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Making Rocket Fuel

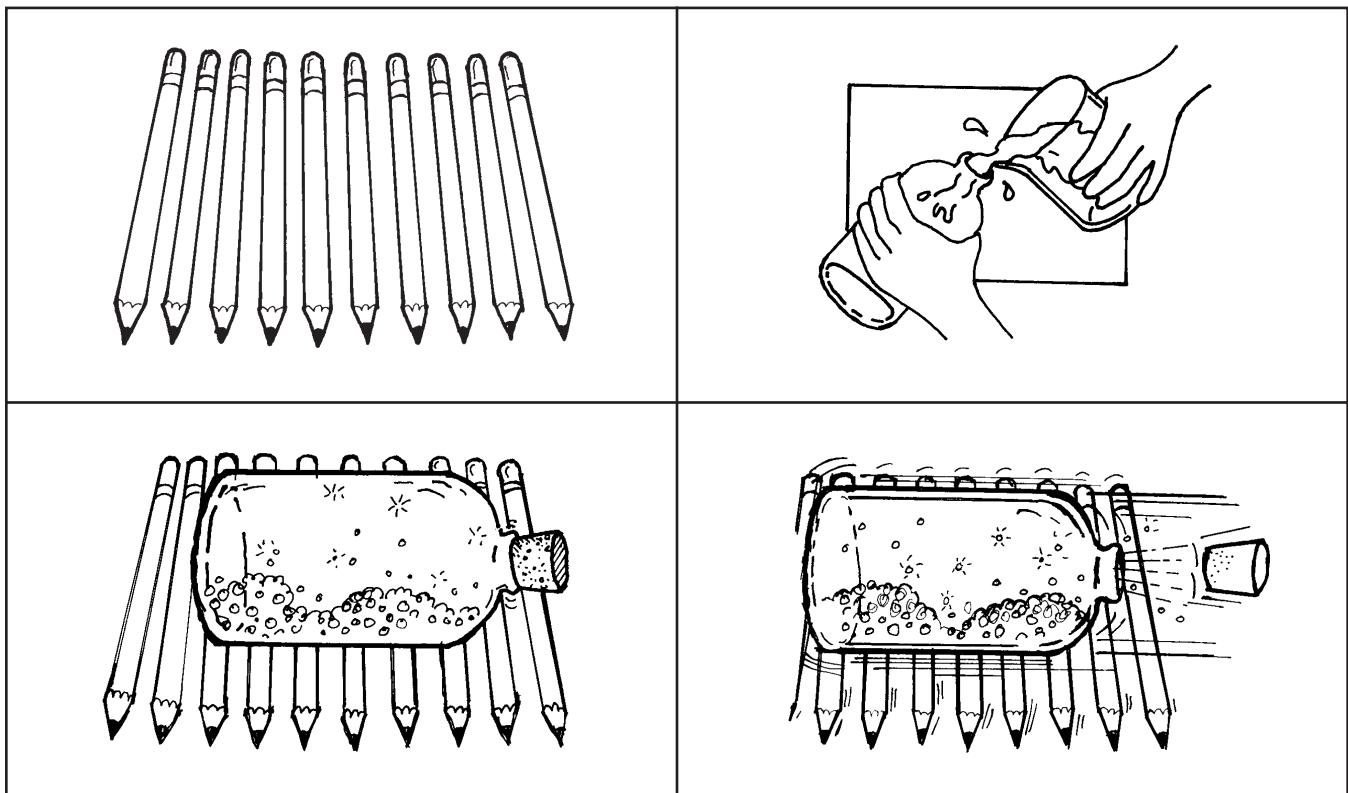
We have seen how Newton's third law of motion (for every action there is always an equal and opposite reaction) has worked in our previous two experiments. In space, however, there is no gravity to force water from a container, nor is there oxygen to fill a balloon.

Ordinary fuel for jets needs oxygen to burn. In space we need a rocket engine which carries its own oxygen supply. Many such engines rely on mixing two chemicals to produce oxygen which is then used to burn the fuel and create expanding gases that will propel the rocket.

Let us see if we can create a liquid fuel rocket engine that produces its own gas pressure to propel the rocket. (To avoid a mess inside, this experiment is best conducted outside.)

Materials: one 16.9 fl. oz. (500 mL) plastic water bottle, a cork to fit the bottle opening, a dozen round-barreled pencils, baking soda (sodium bicarbonate), vinegar, and a measuring cup

- Procedure:**
1. Line the pencils up parallel to one another and about one inch (2.5 cm) apart.
 2. Using a paper cone as a funnel, pour $\frac{1}{4}$ cup of baking soda into the bottle.
 3. Stand to one side of the pencils, pour about $\frac{1}{4}$ cup vinegar in the bottle and quickly place the cork in it.
 4. Immediately place the bottle on the pencils and stand back. Notice the action which takes place. The vinegar and baking soda mix chemically, creating the gas carbon dioxide.



Closure: Tell what you saw happen and explain the reaction using Newton's Laws of Motion.

Vacation in Space

To the Students: Now that you have toured the solar system, pick your favorite planet or the moon that you visited and put together a travel brochure and display that will make people want to take a vacation trip to that location. Use your Space Log, data charts, books, and magazines to help you gather information for your project. Your project should include the following:

- ◇ A colorful travel brochure describing the special features of this vacation spot. Include pictures of the spacecraft used to transport the tourists. Show the cabins, dining and recreation areas on board. Be sure to include the prices for passengers traveling first class or economy. Get brochures from a travel agency to see how they describe cruises and trips to various vacation spots such as Hawaii, Europe, and Antarctica.
- ◇ A three-dimensional representation of the planet or moon they will visit, constructed from a Styrofoam ball. Paint it and show some of the surface features, such as craters, mountains, and polar ice caps. If the planet has moons or rings, be sure to attach these to your model.
- ◇ A map to show where the planet or moon is located in the solar system and what route would be followed from Earth to get there. Use NASA's Exploration of the Solar System chart (page 42) to help calculate how long it takes to make the trip. Use reference books to find the path these satellites used to get to the planets or that the Apollo spacecraft used to get to the moon.
- ◇ A shoebox diorama showing what people will wear and where they will stay when they arrive. Show the sky and any moons which may be visible. If the planet is one of the giant gas planets, people may stay aboard an orbiting space station and make short trips to the moons and rings of these planets.

Remember that you need to interest the tourists in buying the tickets on this vacation trip, so be sure to give as much information as you can to persuade them to go.