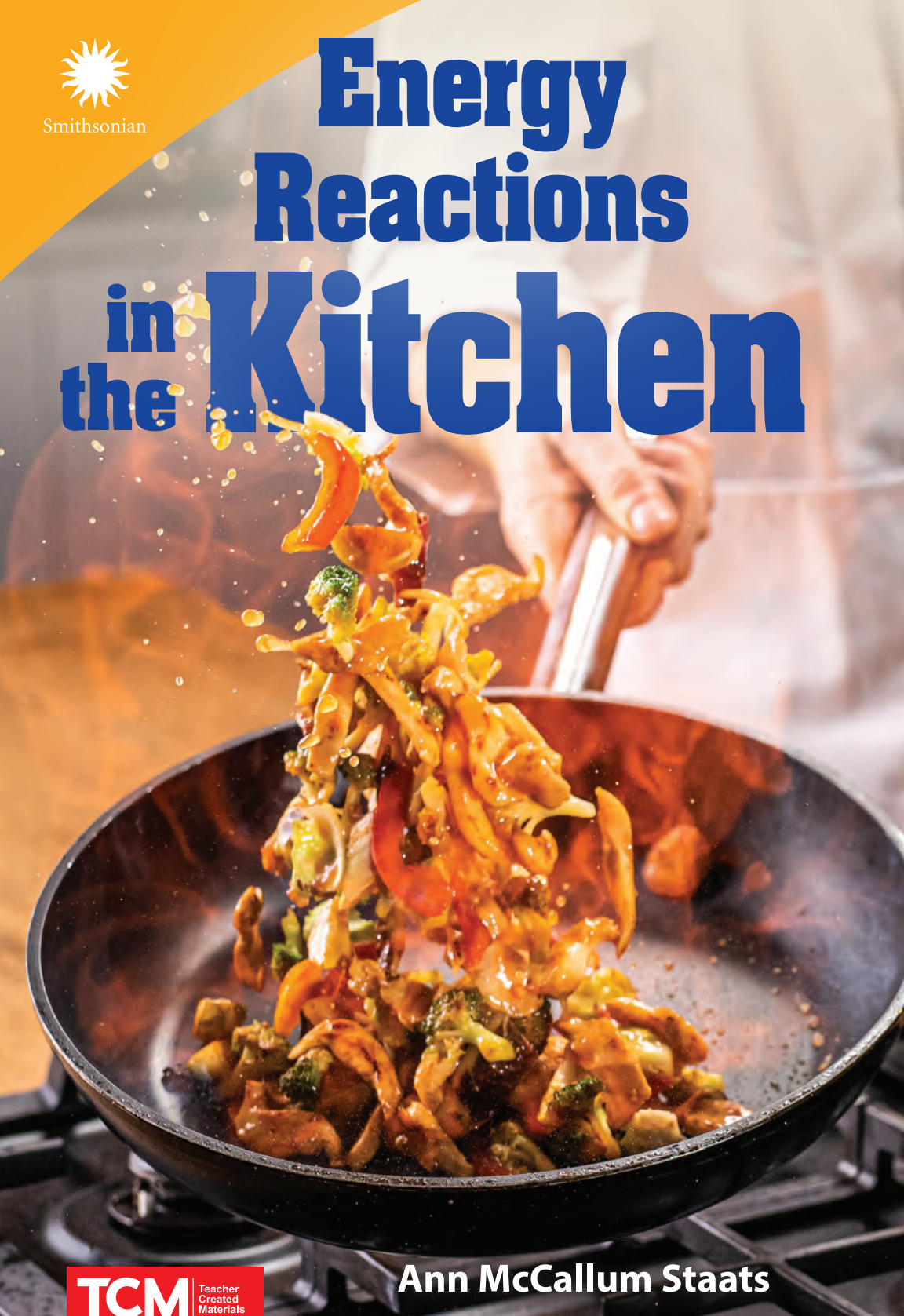
Smithsonian

# Energy Reactions in the Kitchen



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TCM Teacher Created Materials

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# Setting the Table

No matter where people live, how they live, or who they live with, they all share one thing in common: they eat food. People combine various ingredients to create the best-tasting food. But what *is* food? How do simple ingredients undergo complex changes in the kitchen?

On a chemical level, food is made up of atoms and molecules. These atoms and molecules combine into various chemicals that interact with one another. They might be naturally occurring chemicals, such as proteins, carbohydrates, or fats. These are **macronutrients**. Or they might be **micronutrients**, such as vitamins and minerals. Food can also contain other ingredients that might be human-made. (This is true for soda and pepperoni, which we'll get into later!)

