



Investigating Density

Boys and Girls Club After School Science
NSF Center for Chemical Innovation
Chemistry at the Space Time Limit (CaSTL)
<https://www.castl.uci.edu/>

Standard(s) Addressed: The students will observe how the weight and size of an object determine if it will sink or float.

Lesson Objective: The children will learn about density – why objects sink or float in water and the properties of the objects to predict whether they sink or float (**2 day lesson**). They will gain an understanding of how the weight of an object (mass) and the size of an object (volume) contribute to whether it will float or sink.

Materials Used:

- Play Doh
- Water
- Clear plastic cup/bowl
- Graduated cylinder
- Objects to test
 - square/rectangle wood block
 - square/rectangle plastic block
 - plexiglass block
 - cork
 - marble
 - iron nail
 - metal straight pin
- Plastic Falcon or sealed tube
- Baby oil
- Food coloring
- Balance or electronic scale

Student Talk Strategies Used:

Talk to your partner
Think/pair/share

Classroom Management:

Conversation: quiet indoor voices

Help: ask the teacher, ask helpers/volunteers

Activity: work with group of three or four children, brainstorm/answer questions

Movement: groups move from station to station

Participation: working well in groups, doing task, working cooperatively

Funding and Credits:

This project was funded by the National Science Foundation Centers for Chemical Innovation award #1414466 and #0802913 to V. Ara Apkarian, Ph.D. at the University of California, Irvine, Department of Chemistry. This lesson was written by Danielle Watt, Ph.D., CaSTL Center and Long Hoang, M.S., CaSTL Center.

ENGAGE: <i>Connect to Prior Knowledge and Experience and Preview New Vocabulary.</i> Estimated time: 10 minutes		
Teacher's Role	Teacher Questions	Children's Role
<p>Teacher tells children that they are going to investigate sinking and floating today.</p> <p>Students are shown a clay ball. They are asked to predict what will happen when the ball is placed in water. Next the same ball of clay is shaped into a bowl (hollow boat). Students are then asked to predict what will happen to the clay.</p>	<p>We are going to investigate different objects sinking and floating in water.</p> <p>What do you think will happen to the ball of clay when we put it in water? Why?</p> <p>What do you think will happen to the same ball of clay if we shape it into a boat and place into the water? Why?</p>	<p><i>"It will sink because it is too heavy."</i></p> <p><i>"It will float because it is lighter than water."</i></p> <p><i>"It (boat) will sink because it is too heavy."</i></p>
EXPLORE: <i>Hands-On Learning, Cooperative Learning, Check for Understanding</i> Estimated time: 20-25 minutes		
<p>Description of Explore: In small groups, students perform the investigations to determine if their predictions were correct and to further investigate how objects sink or float in water. Staff members at each station ask questions to further children's understanding.</p>		
Teacher's Role	Teacher Questions	Children's Role
<p>Day 1 Teachers help the students make their own clay boat for competition.</p>	<p>Day 1 Will your boat sink or float?</p> <p>How many pennies do you think your boat can hold before it sinks?</p> <p>What do you think will be the best shape that will allow the boat to hold the most pennies?</p>	<p>Day 1 <i>"It will float."</i></p> <p><i>"10, 50, 100 pennies..."</i></p> <p><i>"A half ball/sphere. A box. A canoe shape."</i></p>
<p>Day 2</p>	<p>Day 2</p>	<p>Day 2</p>

<p>Teachers demonstrate each station, help students perform the investigations, and ask relevant and probing questions to test if different objects float and sink.</p> <p>Teacher moves students along so that each group experiences each station.</p>	<p>Which objects do you think will sink or float and why?</p> <p>What can you say about the objects' lightness or heaviness compared to their size? What would happen if...(we try objects of larger size, use a larger container of water, etc.)?</p>	<p>Students perform investigations and compare their findings to their predictions.</p> <p><i>"The wood block and cork floats in water."</i></p> <p><i>"The plastic block, plexiglass block, marble, nail, and pin sink in water"</i></p> <p><i>"The baby oil floats in the water."</i></p> <p><i>"The wood block is light for its size."</i></p> <p><i>"The cork is light for its size."</i></p> <p><i>"The marble is heavy for its size."</i></p>
--	--	---

EXPLAIN: *Listening, Speaking, Reading, and Writing to Communicate Conceptual Understanding* **Estimated time: Throughout**

Description of Explain: Students regroup with the whole class to report their findings and explain what happened.

