3-2-1 POP! **Primary Audience: 3rd – 10th Grade**

Description: Construct a rocket powered by the pressure generated from an effervescing antacid tablet reacting with water.

Keywords: Newton's Laws of Motion

Concepts:

- An object at rest will stay at rest and an object in motion will stay in motion, unless acted upon by a force. (Newton's First Law of Motion)
- Force equal mass times acceleration. (Newton's Second Law of Motion)
- For every action there is an equal and opposite reaction. (Newton's Third Law of Motion)

Materials:

- For Demonstration:
  - Air Pressure Rocket
- Per Participant:
  - Heavy Construction Paper
  - Plastic 35 mm Film Canister
  - Cellophane Tape
  - Scissors
  - Effervescing Antacid Tablet
  - Paper Towels
  - Access to Water
  - Eye Protection

Instructions:

A rocket in its simplest form is a chamber enclosing a gas under pressure. A small opening at one end of the chamber allows the gas to escape, and in doing so provides a thrust that propels the rocket in the opposite direction. A good example of this is an air pressure rocket. The rocket's rubber walls compress air inside. The air pushes back so that the inward and outward pressing forces unbalance. Eventually, the air escapes and the rocket is propelled in the opposite direction.

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To demonstrate this even further, we are going to construct our own rockets using noncombustible fuel.

Have you ever seen a rocket before? Can you describe it to me? What kinds of things have you noticed about rockets? What do they do? How do they move? Let's see if we can make our own working models of a rocket.

1. Grab one piece of paper, any color. This piece of paper will be the body, head and fins of your rocket. Think about how you want your rocket to go together and how much of that piece of paper you want to use on each part. Don't worry about trying to make your rocket look like the example or your friends. We're all scientists here and scientists learn by doing different things and seeing what happens.

2. Go ahead and cut out the body. Do you want it to be long or short? What happens if we leave all the paper and roll it around a couple of times or if we trim it shorter? It should be wide enough to fit around the canister lid. Now roll it up and tape it to the film canister (lid side down).

3. Now we need to tape the fins to the rocket. Where do you think they should go? Where do you see them usually? Why do you think that is? What would happen if we put them someplace else?

4. Next cut out a cone for the top and tape it in place. We'll cut out a PacMan-like shape (circle with an "open" mouth). Your cone can be large or small, flatter or pointier. How do you think the size and shape of your cone will impact your rocket? Will it go higher, lower, faster, slower, left, right, etc. than the person's next to you?

5. Put on these safety glasses before we go any farther. Hold your rocket upside down and fill the canister half-full of water using the pipette. What do you think will happen when we drop the tablet into the water? Why? Once you put the effervescent tablet (1/2 of the tablet) in there put the lid on quickly and tightly. Then place the rocket down on the tarp and back away from it.

6. Post- flight-- Why do you think the rocket flew up in the air like that? What fueled or pushed it? The explosion. The effervescent tablet and water created gas. What are some of the differences between solids, liquids and gases? Help me remember which takes up more space gases or liquids? Gasses! That's right and there just wasn't enough room in the capsule for all that gas and the pressure built up until it exploded throwing the rocket up in the air. (Newton's 1st Law: the rocket lifts off because it is acted upon by an unbalance force)

7. The force of the rocket flying into the air is exactly equal to the force of the water, gas, and lid being pushed down. What do you think we could do to increase that force and what would happen if we did? (Newton's 3rd law) What do you think you could do or change to make it go higher? Faster?

8. When you are done, please put the plastic canister in this bucket. The paper can

go in the trash can.

Possible Interactive Questions:

- How does the amount of water placed in the cylinder affect how high the rocket will fly?
- How does the temperature of the water affect how high the rocket will fly?
- How does the amount of the tablet used affect how high the rocket will fly?
- How does the length or empty weight of the rocket affect how high the rocket will fly?
- How would it be possible to create a two-stage rocket?

What's Going On?

This activity is a simple but exciting demonstration of Newton's Laws of Motion. The vehicle moves because it is acted upon by an unbalanced force (First Law). This is the force produced when the lid blows off by the gas formed in the canister. The rocket travels upward with a force that is equal and opposite of the downward force propelling the water, gas, and lid (Third Law). The amount of force is directly proportional to the mass of water and gas expelled from the canister and how fast it accelerates (Second Law).

