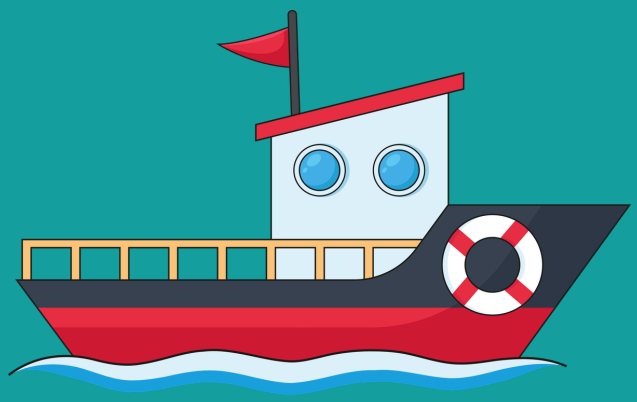
LET'S BUILD A SEA VEHICLE

Unite/Theme: Distinctive Properties of Matter

Pursope: To create a scientific model related to density and produce a sea vehicle that floats on water.



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Learning Outcomes and Process Components

Calculates the densities of various substances based on the experiments they design.

Defines density.

Compares the densities of water in its solid and liquid states and discusses the importance of this for living organisms.

What Do You Know?

- What comes to mind when you hear “mass” and “volume”? ☐
- Why does a piece of wood float in water while a piece of iron sinks? ☐

Explain what you know!

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Let's spark curiosity!

Come on, let's start exploring!

"In our daily lives, we see huge ships and boats floating in the seas. Even though these vehicles are very heavy, they can move without sinking. But why does a small stone we throw into the same water sink immediately? Is this related to the weight of the object, or to another property? Today, using the concept of density, we will design a floating watercraft and explore why objects float or sink."

Then, ask students to take out the activity materials.

Set Contents

The activity video is watched by pausing at key points. Before starting the activity, the contents of the set are checked. All steps for opening lids and packages are performed together with the students at the same time.

- [ ] EVA Template (Base Template) .....
- [ ] Watercraft Template .....
- [ ] Plexiglass Template .....
- [ ] Rubber Band .....
- [ ] "Let's Make a Watercraft" Activity Sheet .....
- [ ] Archimedes Scientist Card .....

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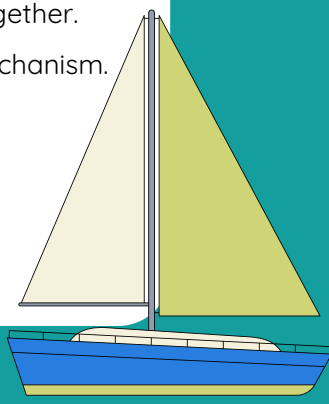
How do we do it?

1. Place the marine vehicle template in front of you and remove all the parts on it.
2. Open the gaps on the parts.
3. Place the EVA template in front of you and remove its parts.
4. Insert the EVA pieces through the square holes in the marine vehicle template so that they remain underneath, and form the base.
5. Attach the sail piece to the marine vehicle.
6. Place the plexiglass template in front of you and fit the two rectangular pieces together.
7. Insert the rubber band onto this model, loop it around, and prepare the motor mechanism.
8. Attach the motor mechanism to the marine vehicle.
9. Place the marine vehicle on the surface of the water.
10. Wind the motor a few turns and release it.
11. Observe how the marine vehicle moves on the water.



What Should the Scientists of the Future Discover?

Biliyor Musun?

Birçok gemi çelikten yapılmıştır, ama çelik suda batar. Peki, çelikten yapılan gemiler nasıl yüzebiliyor? İşin sırrı, geminin şekli ve içerisindeki boşluklarda gizli. Gemilerin taban kısımlarındaki oyuk bölümleri nedeniyle, suyun yoğunluğundan daha hafif kalmayı başarabilmektedirler. Bu sayede gemiler suyun üzerinde rahat bir şekilde yüzme imkanı elde ederler.

Students are asked the following questions:

Why does oil in water stay on top?
Why doesn't ice sink in water?
Why don't large and heavy ships sink in water?
How does the shape of a boat affect its ability to float?

Mass and Volume

All substances around us have a certain mass and volume. Therefore, mass and volume are common properties of matter.

- Mass is the amount of matter that does not change. It is represented by the letter “m,” and its units are gram (g) and kilogram (kg). It is measured with a balance scale.

- Volume can be defined as the space that matter occupies. It is represented by the letter “V,” and its unit is “cm^3.” It is measured with a graduated cylinder.

Density

- The ratio of a substance’s mass to its volume gives its density. Density is defined as the mass of a substance per unit volume (1 cm^3). Density is a distinguishing property of matter. It is represented by the letter “d.”
- To find the density of a substance, the formula
  Density = Mass / Volume (d = m / V) is used.
  When calculating the density of objects that do not have a definite shape:
- The mass of the object is measured with a balance scale.
- The volume of the object is found using a graduated cylinder. A certain amount of liquid is poured into the graduated cylinder. Then the object is placed into the liquid. The initial liquid level is subtracted from the final liquid level in the graduated cylinder. The difference is equal to the volume of the object.

