

What's Cooking - 2

Student Objectives

The student:

- understands how the Sun's radiation, as heat, can be captured and used
- will explain the similarities and differences between two experimental conditions and resulting substances.

Key Words:

radiation
solar collector
solar thermal

Materials:

- large jars, approx. 1 liter each (2 per group)
- tea bags (2 per group)
- water
- pan
- stove or method to boil water
- clear glasses (4 per student)
- sugar packets
- spoons

Time:

15 minutes for discussion and preparation
1 - 3 hours to brew solar tea
½ hour to taste test and discuss

Background Information

Energy is needed to heat water, so many energy conscious people have started using the free energy from the Sun for brewing tea. Solar tea costs less to make, seems less bitter, retains the tea flavor better and won't turn cloudy after being refrigerated.

Boiling water to make tea extracts more tannins and alkaloids than does water heated (but not boiled) by solar energy. A 10° rise in the water temperature during the making of solar tea is not unusual, and many chemists believe that this minor change in temperature is enough to double the rate of the chemical reaction. Furthermore, as the tea solution becomes darker, it absorbs more energy causing the extraction to speed up, which in turn makes the tea darker. This simulates an autocatalytic reaction.

Procedure (prior to class)

1. For younger students, draw a Sun on the glasses to use for the solar tea.

Procedure (during class)

1. Ask the class if anyone makes solar tea at home. If some of your students do make tea using the Sun, have them explain how it is done. If not, tell them that they are going to

- use the energy of the Sun to brew their tea.
2. Explain that they are going to investigate if solar tea is the same as tea made by boiling the water, and if it is different, what are the differences between the two.
 3. Divide the class into groups of 4 - 6 students per group.
 4. Have each group fill one jar with one liter of water and add a tea bag.
 5. Place these jars in the sun and leave for 1 - 3 hours depending on the season and the amount of sunlight on the day of the experiment.
 6. When the tea is a good color, bring in the jars and remove the tea bags.
 7. Boil water for the students and pour one liter into the other jar for each group. Have the students drop in a tea bag and watch until the tea becomes as dark as the solar tea. Remove the tea bag.
 8. When the brewed tea cools to room temperature, pour each student a glass of brewed tea and a glass of solar tea. Distribute sugar packets to those who prefer sweetened tea (remind them to use the same amount of sweetener in both samples).
 9. Have the students look at, smell and taste each sample and lead a discussion. Note: Some students find it easier to taste subtle differences if they close their eyes.
Questions to ask:
 - Do the two samples have the same intensity of color? If not, how are they different?
 - Do the two samples have the same clarity, or is one more cloudy than the other?
 - Do the samples smell the same? If not, how are they different?
 - Do the two samples taste the same? If not, how are they different?
 - Which method of brewing tea do they think tastes better? Graph the results for the class on the board.
 10. Refrigerate the remainder of the group jars overnight and repeat the testing.
 - Are the results the same? If not, how are they different?
 - Which method of brewing tea do they think tastes better today? Add these results to the graph from the previous day.

Key Words and Definitions

- **radiation** – the way we receive heat from the Sun each day. The energy is emitted in the form of waves or particles, and can move from one object to another without heating the area in between.
- **solar collector** – a device that collects and traps solar energy
- **solar thermal** – using the Sun’s energy to heat something

Further Activities

1. Do a ‘blind’ taste. Label the glasses ‘A’ and ‘B’, but don’t tell the students until after the test which is which. Are the results the same? If not, lead a discussion with the class on why they might be different. Did knowing how each sample was made influence the results? Students may want to follow this up with blind taste tests of other products (i.e. brands of juice, soda or ice cream). This is a good opportunity to discuss with the class the effect of advertising on perceptions.

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2. Have the students invite another class over for a taste test. Let them facilitate the experiment and compare the other class' results to theirs. Serve a snack to the guest class after the testing.

