



S'mores Lab

Step A: Examine your graham cracker, marshmallow, and chocolate.

1. Describe some physical properties of each ingredient.

| Graham Cracker | Marshmallow | Chocolate |
|----------------|-------------|----------------------|
| tan | white | brown |
| solid | solid | solid |
| rough | soft | smooth |
| hard | squishy | has a distinct smell |

Step B: Break your graham cracker in half.

2. What kind of change took place? physical

Indicators/Reasons change in size and shape

(Look at yesterday's lab to choose reasons for physical change or indicators of a chemical change.)

Step C: Take your marshmallow to your teacher so that she can roast it. (While waiting to do this, turn over this paper and start on **Step F** of the assignment.)

Step D: Put your S'more together.

3. Describe the physical properties of each ingredient below after you have put your s'more together.

| Marshmallow | Chocolate |
|-----------------------|----------------------|
| softer than before | slightly melted |
| black/brown in places | brown |
| parts are melted | smooth |
| has a burnt smell | has a distinct smell |

4. What kind of change did the marshmallow have? chemical

Indicators/Reasons Color change, smoke formed (new substance formed)

(Look at yesterday's lab to choose reasons for physical change or indicators of a chemical change.)

5. What kind of change did the chocolate have? physical

Indicators/Reasons change of state of matter

(Look at yesterday's lab to choose reasons for physical change or indicators of a chemical change.)

Step E: Eat your S'more.

6. What kind of change is taking place as you chew? physical

Indicators/Reasons change in size and shape

(Look at yesterday's lab to choose reasons for physical change or indicators of a chemical change.)

7. What kind of change is taking place as you digest the S'more? chemical

Indicators/Reasons a new substance will be formed

(Look at yesterday's lab to choose reasons for physical change or indicators of a chemical change.)

Step F: Read the article from *Science World* titled "The Science of S'mores," sent to you in Classroom, and answer the questions below.

You should pay attention to the text of the article, the captions, and the diagrams.



August 10th 1. What day of the year is National S'mores Day?

-flammability 2. "Combustion is a chemical reaction." What word below is a synonym for combustion?

-extinguish

-flammability

-fire-proof

sugar whipped with air 3. What makes the sugar in a marshmallow become fluffy?

gelatin 4. What substance in a marshmallow makes it stretchy?

sugar and proteins 5. When a marshmallow is heated, two substances in a marshmallow react to form a new substance. What are those two substances?

the brown crust on the outside 6. What is the new substance formed?

-solid to liquid 7. The chocolate melts and goes through a phase (state) change. What change is that?

-liquid to solid

-gas to liquid

-solid to liquid

-solid to gas

"...the chocolate's components remain the same." 8. Why is this change a physical change?

carbon, hydrogen, oxygen 9. What 3 elements make up sugar?

water 10. What molecule is released when sugar is burned?

carbon 11. What is the new substance formed, the black bits on a burnt marshmallow?

12. Three things are formed or released when wood burns. Circle those 3 things below.



45°C, 113°F 13. What is the melting point of a marshmallow?

physical 13a. Is this a chemical or a physical property of marshmallows?

33°C, 91°F 14. What is the melting point of chocolate?

physical 14a. Is this a chemical or a physical property of chocolate?

THE SCIENCE OF S'MORES

Discover how chemistry makes these tasty treats possible

ESSENTIAL QUESTION: How does chemistry influence how we cook and consume food?

Did you know that August 10 was National S'mores Day? Don't worry if you missed it; it's not exactly a well-known holiday. To help you celebrate (slightly belatedly), *Science World* investigates what it takes to transform chocolate, graham crackers, and marshmallows into the sweet goodness of s'mores.

NICE 'N' TOASTY

The first step to making a s'more is to make a fire (see *On Fire*, bottom right). "Combustion is a *chemical reaction*," says Sally Mitchell, a teacher in Syracuse, New York, and an expert for the American Chemical Society. During a chemical reaction, new substances are formed. Next, toast the marshmallow.

A marshmallow is mostly sugar whipped with air to make it fluffy. The treat also contains a stretchy molecule called *gelatin* that gives a marshmallow its structure. Gelatin is made up of *proteins*. These large molecules are essential to all living things. Heat from a campfire causes the sugar and proteins in a marshmallow to chemically react and form new substances—the brown crust you see on the outside of a toasted marshmallow.

STICKING TOGETHER

Once toasted, the marshmallow and a square of chocolate are sandwiched between two graham crackers. The hot marshmallow melts the chocolate. "It changes phases from a solid to a liquid," says Mitchell. "This is a *physical change* because the chocolate's components remain the same."

The sticky chocolate and marshmallow hold a s'more together. The graham crackers play an important role too—they keep your fingers from getting too messy as you munch the sweet treat.

—Cody Crane

SCOUT SNACK

The original idea for s'mores appeared in a publication for the Girl Scouts in 1927.

UP IN FLAMES

Sugar is made up of carbon (C), hydrogen (H), and oxygen (O). When sugar burns, hydrogen and oxygen are released as water (H₂O). That leaves carbon—the black bits on a burnt marshmallow.

TEMPTING TREAT

The word s'more is thought to be a contraction of "some more," because the treats are so irresistible.

MAKING A S'MORE

- 1 A graham cracker's perforations make it easy to break in half to become the top and bottom of a s'more.
- 2 Toasting a marshmallow over a flame causes a *chemical reaction* between the sugar and gelatin in the marshmallow, turning its outside brown and crispy. A marshmallow's *melting point*—the temperature at which a solid becomes a liquid—is about 45°C (113°F). So as its outside crisps, its insides become gooey.
- 3 A chocolate bar's indentations allow it to be broken into pieces that fit perfectly on a graham cracker half. A hot marshmallow melts the chocolate, which has a melting point of about 33°C (91°F). That *physical change* secures the snack together.

MAKE IT!

It's possible to use the heat from the sun to make a s'more. Brainstorm ways you could build your own solar oven. Then cook up one of these delicious desserts—no fire needed.

ON FIRE

Wood contains *hydrocarbons*—molecules of hydrogen (H) and carbon (C). Heat causes the hydrocarbons to break apart. Hydrogen and carbon mix with oxygen (O) in the air to form carbon dioxide gas and water in the form of steam. The reaction also releases energy as heat and light.

