

STEAM LAB: FIRE SNAKES

NAME:

DATE:

SUPPLIES

(1) baggie of sand
(1) container baking soda (1 tbsp)
(1) container sugar (4 tbsp)
(1) small ceramic/metal plate or bowl
(1) small cup or bowl for mixing
(1) spoon for stirring
Lighter fluid
Long lighter or matches
Adult supervision
Bucket of water or hose



SAFETY



- Adult supervision required
- Work on concrete or another non-flammable surface
- Keep a fire extinguisher nearby for emergencies

FIRST

FILL YOUR PLATE WITH SAND AND THEN SOAK THE SAND IN LIGHTER FLUID.



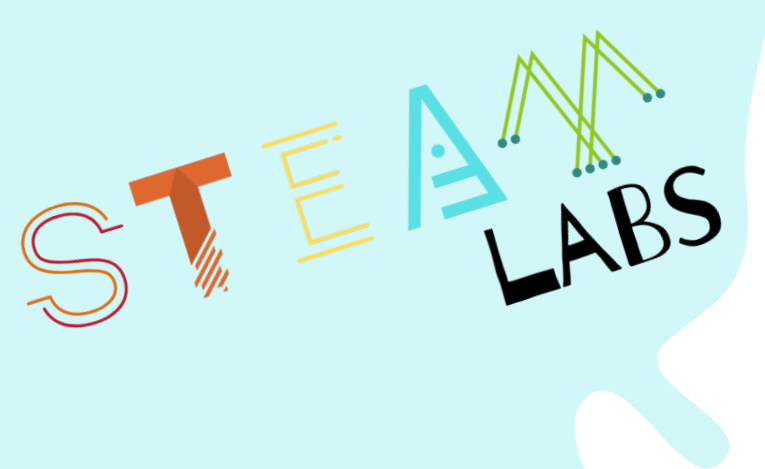
NEXT

MIX BAKING SODA WITH SUGAR AND THEN POUR THE MIXTURE INTO A PILE ON TOP OF THE SAND.



LAST

- Use matches or a lighter to ignite the lighter fluid. Watch closely and be patient--the reaction may be slow to start.
- Douse your fire snake and sand in water to make sure there are no remaining flames, then it is safe to dispose of all the materials in the trash.



Why is this happening?

When you set the lighter fluid on fire, the sugar and baking soda mixture also started to burn. As it burned, it created gas bubbles that got trapped, resulting in the black "snake" structure that rose out of the flames. The snake grows slowly, and may take 10–20 minutes to reach full size. It might be surprising that the snake is so big and seemingly comes out of nowhere, but if you wait until it cools and then poke it or pick it up, you will see that it is extremely lightweight, like foam.

Table sugar, also called sucrose, is a chemical compound that contains lots of carbon. Its chemical formula is $C_{12}H_{22}O_{11}$. Sugar can be oxidized, which means that it can react with oxygen to form other products. When you expose sugar to an open flame, it will burn quickly and react with the oxygen in the air. This is called a combustion reaction.

The end products are carbon dioxide (CO_2) and water (H_2O). A different reaction happens if there is not enough oxygen present during the combustion to form CO_2 . In this case, the sugar decomposes, resulting in elemental black carbon (C), or charcoal. The baking soda (sodium bicarbonate, $NaHCO_3$) decomposes at high temperatures and releases lots of CO_2 . The production of high amounts of CO_2 causes a lack of oxygen. This means that there is not enough oxygen for all the sugar to be converted into CO_2 and water via a combustion reaction. Instead, some of the sugar decomposes into elemental carbon and starts forming the solid black snake-like structure.

The carbon dioxide gas and water vapor push the sugar and baking soda mixture upwards. At the same time, these gases get trapped in the solid carbon, creating the lightweight foam snake that you see emerging from the sand.