Solar Cooking Unit 4th Grade

by Rowena Gerber

Our solar cooking unit spans a six-week time period, and is fully integrated across the curriculum. We are a private school and are not responsible for covering the Florida Sunshine State Standards, though we pride ourselves in developing challenging programs tailored to meet out students needs, abilities, and interests. How does this unit measure up against the Florida Sunshine State Standards? As I looked at a typical week’s assignments in this unit, I found that the students were actively engaged in over thirty SOL's covering health education, language arts, mathematics, science, social studies, visual arts, and technology.

The following objectives are an important part of the unit, as they provide inquiry based science opportunities. The students' questions, experiments, and discoveries give them a full understanding of the basics of solar energy, its power, and its uses.

Each of these objectives will be completed through the "scientific process" and scored using a rubric adapted from the National Renewable Energy Laboratory: The "scientific process" is a National Science Standard and a Florida Sunshine State Standard. It is particularly difficult for students to master, so the step by step process is used and reinforced in all the following objectives. I will write out the entire text for clarification and refer to it by number in the written objectives.

Florida Sunshine State Standards Grade Level Expectations: Benchmark SC.H.1.2.2 The student knows that a successful method to explore the natural world is to observe and record, and then analyze and communicate the results. The student plans and investigates experiments in which hypotheses are formulated based on cause and effect relationships; distinctions are made among observations, conclusions/inferences and predictions: a limited number of variable are controlled; and numerical data that are contradictory or unusual in experimental results are recognized.

Score Description

0  Lab sheet missing
1  Skill absent
2  Almost there (skill is mastered but with minor problems)
3  Meets expectation (skill is mastered to level of expectation-100% correct on format and content)
4  Above and beyond expectation (quality of work is unusually high and beyond expectation)

Objective #1: Model of Sun's shadow patterns

Given a lab sheet outlining the "scientific process", a flashlight, pencil, ruler, clay, and flat surface, working initially in small groups conducting the experiment as demonstrated by the teacher and with prior knowledge of the five components of the scientific process, the student will use the question "How does the shadow of a gnomon change as the light shining on it changes angles?" to form the basis of his/her hypothesis, and will correctly complete each step of the scientific process to record findings on individual lab sheets to demonstrate 100% mastery of the five essential steps of the "Scientific Process." (BenchmarkSC.H.1.2.2 Sunshine State Standards.)
Objective #2: Does color affect heat absorption?
Given a lab sheet outlining the "scientific process", two identically sized empty soup cans (one covered in white paper, the other covered in black), thermometers, and pencils, with prior knowledge of the five components of the scientific method and working in pairs the students will place the cans in direct sunlight and monitor and record the temperatures in the containers every minute for ten minutes, the students will use the question "Does color affect heat energy absorption?" to form the inquiry for his/her individual hypothesis, and will correctly complete each step of the scientific process to record the findings on the individual lab sheet to demonstrate 100% mastery of the five essential steps of the "Scientific Process" (BenchmarkSC.H.1.2.2 Sunshine State Standards.)

Objective #3: Can Solar cookers be used to pasteurize water?
Given a solar cooker, 1 quart of water in a black pot, thermometer, and a lab sheet outlining the "scientific process", with prior knowledge of pasteurization temperature levels and prior knowledge of the five components of the scientific method, working in groups of four the students will place the water in the solar ovens in direct sunlight for two hours before taking a temperature reading, the students will use the question "can solar cookers pasteurize water?" to form the inquiry for his/her hypothesis, and will correctly complete each step of the scientific process to record the findings on the individual lab sheet to demonstrate 100 % mastery of the five essential steps of the "Scientific Process" (BenchmarkSC.H.1.2.2 Sunshine State Standards).

Objective #4: Can solar cookers be used for desalinization?
Given a lab sheet outlining the "scientific process", a solar cooker, two pie tins, two bowls of equal amounts of salt water, two oven bags, and two hangers for constructing domes, after watching the teacher construct a desalinization model and with further coaching when necessary, and with prior knowledge of the "scientific process" the students will work in groups of four to build two desalinization models, placing one in the solar cooker and one next to the solar cooker and measure the fresh water collected in the pie tins after 24 hours, the students will use the question "can solar cookers speed up the desalinization process" to form the inquiry for his/her hypothesis, and will correctly complete each step of the scientific process to record the findings on the individual lab sheet to demonstrate 100 % mastery of the five essential steps of the "Scientific Process" (BenchmarkSC.H.1.2.2 Sunshine State Standards).

Objective #5 Which material forms the best heat trap for solar ovens, oven bags or polypropylene?
Given two solar box cookers without heat traps, an oven roasting bag, a sheet of polypropylene, oven thermometers, and a lab sheet outlining the "scientific process", with prior knowledge of the five components of the scientific method and working in groups of four after watching the teacher demonstrate heat trap construction, the students will use the two materials to form two different heat traps and compare and record their oven temperatures every fifteen minutes for an hour, using the question "which material, oven bags or polypropylene, forms a better heat trap?" to form the inquiry for his/her hypothesis, will correctly complete each step of the scientific process to record the results on the individual lab sheet to demonstrate 100% mastery of the five essential steps of the "Scientific Process" (Benchmark SC.H.1.2.2 Sunshine State Standards)
Objective #6 Which is a better insulator, air or newspaper?
Given two box cookers without insulation, torn newspaper, oven thermometers, and a lab sheet outlining the "scientific process", with prior knowledge of the five components of the scientific method and working in groups of four, the students will fill the insulation cavity of one cooker with torn newspaper and leave the other one empty, place them in the sun for an hour and record the temperatures every fifteen minutes, using the question "does air or newspaper make a better insulator?" to form the inquiry for his/her hypothesis, and will correctly complete each step of the scientific process to record the results on the individual lab sheet to demonstrate 100% mastery of the five essential steps of the "Scientific Process" (Benchmark SC.H.1.2.2 Sunshine State Standards)

**Other Sunshine State Science Standards covered in these objectives are: SC.A.1.2.1; SC.A.1.2.2; SC.A.2.2.1 Strand B; SSC.B.1.2.2; SC.B.1.2.3; SC.B.1.2.4; SC.B.1.2.5; and SC.B.1.2.6.