TEACH EDUCATOR RESOURCES

Film Canister Rockets

Background : The rocket in this activity is propelled according to the principle stated in Isaac Newton's third law of motion: "For every action there is an opposite and equal reaction." Gas pressure builds inside the film canister due to the mixing of an effervescent tablet (e.g. Alka-Seltzer®) and water. This action continues until enough pressure builds to blow apart the canister from its lid.

Preparation: It is most important to use film canisters with lids that snap inside (white Fuji canisters work best). You could add fins and a nose cone to make your canister look more like a rocket, but they launch fine just the way the are!

Safety First: Wear safety splash goggles when doing this experiment. If children under the age of twelve are going to be handling the tablets, use a variety such as Alka-Seltzer for Heartburn that does not contain aspirin (salicylic acid) or have children wear protective gloves. Never point the rocket at anyone! Everyone should stand away from loaded rockets when they are on the launch pad. It may take 15 to 20 seconds to build up enough pressure to launch, so a loaded rocket should not be approached prematurely.

Activity: Launching near a wall outside where a measuring tape has been hung may make it easier to judge how high the rocket goes. Or you could use a stopwatch to time how long it takes to lift off. Add water to fill the canister half-full. Add 1/2 tablet of Alka Seltzer and quickly snap on the lid. Place the canister rocket, lid down, on the ground or on a table in a container. Stand back and count down while you wait for launch. Record your data! Try changing variables in multiple experimental rocket flights.

Record Your Data: One way to record the results of different "fuel" mixtures is to make a simple graph of height vs. amount of water. Such a graph gives a clear, visual record of the observations and can be used as evidence to support interpretations. What happens if you change the amount of water? Does the temperature of the water make a difference? Remember to change only one variable at a time during your investigation. (amount of water, amount of tablet, temperature of the water, type of fluid used, crush the tablet, etc.)

The Science Behind the Launch: This activity illustrates Newton's Laws of Motion. The rocket lifts off 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 to the downward force propelling 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).

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What is happening inside that film canister?

When you mix effervescing tablets with a liquid like water, a chemical reaction takes place between the citric acid and sodium bicarbonate contained in the tablet and the water. This chemical reaction creates many, many bubbles of carbon dioxide gas. Citric acid is a weak acid and is in the juice of most citrus fruits like lemons or limes. We know sodium bicarbonate as baking soda. Baking soda and vinegar (acetic acid) produce the same reaction when mixed together. This is like the famous baking soda and vinegar "volcano" experiment. Lots of bubbles of carbon dioxide gas!

Why does your rocket go up?

It goes up because gas is building up in the closed film canister and since the lid is the weakest point of the canister, the lid pops off and all that gas comes rushing out of the end of the canister. This action can be explained using Newton's Laws of Motion, more specifically it is an example of Newton's Third Law of Motion – "Every action has an equal and opposite reaction". The gas rushing out of one end of the canister (the action) causes your rocket to move in the opposite direction (the reaction). This is exactly how all rockets work whether you use an effervescing tablet as your fuel or a chemical rocket propellant like they do at NASA.

How does the NASA rockets work?

Quite simply, rockets are how NASA can get all those amazing rockets off the ground. These rockets use a pressurized fuel and an oxidizer. The oxidizer is something that allows the fuel to burn without using outside air. (Can you think of a reason why this might be important?) The fuel, in a gaseous state, is pressurized because this forces it out the end of the rocket just like our film canister rocket! However, there are a few more parts to an actual rocket.

The fuel used in the rockets like the ones that helped the space shuttles enter space, used liquid hydrogen as the fuel and liquid oxygen as the oxidizer. The fuel and oxidizer are only in a liquid state when they are in the holding tanks at extremely low temperatures. The fuel and oxidizer are allowed to combine within the combustion chamber and as the burn they turn into a gas (gases take up about 1,000 times more space than a liquid) this causes the intense pressure. It is exactly like our film canister rocket; the carbon dioxide builds up and puts intense pressure on the canister so the lid pops off.

In the case of real rockets, the fuel and oxidizer burn, are put under intense pressure and are released, not by the popping off of a lid, but through a tiny hole on the bottom of the combustion chamber called a nozzle. If you would like to learn more about rockets visit the NASA website. Also, if you want to watch an interesting video conducted on the International Space Station using an effervescent tablet, go to: Alka-Seltzer added to Spherical Water Drop in Microgravity.

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