Chemical-Powered Car

sead : stem

Subjects

Chemistry
Physics
Mathematics

Topics

Chemical Reactions | Balancing Chemical Equations | Stoichiometry | Limiting Reactant | Excess Reactant | Number of Reactants or Products | Rate of Reaction | Measurement | Distance | Displacement | Design | Engineering Process

Key Words

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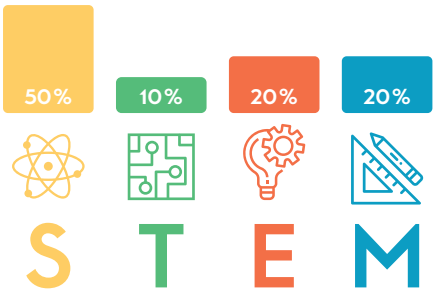
Connection to SDG

STEM Chart



Time for Activity

3 hours

Introduction

A chemical reaction is a process in which a substance (substances) is changed into one or more new substances. There are different types of chemical reaction. The major types are combination or synthesis reaction, decomposition reaction, single displacement reaction, double displacement reaction and combustion reaction. We find these reactions in human being's daily life. To understand the different types of chemical reactions, we apply stoichiometry. Stoichiometry is the quantitative study of the reactants and products in a chemical reaction. This quantitative study will help us learn how much of the reactants are required or how much of the desired products will be produced.

In this activity, the student will come up with an innovative design and create a toy car that will serve as the container for a chemical reaction. Likewise, the student will utilize the reaction between baking soda (sodium bicarbonate) and vinegar (diluted acetic acid) to power up the toy car and move it a significant distance determined by the teacher. The student will perform three trials, using different amount of baking soda, and determines which amount suits the reaction best.

This activity will encourage the students to be inventive and innovative. It will also train the critical thinking skills of the students in assessing how and why the toy car moves. In the future, the students may be able to devise a chemical reaction that could be used as a fuel to power a real affordable and reliable car, without any harmful by-products.

Key Objectives

1. Designing and making a toy car that will be the container of the reaction,
2. Utilizing a chemical reaction in powering a toy car,
3. Writing a balanced chemical equation for a reaction
4. Calculating the amount of baking soda that will give a complete reaction against the given amount of vinegar.

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Materials

1. CDs
2. Glue gun
3. Glue stick
4. Nail
5. Plastic bottles
6. Plastic caps
7. Drinking straw
8. Tissue paper

Chemicals

1. Baking soda
2. Vinegar

Safety

1. Make sure to first read the material safety and data sheet (MSDS) of all the chemicals that will be used in the experiment.
2. Be careful when handling the chemicals during the activity.

Guiding Questions

1. How did you design your car?
2. Which materials did you use as the wheel? Why?
3. Which chemical reaction is involved in powering up your car?
4. How did the design of your car affect the movement of the car?
5. How far did the car move in each trial?
6. How much time did the reaction last in each trial?

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Task

1. Gather all the materials needed. The students may or may not use all the materials given.
2. Let the students design and make their own toy car using the given materials such as plastic bottles, plastic caps, sticks, glue gun, and used CDs. Instruction in making the toy car will not be provided–the students are encouraged to come up with their own design. Please make clear to them that the plastic bottle representing the „body" of the car cannot not contain any holes.
3. Emphasize that the students need to make a hole on the plastic cap and attach it to the plastic bottle because this part is essential for the reaction to power the car.
4. The students will perform the experiment using the reaction of baking soda (sodium bicarbonate) and vinegar (diluted acetic acid) with the following amounts:

Vinegar: 68.0 ml

Trial	Amount of baking soda (in grams)
1	50.0 g
2	100.0 g
3	150.0 g

5. Ask the students to place 68.0 ml of vinegar in the plastic bottle (the body of the toy car).
6. Ask the students to place the baking soda in a tissue and roll up the tissue to make sure that the baking soda will not spill. Repeat this step for each trial.
7. Ask the students to place the rolled tissue with the baking soda inside the plastic bottle and close the bottle quickly with the cap with a hole. Ask the students to shake the bottle three times.
8. Ask the students to measure the time (in seconds) it takes before the reaction to occur after shaking the bottle and the time the reaction lasts. Repeat this step for each trial.
9. Ask the students to measure the distance (in meters) covered by the toy car for each trial.

Assessment

1. Ask the students to write down the balanced chemical equation for the chemical reaction that you used in your toy car.
2. Complete the table below according to your observation.

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Trial No.	Amount of baking soda (g)	Time before the reaction starts after shaking (s)	Time the reaction lasts (s)	Distance the toy car covered (m)
1	50.0			
2	100.0			
3	150.0			

3. Which trial(s) produced the best reaction?

4. What role does the hole in the cap play in the movement of the model car? Why does the bottle need to have a cap?

5. Justify your answer to No. 2 by calculating the amount of baking soda needed against 68.0 mL of vinegar (diluted acetic acid).

   Note: density of acetic acid is 1.05 g/ml.

Note

No. 6 is optional. If the teacher wants to extend the lesson to determine the amounts of product produced and limiting reactants, the students may answer this part.

6. Determine the amount of carbon dioxide produced in each trial.

Trial No.	Amount of baking soda (g)	Amount of carbon dioxide produced (g)
1	50.0	
2	100.0	
3	150.0	

Teacher Tip

This activity is related to the activity Chemical Balloon. You may check it out.