Kitchen Chemistry and Creativity—Baking Bread
By Linda Butler

Bread is one of humanity's oldest, simplest, yet most complex foods. It can be made from three basic ingredients—water, flour, and leavening. Water is the most common liquid on earth. Flour is the powder obtained from grinding a cereal grain such as wheat, rye or oats. Wheat is the most common flour used in bread. Leavening is something that causes the bread to rise. The most common leavening is yeast, a simple sugar-eating fungus.

Mix these three main ingredients plus a few others, give yeast time to grow and heat to bake it and, voila, you have bread. However, there's a bit of "magic" or complex chemistry that takes place in order to make a delicious loaf of bread.

Let's look at these basic ingredients. Water is nearly everywhere. 71% of the earth's surface is covered in water. It's in the clouds above us, in the ground beneath us. It's the wetness of water that helps wake up, or activate, the yeast.

Yeast, in its packaged granulated form, is a dormant living thing, a single cell organism. As yeasts grow, they eat sugars in the starchy wheat and convert them into carbon dioxide gas. This is what makes the little bubbles or holes in bread. Yeast makes bread light and fluffy.

Flour is the powder made from grinding grains, seeds, or beans. Wheat flour is the main ingredient of bread. Corn flour is used to make tortillas. Grains have been ground into flour since 6000 BC and the ancient Romans used mills to grind wheat into flour. Wheat flour is made up of proteins (gluten) and carbohydrates—the sugars and starches that feed the yeast .

Making Bread
Let's make bread and learn about the chemistry that happens while it's made and baked. Here is a simple, basic bread recipe, which makes 2 loaves. It's easy to double (or triple) for large families.
Use a large bowl for mixing your bread dough.
First, **The Sponge:** 2 TBS (2 pkg) active, dry yeast
2 c wrist temperature warm water
1 tsp sugar (we prefer brown, white is fine, too)
2 c whole wheat flour
Add the sugar to the water and stir. Stir in the yeast and let it stand 5 minutes. Note how the yeast is beginning to bubble. Add the flour and beat with a whisk until it is smooth. Cover with a damp towel and let it rise for about 30 minutes. It should be double in size. Making a sponge gets the yeasts growing quickly.

Next, add **The Mix:** ¼ c melted butter
2 TBS brown sugar
2 tsp salt
(optional) 1 egg
Mix these together, then add to the sponge. Beat it 100 strokes or for 2-3 minutes with a wooden spoon. It should be a smooth consistency.
Finally, **add more flour**:

Add 1 c wheat flour
And 2 ½ c unbleached white flour, a half cup at a time. The amount of flour you need may vary, depending on the type of flour you use, the humidity, or other environmental factors. The texture of the dough is more important than the precise amount of flour used. Ultimately it needs to be soft, flexible, smooth, and just barely not stick to your hands. When it's too thick to mix with a spoon, it's time to knead it.

At this point I like to grease my bread pans or baking tray with shortening and then rub a bit more into the palms of my hands to keep the dough from sticking as I knead it. Turn the dough out onto a lightly floured surface and knead it for 15 to 20 minutes. If the dough is sticky, add flour a tablespoon at a time as you knead it. Kneading the dough develops a smooth and satiny texture.

Place the kneaded dough into a lightly oiled bowl and cover it with a damp towel and let it rise until doubled in bulk (about 30-45 minutes).

Punch down the risen dough and knead it again for 5-10 minutes. Form the dough into loaves, oval for bread pans, round for baking sheet. Gently press them into the pans or place slightly flattened round loaves on the sheet. Cover with the towel and let rise until double in bulk. This usually takes 30-40 minutes in a warm kitchen.

Preheat the over to 375 degrees and bake 30-40 minutes or until brown. After baking, remove bread from pans (loaves can stay on the sheet) and let cool for 15 minutes to allow for easier slicing.

Brief explanation: Many recipes don't call for a sponge, but this extra step gives the yeast time to soften and break down some of the toughness of the whole wheat flour, thus making a less dense loaf. Adding a little sugar to the yeast's water helps it start growing quickly. It will then eat the sugars found in the flour. The warm water activates the yeast. Yeast likes warm, but not hot temperatures. Too much heat kills the yeast. Yeast grows best in a warm room from 70-80 degrees.

Here's the chemistry:
FLOUR is made up of protein and starch. The proteins are in the gluten. When flour is mixed with water the gluten swells to form a network of fine strands. Kneading the bread mixes and strengthens these gluten strands, making them stretchy and elastic. To see the stretchiness, take a small piece of bread dough and slowly stretch it. Try stretching it when you start the kneading and again later after kneading it for 20 minutes and note how much stretchier the dough has become.

This stretchiness is important to the yeast. Yeast, as stated above, is a living organism. It eats the sugars found in the flour's starches and it excretes carbon dioxide (CO_2) bubbles. Kneading the dough helps the strong and stretchy gluten contain the yeast bubbles like thousands of tiny balloons. As the busy yeast make more and more bubbles, they pile on top of each other and the bread rises.

SALT is a small but important ingredient. Salt adds flavor to the bread. It also helps keep the bubbling yeast under control and helps the gluten be strong and elastic.

Bread *can* be made with just water, flour, yeast and salt. But a couple other things help bread taste better. As stated earlier, the SUGAR is a food for the yeast and it also gives the bread a richer flavor. The BUTTER also adds flavor and it helps the bread have a softer texture. Brushing a little melted butter onto the top of your bread right after removing it from the oven gives it a shiny and softer crust.

An EGG helps with the bread's rising and makes the bread more flavorful and higher in protein.

Warmth also aids in the yeast's rising. Yeast grows more quickly in a warm room than in a cool place. **Try an experiment** by taking some of the dough and letting it rise in the warm kitchen, and letting another part rise in the refrigerator. Refrigerated bread can take 2-3 times longer to rise.

Baking turns the soft gooey dough into firm crusty loaves. Warm temperatures (up to about 100 degrees) will encourage yeast growth. The heat of baking in the oven kills the yeast. The thousands of little bubbles, however, remain, and that's what gives the bread it's fine crumbly texture.

Getting Creative

Bread baking isn't just a left-brain scientific endeavor. There's a bit of creativity involved, too. Try experimenting with different additives. Substitute the sugar with ¼ c honey or molasses. Add some seeds: sesame, sunflower, or poppy. Add ½ c raisins or dried cranberries.

Making "bread bears" can also be creative and fun. A simple bear face can be made with two shooter marble size balls of dough for ears, three pea to marble size balls of dough for eyes and nose, and a thin roll of dough for a smiling mouth. Make sure you press the features fairly firmly onto the face, otherwise they may come off during the rising and baking. Other shapes can be made—various animals, snakes, bugs, letters. These sculptures generally rise faster and, depending on size, require only 15-20 minutes of baking time.

Learn more about bread and breadmaking with these books from the Pleasant Grove Library: "Bread" by Louise Spilsbury (For children grades K-2 about bread from farm to table.)
"Everybody Bakes Bread" by Norah Dooley (Children's book about bread in different cultures.)
"The Bread Baker's Apprentice" by Peter Reinhart (A good book for the serious breadmaker.)

“Bread Art: Braiding, Decorating & Painting Edible Bread for Beginners” by Stephanie Peterson. (Learn to create stunning breads and pastries.)