Western Engineering

# Outreach

## Clay Boats

## Grade 6-8

## Meet Today's ENG HERO!

J.M. Floryan - Professor with Western Engineering

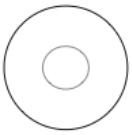
*Dr. Floryan is a professor with the Mechanical and Materials Engineering Department at Western University. He has a Master's degree from Warsaw Technical University, a PhD from Virginia Tech and also did postdoctoral training at the Northwestern University. He specializes in fluid mechanics, with analysis and simulations as the primary methodologies. His current interests are focused on the development of flow manipulation strategies with applications across all flow regimes. To learn more about Dr. Floryan visit:* https://www.eng.uwo.ca/mechanical/faculty/floryan_j/index.html

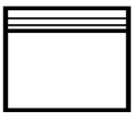
## Learning Goal:

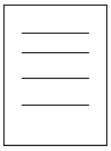
- Students will expand their knowledge of concepts relating to density and buoyancy
- Students will learn about Archimedes' principle
- Curriculum Connections: Grade 7 - Form and Function; Grade 8 - Fluids

## Materials Needed:

- Non-hardening modelling clay
- Tub of water
- Several coins/washers
- Paper/Newspaper







# CLAY BOATS

## Engineering and Science Connections:

Today, we will learn about Archimedes' principle, density and buoyancy. These three all relate to making objects float!

### Archimedes' Principle

Archimedes' principle states that the upward force buoyancy that is exerted on a body immersed in fluid is equal to the weight of the body of fluid which it displaces. While Archimedes' observation is interesting, it provides a limited explanation for how something floats and therefore, exploring topics related to water pressure and density can provide a more in-depth explanation.

### Pressure and Density

In any mass of water, the water on the top half pushes down on the water below. This provides a downwards force (in addition to the atmosphere). An interesting fact about fluid pressure though is that it is a type of force that acts in all directions at once. This means fluids will push against any object that it contacts, regardless of its orientation and where it is in the fluid. Now, if an object has a very high density (more mass per a certain volume), it is able to sink as it has a stronger force downward than the fluid pressure exerts upwards. In other words, if the object has a greater density that the fluid it is in, it will sink! If engineers are able to find out new ways to make objects less dense or spread their mass out across a greater surface area over the water, it will be able to float better!

For our experiment, we're using modelling clay which is denser than water. To allow our boats to float, we must make sure it covers a great enough surface area so that it is able to float. We will later be adding weights to our boats to test how much mass our boats are able to carry.

## Video Recommendation: *What is Buoyancy? | Physics | Don't Memorize*

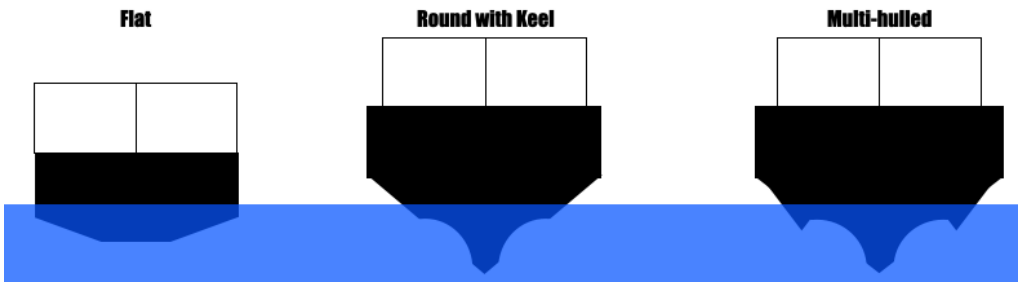
https://www.youtube.com/watch?v=khc2wUBsFU4

## Activity:

Before beginning, think about the following questions:

- What is Archimedes' principle?
- What is density?
- What is buoyancy?
- How does water pressure relate to the above?

# CLAY BOATS



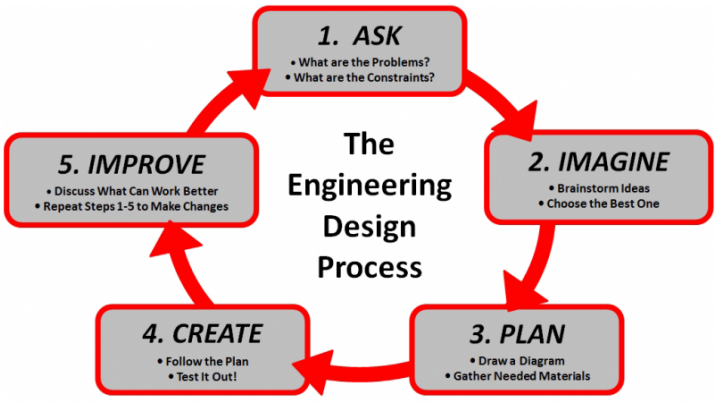

What shape of boat hull will work the best?

## Building

1. Start by setting out paper/newspaper to work on as the modelling clay can be very sticky.
2. Plan out your design on paper before you start building and try to remember and apply the principles discussed above. Also, pick a hull shape. (See image above).
3. Once you are done planning, try and set a constraint of using only one ¼ stick of clay
4. First try to make your clay boat float without any load placed in the boat
5. Once your clay boat floats, your next task is to then try and maximize the amount of load the boat can carry. You can use any mass as a load, but washers and coins work the best.
6. At the end, hold a competition to see which boat design can hold the greatest amount of load without sinking!

## Engineering Design Process

There are many different ways someone may make a boat, and that is up to you! Engineers use something called the engineering design process when creating new things. The first thing an engineer will do is ask "what is/are the problem(s)?" Then an engineer would try and imagine by brainstorming some ideas. Once the best idea has been chosen, a plan is devised usually in the form of a diagram. Now it's time to create and bring your plan to life! Engineers never only make one iteration of their design; they usually continue around this process until they achieve the best result!



## Debrief

- What did you notice while building your boats?
- Why did you make the changes you made?
- What boat designs seemed to work best? What is it about these designs that made them successful?
- What boat designs did not seem to work well? What is it about these designs that made them less successful or unsuccessful?
- How did your boat design change throughout the activity?

## What Did You Learn?

- What is Archimedes' principle?
- What does it mean to be buoyant?
- How density and surface area effect how things float
- What are the steps in the engineering design process?

## Future Learning

- Try and find more ways to experiment in making boats! Try and add more weight! Add more clay to your boat! Try and add sails and race your boats! Try and make your boats out of different materials! How detailed can you make your boat? What's the formula for density? What's the formula for surface area? How does water and air pressure differ? Look up different designs of boats and try and create them yourself! Send us what you end up making!

## Share your creations!

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

Instagram: @westernueng
Twitter: @westernueng
Facebook: @westernueng

Thanks for discovering with us!