BUOYANT BALLOONS

Suggested Grade Level: 3rd - 8th
Time: 50-60 minutes
Summary: Students will explore the concept of buoyancy and apply it to balloons. Students will practice using their knowledge of buoyancy in a small group challenge to build collaboration skills.

Materials Needed

- Clear vessel of water large enough for students to see (glass jug, small aquarium, etc)
- Helium balloons (5-8 per balloons per group of 3-4 students)
- String or ribbon
- Masking tape
- Yard sticks or measuring tapes (one per group)
- Kitchen scale (optional for lesson extension)
- Digital or print access to the “Floating Challenge” activity (1 per group)

Next Generation Science Standards

Grade K-5 Standards

- 3-PS2-1: Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object
- 3-PS2-2: Make observations and/or measurements of an object’s motion to provide evidence that a pattern can be used to predict future motion.

Grade 6-8 Standards

- MS-PS2-2: Plan 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.
- MS-PS2-4: Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.

Global Competencies

- Behaviors.2. Forms opinions based on exploration and evidence
- Behaviors.7. Approaches thinking and problem solving collaboratively
- Values & Attitudes. 4. Valuing multiple perspectives

Essential Questions

- How do force and motion apply to real life objects?
- How do people collaborate to solve real world problems?

Learning Targets

- I can draw conclusions about the world by asking questions and analyzing evidence
- I can listen actively and engage in inclusive dialogue to solve problems collaboratively
- I can listen to and build off the ideas of others

Differentiation strategies

Younger students may benefit from pre-teaching the concepts of gravity as a force and the differences between states of matter. For older students, the lesson can be made more complex by trying to calculate the exact number of balloons needed to lift an object using math proportions and a deeper understanding of the lifting force of helium: roughly one liter of helium per gram. See extension activities below.

Key vocabulary: force, motion, gravity, gas, liquid, upthrust, design, buoyancy

ENGAGE

Students will activate prior knowledge by observing whether items float or sink in water. They will then be asked to predict how items floating in water might be similar or different to items floating in the air. (10 minutes)

Begin with a demonstration.

- Explain to students that you will be placing several objects into a vessel of water. Display each item to the class. Possible items could include a small toy, a coin, a partially filled balloon, a small piece of wood, a metal teaspoon, an orange, etc. Be sure to have at least one item that sinks, one item that floats to the top, and one item that partially floats.
- Invite students to engage in a turn-and-talk in order to make predictions about what will happen when each item is placed in the water.
- After each item is placed in the water, ask students:
  - What happened?
  - Why do you think this happened?
  - Which things were constant in this demonstration? Which things were different?
    - Answers may include the weight of the item, the amount of water, the way each item was placed in the water, etc.

Next, invite students to consider an item floating in the air.

- Show students a balloon inflated with helium.
- Invite students to engage in another turn-and-talk. Ask: What makes this balloon float? What is similar or different between this balloon and the items placed in the water? Follow-up questions: Why do some balloons float while others don't?
- Return to a large group and ask for 3-4 students to share their responses.

EXPLORE

Students will learn about the design process of creating a Macy's Thanksgiving Parade Balloon. This includes the science of buoyancy and wind speed measurement. (12 Minutes)

Watch EXPLR's Parade 101: Creating A Macy's Parade Balloon

After watching, invite students to share something they noticed from the video and something they are still wondering about.

EXPLAIN

Students will discuss the factors that make an item float in the air, including the forces involved. (5-10 minutes)

Ask students:

- Based on the video, how is a balloon floating in the air similar or different to an item floating in water?
- What impacts whether a balloon floats in the air? How do you know?
    - Answers might include:
        - Weight of the balloon materials
        - Which gas is inside the balloon
        - Wind speed
        - Buoyancy and upthrust
- Affirm that just like items floating in water, items will float in the air when the force of upthrust is greater than the item's weight (the force pulling the item towards the earth). Correct any misconceptions if they emerge.

ELABORATE

Students will work collaboratively to apply their understanding of buoyant forces in a "Floating Challenge" (20 minutes)

In groups of 3-4, have students engage in the **"Floating Challenge"** (provided in Lesson Tab). The challenge asks students to design and execute a plan to make a stuffed animal hover three feet in the air for 30 seconds or more.

Teacher set up:

- Introduce the group challenge being sure to highlight group collaboration as a goal
- Create student groupings of 3-4 students
- Randomly assign group roles
- Time students for five minutes during the planning stage and five minutes for the execution stage
- Circulate among groups that need support and redirection as necessary

When students have completed the exercise, return to the whole group and ask students to share what they learned by conducting their experiment.

EVALUATE

Students will reflect on their learning by engaging in a connect-extend-challenge thinking routine (5-10 minutes)

As a large group discussion or written down individually, ask students to think back to the beginning of this lesson:

- Connect: How is the information learned today connected to what you already knew?
- Extend: What new ideas did you learn that broadened your understanding?
- Challenge: What challenges or puzzles came up based on the information you learned today? How might you apply this new knowledge in the future?

Challenge by choice: Ask students to share reflections with the larger group. What similarities do we notice? What differences?

EXTENSION IDEAS

- Challenge students to extend their knowledge of buoyancy by comparing and contrasting the materials needed to float and fly the same object.

- Challenge students who already have knowledge of using proportional reasoning to calculate the exact number of balloons needed to lift a stuffed animal. Or, ask them to find the number of balloons needed to lift a house if they are given the weight of the item. Assume a lifting ratio of 1 liter of helium being able to lift a 1 gram object. Standard party balloons roughly hold 11 liters of helium. Also assume that the weight of a balloon and ribbon is negligible.

    - Students can work to create their own solution or you can provide them with the simple equation ((weight object in grams)/(11 liters))= (# of standard balloons needed to lift an object)
    - The **Omni Helium Balloon Calculator** may be useful

- Have students create their own balloon design. Designs could be 2-dimensional, or invite students to create a 3-dimensional design using the free online program **Tinkercad**.