Berkeley Engineers and Mentors

Title: Balloon Rockets
Lesson Type: Module
Target Grade: Elementary/High School
Author: Julie Liang
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Brief Overview:
Demonstrates Newton's Third Law of Motion through rocket balloons. There are two types of balloons; the straight "rocket" balloons and the round "flying saucer" balloons.

Agenda:
- Introduce everyone and students (~20-25 minutes)
    - Do an ice breaker/name game
        - introduce yourselves and BEAM and what BEAM is
        - establish guidelines for students if necessary
    - What's an Engineer worksheet
        - failure is part of the process
- Introduction of lesson (~10-15 minutes)
    - Give brief overview of Newton's Laws of Motion
    - Mention that we'll demonstrate Newton's Third Law
- Play with the balloons with the students (~25-30 minutes)
    - The rocket ones will fly in a straight line
    - The flying saucer ones will spin
    - Remember to relate them to the kids personal experiences

Teaching Goals:
- Newton's Laws of Motion (especially Third Law) (Note, feel free to come up with your own examples for the students)
    - First law: Every object continues in its state of rest, or of uniform motion in a straight line, unless compelled to change that state by external forces acted upon it.
        - Casually known as "Objects at rest tend to stay at rest, and objects in motion tend to stay in motion"
        - Examples: Big heavy things tend to take more energy to get moving, but once they start moving, they are harder to stop
    - Second law: The acceleration a of a body is parallel and directly proportional to the net force F acting on the body, is in the direction of the net force, and is inversely proportional to the mass m of the body, i.e., F = ma.

        - Casually known as “Objects accelerate (or move) when you exert a force on them, more force = faster movement (more acceleration)
        - Examples: Pushing things, etc.
    - **Third law**: When two bodies interact by exerting force on each other, these action and reaction forces are equal in magnitude, but opposite in direction.
        - Casually known as “every action has an equal and opposite reaction”
        - Example: Two people skating and exerting force on each other, two people on chairs with wheels pushing each other, etc.

Lesson Introduction:

- After the icebreaker, do a short lecture on Newton’s Laws of Motion. Use examples that the students can relate to. Then focus in on the Third law and bring out the balloons. Do the rocket balloon first and ask the students where they think the forces are in terms of the balloon. Then show them. Next do the flying saucer balloon and ask them the same thing. Explain the forces on each balloon. Then spend the rest of the lesson playing with the balloons.

Materials:

- Air Pump (one per class)
- “Rocket” Balloon (ideally one per student)
- “Flying Saucer” Balloon (one or two per class)

Module: Rocket & Flying Saucer Balloons

Introduction

- Demonstrate Newton’s Third Law of Motion

Material to Teach

- The balloons demonstrate Newton’s Third Law of Motion. The elastic walls of the balloon exerts force on the air inside the balloon and when the balloon is released, the air is forced out. The opposite reaction of air pushing on the balloon is what propels the balloon through the air. This is similar to how rockets to space works.
- The Flying Saucer balloons also display rotational motion since the force is perpendicular to the edge of the balloon, causing it to spin (torque).
- The humming sound is because the mouth end vibrates as air is released from it.

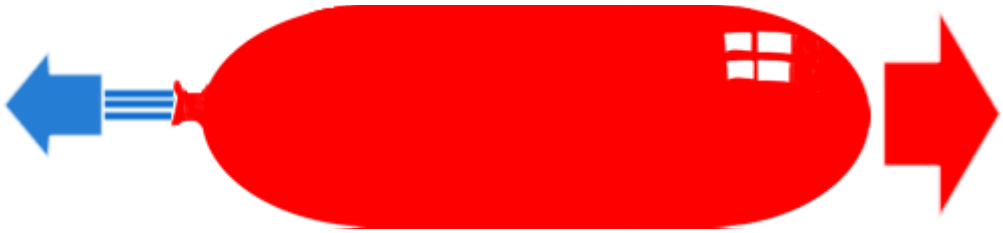

Diagram of rocket balloon

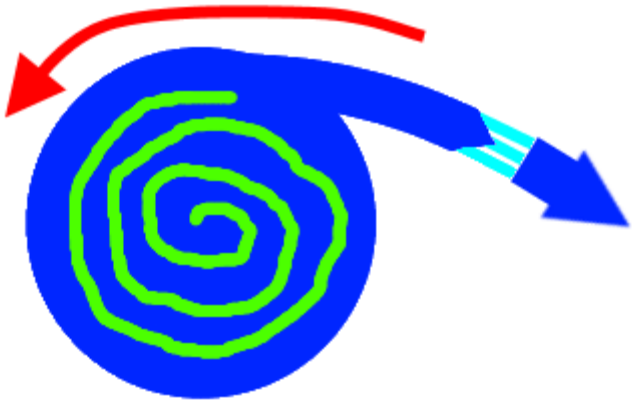

Diagram of flying saucer balloon

Procedure

- Blow up balloon with pump, release.
    - For the Flying Saucer Balloon, you can either release it on its side (so it “rolls”) or release it on the flat face so that it spins
    - For the Rocket Balloon, release it into the open air, slightly upward in angle.

Notes for Mentors

- The best way to inflate the balloons is to use the pump. After demonstrating the balloons and explaining the lesson, students can play with the balloons. I would recommend inflating the balloons with the pump and then handing them to the students to let go of. But you can also blow them up manually as well.

Summary Materials List

For each site

- Air Pump - At least one per site
- “Rocket” Balloon - Ideally one per student
- “Flying Saucer” Balloon - Two per site