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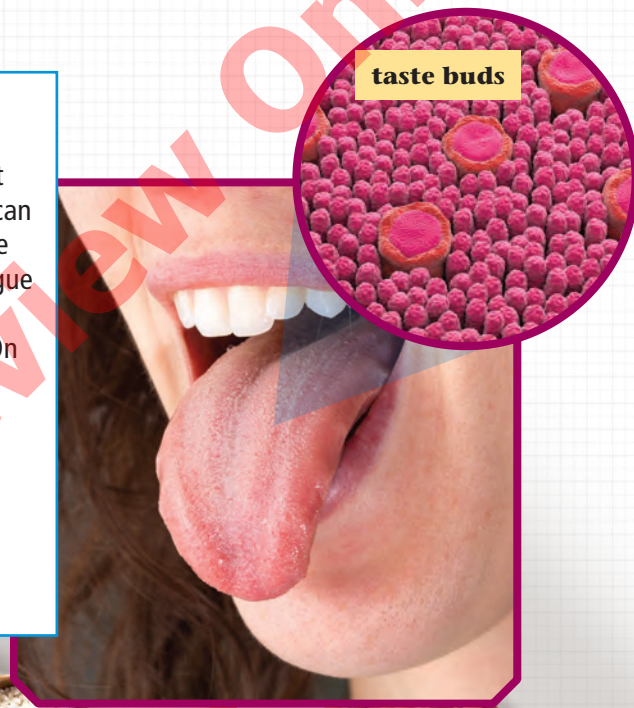
Methods of food preparation involve two kinds of reactions that use energy. First, physical reactions in the kitchen can change how food looks without changing the molecules. This is true for foods like ice cream and butter. Second, chemical reactions cause permanent changes to molecules. Transforming a batter into a cake or grilling a steak are two examples of chemical changes. Let's dig into some ingredients and dishes that undergo these reactions!

SCIENCE

## Tasty

Think of all the different flavors you enjoy. You can taste them thanks to the tiny bumps on your tongue called *papillae*, where taste buds are found. On average, humans have 2,000 to 10,000 taste buds. Children have more taste buds when they are younger. The number decreases as a person ages.

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# Ways of Preparing Food

Many methods exist for preparing food. And when food is cooked, it undergoes changes that involve chemical reactions. For example, you might fry onion rings, bake cookies, or boil oatmeal. In each of these cases, cooking the food involves an **endothermic reaction**. In this type of reaction, heat is a key factor. The food absorbs heat, causing a permanent chemical change. To cook certain types of food, different heating methods are used.

Flour-based foods usually need an even heat source. That is why cookies, pies, bread, and cakes are baked in an oven where they can be surrounded by heat. During this cooking process, the outer surface of a dough or batter bakes faster than the middle. So, while the outside may look done, the inside may still be undercooked. To check that the inside is cooked, bakers often insert a toothpick into the middle.


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## FUN FACT

Microwaves can heat food about six times faster than regular ovens. Every microwave has a device that converts electricity into electromagnetic waves. These waves of energy are absorbed by the water, sugar, and fat molecules in food. The molecules begin to vibrate quickly. This movement heats the food.

Frying and grilling are other methods of cooking. A fat, such as butter or vegetable oil, is often needed for frying. This creates a barrier that prevents food from sticking to hot pans. Some special equipment, such as nonstick frying pans, have coatings on them that allow food to be heated without sticking. When using a grill, direct and intense heat is applied to food for a short time. Meats and vegetables are often cooked on grills.

Deep-frying involves covering food in hot oil to cook it.

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Gas grills use flames to cook food.

## Unique Methods

Baking, frying, grilling, and microwaving are not the only ways to prepare food. Here are a few unique food and drink preparation methods.

*Zing!* Some foods like sauerkraut and kimchi are prepared through fermentation. Fermentation uses bacteria to change the sugars and starches in food to lactic acid. Lactic acid is what gives these foods their tangy, sour taste. To make sauerkraut, cabbage is finely shredded and combined with salt. Kimchi is made the same way, but other vegetables and spices are added. Then, the mixture is put into an airtight jar. Over time, the salty brine allows the bacteria to get to work. The bacteria creates acid and releases carbon dioxide as it changes the food. The carbon dioxide builds up pressure, so the jar will need to be opened occasionally to release it. Fermentation can take anywhere from 3–6 weeks.

