

Robogals Science Challenge



Minor Challenge Set #2

STEM Field: Chemical Engineering

Level: Intermediate

Challenge Name: Fire Tower

Project cost: 0-20 USD

Materials required:

- Sand (must be dry)
- 1 Tablespoon Baking soda
- 4 Tablespoons Sugar
- Small ceramic plate or bowl that is no longer used for food (an old tile or brick would work well too)
- Small cup
- Measuring spoons
- Lighter fluid
- Long lighter or matches
- Bucket of water or hose

Safety:

- Adult supervision when lighting the snake and a bucket of water or a hose

Duration:

- The hands-on time for this challenge is about 45 minutes.
- The time guideline is an estimation only, and students and mentors can complete the tasks around their schedules.

Introduction:

In this experiment we will watch the baking soda and sugar grow as they burn! When we light the lighter fluid on fire the baking soda and sugar begin to burn as well. Sugar molecules contain lots of carbon atoms which can react with oxygen to form carbon dioxide and water. This type of reaction is called combustion and, in order for combustion to occur we need to introduce some energy such as heat (provided by the flame in this reaction). This reaction is shown below.

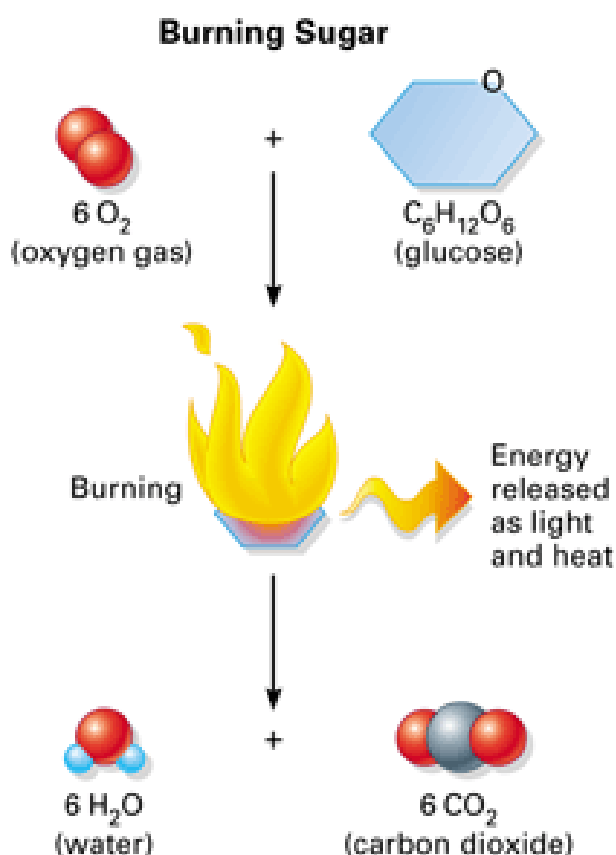


Figure 1: Illustrates the combustion of sugar into carbon dioxide and water.

When there is not enough oxygen for the sugar to turn completely into carbon dioxide and water a different reaction will occur. In this experiment we will see a decomposition reaction that results in elemental black carbon (C) which is also called charcoal.

When baking soda decomposes at high temperatures it releases a lot of carbon dioxide. This production of carbon dioxide results in a lack of oxygen which, in turn, means some of our sugar will decompose into charcoal rather than combust into carbon dioxide.

As this mixture burns carbon dioxide gas bubbles formed by the baking soda are trapped in the forming charcoal which increases the volume of the mixture making it look as though it is growing!

Instructions:

1. Cover the bottom of your plate or bowl with sand.
2. Now spray the sand with lighter fluid. It's good to be a bit generous.
3. In another container mix the baking soda and sugar together, then pour this mixture on top of the sand.
4. With an adult's help, use a match or lighter to ignite the sand soaked in lighter fluid.
5. Be patient, the reaction may be slow to start.
6. After the reaction is complete, wait at least 10 minutes for the tower to cool before you touch it.

Extension

1. If you double the amount of sugar and leave the quantity of baking soda the same, does the volume of the tower increase? How has the burn time changed?
2. What if you double the volume of the baking soda and leave the amount of sugar the same? How has the burn time changed?

Reflection Questions:

- Are there any improvements you would make to this challenge?
- What real world application/s can you apply this challenge to?
- What are the key science and engineering concepts that relate to this challenge?
- Do some research to learn about some everyday reactions that involve combustion. What impact do these reactions have on the environment?

Submission Guidelines:

- Submit a photo of your experiment setup. Include a short summary that addresses the reflection questions.

Note: Remember, if you want to upload pictures of your Minor Challenge that also include you, please check if it is OK with your mentor first.

- The submission form is on the Minor Challenges page:
<https://sciencechallenge.org.au/index.php/minor-challenges/>
Fill out the details and make sure you upload your submission.

Learn More! Resources:

- To learn more about how a combustion works check out the link below:
<https://flexbooks.ck12.org/cbook/ck-12-chemistry-flexbook-2.0/section/11.6/primary/lesson/combustion-reaction-chem/#:~:text=O>

[verview-.Combustion%20reaction%20is%20a%20reaction%20in%20which%20a%20substance%20reacts,hydrogen%20gas%20produces%20water%20vapor](https://www.bodell.mtchs.org/OnlineBio/BIOCD/text/chapter7/concept7.4.html)

Bibliography:

- Figure 1: Online , T. (no date) *Concept 7.4, Chapter 7: Concept 7.4*. Available at: <https://bodell.mtchs.org/OnlineBio/BIOCD/text/chapter7/concept7.4.html> (Accessed: April 5, 2023).
- Finio, B. and Lohner, S. (no date) *Make a fire snake: Stem activity*, Science Buddies. Available at: <https://www.sciencebuddies.org/stem-activities/make-a-fire-snake> (Accessed: April 5, 2023).