Water Rockets

Objective:
In this activity, you will launch a **water rocket** to explore **Newton's Third Law of Motion**: "For every action, there is an equal and opposite reaction." You will see firsthand how the pressure of water is expelled from the rocket and how this creates a powerful force to launch it into the air. This experiment will help you understand the principles behind rocket propulsion and motion.

Materials:

- **Plastic soda bottles** (2-liter size works best)
- **Water**
- **Air pump** (with a pressure gauge if available)
- **A watering can** (for filling the bottle with water)
- **Safety goggles** (for protection during launch)
- **Large open space** (like a playground or field)
- **Stopwatch or measuring tape** (optional, for measuring flight time or distance)

Preparation:

1. **Set up the Launch Area:**
   Find a large open space outdoors where students can safely launch their water rockets. Make sure there are no obstacles or people nearby to avoid accidents.
2. **Safety First:**
   Ensure all students are wearing **safety goggles** to protect their eyes during the rocket launches, as the pressure can cause the rockets to launch unexpectedly.
3. **Materials Ready:**
   Each group will need a pvc launcher, 2-liter plastic bottle, water, and the air pump setup.

Activity Timeline:

25 minutes per rotation. 5 rotations. 26-28 students per rotation.

2 minutes: Introduction – Newton's 3 Laws of Motion

20 minutes: Students launch water rockets.

3 minutes: Discuss observations.

Notes: Enlist parent volunteers to supply water for student's usage to minimize the temptation for students to have water fights. Periodically the black electrical tape on the threaded fitting will need to be replaced to ensure a tight fit of the bottle nozzle.

Activity Instructions:

1. Introduction to the Challenge:

- Start by explaining **Newton's Third Law of Motion**: "For every action, there is an equal and opposite reaction." This law means that when you push something (action), it pushes back with the same force in the opposite direction (reaction). In the case of the water rocket, the action is the water being forced out of the rocket, and the reaction is the rocket being pushed upwards.
- **Objective of the Activity:**
  You will launch a water rocket using air pressure and water. The air pressure will force water out of the rocket, creating thrust and propelling it into the air. The more air pressure and water you have, the higher the rocket should go!

---

2. Launch the Water Rocket:

- **Step 1: Prepare the Launch Area:**
  Find an open space, away from people, where the rocket can launch freely. Place the rocket upside down (with the neck facing the ground) on the launch pad or a secure, stable surface.
- **Step 2: Attach the Air Pump:**
  If using an air pump, connect it to the needle valve or tire valve that is attached to the launcher. Ensure that the pump is securely in place and ready to add air pressure.
- **Step 3: Safety Check:**
  Everyone should be wearing **safety goggles**. Keep a safe distance from the rocket to avoid any risk when the rocket launches.
- **Step 4: Fill Bottle with Water and Attach Bottle to Launcher**

  Use the watering can to fill the bottle one third full. Raise the long pipe of the launcher 90 degrees so that the pipe the bottle is attached to is horizontal to the ground. This minimizes the amount of water lost.

- **Step 4: Pump and Launch:**
  Begin pumping air into the bottle using the air pump. The air pressure will build up inside the rocket. As the air pressure increases, it forces the water out of the bottle's opening, propelling the rocket upwards.

Important Note: When the air pressure is high enough, the rocket will launch into the air! Make sure to watch it carefully!

---

3. Experiment and Observe:

- **Test #1 - Launch and Measure:**
  - Launch the rocket and observe how high it goes. Use a **measuring tape** to measure the distance the rocket travels or use a **stopwatch** to time how long the rocket stays in the air.
- **Test #2 - Adjust Variables:**
  - Now, test different variables:
    - **More Water:** Try adding more or less water to see how it affects the rocket's flight. Does more water make the rocket fly higher or lower?
    - **More Air Pressure:** Try pumping the rocket with different amounts of air pressure. Does more pressure lead to a higher flight?

---

4. Reflection and Discussion:

After several launches and adjustments, bring the class back together for a discussion.

Discussion Questions:

1. **Newton's Third Law:**
   - How did **Newton's Third Law of Motion** apply to the launch of the water rocket? What was the action, and what was the reaction when the rocket launched?
   - Why do you think the rocket flies upward when the water is forced out?
2. **Air Pressure:**
   - How does **air pressure** inside the rocket relate to how high it flies? What happens if there is too much air pressure? Too little?
   - How does water play a role in the rocket's flight? Why do we use water and air together in the rocket?
3. **Rocket Design:**
   - What could you change in your design to improve your rocket's performance?
4. **Real-Life Connection:**
   - How is the process of launching a water rocket similar to launching a real rocket into space? What forces do engineers need to consider when designing real rockets?