



20 minutes - 1 hour

Learn how to grow your own black snake with fire! Using simple ingredients you can find from your house, explore amazing chemical reactions by observing the combustion of sugar and baking soda.

\rm Adult supervision required

This experiment involves fire, so be sure to be careful and explore with an adult.

- Tie long hair back, and keep an eye on the experiment at all times.
- Make sure you are in a well ventilated but non-windy area
- Keep water nearby, and last, have fun!

Procedure

Step 1:

Fill your container with sand. Make sure that the sand is dry–you can ensure this by leaving it in the sun on a baking tray.



Step 3:

Mix 4 tablespoons of sugar with 1 tablespoon of baking soda in a small cup.



Step 2:

Soak the sand in lighter fluid.



Step 4: Pour this sugar and baking soda mixture into a pile at the center of the sand.





Materials

- Dry sand
- 1 tablespoon of baking soda
- 4 tablespoons of sugar
- Small ceramic plate, ceramic bowl, or pie tin
- Small cup
- Lighter fluid (Zippo fuel works best)
- Long lighter or matches

Step 5:

Get an adult to carefully light the sand near the sugar and baking soda mixture.



Step 6:

Watch carefully to see what happens! The reaction may be slow, so be patient.

The fire may burn for 20 minutes. Wait for at least 10 minutes after the fire has stopped, then have an adult make sure that the snake is no longer hot. You can then touch it!

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Diving Deeper!

Let's see what causes this fascinating snake to grow.

How does it form?

You may be wondering why the black snake looks like it is growing out of the sand. Lighting the fire causes a combustion reaction to happen. The products of this are carbon dioxide gas, water vapor, and carbon. The two gases push the carbon upwards, making it grow out of the sand. This snake has gases caught inside the black carbon, making it very light and giving it a foamy texture.

The more complicated chemical reaction:

This growing carbon snake is a product of three reactions.

First, when the sugar ($C_{12}H_{22}O_{11}$) meets the open flame, it burns quickly and reacts with the oxygen in the air in what is called a **combustion reaction**. The products of this reaction are carbon dioxide CO_2 and water vapor (H2O). Keep in mind that a complete combustion reaction requires enough oxygen.

Chemical equation for combustion of sugar: $C_{12}H_{22}O_{11} + 12O_2 \rightarrow 12CO_2 + 11H2O$ sugar + good oxygen supply \rightarrow carbon dioxide + water vapor





The second reaction happens when baking soda (NaHCO₃) undergoes **thermal decomposition** at a really high temperature. This reaction releases a lot of carbon dioxide as a product, creating a decrease in oxygen. This affects the first combustion reaction, since there is now not enough oxygen for the sugar to access and completely burn. Aside from carbon dioxide, this reaction also produces sodium carbonate, which forms part of the snake.

Chemical equation for thermal decomposition of baking soda $2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$ Baking soda \rightarrow sodium carbonate + carbon dioxide + water vapor

Since all the sugar can't turn into carbon dioxide and water through combustion because of the lack of oxygen, the rest undergoes thermal decomposition. This reaction produces solid elemental carbon as well as more water vapor. This carbon is what makes up most of the snake that you see at the end of your experiment and gives it its black color.

> Chemical equation for thermal decomposition of sugar $C_{12}H_{22}O_{11} \rightarrow 12C + 11H_2O$ Sugar \rightarrow carbon + water vapor

