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**Density Mystery**

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| **Estimated Time:** 45 minutes to 1 hour |
| **GSE Standard(s) and Element(s):****S8P1. Obtain, evaluate, and communicate information about the structure and properties of matter.** c. Plan and carry out investigations to compare and contrast chemical (i.e., reactivity, combustibility) and physical (i.e., density, melting point, boiling point) properties of matter |
| **Science and Engineering Practices:****Developing and Using Models**Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems. | **Disciplinary Core Idea:****Structure and Properties of Matter**Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.  |
| **Crosscutting Concepts:****Structure and Function**Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.  |
| **Authentic Scenario (Phenomena):**Show students the photo of where two oceans meet in the Gulf of Alaska: [Mythbusting 'the place where two oceans meet' in the Gulf of Alaska (adn.com)](https://www.adn.com/science/article/mythbusting-place-where-two-oceans-meet-gulf-alaska/2013/02/05/) | **Vocabulary:*** estuary
* density
* salinity
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| **Guiding Questions:**What is density? |
| **Materials Needed:**For Demo * clear cup
* oil
* water
* food coloring

Second Activity* clear drinking straws (6 straws cut in half and one uncut straw per group)
* modeling clay
* shallow tray for each group
* small cups
* food coloring
* salt
* four empty plastic bottles or cups (for saltwater mixtures)
* pipettes
* data sheet
* pencils
 | **Safety Considerations:*** Students should not taste the water samples.
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| **Technology Integration:*** Devices with Internet access
* Students can visit <https://www2.usgs.gov/water/southatlantic/projects/coastalsalinity/index.html> to see real-time salinity level data.
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| **5E Stage** | **Student Activities**How will students engage actively in the three dimensions throughout the lesson?**Teacher Activities**How will the teacher facilitate and monitor student learning? |
| **Engage** | Show students the photo of where two oceans meet in the Gulf of Alaska: [Mythbusting 'the place where two oceans meet' in the Gulf of Alaska (adn.com)](https://www.adn.com/science/article/mythbusting-place-where-two-oceans-meet-gulf-alaska/2013/02/05/)Ask, “What do you notice? What do you wonder?”Fill a clear cup halfway with water. Next, pour some oil into the cup. Add several drops of food coloring to the cup. Have students observe what happens and write down their observations. Ask, “Which do you think is denser – the oil or the water? Explain your answer.”Tell the students that today, they will be investigating density. |
| **Explore** | ***BEFORE STARTING THIS LESSON:******Bottle 1: Red food coloring and 15 teaspoons of salt in a cup or bottle of water******Bottle 2: Green food coloring and 10 teaspoons of salt in a cup or bottle of water******Bottle 3: Orange food coloring and 5 teaspoons of salt in a cup or bottle of water******Bottle 4: No food coloring and no salt in a cup or bottle of water***Scientists working around the Harris Neck National Wildlife Refuge recently collected water samples from a freshwater pond, a tidal creek, the marsh, and the ocean. The labels came off the samples on the way back to the lab. Can you help the scientists determine which samples came from each location? You must investigate the density of these samples to see which water samples layer on top of the other. Which area do you think would have the densest water? Which area would be the least dense? Use your investigation skills to test and determine! **Directions:** Test the water samples by adding about 10 drops of two water samples at a time to the straw “test tubes” to determine which sample is the densest and the least dense. The straw “test tubes” work by standing them up in a small ball of clay. They can then be placed in a shallow tray for observation. Once you have determined the order, place the samples in the large clear straw in the order from the least dense (top) to the densest (bottom).*Teacher Note: Only two samples will be tested at a time in each straw. If the mixtures stay separated, you will know that one sample is denser than the other with the densest at the bottom. If the samples begin to mix, you will know that the densest was placed on top. The goal is to figure out the samples from the densest to the least dense.*Make a chart showing the color and the location where you believe each sample was collected.  |
| **Explain** | Density is the measure of how much “stuff” is in a given amount of space. A block of Styrofoam is less dense than a brick. Density is defined as mass over volume and is a physical property. Physical properties can be observed without changing the chemical makeup of the substance. Other physical properties include melting point and boiling point. Every substance, element, and compound has unique densities. Oil and water do not mix due to the properties of oil and water. Because oil is less dense than water, it will float on top of the water, creating a surface layer of oil. Water by itself has a specific density. Many things can change the density of water, such as temperature and salt. Salty ocean water is denser than freshwater because it has more salt. Things with high density will sink and low density will rise (buoyancy). Because of this, salt water will slide under upper fresh water because it is denser. |
| **Elaborate** | Have the students brainstorm a list of machines and objects in their everyday lives that use or contain fluids. How are these items designed differently depending on which fluid it uses and/or contain? Remind students that fluids can be any gas or liquid, including air and water. Then, have the student write a one-page paper on what they observed. (Answers will vary. Ideas include: How the pipes are set up at their house to reach the shower and the water taps. How drains are positioned on our streets to drain and collect rainwater. How this explains the shapes of different bottles, such as water bottles being ridged, ketchup bottles being very flat on the sides, hair conditioner bottles many times have an opening on the bottom and tend to be cone-shaped [larger at the top than at the bottom]. |
| **Evaluate** | Using the C-E-R Model, have students make a claim stating where they think each sample was from and why. |