Post-Show

LIFE IN SPACE

After the Show

We recently presented a Life in Space show at your school, and thought you and your students might like to continue investigating this topic. The following activities are designed to review and extend the ideas covered in the show.

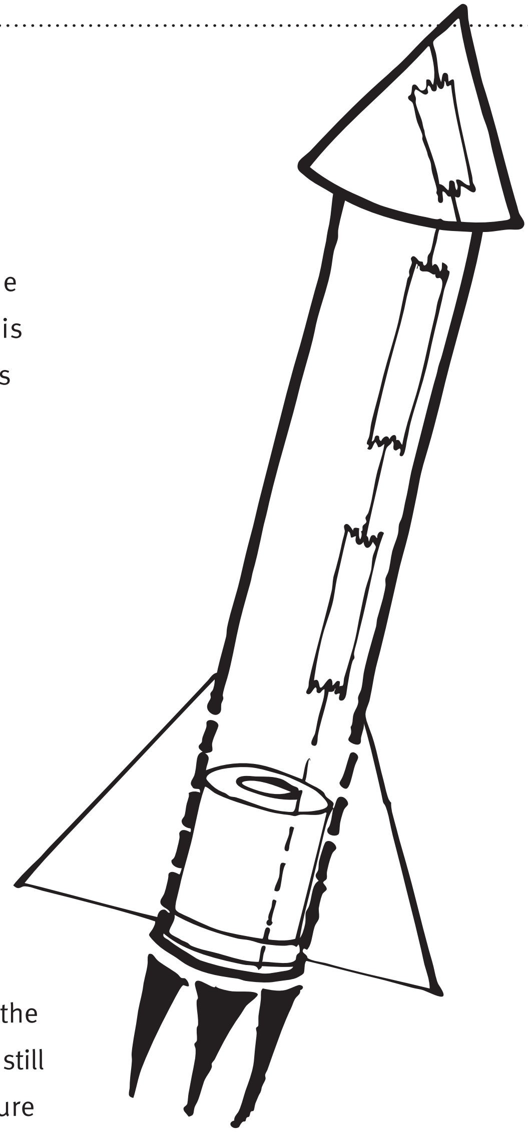
Please remember to use appropriate safety measures for all activities. An adult instructor should always supervise students during experiments.

Visit us online at www.fi.edu/TSS or contact us at tss@fi.edu.

MAKE YOUR OWN ROCKET

FOR GRADES 1-4

During the show, we learned that rockets are propelled up when the combustion of fuel produces gas that is expelled downwards. In this activity, students will build and launch a jet-propelled rocket. Note: This activity should be done outdoors.



EQUIPMENT

5” x 8” index cards
Markers
Empty film canister with snap-on lid
Tape
Scissors
Effervescent antacid tablets (e.g. Alka-Seltzer)
Water

PROCEDURE

1. Decorate the index card, which will form the body of the rocket.
2. Roll the index card into an 8” long tube. Slide the film canister into the tube so that the canister opens at one end of the tube and the lid can still snap on. This end will be the base of the rocket. Use tape to secure the paper tube to the canister. Then tape the 8” seam of the paper tube.
3. Cut four triangular fins from another index card and tape them to the base of the tube.
4. Twist another index card into a small cone, and tape it to the top of the rocket to form the nose cone.
5. Take your rocket outside. Hold the rocket upside down. Fill the canister about ¼ full with water.
6. Add half an antacid tablet to the water in the canister, and quickly snap on the lid.
7. Place the rocket on the ground, lid down. Stand back and enjoy the launch!

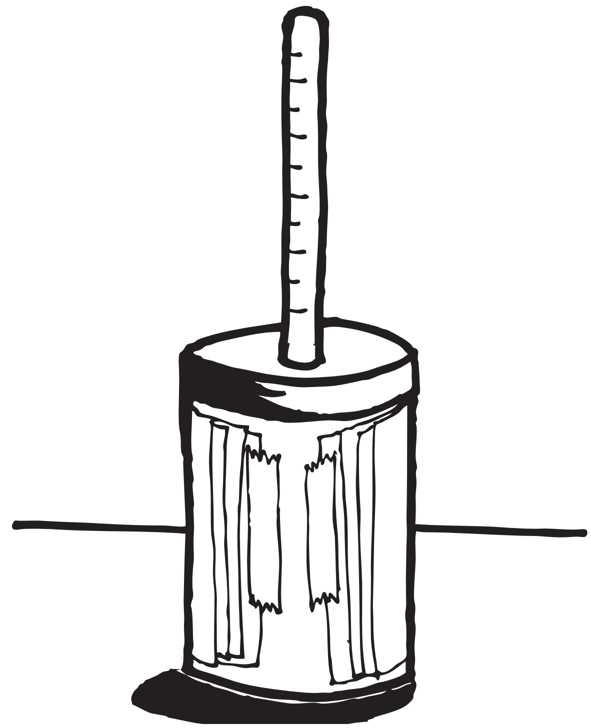
WHY?