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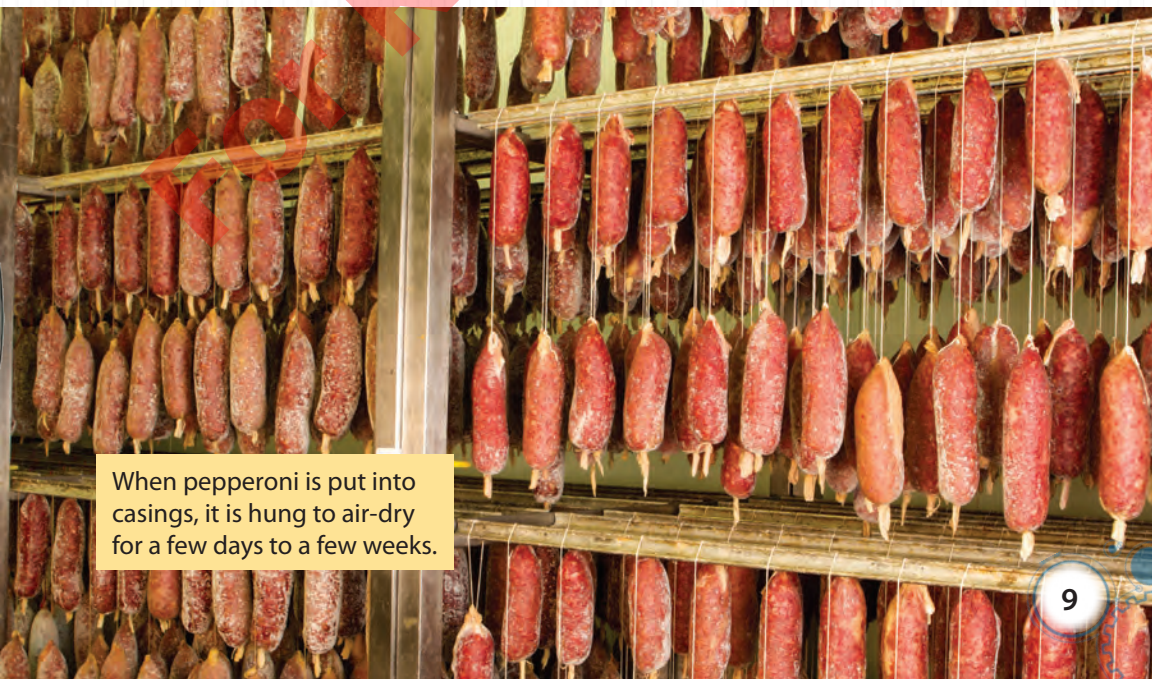
sauerkraut

kimchi

*Fizz!* The sharp, bubbly effect in sodas comes from carbon dioxide gas. At a soda factory, the gas is forced into each beverage using pressure and cool temperatures. When the gas is trapped inside a bottle or can, it can't escape. But when the container is opened and exposed to the air, you'll hear the bubbles inside fizzing.

*Spicy!* Pepperoni is a blend of meat that is cured rather than cooked. When beef, pork, or other meat is ground up, lactic acid is mixed in. This makes the meat more acidic and helps **preserve** it. Salt is added too, removing water and slowing down harmful bacteria growth. The meat is then put into **casings**, where it gets air-dried and then smoked for a unique flavor.



When pepperoni is put into casings, it is hung to air-dry for a few days to a few weeks.

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# STEAM CHALLENGE

## Define the Problem

Restaurant workers are looking to learn more about the acidity and alkalinity of common cleaning substances, including baking soda, dish soap, hydrogen peroxide, vinegar, and more. They want to create a new combination of substances that results in a chemical change. Your job is to test six materials for their acidity or alkalinity. Then, you will create a combination of the materials and evaluate it for chemical changes.

**Constraints:** You may only use the materials that are provided to you.

**Criteria:** You must test the materials to determine whether they are basic, acidic, or neutral. Then, you will create a combination of the materials. Your resulting combination must have a visible chemical change.


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# CAREER ADVICE
from Smithsonian

## Do you want to conduct experiments and be a scientist?

### Here are some tips to keep in mind for the future.

"Experiments can be messy! But that makes them fun and helps us learn about nature. Sometimes, the ideas that are the most exciting take a lot of work. Push yourself in classes and keep trying."

*– Benjamin Andrews, Geologist, National Museum of Natural History*

"Pay attention to how your actions affect or change the world around you."

*– Cari Corrigan, Geologist, National Museum of Natural History*

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# Read and Respond

1. What experiences do you have with physical or chemical reactions in food?
2. What is the difference between a physical and a chemical reaction?
3. Why is heat necessary for the Maillard reaction?
4. What are some reasons why fruits and vegetables turn brown?
5. How do leavening agents work in baked goods?
6. What similarity exists between the process of making cheese and milk becoming spoiled?

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