



Drexel-SDP GK-12 ACTIVITY

Subject Area(s): Solar Energy, Scientific Method, Variables

Associated Unit: None

Lesson Title: Thermodynamic Reactions

Header:

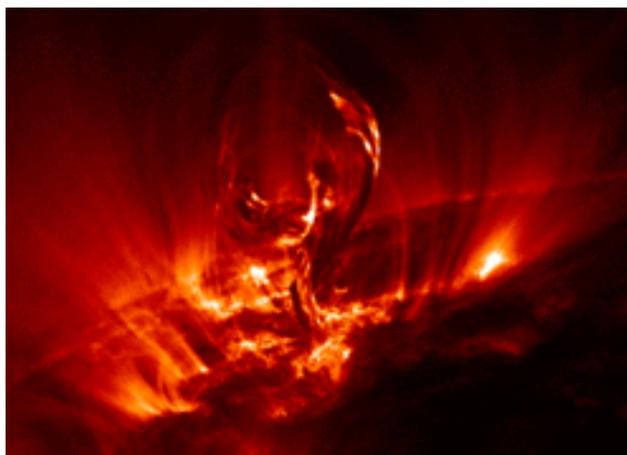


Image 1

Description: Picture of a solar flare on the sun's surface

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Grade Level 5

Lesson # 1 of 1

Time required: 2 hours

Summary

Students will learn how heat can be produced through both nuclear and chemical reactions. Students will perform chemical reactions to both produce and use heat and they will use the scientific method to make predictions and analyze their results.

Engineering Connection

Engineers must use the scientific method if conducting experiments. Chemical engineers can use the heat from chemical reactions to solve various applications.

Keywords

Nuclear reactions, chemical reactions, exothermic, endothermic, scientific method

Educational Standards

- Science: 3.1.7b, 3.2.7a, 3.2.7b, 3.2.7c
- Math: Graphing

Pre-Requisite Knowledge

Learning Objectives

After this lesson, students should be able to:

- Understand that heat can be both produced and used via chemical reactions
- Make predictions and test those predictions using the scientific method
- Understand how to run and measure the results from a chemical reaction
- Understand how to analyze data

Introduction / Motivation

This lesson was taught towards the end of the solar energy term when students had a few questions involving the sun. Examples of questions include: What is the sun made of? If the sun is so far away, how do scientists know what the sun is made of? How does the sun heat the earth? If space is a vacuum and heat cannot travel through a vacuum, how does the sun heat the earth (ok, I added this question, but it is a good one to bring up)? How big is the sun in comparison to earth? How far away is the sun? Why does the sun get so hot? As an introduction, go over a few overheads with the students to get them thinking and to better explain a few points (see “sun presentation” at the end of this document). Introduce nuclear explosions to the students and that nuclear explosions are what produces the heat from the sun. Explain the difference between nuclear and chemical reactions. Since we can’t very easily perform a nuclear reaction, explain that we will be performing chemical reactions instead. Chemical reactions can both produce heat (exothermic) and use heat (endothermic). Explain that students will have to perform experiments to identify whether reactions are exothermic or endothermic.

Go over with the students the scientific method and how they should set-up their experiments to determine the type of reactions they have. For starters, only perform the reactions with ice melt (don’t do the urea + water reaction till next time) and take a poll as to which ones the students think will produce the most heat. Put their predictions in the form of a hypothesis and go over with them what they are supposed to do. This is also a good introduction into variables (which they will have next term), so you can start to introduce the various types of variables here (i.e. control, independent, dependent).

Lesson Background & Concepts for Teachers

How does salt melt ice if it doesn’t produce heat?

- The way I like to think of and explain this one is to imagine water molecules as a box full of unconnected legos. When the water freezes and becomes ice, the water

molecules stack together in symmetrical structure. In the case of legos, assembling the legos into one solid cube would be representative of water freezing. Now, imagine that the salt is a giant rubber ball (i.e. a soccer ball) in the middle of the box of legos. It would certainly be more difficult to assemble the same solid cube of legos around a few soccer balls. In terms of water freezing, the more difficult cube formation results in lower temperatures required to freeze water when salt is dissolved in the water

Why do some salts produce heat when dissolved in water?

