

Investigating Buoyancy: Engineering Floating Boats

Objective: Students will be able to explain the concept of buoyancy and design a boat that successfully floats using various materials.

Assessment:

Students will design a boat using provided materials and test its buoyancy by placing it in water. Success will be determined by whether the boat can support a specific weight without sinking. Additionally, students will complete a reflection worksheet discussing what materials worked best and why.

Key Points:

- **Buoyancy:** The upward force that keeps objects afloat in a fluid.
- **Density:** The mass of an object divided by its volume; affects whether an object sinks or floats.
- **Engineering Design Process:** Steps that engineers follow to solve problems, including designing, building, and testing.
- **Materials Properties:** Different materials have different properties that affect their buoyancy (e.g., weight, shape).
- **Trial and Error:** A method of problem-solving used in engineering to test different designs and improve based on results.

Opening:

- Begin with a question: "What makes a boat float?"
- Show a short video of various boats in action.
- Conduct a quick class poll to see who has experience with boats or has seen them float and what they think makes them successful.
- Discuss responses to engage students in thinking about buoyancy.

Introduction to New Material:

- Show the following videos to introduce buoyancy:
 - "What is Buoyancy?" - SciShow Kids
 - "Buoyancy and Density" - Crash Course Kids
 - "Floating and Sinking" - PBS LearningMedia
- Explain the concept of buoyancy using visual aids and hands-on demonstrations with different objects in water.
- Discuss density and its relationship to buoyancy, providing examples of objects that float and sink.

- Present the engineering design process, outlining the steps students will follow in their boat design.
- **Common Misconception:** Students may believe that larger boats always float better than smaller ones; clarify that it's the shape and material that matter more than size.

Guided Practice:

- Students will work in small groups to brainstorm and sketch possible boat designs.
- Establish expectations for collaboration and sharing ideas respectfully.
- Provide examples of successful boat designs and discuss what made them effective.
- Scaffold questioning by starting with "What materials do you think will float?" and progressing to "How can you alter your design to hold more weight?"
- Monitor group discussions and provide feedback on their design ideas.

Independent Practice:

- Each student will create their own boat design using provided materials (e.g., aluminum foil, straws, tape, etc.).
- They will then test their boats in water, adding weights to see how much their design can hold while floating.
- Students will document their process and results in a science journal, detailing what worked, what didn't, and modifications made.

Closing:

- Have students share their boat designs and results with the class.
- Lead a discussion on what they learned about buoyancy and design.
- Ask students to reflect on what they might do differently in their next design.

Extension Activity:

- For students who finish early, challenge them to redesign their boat to hold even more weight or to create a boat using only one type of material.

Homework:

- Assign students to research a famous boat or ship and write a short paragraph about its design and how buoyancy plays a role in its functionality.

Standards Addressed:

- NGSS 3-PS2-4 Forces and Interactions: Students will plan and conduct an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

- NGSS 3-PS2-3: Students will ask questions to determine cause-and-effect relationships of electric or magnetic interactions between two objects not in contact with each other.

Note 1: Safety is important while conducting experiments. Ensure students handle materials carefully and are supervised when working with water. Provide safety instructions, such as avoiding slipping on wet surfaces and not submerging entire bodies in water.

Note 2: Accommodations will be made for English Language Learners (ELL) and Exceptional Student Education (ESE) students by providing visuals, simplified instructions, and pairing them with supportive peers during group work.