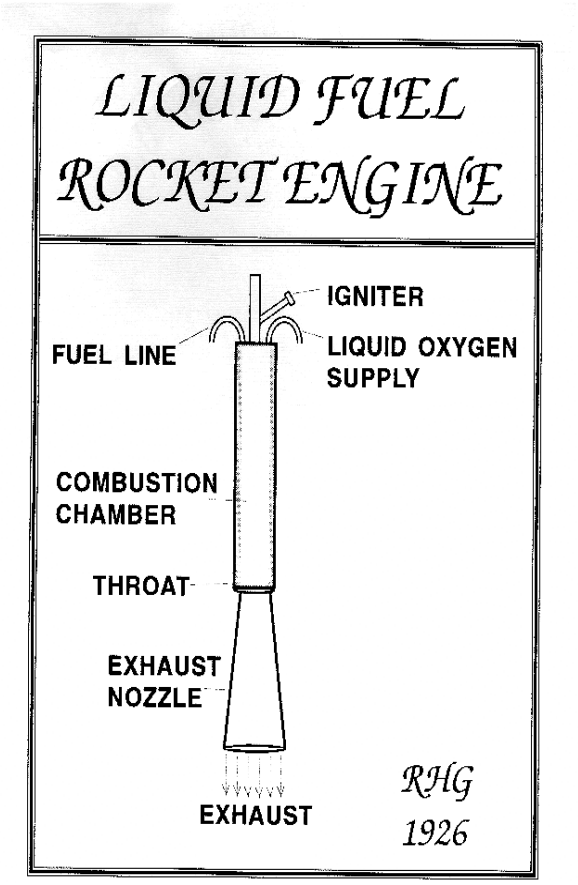
Water Bottle Rocket (Newton's 3rd Law)

Purpose: To demystify rocket science and to graphically demonstrate Newton's third law of motion.

Materials: 5 gallon water bottle, denatured alcohol, long matches, launch cradle, spray bottle.

The diagram below shows all of the ingredients required to make a simple rocket.



The rocket is a relatively simple device, but must always be treated with respect. Be sure that there are no objects within ten feet of the rocket at ignition that can even be remotely classified as flammable. First elicit from students what three things must be present to start a fire. (fuel, Oxygen, heat) Point out that you will be starting with a liquid fuel. You may easily

demonstrate how poorly liquids burn by forming a small pool of liquid first and burning it. It is fairly easy to see that it is actually the vapor, not the liquid, that burns.

Add liquid fuel to the bottle while explaining the parts of a rocket using the diagram and the bottle. The rocket itself consists of three main parts; the combustion chamber, where fuel and Oxygen are combined awaiting heat to combust; the throat, which constricts the flow of escaping gasses causing them to accelerate; and the exhaust nozzle, which gives the accelerated gasses a place to go to avoid manufacturing a bomb.

Once all of this has been made clear, ignite the bottle and enjoy the reaction of your students. At the moment of combustion the gasses become very excited and try to escape. Lacking intelligence, the gas molecules tend to collide with the walls. If the walls are too weak they will break and you have created a bomb. If the walls are strong they compel the gas molecules to escape out of the exhaust nozzle. The rapidly escaping molecules constitute an action which results in the reaction of the bottle accelerating the opposite direction.

Helpful Hints:

Denatured alcohol is highly explosive and must be handled with care. If you have spillage on your fingers be sure it evaporates before lighting the bottle.

The bottle will go very fast. Be sure your cradle is stout. Drill several ¼" holes in the blunt end of the bottle opposite the exhaust nozzle to counter the power of the thrust.

Spray the fuel into the bottle and twirl the bottle around several times during your explanation of what is about to happen. This gives the slow burning liquid ample opportunity to evaporate into the rapidly burning vapor.

Obviously this experiment is hazardous but extremely fun. Do not try this at home.