Floating and Sinking Objects

Water has different densities in its solid, liquid, and gas states. Generally, as substances cool down, their particles move closer together, their volume decreases, and their density increases. However, water does not follow this rule.

The density of ice is lower than the density of liquid water because when water freezes, its particles do not move closer together; instead, they move farther apart. This causes ice to have a larger volume than water, which is why ice floats in water and why frozen bottles can burst.

This property plays an important role in aquatic ecosystems. During winter, ice remains on the surface of the water and prevents the water below from freezing completely, allowing fish and other aquatic organisms to survive. This situation is vital for the continuity of freshwater ecosystems.

Density of Liquids

When comparing the densities of liquids that do not mix with each other, liquids with different densities are poured into the same container. These liquids arrange themselves in layers according to their densities, with the densest liquid at the bottom and the less dense liquids above it.

For this reason, when we add oil to water, the oil does not sink; it floats on the surface of the water. In addition, oil and water do not mix, which causes the oil to remain as a separate layer on top.

The Importance of Water's Density for Living Things

The densities of substances in different states of matter vary from one another. Generally, when a substance cools down, its particles slow down, move closer together, and its volume decreases. Since the mass does not change, the density increases. However, water is one of the rare substances that does not behave this way.

Although the solid state of most substances has a higher density than their liquid state, the density of ice is lower than that of water. This is because when water freezes, its particles do not move closer together; instead, they move farther apart. As a result, the volume of ice is greater than the volume of the same amount of liquid water.

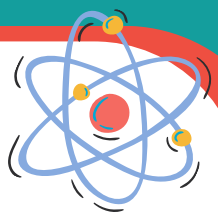
For this reason, a piece of ice floats in water, and bottles filled with water may burst when the water inside freezes.

Floating Ships

Large and heavy ships do not sink in water because their average density is lower than the density of water. Although ships are made of metal, they contain very large empty spaces (air-filled compartments) inside. These spaces increase the ship's volume but do not increase its mass by the same amount.

Density is the ratio of a substance's mass to its volume. Since a ship's volume is very large, even if its total mass is great, the mass per unit volume (density) decreases. For this reason, the ship's average density becomes lower than that of water, and the ship remains afloat on the surface of the water.

A SCIENTIFIC Explanation



Students are asked the following questions:

- Why don't lakes and seas freeze completely in winter?
- What would happen if water's density increased when it froze?
- How does the shape of a boat affect its ability to float?

Why Don't Lakes and Seas Freeze Completely in Winter?

When water freezes, its density decreases and ice floats on the surface. The layer of ice formed on top acts as insulation between the cold air and the water below. As a result, the lower parts of the water do not freeze and remain in liquid form.

This situation is very important for the survival of living organisms in lakes and seas during the winter.

What Would Happen If Water's Density Increased When It Froze?

If water's density increased when it froze, the ice formed would sink to the bottom. In this case, the cooling water would continue to freeze from the top downward, and over time, lakes and seas could freeze completely.

In such a situation, aquatic life would not survive, ecosystems would suffer great damage, and the balance of life on Earth would be negatively affected.

The Shape of Ships

The shape of a boat directly affects its ability to float. This is because the boat's shape determines how its mass is distributed in the water and influences its average density.

In boats with wide and hollow hulls, the mass is spread over a larger volume. As a result, the boat's average density becomes lower than that of water, allowing it to float.

For this reason, ships are designed to have wide, flat bottoms and hollow interiors. If the same mass of material were compressed into a smaller volume, it might sink. However, when the volume is increased through proper design, the density decreases.

In short, a ship's ability to float depends not only on the material used but also on how its design affects its density.

Question of the Day

What is the instrument used to measure the density of liquids?

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What Did We Discover?

"Today, we explored the concept of density and learned why substances float or sink in water. We made observations by designing a boat that floats." So, how did you feel about it?

What Else Can We Do?

Come on, try it yourself!

Dear Teacher,

You explored the concept of density and the reasons why substances float or sink in water with your students. You also designed your own boat for this purpose.

You can carry out the "Density Tower" activity to compare the densities of different liquids.

Materials

- Clear glass or jar
- Water
- Cologne
- Vegetable oil
- Liquid detergent
- Milk
- Pomegranate molasses
- Spoon

1. A clear glass or jar is placed on a flat surface.
2. Students are asked to predict which liquids might be denser.
3. The liquids are added slowly and carefully into the glass, without following any specific order of density.
4. After each liquid is added, the glass is not shaken or stirred.
5. Over time, the liquids form layers on top of each other, which can be observed.
6. By examining the layers, students conclude that the liquids have different densities.
7. Students note which liquid remains at the bottom and which stays on top.

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