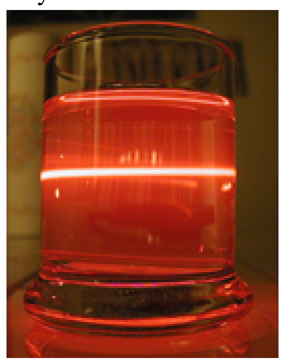
Chemical Sunset

Kitchen Table Demonstration

The Rundown

Time: 10 - 15 minutes
Content: solution chemistry, colloidal suspensions, Tyndall effect
Safety Concerns: Minimal
Materials Availability: Sodium thiosulfate and hydrochloric acid are necessary chemicals for this demo. All other materials are common.
Integration: Moderate

Have you ever watched the sunrise on a damp morning? You might notice that sometimes you can see the rays of light coming from the sun through the air. What you are observing is something called the Tyndall effect. It is the scattering of light by the particles in the air. Believe it or not, we can also observe the Tyndall effect in liquids if the conditions are right. If the particles within the liquid are too small, they will not be capable of scattering light, and the Tyndall effect will not be observed. However, if the suspended particles are large enough to scatter light, a similar ray will be seen through the liquid upon exposure to light.



Content Application

- Solution chemistry
- Colloidal suspensions
- Tyndall effect

Enduring Understandings

- Liquid mixtures which exhibit the Tyndall effect contain particles that are large enough to scatter/reflect light.

Chemistry

A **solution** is a homogeneous mixture. Typically when we think of liquid solutions, we think of a transparent liquid that contains a solute dissolved in a solvent. However, some solutions are homogenous mixtures that contain large enough "solute" particles that they don't appear to be transparent. These types of mixtures are called colloids.

A **colloid** contains suspended particles that are large enough to scatter light. This ability of a colloid to scatter light is called the **Tyndall effect**. If you were to shine a light through a colloidal suspension, you would see a beam of light where the particles of the mixture are reflecting the light. On the other hand, a solution does not exhibit the Tyndall effect because the particles of a solution are not large enough to scatter light.

In this demonstration, sodium thiosulfate reacts with hydrochloric acid to produce colloidal sulfur in a two step reaction:

$$2H^+(aq) + S_2O_3^{2-}(aq) \rightarrow H_2S_2O_3(aq)$$

$$H_2SO_3(aq) \rightarrow H_2SO_3(aq) + S(s)$$

As the reaction proceeds, a beam of light can be seen as it passes through the solution (Tyndall effect). As the concentration of colloidal sulfur continues to increase, the shorter wavelength light (blue) is scattered while the longer wavelength light (red) continues to pass through the solution. The projected light beam becomes more red in color. Eventually, the concentration of colloidal sulfur becomes so great that no light will pass through the container contents at all.

Materials

1. Overhead projector
2. Hydrochloric acid, 1M HCl (10mL)
3. Sodium Thiosulfate, 10% solution $Na_2S_2O_3$
4. 600mL beaker or crystallizing dish
5. Sharp knife or single edge razor blade
6. Stirring Rod
7. Posterboard

Safety

- Goggles and apron – Hydrochloric acid is extremely corrosive to the eyes and skin.

Procedure

1. Prepare 10% Sodium thiosulfate solution by dissolving approximately 70 grams in 400mL of distilled water.
2. Cut a pieces of posterboard that is slightly larger than the overhead projector stage.
3. Cut a round hole in the center of the posterboard that is a little smaller than the diameter of the beaker.
4. Fill the beaker with the sodium thiosulfate solution.
5. Place the posterboard on the overhead stage and put eh beaker over the hole.
6. Focus the projector to get a bright spot over the screen. Note the solution is clear when viewed from the side.
7. Add 2-3 drops of the HCl solution and stir. Note how the solution becomes cloudy and takes on a bluish cast. Note any changes in color of the projected spot.
8. Add a few more drops of HCl and stir. Repeat observations.
9. Continue to add HCl and soon the projected spot will become too dark to see.

Disposal

- Solution can be washed down the drain with excess water.

Student Participation and Follow-Up

Questions to ask:

1. What changes occur throughout the entire reaction. Why did these changes occur?

2. Why is this demonstration called a chemical sunset? In what way were your observations of the reaction similar to a sunset.

Suggestions:

1. This lab could also be used to study redox reactions.

Follow-Up:

1. After showing the students what the Tyndall effect looks like through this demonstration, have different stations of solutions or colloids set up with little flashlights to see if the students can classify the mixtures.