The seltzer tablet reacts with water to produce carbon dioxide gas. The gas builds up in the film canister until the pressure is so great that it forces the cap to pop off. The force of the gas pushing downwards propels the rocket up – an example of Newton’s third law of motion. In a real rocket, the propulsion would be created by the expanding, heated gas produced by burning fuel. Now experiment with different variables, such as the shape of the nose cone or the number of fins, to see how high you can make the rocket go!

INVENTING INSULATION

FOR GRADES 3-6

An astronaut's space suit, like the one we built during the show, performs many roles, including protecting the astronaut from extreme temperatures. Astronauts experience temperatures of over 250° F when in the sun, down to -250° F in the shadow of the Earth! To help insulate, or regulate their temperature, astronauts wear multiple layers of special fabric. In this activity, students design an insulation suit to keep a mock astronaut warm.



EQUIPMENT

Film canisters with lids
Thermometers
Hot water
Scissors
Tape
Rubber bands
Samples of various materials: felt, cotton, nylon, newspaper, plastic wrap, etc.

PROCEDURE

1. In your small group, collect a film canister and lid. Punch a hole in the lid, large enough for the thermometer to fit through. This container represents an astronaut.

2. Your challenge is to use various materials to construct an insulation suit for the exterior of your "astronaut." The goal is to keep hot water in the container as hot as possible for as long as possible. Make sure to keep the thermometer hole in the lid accessible.

3. After you have designed the insulation suit, fill each insulated canister with hot water, representing the water in our bodies. Record the initial temperature of the water. Then record the temperature at five minute intervals for twenty-five minutes.

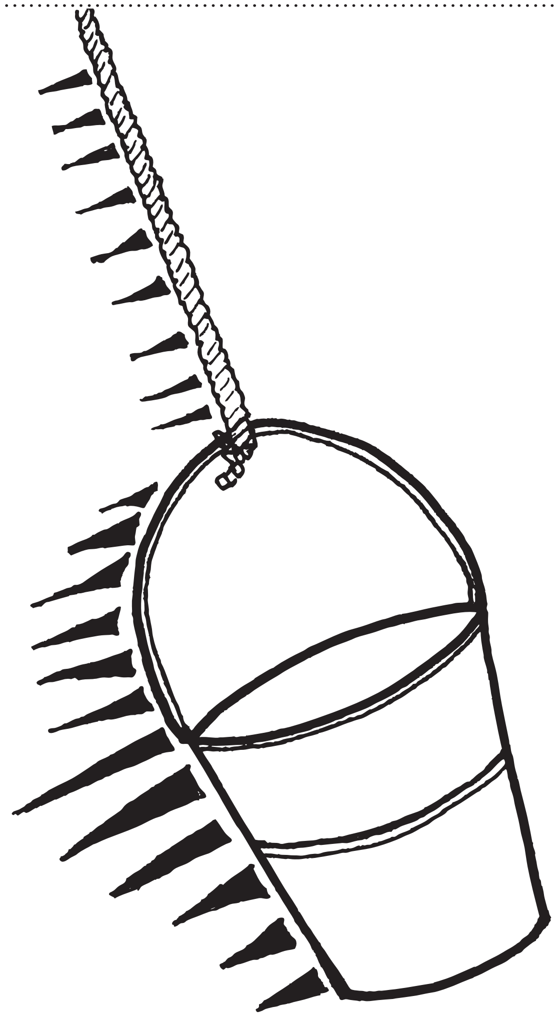
4. Chart or graph the results of each insulation suit. Did the water in the various containers cool off at the same rate? Which materials were the most effective insulators? Based on your results, what recommendations could you make to someone designing an astronaut's space suit?

WHY?

An insulator is a material that prevents heat transfer. In the space suit, multiple layers of aluminized Mylar help insulate the astronaut. In this activity, students participate in the engineering design process, in which engineers develop, test, and refine solutions to a problem. Engineers are crucial to the development of space technology, from the shuttle to the astronaut's breakfast!

UP IN ORBIT

FOR GRADES 5-8



In the show, we learned that rockets move in orbit around the Earth. In this activity, students observe and conduct experiments with another object in orbit. Note: We suggest practicing this experiment outdoors!

EQUIPMENT

1-gallon bucket with handle
Water
Rope, approximately 3 feet long

PROCEDURE

1. Fill the bucket about half full with water. Is it possible to get the bucket upside down without spilling the water? Brainstorm ideas.

2. Tie the rope securely to the handle of the bucket.

3. Hold onto the end of the rope and carefully begin swinging in a circular movement until the bucket moves fluidly. What happens to the water? What do we call the path that the bucket is moving in?

4. To stop the bucket, slow down your swing as the bucket approaches the ground.

5. Predict what would happen if the rope were shorter. Wrap the end of the rope around your hand a couple times, then repeat step 3. How does the path of the bucket change?

