States of Matter

Grade Levels: 2nd and 3rd

Student Objectives

- Understand what is matter and how matter can change (solid to liquid to gas)
- Understand two areas within a race car change states of matter (engine/radiator and tires)
- Understand matter changes through heating and cooling as it relates to water (radiator) and tires
- Conduct an experiment by building a car with both liquids and solids to understand the change in matter and how solids and liquids react to create a gas which propels the car

The magic of matter - and the states it can take on - is a fun process you and your student can experience right at home! In NASCAR, these aspects are critical to the functionality and success of a stock car. With a few household items, you can showcase your own race car and the reactions that fuel them in your own backyard.

Materials List

Car Building Supplies

- Plastic soda or water bottle (20 oz. or liter) and cap with a 1/4 in. - 3/4 in. hole drilled into it
    - If you don't have a drill, you can also use a hammer and nail. Please be careful and tape the lids to a solid surface like a board before driving the nail into the cap. If you don't own a hammer, you can heat a non-plastic knife tip on the stove until it is red. Then push it through the cap carefully using pot holders.
- 5 in. x 7 in. wooden plank or plastic board (election sign), cardboard (cereal box or shipping box) or index card
- 2 jumbo straws or plastic tubes (pens)
- 2 wooden dowels (1/4 in. thick and 6 1/2 in. long), bamboo sticks or sticks from yard (the straighter, the better)
- 4 wheels (need to fit on the dowels) which can be round items in your house (bottle caps, tops from pint-sized ice cream, yogurt tops)
    - Remember to add a hole to the wheel in the center.
- Masking or duct tape

** The base of the car, dowels and wheels can be built with LEGOs.*

NASCAR HALL OF FAME CHARLOTTE

Experiment Supplies

- Vinegar
- Lime juice
- Lemon juice
- Baking soda
- Measuring spoons
- Measuring cups

Lesson Plan and Procedures for Adults

1. Introduce that you will be talking about states of matter. Have your student explain how they are familiar with states of matter and what the three main states of matter are: solid, liquid and gas.
2. Highlight states of matter in your home and discuss with the student how an object can change states of matter via heat or cold.
3. Using an ice cube placed in a container, demonstrate this process over the course of a couple of hours and have the student record what is happening.
4. Talk with the student about how states of matter are important for racing. Discuss where states of matter exist on a race car.
    - The car is solid. It uses fuel, oil and water (liquids). Air (gas) goes into the engine and exhaust (gas) comes out. Also, nitrogen (gas) is used to fill the tires.
    - TIP: Use your own car as a visual reference: walk outside and look at your car under the hood. Or use the photos or links to look at race cars.
5. Explain you will conduct an experiment to change states of matter and see if you can make the car move by combining the liquids (vinegar, lemon juice or lime juice) with baking soda.
6. Building the car:
    - Tape half of the straw or tube at the top and bottom of the board on the same side
    - Slide each dowel or stick into each of the straws.
    - Attach the wheels to either end of the dowel. If a wheel is loose, wrap a tiny piece of tape around the end of the dowel to secure the wheel in place.
    - Test the car to make sure the dowels (axels) are spinning and there isn't any friction happening.
    - Tape the plastic bottle to the top of the car base.

** Steps 6 through 9 can happen inside or outside. If inside, do not put the baking soda into the bottle until you are outside.*

7. Review the items being used and have the student identify their state of matter for their car and the ingredients they are using for the experiment.
8. Have the student select the liquid they want to use and guess how much they think is needed to fuel their car.
9. Measure out the liquid and pour into a cup or place the liquid directly into the bottle. Suggested amount of liquid by bottle size:
    - 3 oz (small bottle – 8 oz)
    - 5 oz (medium bottle – 12-16 oz)
    - 8 to 10 oz (large bottle – 20-32 oz)
10. Have the student choose how much baking soda they think is needed to make their car run.
11. Measure out the baking soda in teaspoons or tablespoons and place into a cup. Suggested amount of baking soda by bottle size:
    - 1 to 1 ½ teaspoons (small bottle – 8 oz)
    - 2 to 2 ½ teaspoons (medium bottle – 12-16 oz)
    - 2 to 3 teaspoons (large bottle – 20-32 oz)

** Take the materials outside if you aren't there already.*

Read all the following steps first before conducting the experiment:

12. Have the student crouch near the ground and, if not already, pour the liquid into the bottle.
13. Holding the car at an angle, have the student pour the baking soda into the bottle.
14. Quickly place the cap on the bottle.
15. Cover the hole in the cap with your finger and shake the car.
16. NOTE: Crouch or squat down to the side of the car - do not be directly behind the cap of the car or you will get sprayed by escaping gas and liquid
17. Place the car on the ground so all four wheels are touching…and see what happens
18. If the reaction is minimal, repeat the process by varying the amount of liquid and baking soda until the experiment is successful and the car moves.

Additional Resource

Watch part of a NASCAR race: https://www.nascar.com/video/franchise/rearview-mirror/phoenix-recap-logano-jones-drive-away-in-rearview-mirror/