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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 (H_2O). 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_2) in the air to form carbon dioxide gas and water in the form of steam. The reaction also releases energy as heat and light.