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Florida NGSS Standards & Related Subject Common Core

			.1	.2	.3	.4	.5	.6
Grade K								
The Practice of Science	Big Idea 1	SC.K.N.1	X	X			X	
Grade 1								
The Practice of Science	Big Idea 1	SC.1.N.1		X				
Earth in Space and Time	Big Idea 5	SC.1.E.5				X		
Grade 2								
The Practice of Science	Big Idea 1	SC.2.N.1		X			X	
Earth Systems and Patterns	Big Idea 7	SC.2.E.7		X				
Forms of Energy	Big Idea 10	SC.2.P.10	X					
Language Arts Standards	Kindergarten: LAFS.K.W.3.8, LAFS.K.SL.1.1 First Grade: LAFS.1.W.3.8, LAFS.1.SL.1.1 Second Grade: LAFS.2.SL.1.1							
Mathematics Standards	Kindergarten: MAFS.K.MD.1.1, MAFS.K.MS.1.2 First Grade: MAFS.1.MD.3.4 Second Grade: MAFS.2.MD.4.10							

Kindergarten Benchmarks

Science--Big Idea 1: The Practice of Science

- SC.K.N.1.1 - Collaborate with a partner to collect information.
- SC.K.N.1.2 - Make observations of the natural world and know that they are descriptors collected using the five senses.
- SC.K.N.1.5 - Recognize that learning can come from careful observation.

Language Arts--Writing Standards

- LAFS.K.W.3.8 - With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

Language Arts--Standards for Speaking and Listening

- LAFS.K.SL.1.1 - Participate in collaborative conversations with diverse partners about kindergarten topics and texts with peers and adults in small and larger groups.

Mathematics--Measurement and Data

- MAFS.K.MD.1.1 - Describe measurable attributes of objects such as length or weight. Describe several measurable attributes of a single object.

- MAFS.K.MD.1.2 - Directly compare two objects with a measurable attribute in common, to see which object has ‘more of’ / ‘less of’ the attribute, and describe the difference.

First Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.1.N.1.2 - Using the five senses as tools, make careful observations, describe objects in terms of number, shape, texture, size, weight, color, and motion, and compare their observations with others.

Science–Big Idea 5: Earth in Space and Time

- SC.1.E.5.4 - Identify the beneficial and harmful properties of the Sun.

Language Arts Standards–Writing Standards

- LAFS.1.W.3.8 - With guidance and support from adults, recall information from experiences or gather information from provided sources to answer a question.

Language Arts Standards–Standards for Speaking and Listening

- LAFS.1.SL.1.1 - Participate in collaborative conversations with diverse partners about grade 1 topics and texts with peers and adults in small and larger groups.

Mathematics–Measurement and Data

- MAFS.1.MD.3.4 - Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.

Second Grade Benchmarks

Science–Big Idea 1: The Practice of Science

- SC.2.N.1.2 - Compare the observations made by different groups using the same tools.
- SC.2.N.1.5 - Distinguish between empirical observation (what you see, hear, feel, smell or taste) and ideas or inference (what you think).

Science–Big Idea 7: Earth Systems and Patterns

- SC.2.E.7.2 - Investigate by observing and measuring, that the Sun's energy directly and indirectly warms the water, land, and air.

Science–Big Idea 10: Forms of Energy

- SC.2.P.10.1 - Discuss that people use electricity or other forms of energy to cook their food, cool or warm their homes, and power their cars.

Language Arts–Standards for Speaking and Listening

- LAFS.2.SL.1.1 - Participate in collaborative conversations with diverse partners about grade 2 topics and texts with peers and adults in small and larger groups.

Mathematics–Measurement and Data

- MAFS.2.MD.4.10 - Draw a picture graph and a far graph to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.

National Next Generation Science Standards

Kindergarten Standards

Science–Energy

- K-PS3-1 - Make observations to determine the effect of sunlight on Earth’s surface.

Engineering Design

- K-ETS1.1 - Ask questions, make observations, and gather information about a situation

people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

Note: Related Common Core Mathematics and Language Arts Standards are listed in the Florida section above.

First Grade Standards

Engineering Design

- 1-ETS1.1 - Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

Note: Related Common Core Mathematics and Language Arts Standards are listed in the Florida section above.

Second Grade Standards

Engineering Design

- 2-ETS1.1 - Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

Note: Related Common Core Mathematics and Language Arts Standards are listed in the Florida section above.