

Tick Tock - A "Vitamin C" Clock

Two colorless liquids are mixed together and after a few moments the mixture turns a dark blue color. This version of the classic "iodine clock reaction" uses safe household chemicals that most people have on hand at home.

Clocks have been around to measure time thousands of years. They have been made from different materials, like stone on a sundial, and liquid crystals in watches. A clock can be formed from molecules that react at a rate from the time the chemicals are mixed to the time the reaction occurs.

What you need:

Distilled or tap water

Plastic cups (beakers)

Graduated cylinders

1000 mg vitamin C tablets (or two 500mg tablets)

Tincture of iodine (2%)

Hydrogen peroxide (3%)

Liquid laundry starch

What to do:

Make a vitamin C solution by crushing a 1000 mg vitamin C tablet and dissolving it in 60ml of water. Label this as "vitamin C stock solution". This will be a bit cloudy so let it sit for a bit before using if you want a really clear liquid.

Activity 1

1. Combine 5ml of vitamin C stock solution, 5ml of iodine and 60ml of water. Label this "solution A".
2. Prepare "solution B" by adding 60ml of water, 15ml of hydrogen peroxide and 2ml of liquid starch solution.
3. Pour solution A into solution B, and pour the resulting solution back into the empty beaker and then back again to make sure they are thoroughly mixed.
4. Start timer. Record the amount of time it takes for the reaction to occur.

Activity 2

1. Repeat the experiment but this time use only 30ml of water when preparing solutions.
2. Combine 5ml of vitamin C stock solution, 5ml of iodine and 30ml of water. Label this "solution A".
3. Prepare "solution B" by adding 30ml of water, 15ml of hydrogen peroxide and 2ml of liquid starch solution.
4. Pour solution A into solution B, and pour the resulting solution back into the empty beaker and then back again to make sure they are thoroughly mixed.
5. Start timer. Record the amount of time it takes for the reaction to occur.

What is going on?

There are actually two chemical reactions going on at the same time when you combine the solutions. During these reactions two forms of iodine are created - the elemental form (iodine) and the ion form (iodide). What you should about these two atoms are...

Iodide (ion) + Starch -----> Colorless

Iodine (element) + Starch -----> Dark Blue

The iodide ions inside the liquid iodine react with hydrogen peroxide to produce iodine element which is blue in the presence of starch. BUT... the vitamin C you added does not get along well with the iodine element! In fact, they break each other apart! So, since the iodine (element) is being torn apart, the solution cannot turn dark blue. Until...

...all of the Vitamin C gets used up! Once the Vitamin C is used up, it cannot break apart all of the new iodine (element) that is being made so the solution turns blue!

In activity #1, you should notice the clock reaction moves much slower than activity #2!

Since you added less water in activity #2, there are fewer molecules to get in the way of the iodide and the hydrogen peroxide reacting to form iodine. As this reaction moves much faster, the vitamin C is used up faster too. And as soon as the vitamin C is gone, you see the color change!

Safety Precautions

Do not drink the solutions! Be careful when working with the iodine - it stains, and it stains really well. Be very careful not to spill any of the solution.

Waste Disposal

Dispose all liquids down the drain with plenty of water.

A HUGE thank you to:

Wright, Stephen W. J. Chem. Educ. 2002 79 40A. (January 2002)