



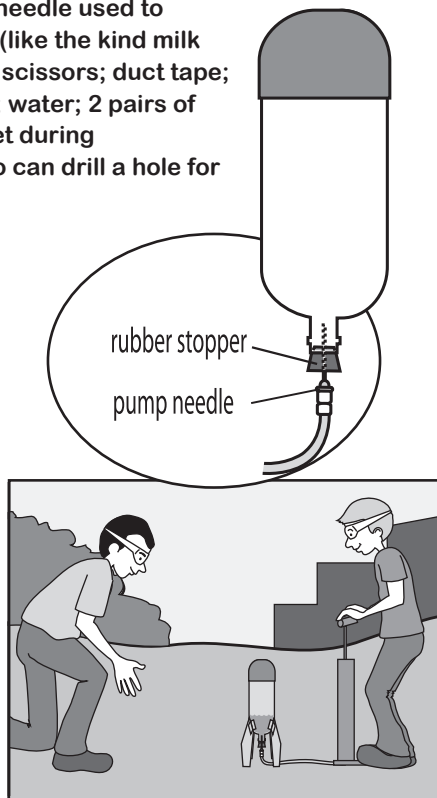
## 1. Out of This World

When is a soda bottle not a soda bottle?  
When it's a **WEIGHT**-defying rocket!

### You Will Need:

plastic 2-liter soda bottle; rubber stopper that fits tightly in the top of the bottle; bicycle pump with pump needle used to pump up balls; piece of sturdy, flat plastic (like the kind milk bottles or notebook dividers are made of); scissors; duct tape; a clear, open outdoor space on a nice day; water; 2 pairs of safety goggles; a towel (in case you get wet during launching). You will also need an adult who can drill a hole for you.

1. Have the adult drill a small hole through the stopper so that the pump needle fits through tightly.
2. Design sturdy fins, so that the rocket can stand up on the launching pad. Cut the fins out of the plastic with the scissors.
3. Using duct tape, attach the fins to the sides of the bottle, near the bottom, so that the fins touch the ground evenly.
4. Fill the bottle 1/3 full with water.
5. Insert the stopper and attach the bike pump.
6. Take the rocket outside to a clear, open space. Put on your safety goggles. Tell everyone to get out of the way and start pumping!
7. Watch your rocket's flight pattern closely. What would happen if you changed the size, number or position of the fins? What if you used more or less water?



## 2. Ready for Take Off

How about some rocket fuel you can mix up in your own kitchen? It may not send you to the Moon, but it will definitely produce **THRUST**.

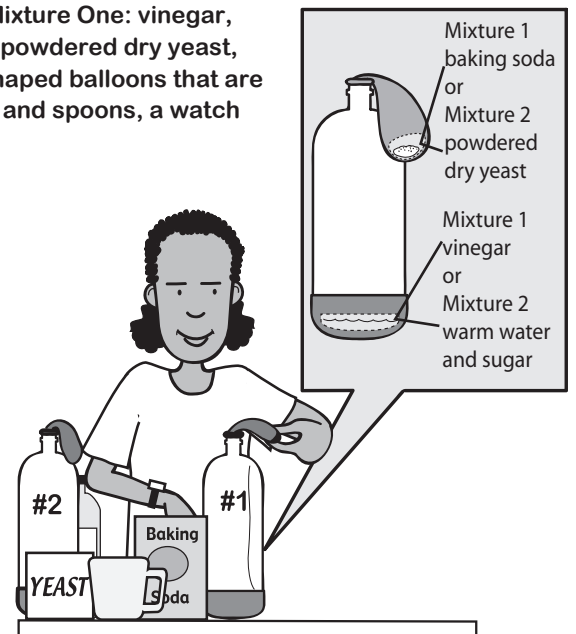
### You Will Need:

two 2-liter plastic bottles; For Mixture One: vinegar, baking soda; For Mixture Two: powdered dry yeast, warm water, sugar; 2 oblong shaped balloons that are the same size; measuring cups and spoons, a watch with a second hand

1. For Mixture One, put the vinegar into the bottom of one of the 2-liter bottles.
2. Next put the baking soda inside the balloon and seal the balloon over the top of the bottle.
3. Get the watch ready. Lift the balloon up and let the baking soda drop into the bottle. Time what happens.

4. What properties are most important for your rocket fuel? Do you want something that works fast or is lightweight? Adjust the proportions of your mixture to get the best results.

5. Now try Mixture Two. Use the watch to time how many seconds the reaction takes. How do the two compare? Write up what you observe and conclude.



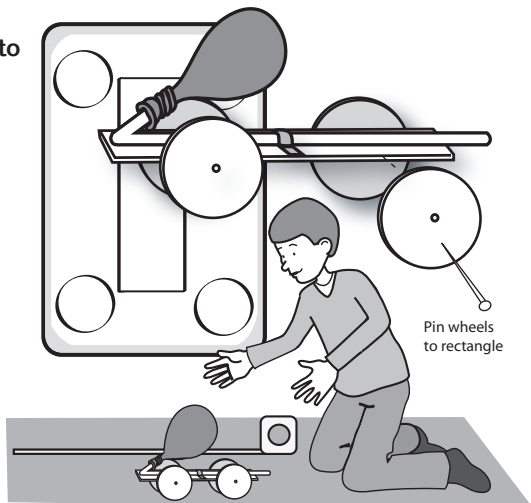
## 3. What a Drag

Rockets aren't the only things that need to overcome **DRAG**. You can feel drag when the wind rushes by your open car window and watch it slow down your rocket car.

### You Will Need:

4 pins, flat Styrofoam tray, tape, bendable straw, scissors, marking pen, small party balloon, ruler, measuring tape

1. Using the ruler and marker, draw a rectangle and four circles on the tray. Cut out each piece.
2. Push one pin into the center of 4 of the circles and then into the edge of the rectangle. Test the wheels to make sure they can turn around easily.
3. Pull the balloon to stretch it out and attach it to the bent end of the straw.
4. Tape the mouth of the balloon tightly to the straw so that you can inflate it by blowing into the straw and air does not escape.
5. Tape the straw to the car.
6. Inflate the balloon and pinch the straw to hold in the air. Set the car on a smooth floor. Use the measuring tape to see how far it goes.
7. Can you alter the design of your rocket car to create drag and slow it down? Cut up the leftover Styrofoam pieces and attach them to the car to create a new shape. Repeat your experiment. How do you think the shapes of rockets and cars affect the way they move?



## 4. On the Wing

The thrust of the engines does a great job of getting the Space Shuttle off the ground, but how does it get back down? You need the power of **LIFT** to glide in for a landing

### You Will Need:

paper, tape, scissors, pencil, a drinking straw thinner than the pencil

1. Wrap a piece of paper around the pencil and tape it to make a cylinder. Remove it from the pencil and you have the body of your shuttle.
2. Fold the end of the cylinder to a point and tape it to make the shuttle's nose.
3. Put the straw inside the shuttle, aim it carefully so that no one will get hit and blow!
4. Observe the flight path when you send it across the room or straight up into the air.
5. Cut additional pieces of paper to make fins and wings and tape them to the sides of the shuttle. Bring your shuttle in for a landing with or without wings. What shapes work best to create lift and stability?

