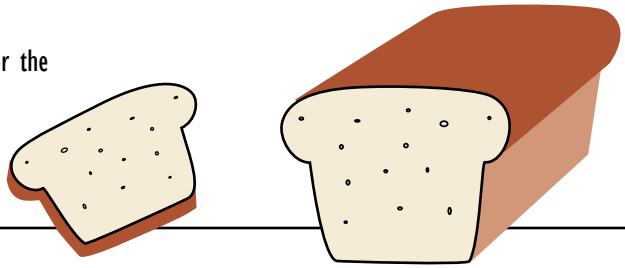
What makes the holes in bread?

Have you ever noticed the holes in bread?
If not, or you are not quite sure, slice a piece of bread and look on the flat surface for the holes. They are all different shapes and sizes. They make the bread light, rather than dense. What makes the holes? Do an experiment to find out.



What you need:

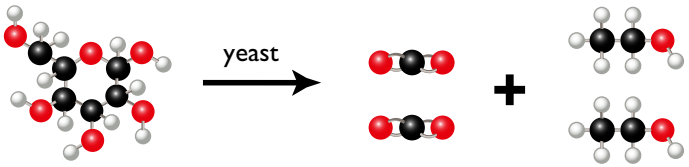
- one narrow clear glass bottle, with a cap
  an empty vinegar bottle works well, washed clean, with the label and glue removed. (Soak the bottle in warm water to remove the label.)
- warm water - very warm, but not hot to the touch (about 40˚C/100˚F or body temperature)
- one sheet of paper folded into a cone
- one package of dry active yeast
- one tablespoon of sugar

What to do:

- Fill the bottle half way with warm water.
- Using the cone of paper as a funnel, pour a package of yeast and a tablespoon of sugar into the water.
- Cap the bottle and shake it to break up any clumps of yeast.
- Uncap the bottle and let it sit for 15 minutes.
  While you wait you may notice foam starting to collect on the surface of the water, yeast and sugar mixture.
- After 15 minutes, take the bottle under a light, or next to a window.
- Look closely at the foam on the surface of the water - it is made up of many small bubbles.
- Tip the top of the bottle away from you, hold it still, and look carefully below the foam. You may be able to see masses of tiny bubbles, rising up to meet the foam.

What's going on?

The bubbles are made by a chemical reaction.
The yeast is a living thing. It feeds on the sugar molecules and breaks them apart into carbon dioxide molecules



The carbon dioxide molecules make the gas bubbles that you saw in your experiment.

Yeast and sugar are the important part of breadmaking:
Yeast in bread dough breaks apart sugar molecules (in flour), just like in your experiment.
This chemical reaction makes carbon dioxide molecules, which form gas bubbles.
The bubbles get stuck in the dough and then leave holes when the bread is baked - the same holes that you see in a slice of bread.

More to try: what makes the holes in cakes?

Cakes also have holes in them, and, like bread, these holes are made from bubbles of carbon dioxide gas. But the chemical reaction that makes the carbon dioxide molecules is different from bread. Try these experiments to see which ingredients in cakes make the carbon dioxide molecules.

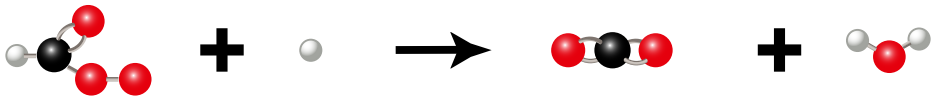
What you need:

- three drinking glasses
- water
- one tablespoon
- baking powder
- baking soda
- cream of tartar
- lemon juice
- flour
- other cake ingredients (look in a recipe book)

What to do:

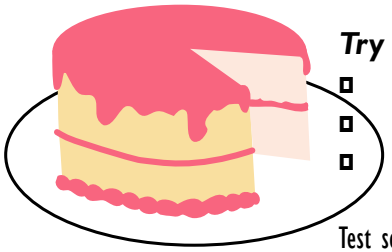
- Fill a glass half way with water.
- Add a tablespoon of baking **powder** (an ingredient in some cakes).
- What do you see?

The bubbles are from a chemical reaction between the "base" and the "acid" in the baking powder. When the base and acid dissolve in water (here in your experiment, or in cake batter) they are free to mix with each other, and chemically react:



The carbon dioxide makes gas bubbles (like it did in your experiment with yeast). If a cake is made with baking powder, the carbon dioxide gas bubbles are trapped in the cake mix, and leave holes when the cake is baked.

Some cakes are not made with baking powder. They are made with baking soda instead.
How does baking soda make the gas bubbles that leave the holes in cake?



Try this:

- Fill a clean glass half way with water.
- Add a tablespoon of baking soda. What happens?

Nothing should happen, because baking soda cannot make bubbles on its own. Baking soda is a base, and it must mix with an acid to make bubbles (like the base and the acid in your baking powder experiment above).

Test some other ingredients in cakes to find out which ones are acids, and help the baking soda to make bubbles.

- Fill three clean glasses half way with water and add a tablespoon of baking soda to each. Stir it in.
- Wash off the spoon. Add a tablespoon of cream of tartar to one glass. What happens?
- Wash off the spoon. Add a tablespoon of lemon juice to another glass. What happens?
- Wash off the spoon. Add a tablespoon of flour to the last glass. What happens?
- Try mixing other cake ingredients with water and baking soda.
- Which cake ingredients are acids and make bubbles with the baking soda?

The bubbles are made of carbon dioxide, and are made by the chemical reaction above.

Now you know the chemistry behind cake making, find a cake recipe and bake yourself a delicious cake!