



DENSITY TOWERS

ABOUT THIS CHALLENGE

Most substances exist in one of three states: a solid, a liquid, or a gas. Two of these states have very similar qualities. They are so similar in fact, that we have given them a name to share: fluids! In this guide, students will learn the basic principles of what a fluid is, how it behaves and interacts with other fluids, and the principles of density and viscosity.

CONTENT AREA

Grade Levels: 5-8

Content Area: Science

Context for Learning: Before using this lesson, students must have a concrete understanding of the three states of matter.

TOPICS

Volume
Viscosity
Density
Fluids

ACADEMIC LANGUAGE

Fluid
Viscosity
Density



STANDARDS

Science Standards (NGSS):

5-PS1-2. Make observations and measurements to identify materials based on their properties.

Note: This lesson plan may align with other sets of standards not included here.

LEARNING OBJECTIVES

Students will be able to:

Order fluids from highest density to lowest density.

Order fluids from highest viscosity to lowest viscosity.

MATERIALS

Buckets for students to mix fluids in

Marbles or similar objects

An easy source of water

Cooking oil

Corn syrup

Clear cups

Small scales or balances

Recommended:

Food Dye

Colored Paints

Additional liquids for experimenting (dish soap, bubble solution, baby oil, honey, etc.)



INSTRUCTIONAL DELIVERY

OPENING ACTIVITIES/MOTIVATION

Optional: Show the [“Upside Down and Inside Out”](#) music video (3 minutes and 21 seconds).

Show the [“Art of Experimentation”](#) video. (5 minutes 35 seconds).

Some Vocabulary for this Lesson:

A **fluid** is a substance which has no rigid shape. In other words, its shape will change to fill its container. This means that not only are liquids like water and honey fluids, but gases are fluids too! Air, Helium, and all the other gases are fluids as well.

All fluids have a **viscosity**. The viscosity of a fluid describes its resistance to flow, or how hard it is for the fluid to change its shape, or for an object to travel through the fluid. This is what makes it harder to swim through a pool than walk alongside one. The viscosity of air is less than the viscosity of water.

Like all substances, fluids also have a **density**. A substance's density describes how much mass it has in a given volume. Volume is the amount of space something takes up. An object that is very dense could have lots of mass but take up very little volume, like a block of lead. An object which is not very dense could take up lots of space, but have very little mass, like a balloon filled with air. Very dense liquids will sink in liquids which are less dense.



PART ONE: LEARNING THE BASICS

Lead a discussion introducing fluid mechanics to your students.

Organize your students in groups of 2 or 3. Equip each group with an identical set of materials. Each student group should have at least one cup per fluid they have been provided. Using the material in the vocabulary section below, teach your students about the fluid properties. Using the guiding questions below and a method of your choice, begin a short discussion where students share examples of different types of fluids (e.g. low-density fluids, high viscosity fluids, etc.) to familiarize each other with the ideas.

PART TWO: EXPLORATION

Observe and record data about the properties of fluids.

In part two, students will be observing and recording data about the properties of fluids before them. Students should fill each cup with the same amount of one of each of their fluids. Each cup should have a different fluid in it.

Students should measure the mass or weight of each cup, and record the data they observe. Using this data, they should determine the order of the fluids in terms of density (ie. the largest weight is the densest).

Following this, students should take their marbles, and drop them one by one into each cup, using the stopwatch to determine how long it takes the marble to sink to the bottom of the fluid. They should record this data, and use it to place their fluids in order of viscosity.



PART TWO: EXPLORATION CONTINUED

We recommend performing this yourself first to determine the correct order of fluid viscosities. (Note: It is possible that in some cases, the marble may not sink at all, this is because the fluid is denser than the marble!)

Notice how our objects (we used bb pellets) did not sink through the red liquid. That's because the red corn syrup is denser than the pellets, but the dish soap and oil above it were not!



PART THREE: CHALLENGE

Let's create art with what we've learned!

With the fluids organized by density, students can begin to build a fluid density tower. Since denser fluids are affected more by gravity, they will tend to sink below fluids which are less dense. By adding dyes to fluids of different densities we can create a stack of colored fluids. The densest fluid will go to the bottom, and the other fluids will stack up in order of density.

By thinking through what color of dye is added to the fluids, students can plan out the order in which the tower's colored bands will stack.



PART THREE: CHALLENGE CONTINUED

Students should use their density data from part two and prepare cups of different density fluids to which they can add the dye colors of their choice.

Provide students with a tall cup, tube or beaker. One by one, add the fluids to the cup, beginning with the densest fluid, and ending with the least dense fluid.

Encourage students to explore different color combinations for their fluid towers.

Can they mix their fluids so that they stack in rainbow order (Red, Orange, Yellow, Green, Blue, Indigo, Violet)?

Ask teams to sketch a color tower that they want to create, and then have them mix the dyes and fluids that would create this tower.

Be a bit silly with this! What would a candy colored tower look like? A happy tower? A peaceful tower?





ASSESSMENT

Evaluation of Learning Objectives: Students should hand in a sketch of their density tower to demonstrate their mastery of the learning objectives. Make sure to have students label what each liquid in the density tower is on their sketch.

Closure: Bring the class back together and lead a discussion about the activity. Prompt them to explain their thought processes while building the density towers. Did any fluid not behave the way they thought it would? Were there any fluids that the marble wouldn't sink through? Make sure to have them discuss how their knowledge of density and viscosity helped them with this activity.