Western Engineering

Outreach

Raft Transport Challenge

Grades 3-5

Meet Today's ENG HERO!

Kelly Ogden -Associate Professor with Western Mechanical Engineering

Dr. Ogden pursued her PhD at MIT and is now an assistant professor in Materials and Mechanical Engineering. She conducts numerical and analytical research to further understand mixing, waves, and hydraulic processes in coastal flows. These flows affect tidal energy and greatly impact ecosystems and can have a significant impact on society amidst the changing climates. To learn more about her research, visit https://www.researchgate.net/profile/Kelly_Ogden

Learning Goal:

- Learn about buoyancy
- Students will learn about the Archimedes principle
- Curriculum Connections: Grade 5 - Properties of and Changes in Matter, Grade 5 - Forces Acting on Structures and Mechanisms

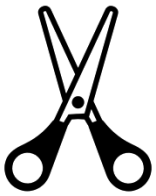
Materials Needed:

For testing:

- Children's pool / big basin of water or bathtub for the raft to travel from one side to the other
- Scotch tape
- blow dryer or fan (wind simulator)
- Tarp to catch water spills
- Package:
    - something that is about 2 lbs in weight, wrapped in paper or material that easily indicates when it interacts with water

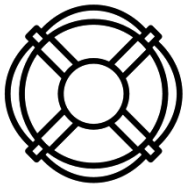
For the raft itself:

- string / twine
- straws
- plastic wrap
- popsicle sticks / skewers/ twigs
- paper / pencils
- paper cups
- pipe cleaners
- hot glue
- scissors



Engineering and Science Connections:

Today we will be talking about buoyancy and introductory fluid mechanics and the forces acting on aquatic mechanisms.
What are some examples of buoyant objects?



Why do things float?

If the weight of the object being placed in the water is less than the weight of the water being displaced in the container, the object will float. This is the **Archimedes principle.**

In the case of two pop bottles of different sizes being pushed down into a container of water, the larger pop bottle would be harder to push down because the bottle is displacing a larger weight of water than it weighs itself (since it's full of air and therefore a negligible amount of mass inside). Buoyancy is the force that is pushing back up on the bottle. The more buoyancy something has, the higher it floats on water.

A ship made out of metal is able to remain lighter than the amount of water it displaces because the bottom of the ship, the hull, is hollow and therefore adds support to the ship without adding a lot of mass. When the ship is loaded with too much cargo though, the weight of the ship would have increased past the amount of water it displaces and will start to sink.

Density and Buoyancy

Density refers to how much space an object or substance takes up (its volume) in relation to the amount of matter in that object or substance (its mass). Another way to put it is that density is the amount of mass per unit of volume. If an object is heavy and compact, it has a high **density**.

Buoyancy refers to an object's ability or tendency to float in a fluid (for example, water or air). When we think of common buoyant objects, we are usually referring to an object's buoyancy in water.

In general, objects with a lower density are more buoyant. For example, a foam noodle has a low density and will float on water. However, a rock has a high density and will sink.

Fun Thought

Have you noticed that when you float in a pool, you are more buoyant when you inhale than when you exhale? This is because the air in your lungs makes you lighter compared to the water (less dense) so more buoyant. Air is less dense than water and will float, so it will act against the sinking tendency of your body.

Video Recommendation: *Buoyancy: What Makes Something Float or Sink?*

https://www.youtube.com/watch?v=nMIXU97E-uQ

Activity:

Before you start, think about the following questions:

- What is the relationship between density and buoyancy? What are some examples?
- Which objects on the materials list would be buoyant? Feel free to write down some predictions and then test them before starting the design process.

Urgent Delivery

Someone gave you a package to give to your friend that needs to arrive within the end of the week. However, there has been a pretty bad storm the past couple of days and your friend's house and yours are blocked off by some

major flooding pools. You have an idea and call your friend to tell them that you are going to make a raft and essentially have it float to the other side of the pool where your friend will be waiting. Your friend agrees, but warns you that the package is extremely water sensitive; it cannot get water on it or else the device inside would be destroyed. You test the winds, and to your relief the wind is blowing toward your friend.

