

# Rocket Car

**Overview:** Let's take a good look at Newton's laws of motion while making something that flies off in both directions. This experiment will pop a cork out of a bottle and make the cork fly 20 to 30 feet, while the vehicle moves in the other direction! This is an outdoor experiment. Be careful with this, as the cork comes out with a good amount of force. (Don't point it at anyone or anything, even yourself!)

**What to Learn:** You'll learn how to solve problems involving distance, time, and average speed.

## Materials

- toy car
- baking soda
- vinegar
- tape
- container with a tight-fitting lid (I don't recommend glass containers... see if you can find a plastic one like a film canister or a mini-M&M container.)
- measuring tape
- stopwatch

## Lab Time

1. Strap the bottle to the top of the toy car or bus with the duct tape. You want the opening of the bottle to be at the back of the vehicle.
2. Put about one inch of vinegar into the bottle.
3. Shove a wad of paper towel as far into the neck of the bottle as you can. Make sure the wad is not too tight. It needs to stick into the neck of the bottle but not too tightly.
4. Pour baking soda into the neck of the bottle. Fill the bottle from the wad of paper all the way to the top of the bottle.
5. Now put the cork into the bottle fairly tightly. (Make sure the corkscrew didn't go all the way through the cork, or you'll have leakage issues.)
6. Now tap the whole contraption hard on the ground outside to force the wad of paper and the baking soda into the bottle.
7. Give the bottle a bit of a shake.
8. Set it down and watch. Do not stand behind the bus where the cork will shoot.
9. In 20 seconds or less, the cork should come popping off of the bottle.
10. After a few runs, it's time to do this experiment and take data as you go along. You'll need to measure how much vinegar and baking soda you use as well as how far it went using a ruler, and how long it traveled for using a stopwatch.
11. Complete the data table.

## Rocket Car Data Table

| How Much Baking Soda? | How Much Vinegar? | Travel Distance<br><i>(inches/feet or cm/m)</i> | Travel Time<br><i>(seconds)</i> | Average Speed<br><i>(<math>v = d/t</math>)</i> |
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### Reading

There are two ways to do this experiment. You can either strap the bottle to the top of a toy car and use baking soda and vinegar, OR use effervescent tablets (like generic brands of Alka Seltzer) with a modified pop rocket (which you can strap to a toy car, or add wheels to the film canister itself by poking wooden skewers through milk jug lids for wheels and sliding the skewer through a straw to make the axle). Both work great, and you can even do both! This is an excellent demonstration of Newton's Third Law, inertia, and how stuff works differently here than in outer space.

What you should see is the cork firing off the bottle and going some 10 or 20 feet. The vehicle should also move forward a foot or two. This is Newton's Third Law in action. One force fired the cork in one direction. Another force, equal and opposite, moved the car in the other direction. Why did the car not go as far as the cork? The main reason is the car is far heavier than the cork.  $F=ma$ . The same force could accelerate the light cork a lot more than the heavier car.

**Exercises** Answer the questions below:

1. What is inertia?
2. What is Newton's First Law?

### **Answers to Exercises: Rocket Car**

1. What is inertia? (The resistance something has to change its motion.)
2. What is Newton's First Law? (Objects at rest stay at rest, and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.)