx. 15 min):

- All used solutions can be discarded down the drain.
- All solutions are stable so that extra solutions can be stored for later.
- Clean goggles with window cleaner and white paper towels.
- Disinfect in goggle cabinet for full 15 minutes.

Safety Issues:

Participant must wear a pair of safety goggles before beginning!
Goggles must be sterilized before use.

Ethanol and its solutions are flammable.
Ethanol is irritating to skin and eyes.
Flush with water. Do not drink!



Tips For Doing the Activity:

- You may need to demonstrate how to put liquid in the tube.
- You need to add it slowly by running liquid down the side of the tube.
- For some children it is helpful to add two different solutions and to demonstrate that one sits on top of the other.
- Some young children seem to enjoy just putting colored solutions together rather than trying to solve the challenge.



Background Information:

Ethyl alcohol is less dense than water. Adding water increases the density of a solution. A less dense solution placed on top of a more dense solution does not mix, unless the mixture is stirred or shaken.

Density is not the same as weight or mass. Density is ratio of the mass of an object or liquid to the volume of that object or liquid. Density is not usually discussed until the third grade. Because it is difficult to explain density to small children in this activity we talk about heavier solution rather than use the correct term denser solution.

Questions:

1. How do you know which solutions are the most dense (heavy)?
2. What happens if a heavier solution is added to a lighter solution?
3. How do you make a rainbow tube? In what order do you add the solutions?

Credits and Disclaimer



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