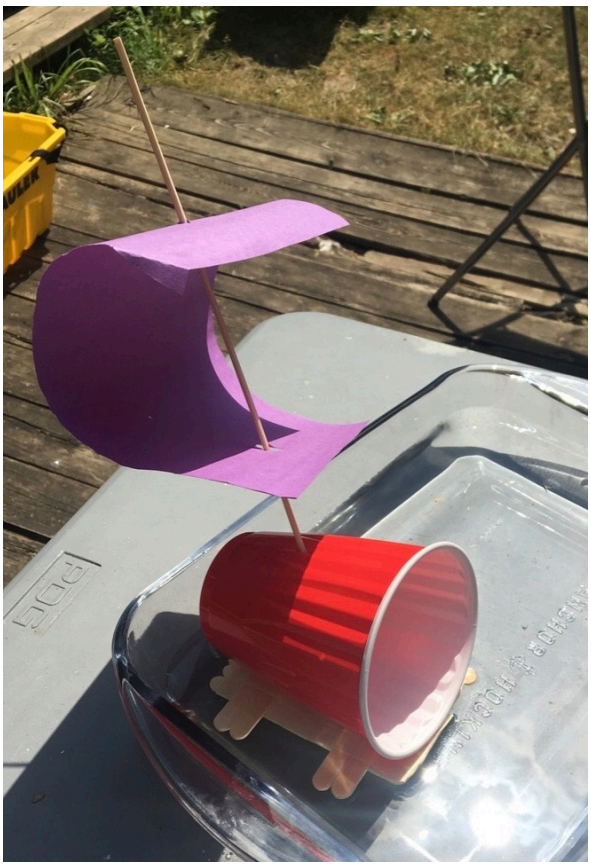
Challenge

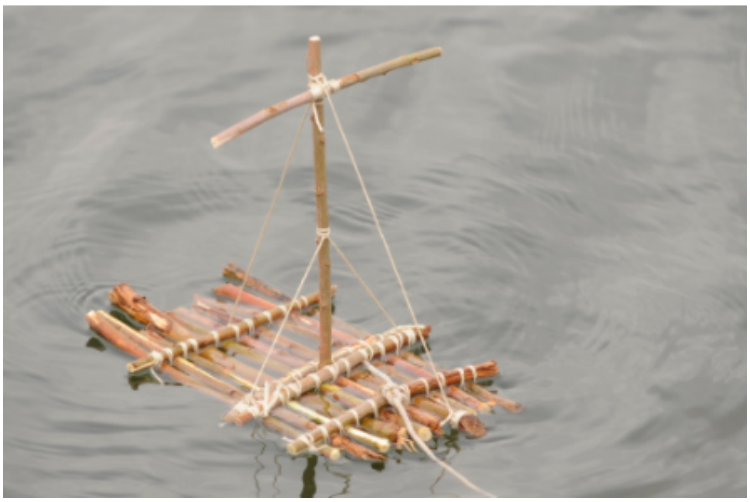
You must get the water-sensitive package to the other side of the water pool without the package getting wet. If it gets wet, the device inside will be destroyed (think water falling on a circuit board but worse).

- your raft must be able to hold the weight of the package and stay above water
- the package must be securely fastened to the raft but able to be removed by your friend on the other side without using scissors or any other sharp objects

Put the hairdryer or fan on a low setting and blow the air such that the raft can be 'pushed' to the other side. This simulates wind currents.

Here is an example of a raft built with popsicle sticks, a plastic cup, skewers, and construction paper. The other one twigs and string:





What Did You Learn?

- What is Archimedes Principle?
- How did you choose which materials to use for your raft?
- What is density and how does it affect an object's ability to float?
- Why do we float better when we have air in our lungs?

Future Learning

- After your first test, re-design your raft to include sails or something that can harness the wind currents as power. Which design was better?
- If your raft had to carry twice the weight, what kind of adjustments would you make?

Share your creations!

We would love to see what you made. Email as at discover@uwo.ca or tag us on social media.

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Thanks for discovering with us!