Further Exploration:

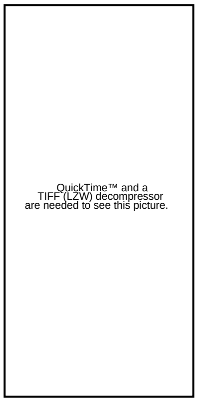
1. Hold an altitude contest to see which rockets fly the highest. Launch the rockets near a wall in a room with a high ceiling. Tape a tape measure to the wall. Stand back and observe how high the rockets travel upward along the wall. Let all students take turns measuring rocket altitudes.

Relevant Ohio Science Content Standards:

- Physical Sciences 3-5: Describe the forces that directly affect objects and their motion.
    - 3.4: Predict the changes when an object experiences a force (e.g., a push or pull, weight and friction).
- Physical Sciences 6-8: In simple cases, describe the motion of objects and conceptually describe the effects of forces on an object.
    - 8.3: Explain that an unbalanced force acting on an object changes that object's speed and/or direction.
- Physical Sciences 9-10: Explain the movement of objects by applying Newton's three laws of motion.
    - 9.22: Demonstrate that any object does not accelerate (remains at rest or maintains a constant speed and direction of motion) unless an unbalanced (net) force acts on it.
    - 9.23: Explain the change in motion (acceleration) of an object. Demonstrate that the acceleration is proportional to the net force acting on the object and inversely proportional to the mass of the object. (F net=ma. Note that weight is the gravitational force on a mass.)

- 9.24: Demonstrate that whenever one object exerts a force on another, an equal amount of force is exerted back on the first object.

3-2-1 Pop!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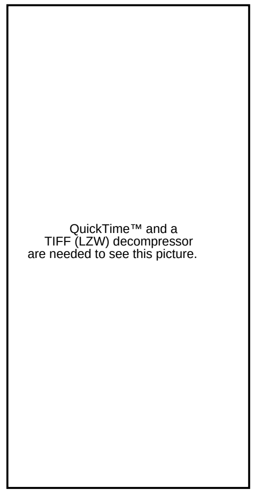
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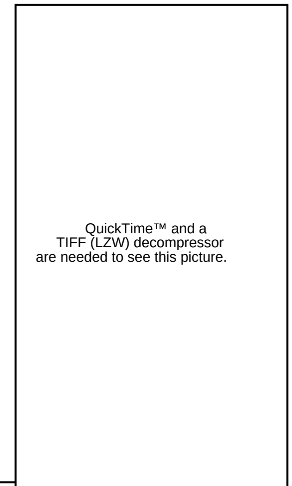
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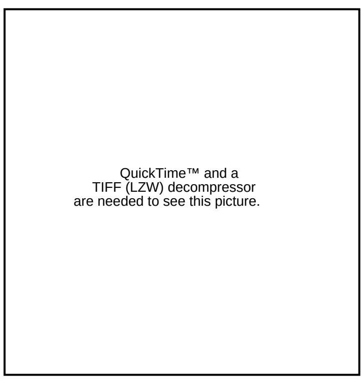
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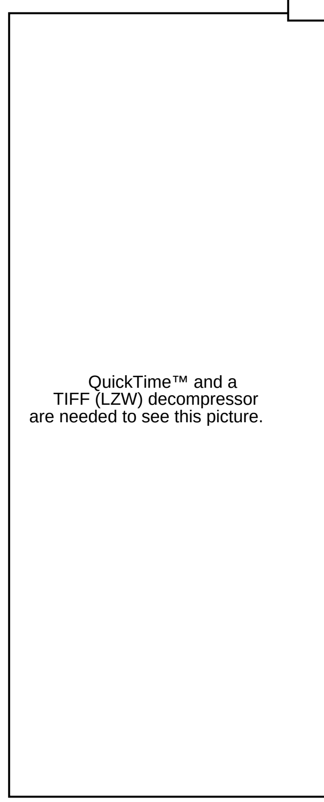
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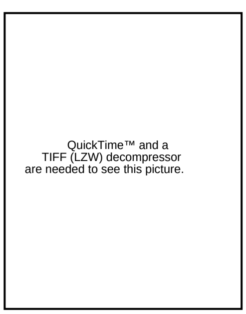
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