

ScienceNews

Activity Guide for Students: Building Bread Reveals Physical and Chemical Changes

Directions: Many of the things people make — from concrete to bread — undergo physical and chemical changes during production. Before starting this activity, read “[These chemists cracked the code to long-lasting Roman concrete](#)” from *Science News* online and complete the associated discussion activity “[Concrete physical and chemical changes](#).” A version of this article titled “Chemists crack the code to ancient Roman concrete” appears in the Feb. 11, 2023 print issue of *Science News*.

After your teacher explains fermentation, gluten formation and the Maillard reaction, you will answer the following questions about the chemical reactions that occur when making bread.

The science behind breadmaking

1. How are the processes of making self-healing concrete and bread similar?
2. How do chemical reactions change the physical properties of bread?
3. What is the gluten matrix, and why is it important in breadmaking?
4. What happens to the gluten matrix when the dough is overworked, meaning it was kneaded too long? How could excessive kneading affect the bread’s structure?
5. What happens to the gluten matrix when the dough is underworked, having not been kneaded enough? How could this affect the bread’s structure?
6. Exothermic reactions release energy to convert one chemical compound to another. Endothermic reactions require energy to convert one chemical compound to another. Was Roman concrete production exothermic or endothermic? Why?

7. Predict whether breadmaking is primarily an endothermic or exothermic process. Explain your answer.

Making the bread

Your teacher will give you directions and ingredients for breadmaking. Follow the directions carefully and fill out the Breadmaking chart as you go.



Breadmaking chart

As you make your loaf of bread, record your observations in the chart and use your knowledge of fermentation, gluten formation and the Maillard reaction to identify the type of changes that occur. If any chemical reactions are present, identify whether that chemical reaction is exothermic or endothermic and create a diagram showing how the chemical reaction alters the bread chemically and physically.

Process	Observations	What types of changes occur, physical or chemical? Explain why, based on your observations.	Is the process exothermic or endothermic? Why?	When appropriate, create a diagram that represents the chemical changes that take place. (These do not need to include full molecular formulas.)
Knead				
Rise				
Shape				
Bake				