6. Think of other variables that might affect the motion of the bucket. Make a hypothesis about what will happen – then test it out!

WHY?

The circular path of the bucket mimics an orbit. The bucket (and water) is held in orbit by the string. The force that you apply to the bucket through the string is called centripetal force. In the case of a rocket or other satellite, the force of gravity provides the centripetal force. The Earth pulls on the satellite just as you pull on the string to keep the bucket in orbit. You must constantly apply force to the string to keep the bucket from flying off in a straight line. If the rope is shorter, then the orbit is smaller and so the speed of the bucket increases.

MORE INFORMATION…

We've provided the following guide to help refresh your memory about the topics we covered during the show, and to deepen your understanding about life in space.

Newton's Third Law of Motion: For every action, there is an equal and opposite reaction. If you punch a wall, for example, the wall pushes you back in the opposite direction with an equal amount of force. In our rocket, the gases within the bottle expanded and pushed out of the nozzle on the bottom. When the gases pushed down, our rocket reacted by shooting skyward.

Gravity: An attractive force between any two objects. As Isaac Newton explained, this is the force that pulls us towards the center of the Earth. When a rocket or satellite is launched into space, it must overcome the force of gravity that is pulling it back towards the Earth; to do so, it must be moving 17,500 miles per hour at a great distance from earth.

Orbit: The motion of an object, usually in a circle or ellipse, around a center of gravity. In order to enter and remain in orbit, a rocket or satellite's inertia (which is pushing it forward) must exactly balance the force of gravity (which is pulling it back towards the center of the Earth).

Free Fall: Motion where gravity is the only force acting on an object. A rocket in orbit is falling continuously around the earth without ever hitting it. As a result, astronauts and everything else in the space shuttle are also in free fall.

Microgravity: The apparent weightlessness experienced in orbit. Because the astronauts and everything else in the space shuttle are in constant free fall, the apparent effects of gravity are greatly reduced. In a microgravity environment, scientists can perform experiments that could never be performed on earth! Unfortunately, they also experience some unpleasant physiological effects, like a head cold, disorientation, and weakness. If you have ever been on an amusement park ride in which you dropped down a tall tower, you may have briefly experienced microgravity.

Friction: A force that resists motion, especially motion of an object sliding over something else. For instance, it is hard to slide a heavy box across a carpeted floor because of the friction between the two surfaces. Here on earth, friction helps us stand in one place without sliding all over the ground; in space, however, there is no "ground" in space for astronauts to stand on. Instead, they rely on foot-holds, Velcro, and other means to secure themselves in place.

Air Pressure: The weight of the air in the atmosphere pressing against a given area. Since air is everywhere, this pressure pushes on everything, including you, with a force of 1 kilogram per square centimeter (14.7 lbs per square inch). We don't feel it because air is around us all the time, so we are used to it. It doesn't crush us because the pressure of the air (and other fluids) inside our bodies balances the pressure outside. In space there is no air, and no air pressure, so astronaut space suits have to be pressurized, or filled with air.

Vacuum: The absence of all matter, including air. Space is essentially a vacuum, since the matter is so thinly distributed. Hence astronauts have to bring an oxygen supply and wear a pressurized suit when they go on a space-walk.

Rocket: A tube-like device containing combustible fuel. When the fuel is burned, it produces gas that expands rapidly and is forced out through a nozzle pointing downwards, propelling the rocket up. Rocket fuel is made of a fuel, such as gasoline, and a substance that supplies oxygen. The oxygen supply is necessary for the rocket to work in space, where there is no air. Most rockets have several sections, called stages, each of which serves a specific function. Rockets are used to launch manned or unmanned spacecraft, for research and exploration, or for war.

Satellite: An object that orbits around something else. Natural satellites include objects that orbit around planets, like our moon. Man-made satellites are used for communication, research, global positioning systems, or weather monitoring.

International Space Station: A large satellite that serves as a laboratory and living quarters for astronauts. Since 1998, 15 countries have contributed to the development of the ISS. It orbits at about 400 kilometers (250 miles) above the Earth's surface, and circles the planet once every 90 minutes.

Space Suit: A full-body garment that astronauts wear during extra-vehicular activity (EVA), or space-walks. The suit is pressurized to simulate the air pressure felt on earth, allowing the astronaut to breathe normally. It also provides temperature regulation, an oxygen supply, water, communication equipment, and more.

MORE RESOURCES...

The Franklin Institute: On your next field trip, visit Space Command, an interactive exhibit that puts you through astronaut training! Then head up to the Joel N. Bloom Observatory, and use our powerful telescopes to gaze into space. Go to http://www.fi.edu/teacherresources/ for a guide to the exhibits.

Astronomy: Visit http://www.fi.edu/msp/astronomy/index.html for a collection of relevant teaching resources. You'll find lesson plans, games, videos, and more!