# Building a Boat to Understand Buoyancy

## Driving Question or Challenge:

How can we design and build a boat that effectively utilizes the principles of buoyancy to carry a load across water?

## Real-world Context:

This project connects to real-world issues by exploring how boats are designed to float on water. Students will learn about the importance of buoyancy in transportation, especially in industries like shipping and fishing. They will consider challenges faced by engineers, such as how to make boats more efficient and environmentally friendly, which resonates with current discussions about sustainable practices.

## In-depth Inquiry:

Students will dive deep into the scientific concepts of buoyancy and density. They will ask questions about why certain materials float or sink and how the shape of a boat affects its ability to carry loads. Research will include exploring different boat designs and their effectiveness in various water conditions, encouraging students to consider multiple perspectives on engineering challenges.

## Student Voice and Choice:

Throughout the project, students will have the opportunity to make decisions about their boat designs, materials used, and how they present their findings. Each group can choose the approach they want to take, whether it's focusing on speed, capacity, or unique design. This fosters ownership of their learning and encourages creativity.

## Reflection:

Students will regularly reflect on their learning process through journal entries and a final reflection worksheet. They will discuss what they discovered about buoyancy, the challenges they faced during the design and building phases, and how teamwork influenced their project outcomes.

## Critique and Revision:

The project will promote a culture of feedback where students share their designs and results with peers. They will receive constructive criticism and suggestions for improvement. This process of critique and revision will help students refine their designs and enhance their understanding of the engineering design process.

## Public Product:

Students will produce a tangible product—a functioning boat that they will race. They will also create a presentation summarizing their research, design process, and results from the boat race, which will be shared with the class and potentially broader audiences, such as parents or other classes.

## Collaboration:

The project is structured to foster collaboration. Students will work in groups, pooling their skills and ideas to solve problems and build their boats. This collaborative environment will enhance their communication and teamwork skills, essential for future projects and real-world scenarios.

## Teacher Facilitation:

The teacher will act as a facilitator, guiding students through the project without being the main source of information. They will mentor students, provide resources, and scaffold learning experiences to help students navigate challenges, encouraging independence and critical thinking.

## Interdisciplinary Connection:

This project bridges multiple subject areas, including science (buoyancy and density), engineering (design process), and math (measuring weights and calculating dimensions). By integrating these subjects, students will see the interconnected nature of knowledge and its application in real-world scenarios.

## Assessment:

Assessment will be both formative and summative, using various methods to gauge understanding. This will include rubrics for the research presentations, peer feedback during the design process, and the final reflection worksheet. Teachers will also observe group dynamics and participation throughout the project to ensure all students are engaged.

## Aligned Standards:

- NGSS 3-PS2-4: 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.

## Materials Needed:

- Aluminum foil
- Straws
- Tape
- Plastic containers for testing (tubs or large bowls)
- Weights (small stones, washers, or coins)
- Markers and paper for planning and presentations
- Science journals for documentation
- Access to videos and resources on buoyancy

# Detailed Project Guide:

## Day 1: Introduction

1. **Introduce the Project**:
    - Present the driving question and project overview to the students. Explain the importance of understanding buoyancy.
2. **Engaging Videos**:
    - Show videos such as "What is Buoyancy?" - SciShow Kids and "Buoyancy and Density" - Crash Course Kids.
    - Facilitate a discussion about what students learned from the videos.
3. **Concept Introduction**:
    - Discuss key concepts: buoyancy, density, and the engineering design process.
    - Encourage students to share prior knowledge about boats or floating objects.

## Days 1-2: Research Phase

1. **Group Research**:
    - Divide students into small groups (3-4 per group).
    - Assign each group to research buoyancy and density, focusing on how different materials affect a boat's ability to float.
2. **Presentation Preparation**:
    - Each group will create a presentation summarizing their findings. They should include:
        - Key scientific concepts
        - Examples of successful boat designs
        - Diagrams or images to illustrate their points

## Day 3: Design Phase

1. **Brainstorming Session**:
    - Groups will brainstorm ideas for their boat designs.
    - Encourage creativity and innovative thinking.
2. **Sketching Designs**:
    - Each group will sketch their boat design, considering the materials available and the weight they need to carry.
    - Create a materials list and outline steps for construction.

## Days 4-5: Build Phase

1. **Construction**:
    - Students will construct their boats using the materials provided.
    - They should work collaboratively, sharing tasks and responsibilities.
2. **Testing During Construction**:
    - Encourage groups to test their designs during the building process.
    - They should document any challenges faced and modifications made in their science journals.

## Day 6: Testing Phase

1. **Boat Race Setup**:
    - Set up a designated area for testing (e.g., a large tub of water).
    - Ensure safety measures are in place for handling weights and water.
2. **Conducting the Race**:
    - Each group will test their boat by gradually adding weights until it sinks.
    - Record how much weight each boat can hold before sinking.
3. **Present Findings**:
    - Groups will present their findings to the class, discussing:
        - What worked and what didn't
        - How they could improve their designs based on testing

## Day 7: Reflection and Presentation

1. **Reflection Worksheet**:
    - Each student will complete a reflection worksheet, discussing their learning experiences related to buoyancy, their design process, and teamwork.
2. **Class Presentation**:
    - Host a presentation session where each group shares their learning, design process, and results from the boat race.
    - Invite other classes or parents to attend, showcasing student work and learning.