Adapted to STEMAZing ECE Format by
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Density: See Level

NOTE: Children should always be given ample time to experiment, notice, and wonder before they are provided an explanation.

Always engage children with our two favorite questions:

What do you notice? What do you wonder?

Resist the urge to answer any questions children have while exploring. Instead, respond back with questions to children and let them make sense of the world. Sample questions you might use: What do you think? Do you notice any patterns? What could we change? Can we test something else? What can we try next? If children ask a testable question, which they could answer by doing an experiment, talk through with them how they might design a test to help answer their question. As much as possible and within reason, let them actually test their questions by trying the experiments they propose.

Vocabulary (See **What the heck? Explanation of Science** at the end for definitions.)

Density	Gas	Buoyancy
Mass	Liquid	Weight
Volume	Sink	Gravity
Fluid	Float	Force

Learning Objectives

Children will…

- construct a density column using different liquids.
- observe what happens when you mix different liquids together.

Materials

Honey	Rubbing alcohol	A grape
Light corn syrup	Tall glass vase	Paper clip
Dish soap	Small drinking glass	Other small objects
Vegetable oil	Food baster	Food coloring (optional)
Water	Glass Marble	Measuring cup (¼ cup)

Key Question

Do liquids have different densities?

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Notice and Wonder Developmentally Appropriate Practice

Oil vs. Water

1. Fill the small drinking glass with water.
2. Ask the children what they think will happen when you pour some oil into the water. Will the oil sink? Will the oil float? Will it dissolve into the water?
3. Give children ample time to either draw or write down their prediction.
4. Pour some oil into the water and let the children observe what happens.
5. Use the rule about density and sinking and floating to explain what the children see – oil is less dense than water so it floats on top of the water.

Six-Layer Density Column

6. Explain to children that you are now going to create a density column with them using many different liquids. (NOTE: If you don't have all the liquids on the materials list, you can still make a column with fewer layers.)
7. Starting with honey, measure out ¼ cup of honey.
8. Use the food baster to put the ¼ cup of honey into the bottom of the empty vase. Be sure to not get honey of the side of the vase.
9. Measure out ¼ cup of corn syrup.
10. After washing out the food baster, use it to add the ¼ cup of corn syrup on top of the honey. Be sure you slowly and steadily add the corn syrup to the top of the honey right in the middle. Be careful to avoid getting liquid on the side of the vase as you put each layer in place.
11. After adding the corn syrup, ask children to make observations and draw their observations. Give children ample time to discuss their observations. Help them label each layer in their drawing of the density column.
12. Repeat steps 9-11 adding in each liquid on top of the next using the same method. The liquids should be added in this order: honey [done], corn syrup [done], dish soap, water, vegetable oil, and rubbing alcohol. (NOTE: If you have liquids of similar color, you can add a couple drops of food coloring to them to change their color before you add them to the column.)

Discussion Questions for Children

- What liquid is the densest?
- What liquid has the lowest density?
- What do you notice?
- What do you wonder?

13. Collect all of the small objects you can drop into the density column. These can be things like a grape, a paper clip, a marble, a small plastic toy, a peanut, a raisin, a small pebble, etc.
14. One at a time, have children predict what will happen as each object is dropped into the density column.
15. Then, let them drop the object in and make their observations. They should draw where they wind up in their diagram.

Extensions for Additional Learning

As always, ask the children throughout the experiment what they notice and what they wonder. If their wonder questions are testable, as much as possible and within reason, let them actually test their questions by trying new experiments.

See below for examples of what they might wonder and experiments they might do to test their wonderings.

- I wonder what would happen if changed the order we added the liquids?
  - If you have plenty of the liquids, let them try it! You will find it doesn't work as well to keep all the layers separated nicely. It is best to add them in order of their densities from highest density first to lowest density last.
- I wonder what would happen if we dropped [another small object] into the column?
  - Let them try it! If the object won't get damaged by the liquids, let them experiment.
- I wonder what would happen if we stir up the density column?
  - If you are done experimenting, give this a try last. Once the liquids have time to settle, they won't go back to six distinct layers. Instead, some will combine together. Children can make observations about how many layers form as the mixed column settles. This could take quite a bit of time and might be best to leave it overnight before making final observations.
- I wonder if we could get a density column with more than six layers?
  - Steve Spangler has directions for a seven-layer column and there are others who have as many as nine. Search online to get some advice about how to get a density column with more layers and which liquids to use.

