

Experiments for the 2018 ASTC Live Demo Hour

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Science Principles: Chemical Reactions; Surface Tension

Demo 1 - Plasma Spheres

1. Definition :
 - a. A thermite reaction is an exothermic oxidation-reduction reaction similar to the ignition of black powder. The reaction requires a metal oxide and fuel. The fuel in the thermite reaction you produce is aluminum in the foil. Your metal oxide is iron oxide, more commonly known as rust.
 - b. Knocking the ball bearings together creates a small area of heat. This heat, combined with the aluminum and iron oxide, produces aluminum oxide, elemental iron, and a large amount of heat and light. This heat is so extreme that thermite reactions can be used to weld other metals together, similar to the process of creating railroad tracks.
2. Activity/Procedure:
 - a. Wrap one of the rusted iron balls with a single layer of aluminum foil.
 - b. Place the rusted iron ball in one hand and the aluminum foil-wrapped one in the other hand.
 - c. Making sure the fingers are out of the way, strike down on the aluminum foiled-wrapped ball with the rusted one. Try to strike a glancing blow with the two surfaces.

- d. As the balls strike and slide past one another, a loud crack and white sparks are produced and the aluminum is literally welded to the iron ball.
 - e. Rotate the rusted iron ball to get a fresh surface of iron oxide. Repeat the process for further sparks and cracks! With a little practice, a loud and flashy scene will be created.
3. Explanation
- a. When the balls are struck, the rust (Fe_2O_3) reacts with the aluminum foil (Al) to produce aluminum oxide (Al_2O_3), elemental iron (Fe) and heat. This reaction is a highly exothermic, single replacement reaction. Aluminum is oxidized and iron is reduced. The melting point of iron is $1530\text{ }^\circ\text{C}$ and the reaction temperature reaches approximately $2200\text{ }^\circ\text{C}$. ($\Delta H^\circ = -849\text{ kJ/mole}$).

Demo 2 - Surface Tension

1. Definition :
 - i. Surface tension is the elastic tendency of a fluid surface, which makes it, acquire the least surface area possible. Surface tension allows insects, usually denser than water, to float and stride on a water surface.
2. Activity/Procedure:
 - i. Take an Erlenmeyer flask and put mesh around the opening. Fill it an estimated $2/3$ s the way with water (the big Erlenmeyer flask up to 5000mL). Put a card on top and flip it over a small bucket. Slowly remove the card and see that using the mesh the surface tension of the water is holding all (whatever amount

you decide to use) in the Erlenmeyer flask. You can even slide toothpicks in carefully without disrupting the surface tension.

3. Explanation:

- i. Cohesive properties of water cause it to form a bond in small openings of the screen, creating a “membrane” that essentially seals the mouth of the bottle. The outside air pressure is also greater than the pressure of the air pockets inside, holding the water up.

When the toothpick is pushed, the water wraps itself around the toothpick due to its cohesive property. Once the toothpick is through, the water releases it and floats up since it's less dense than the water.