- Some salts (i.e. calcium chloride) prefer to be dissolved in water and this is a much more favorable configuration. Because they favor this state, that preference is represented by a decrease in the overall energy of the system. That energy difference is given off in the form of heat.

Vocabulary / Definitions

Word	Definition
Variables	Things that are likely to vary
Control variable	Variables that are kept constant
Dependent variable	Variable that we measure
Independent variable	Variable that we change
Endothermic	A reaction that absorbs heat (i.e. heat goes into the reaction)
Exothermic	A reaction that releases heat (i.e. heat exits the reactions)
Dissolve	Go into a solution

Associated Activities

Materials

- Tap water
- Ice melt (one each containing the following active ingredients)
 - o Calcium Chloride
 - o Potassium Chloride
 - o Sodium Chloride
- Glass jars or glass beakers
- Stirring spoons
- Measuring spoons
- Containers (small Tupperware containers worked well to divide out the salts)
- Non-mercury thermometers

Pre-Activity Preparation

- Determine the amount of water that each group will use per experiment (I used about 250 ml), determine how much salt will be added each time (I used about 1 tablespoon), and determine the time increments for measurement (I used about 3 minutes)

With the Students

1. Show the students the various types of ice melts and see if they can identify which one will cause an exothermic reaction.
2. Divide the students up into groups of three (dependent on the amount of material) and one student will add the salt, the other student will stir, and the other will record the data.
3. Have the students set-up a table with three columns in their lab books. One column should be labeled # of spoons added, one column should be labeled time (in minutes) and the other labeled temperature.
 - a. To make things easier, students can eliminate either the time or the # of spoons added column.
 - b. Remind the students not to add any additional spoonfuls until all the salt is dissolved.
 - c. Also, remind the students that one spoon is exclusively for mixing and the other is for adding the salt.
4. Give each group a different container of salt.
5. Before beginning, make sure the students can repeat back what they are supposed to be doing.
6. Before beginning and before adding any salt, be sure that the students measure the water temperature. This will be the temperature at time point zero. Have the students start the time when the first spoonful is added.
7. Add spoonfuls until no more salt will dissolve.
8. Continue until each group has tested each salt type.

Post-Activity Assessment

Have the student graph the results (time vs. temperature or spoonfuls vs. temperature) and determine if their hypothesis was correct. Examples of other exothermic reactions include: vinegar + steel wool, baker's yeast + water. Example of an endothermic reaction includes: urea + water.

Lesson Closure

Investigating Questions

- What could we change to improve upon the experiment?
- Was our hypothesis correct?
- Which type of salt was exothermic? Were any endothermic?
- What other variables did we introduce into the experiment?
- How high did the temperature get up to? (Previous experiments showed a temperature of almost 80 C)

