

What's Cooking - 2

Student Objective

The student:

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

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

Key Words:

radiation
solar collector
solar thermal

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.

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.
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.

EnergyWhiz

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			.1	.2	.3	.4	.5
Energy	Standard 1	SC.B.1.1-	X			X	
	Standard 2	SC.B.2.1-	X				
Nature of Science	Standard 1	SC.H.1.1-	X		X		X
	Standard 2	SC.H.2.1-					
	Standard 3	SC.H.3.1-					

Benchmark SC.B.1.1.1 - The student knows that the Sun supplies heat and light energy to Earth.

Grade Level Expectations

The student:

Kindergarten

- knows the effects of sun and shade on the same object

First

- knows that heat from the Sun has varying effects depending on the surface it strikes.

Benchmark SC.B.1.1.4 - The student knows that heat can be produced in many ways.

Grade Level Expectations

The student:

Kindergarten

- knows some processes where heat can be released

Second

- knows different heat sources.

Benchmark SC.B.2.1.1 - The student knows that the Sun supplies heat and light energy to Earth.

Grade Level Expectations

The student:

Second

- understands ways energy and matter interact.

Benchmark SC.H.1.1.1 - The student knows that in order to learn, it is important to observe the same things often and compare them.

Grade Level Expectations

The student:

Kindergarten

- knows that learning can come from careful observation

Benchmark SC.H.1.1.3 - The student knows that in doing science, it is often helpful to work with a team and to share findings with others.

Grade Level Expectations

The student:

Kindergarten

- works with a partner or small group to collect information
- shares findings about scientific investigations with others

First

- works with others to complete an experiment or to solve a problem
- listens, records, and compares the ideas and observations of others

Second

- participates in groups to conduct experiments and solve problems.

Benchmark SC.H.1.1.5 - The student uses the senses, tools, and instruments to obtain information from his or her surroundings.

Grade Level Expectations

The student:

Kindergarten

- knows that the five senses allow us to take in and respond to information in order to learn about our surroundings.

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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