Clock Reaction

Grade Level: 8-12

Duration: 30-60 minutes

Classification: Classroom and/or STEM Spark

Subject(s): Biochemistry, Chemistry

Categories (STEM): Science

Keywords: carbohydrates, clock reaction, starch test

Introduction

- Summary: Students will observe the clock reaction and learn the scientific process by altering an experimental variable to change the rate of reaction.
- Description: Two colorless liquids are mixed together and in a few moments, the mixture will turn a dark blue color. Many different chemical reactions are going on to make this "clock reaction" occur. Students will perform an experiment and record color changes and indicators that a chemical reaction has occurred. Explore how reaction times can be sped up or slowed down. This experiment helps introduce students to rates of reaction and the scientific process.

Online Resource: https://www.imaginationstationtoledo.org/educator/activities/iodine-clock-reaction

Vocabulary

- **Polysaccharide**: a carbohydrate that is composed of more than 2 sugars bonded together
- **Disaccharide:** a carbohydrate that is composed of 2 sugars bonded together
- **Monosaccharide**: a carbohydrate that is composed of only 1 sugar (no glycosidic bonds)

Materials

Material	Quantity	Reusable?
Water Pitcher	1 total	Yes
Thermometer	1 per 3 kids	Yes
Paper Towels	1 roll	No
Spoons	1 per kid	Yes
Vitamin C powder	1 container	No
2% Iodine solution	1 bottle	No
Liquid Laundry Starch (can substitute for ½ tsp cornstarch per reaction, may slow down reaction time)	1 container	No
Small plastic cups (100-200ml)	1cup per kid	Yes
Measuring Spoons	1 set	Yes
Hydrogen Peroxide Solution	1 bottle	No
Timer	1 per 3 kids	Yes

Before the Activity

1. Make a vitamin C stock solution by crushing 1 tablet and dissolving in 60 ml water.
2. Make solution A by mixing:
    a. 1 teaspoon (5 mL) vitamin stock solution
    b. ½ teaspoon (2 ml) of iodine solution
    c. 30 ml water

    *the solution should be clear, if not, add more vitamin C solution
3. Make solution B by mixing:
    a. 1 tablespoon (15 mL) hydrogen peroxide
    b. ½ teaspoon (2 mL) starch solution
    c. 2 tablespoons (30 mL) water

Directions

1. Go over the difference between a monosaccharide and polysaccharide.
2. Pour solution A into solution B, and then pour both back into the A cup. Record the time it takes for the color to change.
3. After the reaction occurs, have the class brainstorm variables in the experiment that they could change to make the reaction happen faster.
4. Have the students form groups of four. Students will make their own stock solution and alter either solution A or B to change the speed of the reaction.
5. Write the ingredients and amounts that go into each solution on the board. They should discuss what variable (concentration or temperature) they want to change as a group. **They should come to the front of the classroom to add iodine, starch, and hydrogen peroxide to avoid wasting supplies.** If you want, you can challenge the class to make their reactions occur in less than 90 seconds. Give them around **15 minutes** to work.

    Temperature: Students cannot alter the temperature past 40 degrees Celsius for this reaction.

    Concentration: Students should work by increasing or decreasing the water concentration thus concentrating or diluting the reactants. Using increments of **10 mL** seems to work well, but any uniform increase or decrease in amount of water should give acceptable results.

6. Repeat step 1 with altered procedure.

Make sure to rinse and DRY each of the used cups. If there is time, have the students help with this. All open Iodine bottles must be returned in a SEALED bag.

clocActivity Extension

Have students continue to experiment, changing variables until they optimize the fastest clock reaction.

Discussion Questions

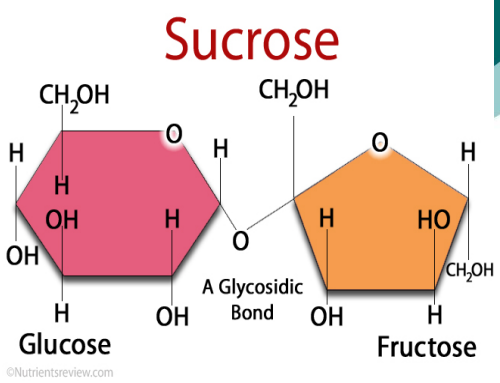
- How fast was the original clock reaction?
- What increased the rate of reaction? What decreased the rate of reaction?
- What is the fastest clock reaction?
- What is a carbohydrate? What are different types? **mono, di, poly (saccharides)**
- Is starch a mono or polysaccharide? **polysaccharide**
- Why does the reaction turn blue? **amylose is detected in polysaccharides**
- Would a table sugar (sucrose) water solution change colors? Why not? **No. It's a disaccharide not a polysaccharide. Amylose is only in polysaccharides.**
- What is the starch test? **Starch test is another name for the clock reaction. It is used in biochemistry to determine if unknown carbohydrate solutions contain polysaccharides.**

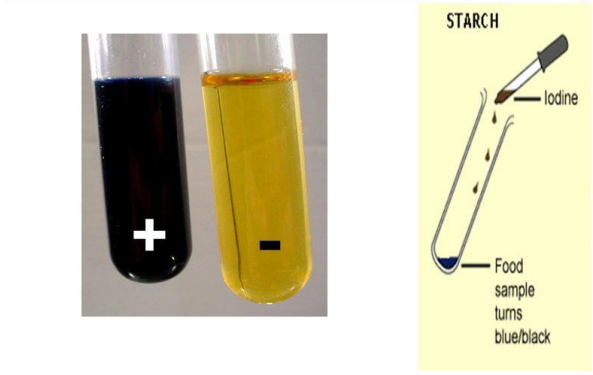
What is happening?

- Students first observe the clock reaction. Students then learn the scientific process and create an experimental variable, learning the importance of controlled variables. Students optimize the rate of reaction and learn about the starch test and why the reaction changes color.

Applications:

- Majors
  - Biochemistry
  - Chemistry
- Jobs
  - Chemist, biochemist
- Real world applications
  - Starch Test
  - Carbohydrates





Sucrose is standard table sugar.