Reference

Adapted from Steve Spangler's Seven-Layer Density Column Experiment (https://www.stevespanglerscience.com/lab/experiments/seven-layer-density-column/)

AZ Early Learning Standards

Science Standard - Strand 1: Inquiry & Application - Concept 1: Exploration, Observation & Hypotheses
The child observes, explore, and interacts with materials, others, and the environment.

Science Standard - Strand 1: Inquiry & Application - Concept 2: Investigation
The child researches their own predictions and the ideas of others through active exploration and experimentation.

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Density: See Level

What the heck? Explanation of the Science (Vocabulary in bold.)

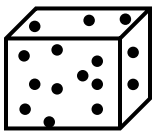
These phenomena can all be explained using density. What is density? Technically, **density** is the ratio of an object's **mass** to its **volume**. **Mass** is the amount of matter in an object. **Volume** is the size of the object.

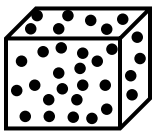
IMPORTANT NOTE: Mass is not the same thing as the weight of an object. **Weight** is the **force** (pull) due to **gravity** on an object. For example, your mass (the amount of matter you are made up of) would not change if you were standing on the Moon's surface. However, your weight would change (it would be less) because the strength of gravity on the Moon is less than the strength of gravity on Earth. It should also be noted that the weight of an object does not determine whether it sinks or floats in a fluid. **Fluid** is a term used to describe either a gas or a liquid. So, air (a **gas**) is a fluid and water (a **liquid**) is a fluid. The density of an object compared to the density of the fluid it is in determines whether it will sink or float. More on this below.

In equation form: $$density\ (\rho) = \frac{mass\ (m)}{volume\ (V)}$$

Density is a measure of how much matter is packed into an object. You cannot easily compare the density of two **solid** objects unless they are both the same mass or both the same volume (size).

Two solid objects with the same volume but different masses.


Less Dense


More Dense

If two solid objects are the same size, as shown above, then the one with less mass is less dense. The object with more mass packed into the same volume is more dense. The more matter packed into a certain volume or object, the greater its density. If it has less matter packed into a certain volume, then it is less dense.

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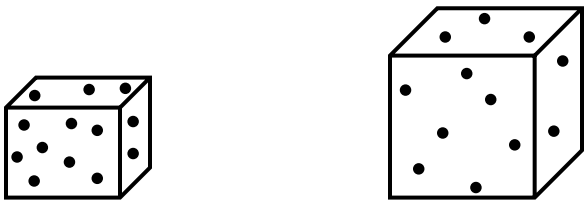
Two solid objects with the same mass but different volumes.



More Dense Less Dense

If two solid objects have the same mass, as shown above, then the one with a smaller volume is more dense. The object with the same amount of matter spread throughout a larger volume is less dense. If an amount of mass is packed into a smaller volume, the density is greater than the same mass packed into a larger volume.

So, what determines if a solid object will **sink** (fall to the bottom) or **float** (rise to the top) of a fluid?

Here is the rule:

A solid object will **SINK** if it is MORE DENSE than the fluid it is in.

A solid object will **FLOAT** if it is LESS DENSE than the fluid it is in.

Video Lesson: https://bit.ly/SciShowKidsSinkFloat

NOTE: An object DOES NOT sink or float because it is lighter or heavier. The weight of an object DOES NOT determine if it will sink or float. The object's density compared to the fluid it is in, as noted in the rule above, is what determines if it will sink or float. Just because an object is heavy, or weighs a lot, does not mean it will sink. Think about a big ship, which weighs a lot, and still floats. It floats because it is less dense than the water it is in. Just because an object is light, or weighs a small amount, does not mean it will float. Think about a small pebble, which weighs just a little, but will sink when placed in water. The small pebble sinks because it is more dense than the water. **PLEASE be careful to reference density and not weight when describing why something sinks or floats.**

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What the heck? Explanation of See Level

Just like solid objects, different liquids have different densities. Different gases also have different densities, though we are not using different gases in this experiment. Just as the rule about the density of a solid object compared to the fluid (liquid or gas) it is in, the same rule holds true for fluids in fluids.

Here is the rule for fluids:

> Fluid 1 will **SINK** to bottom of fluid 2 if fluid 1 is MORE DENSE than fluid 2.
>
> Fluid 1 will **FLOAT** on top of fluid 2 if fluid 1 is LESS DENSE than fluid 2.

In the first part of the experiment, children will observe that oil will float on top of water. Using the rule above, we would say: Oil will float on top of water because oil is less dense than water.

Using the rule above, you could have children make predictions about whether one fluid will sink or float in another. After they have done the density column, they should know the densest liquid is on the bottom and then the densities get smaller as you go up.