Grade Level: 3

Title: It's Too Hot! It's Too Cold! It's Just Right! (Nov. – Jan*)

* parts of this lesson work well at other times and can also be worked into care of a strawberry garden; see experiments below

Purpose:

Students will understand how energy can be transferred from one object to another.

Subject Area(s) Addressed:

Science

Common Core/Essential Standards:

Science:

3.P.2 Matter: Properties and change: Understand how energy can be transferred from one object to another.

3.P.2.3 Summarize changes that occur to the observable properties of materials when different degrees of heat are applied to them, such as melting ice or ice cream, boiling water or an egg, or freezing water.

Vocabulary:

cooling
energy
freezing
heat

Materials Needed:

strawberry plants
black plastic
clear plastic
water
thermometers
minimum-maximum thermometer

Teaching Strategy:

Essential Questions:

What affect does hot weather/freezing weather have on strawberry plants, flowers, or fruits? What does a farmer do to protect the plants at different stages to prevent the changes to the plant, flowers or fruit?

Have students discuss what affect hot weather and freezing weather have on strawberry plants.

Have students discuss how to protect the plants. Ask students to record their responses to these questions in their science journals before conducting experiments. Then, readdress the questions after completing the experiments.

Complete the following experiments to understand how heat energy is transferred in the strawberry field.

Experiment #1:
Put a piece of black plastic on the ground if you don't have a garden, or use the strawberry bed. On a sunny day, measure the temperature in the air 4-5 feet up, on top of the plastic, under the plastic, and several inches into the soil. How are they different, and why? Is the temperature of the soil different if the soil is damp or dry? If the plastic is smooth to the ground or loose? What happens if you use clear plastic instead? Do this experiment on a warm day and also on a very cold day. (On a hot day in spring/summer, the heat collected and stored because of the black plastic actually stresses the plants; on a cold day it benefits them.)

Experiment #2
Put a piece of clear plastic and/or a piece of row cover over a plant (any kind) on a cold sunny day, and measure the temperature under the cover compared to with no cover. Do the row cover and clear plastic produce different temperatures? During a frost/freeze event, do the same thing; observing whether plants under the cover freeze (covers give a few degrees of protection). Use a min/max thermometer to observe how cold it got at night compared to how cold it is when you measure later in the morning.

Experiment # 3
Irrigation/Evaporative cooling: Observe a water-sensitive plant (Impatiens are great for this) in the sun on a very hot day (>85% or if conducting experiment during the winter, reproduce a "hot day" indoors with heat lamps). Don't water, and watch the plant wilt. Water and watch it revive. Measure the temperature at the plant and then water it with a light spray for a few minutes. Measure it again as the water evaporates (the temperature should rise).

Experiment #4
Students will put one strawberry plant (in a pot) in the refrigerator and one strawberry plant in the freezer overnight and determine the effects of cold temperatures on strawberry plants. Using a plant with flowers will show more dramatic effects. Prior to placing the plants inside, students should use appropriate thermometers to determine the temperature in the refrigerator and freezer. When plants are removed the next day, students will record the temperature of the soil at the surface and a few inches in the soil. Continue this experiment for one week and record the temperatures and what is happening to the plant physically. How is it changing? What is happening to the soil temperature? (Note that soil temperatures in a small pot will change much more quickly than the large soil mass of a garden or field.) What are some options for farmers to protect plants from cold weather damage? Have students use the

Strawberry blog http://wegrowstrawberries.blogspot.com to ask a farmer what action he takes during cold and freezing temperatures.

Extension Activity:

Invite a farmer to your class to discuss the effects of weather on strawberry plants and how they monitor the weather and manage for it.

Background Information:

Weather is one of the most crucial variables for strawberry farmers' success. Each year, they try to figure the best time to set out their plants based on what they think the coming year will be like. Yields and the start of harvest are affected by when they plant and how cool/warm the weather is in the fall, winter, and spring.

The most sensitive period is in the spring, when the plants are flowering and frosts can damage or kill the flowers, buds, and developing fruit. Growers then protect their plants with overhead irrigation and/or row covers. During that vulnerable period, growers listen carefully for forecasts of a frost/freeze event in their area. Many have frost alarms that will wake them up at night when temperatures fall to a certain level, so they can get up and turn on their irrigation system (which they have to do before temperatures actually reach freezing). Frost/freeze events happen every year and strawberry growers are prepared for them. Schools with gardens will need to watch the weather, too, and cover their plants if frost might damage them.

Other particular weather issues for strawberries:

1. Very cold weather (below 15-20 degrees F) Dec-Feb can damage plant crowns. Growers sometimes cover plants with row covers then.
2. Hot weather in March-April (above 85-90 degrees F) can kill flowers. Some growers give their plants cooling showers with short bursts of their irrigation on these very hot days. They generally don't continue this practice after harvest starts.
3. Rain during harvest damages fruit, makes pick-your-own customers reluctant to come to the farm, and encourages plant diseases. A rainy weekend can be a serious economic loss for a farmer.
4. Drought is not generally a problem, because farmers have drip irrigation. But if it is very dry in the summer, it can be hard to get the land ready, and extended drought can reduce irrigation water supplies in farm ponds.

The black plastic which NC strawberry farmers use raises the soil temperature in fall and winter, which helps the plants keep growing when the weather is cold and helps provide a larger harvest in the spring. Growers try to create nice firm beds with the plastic tight to the soil, so heat transfer to the soil is maximized. Clear plastic is sometimes used in California—your experiments may show that it actually transfers more heat. In the spring, when it gets hot, the black plastic can become a liability, as it makes the temperature even hotter at plant level. Some

growers raising types of plants that bear through the summer (day neutrals) therefore use white plastic instead, or coat the black plastic with whitewash in spring.

Row covers, made of spunbonded polyester, provide several degrees F. of protection against cold, with the amount depending how heavy the cover is and how warm the soil is when the covers are applied. They also provide a protected environment, shielding plants against the harsh, drying winds that often accompany cold weather. The row covers let air and moisture through, which clear plastic does not, and the row covers can be left on the plants for many days (though there is reduction of light to the plants). If clear plastic were used instead (as your experiment will show), the temperature would rapidly rise on a sunny day to a dangerously high level.

Websites where farmers go for weather information:
http://strawberries.ces.ncsu.edu/author/strawberries/
www.skybit.com/e-weather/agweather/ipm-strawberry-canopy/ (This is one of several subscription products, but this page gives the idea without having to subscribe.)

Ideas for teaching energy transfer:
Lesson plan and background on heat energy for plants.
www.uen.org/Lessonplan/preview?LPid=11067

www.vrml.k12.la.us/3rd/homework/science/unit_activities_SC/unit2/Un2_Act1.html

Assessment:

Student entries in science journals

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