Teacher's Role	Teacher Questions	Children's Role
<p>Teacher regroups students and has them report what they did and what they observed at each station. Teacher has students explain why they think it happened.</p> <p>Teacher records each group's response on 1 chart paper per station.</p>	<p>Day 1</p> <p>Why do you think these boats won?</p> <p>Why did the boats that sank early on hold fewer pennies than the winning boats? (Focus on shape and design of the boats.)</p> <p>Day 2</p>	<p>Day 1</p> <p><i>"The boat had a larger size and a stronger boat."</i></p> <p><i>"The clay walls were thicker but not too thick so they could support more pennies without breaking."</i></p> <p><i>"The walls were too thin so they broke when the pennies were put in."</i></p> <p><i>"The boat walls were too thick and heavy so they couldn't hold many pennies"</i></p> <p>Day 2</p>

<p>When we measure how light or how heavy an object is, we measure its mass.</p> <p>When we measure how much space the object takes or we talk about its size, we measure its volume.</p> <p>We call the relationship between mass and volume “density”. So instead of saying “the mass compared to the volume”, we use the word “density”.</p>	<p>What happened at the stations?</p> <p>Why?</p> <p>Can you rephrase your explanation using these new words: mass and volume?</p> <p>Teacher provides a sentence frame for students to use: “I think the _____ (name the object) floated because its _____ compared to its _____ was _____ than water’s mass compared to its volume.</p> <p>“I think the _____ (name the object) sank because its _____ compared to its _____ was _____ than water’s mass compared to its volume.</p> <p>Can you restate your explanation using the word density?</p> <p>Have you ever seen anything like that before?</p>	<p>Students share their learnings with peers and listen to the others.</p> <p><i>“Some objects floated but some sank in the water.”</i></p> <p><i>“I think this happened because how heavy the object was for its size compared to water will make it sink or float.”</i></p> <p>“I think the cork floated because its mass compared to its volume was smaller than water’s mass compared to its volume.”</p> <p>“I think the marble sank because its mass compared to its volume was bigger than water’s mass compared to its volume.”</p> <p>“I think the cork floated because its density was smaller than water’s density.”</p> <p>“I think the marble sank because its density was bigger than water’s density.”</p> <p><i>“I have seen this before with ice cubes floating in water or other drinks.”</i></p>
<p>EVALUATE: Summarize Lesson and Review Vocabulary, Variety of Assessment Tools</p>		

Estimated time: Throughout

Description of Evaluate: Evaluation will occur throughout the lesson and particularly during the explain component. Teachers should listen carefully to the conversations and presentations during the explain. Teachers should check for understanding throughout the investigations and explain.

Teacher's Role	Teacher Questions	Children's Role
<p>Teacher will review what students had previously learned about density. Teachers check for understanding.</p>	<p>What is density?</p> <p>Why did some of the boats sink and others float?</p> <p>When you were making the clay boats from the ball of clay what were you changing, the mass or the volume of the clay?</p>	<p><i>“Density is an object’s mass compared to the volume of an object.”</i></p> <p><i>“Mass is the amount of the object.”</i></p> <p><i>“Volume is the size or amount of space the object takes up.”</i></p> <p><i>“Density is the concentration of mass in a given space of an object.”</i></p> <p><i>“The mass changed which caused the density to be higher than water and made the boat sink.”</i></p> <p><i>“It is easier to change the volume if we can’t change the mass.” (Though some students thinking outside the box could say it’s easy to change the mass by taking or removing clay from the boats.)</i></p> <p><i>“We were changing the volume of the boats and keeping the mass the same.”</i></p>

Investigating Density

Data Table to record observations in the investigations.

Object	Prediction: Will it sink or float?	Observation: Did it sink or float?
Small wood block		
Large wood block		
Plastic block		
Small plexiglass block		
Large plexiglass block		
Cork		
Marble		
Iron nail		
Metal straight pin		

What do you notice about the objects that sink or float?

Use these sentences to summarize your observations.

I think the _____ (name the object) floated because its _____ compared to its _____ was _____ than water's mass compared to its volume.

I think the _____ (name the object) sank because its _____ compared to its _____ was _____ than water's mass compared to its volume.