References

Owner

Drexel University GK-12 Program

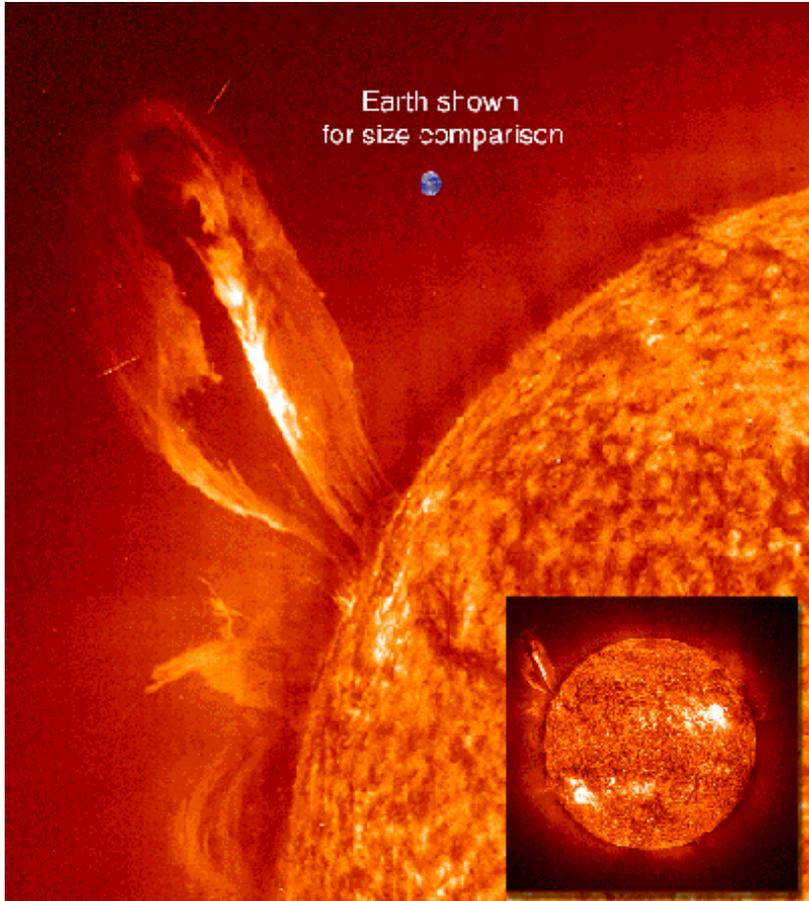
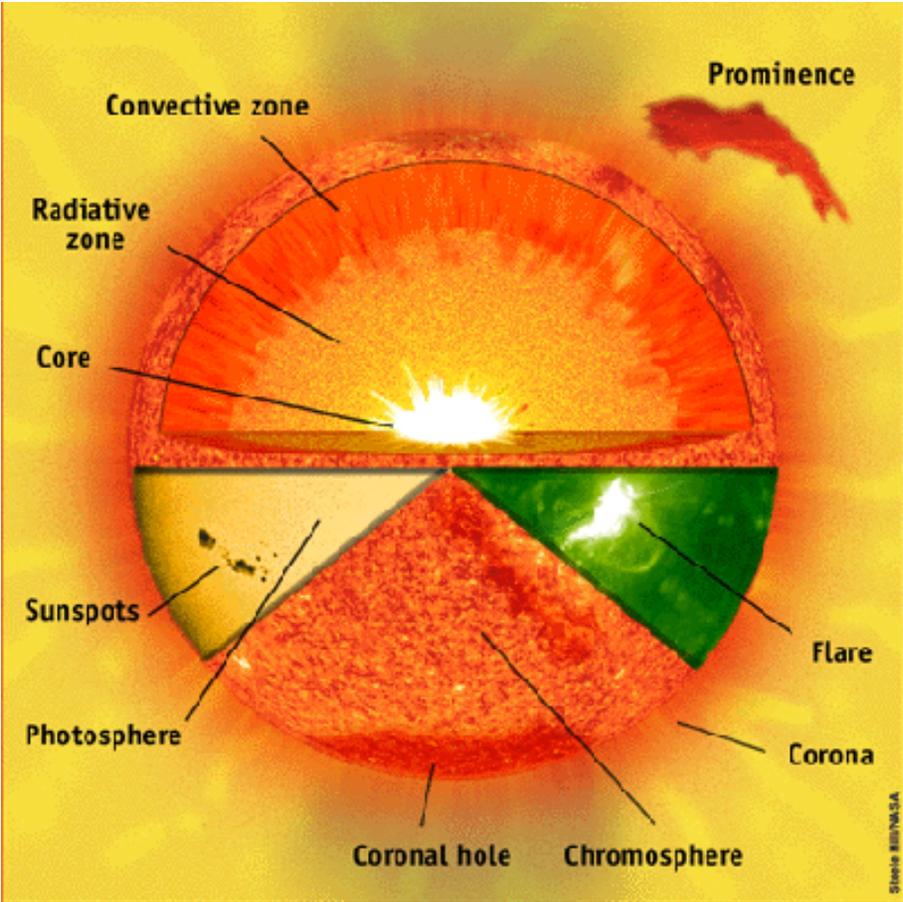
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How The Sun Works



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