Grade Level: 4

Title: What's With the Plastic? (July - Sept)

Purpose:

Students will learn that radiant energy can be absorbed or reflected by objects and converted into heat.

Subject Area(s) Addressed:

Science

4.P.3.1 Recognize the basic forms of energy (light, sound, heat, electrical, and magnetic) as the ability to cause motion or create change.
4.P.3.2 Recognize that light travels in a straight line until it strikes an object or travels from one medium to another, and that light can be reflected, refracted, and absorbed.

Social Studies

4.E.1.2 Understand how scarcity and choice in a market economy impacts business decisions.

ELA

4. ELA. RIT.3. Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.
4. ELA. RIT.9. Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.

Vocabulary:

absorption
black plastic
choice
economy
market
plasticulture
reflection
solarization

Materials Needed:

sample pieces of black plastic*
sample pieces of clear plastic*
sample pieces of white plastic*
measuring tools
cups
grass plugs (from someone's yard; use a bulb planter to cut them out)
rubber bands
* ordinary household garbage bags or similar plastics can be used for these; a sample of the black plastic used by strawberry farmers is available from the NC Strawberry Association to NC teachers on request or may be obtained from a farm

Teaching Strategy:

Part 1:

Present students with the following question: Why do farmers use black plastic in their fields? Allow students to brainstorm ideas and develop an hypothesis. Next, have students conduct an experiment to determine if their hypothesis is correct.

Experiment: Students will need 3 cups, 3 grass plugs, sample pieces of clear and black plastic and white paper to cover cups, and thermometers. Have students record the temperature of each cup before covering. (They should be the same.) Next, they will cover one cup with black plastic, one cup with clear plastic, and one cup with the white paper. Use rubber bands to secure the coverings on the cups. Place the cups in the window or under a lamp. Students will observe the three samples over the course of one to two weeks (use teacher judgment for duration). They will need to carefully remove the plastic to record the temperature each day and record their observations of the grass.

Students should see the grass die and soil temperature increase under the black plastic. Under the clear plastic, students should see condensation occur (greenhouse effect). The soil temperature should increase but the grass should still be living. The cup covered with white paper should show some dying grass and temperature should not be significantly different from original temperature. This cup should be the *reflective* cup.

Follow up the experiment with a discussion of reflection and absorption of light. Use your school's science resources to teach this concept. Now, make the connection with the strawberry farm/garden by discussing how plasticulture (use of plastic in farming) and solarization (use of light energy}, prepare the soil for planting.

Part 2: Once students have an understanding plasticulture and solarization, have students discuss, other benefits of using black plastic in the fields before planting. Students should understand how and why farmers decide to use plasticulture. Explain to students that this is a business choice farmers make that impacts the cost of production. Have students research the economic impact of using plasticulture. One reason plastic used is for the reasons covered in the experiment above -- more warmth. This allows the farmer to use a completely different system and grow varieties that they would not be able to if they grew on open ground (the matted row system). Weed control via plastic rather than herbicides is also a benefit.

Extension Activity:

Students can create mini-greenhouses using 2 plastic cups. In one cup, place soil and seeds. Water enough to set the seed. Cover with the other cup (lip to lip) and tape together. Set the mini greenhouse on the window sill or under a lamp. Watch it grow. This is a great way to see the water cycle as well.

Background Information:

When energy hits objects it can be reflected or absorbed. The absorbed radiant energy can be converted into heat (thermal energy). Black objects tend to absorb radiant energy. Shiny objects tend to reflect radiant energy. Radiant energy can be by the sun or by an artificial source.

What is energy?

Energy is the ability to do work, the ability to make a change. Everything that happens in the world involves a change of some kind, the exchange of energy in some way. The total amount of energy in the universe remains the same. When we use energy, we do not "use it up", we convert one form of energy into other forms. Usually the conversion of energy produces some heat, which is considered the lowest form of energy, since it dissipates into the surroundings and is difficult to capture and use again. Energy is categorized in many ways-by the forms it takes and by what it does-the changes it makes-the effects we can see or feel or measure.

Solar Energy

Solar energy is energy from the sun. The sun is a giant ball of hydrogen and helium gas. The enormous heat and pressure in the interior of the sun cause the nuclei of the two hydrogen atoms to fuse, producing one helium atom in a process called fusion. During fusion, nuclear energy is converted into thermal (heat) energy and radiant energy. The radiant energy is emitted from the sun in all directions and some of it reaches Earth.

Radiant Energy

Radiant energy is energy that travels in electromagnetic waves or rays. Radiant energy includes visible light, x-rays, infrared rays, microwaves, gamma rays, and others. These rays have different amounts of energy depending upon their wavelength. The shorter the wavelength, the more energy they contain.

Information is from The NEED Project in the Exploring Solar Energy Teacher guide http://www.need.org/

Black Plastic

The southeastern strawberry production system uses a special black plastic to cover the soil. Made for farming, this plastic is very thin yet strong and flexible. The flexibility of the plastic allows it to gently stretch over the soil without tearing. The black plastic warms the soil, acts as a mulch to suppress weeds, and conserve water. It also limits diseases by keeping fruit from contacting the soil. Agricultural black plastic is usually 5 feet wide and comes in rolls. New types of "virtually impermeable plastic" and "totally impermeable plastic" have made it possible for growers who fumigant to switch to using much smaller quantities of fumigants.

For information on use of plastic with school garden strawberries see http://cals.ncsu.edu/hort_sci/extension/documents/TeachFromTheGardenStrawberries.pdf

Plasticulture
This is the use of plastic in agriculture. This website gives an excellent overview for background information for teachers:
http://extension.psu.edu/plants/plasticulture

The **strawberry plasticulture system** is a high-density system that grows strawberries as annuals. This planting consists of closely spaced plants in double (or even triple) rows planted on raised beds covered with black plastic mulch and equipped with drip irrigation. Freshly dug plants or plugs are planted in late summer and removed after spring harvest.

For growers who *fumigate* their soil to before planting to control diseases and weeds, plastic mulch is essential, as it keeps volatile fumigants in the soil to do their work and to keep the applicators safe while the fumigants are being applied. (After a few weeks, the fumigants break down or have dissipated gradually.)

The advantages of plasticulture are uniform plant stands less affected by diseases, drought or weed competition; earlier fruit harvest; larger berry size; and shorter turnaround time from planting through harvest (eight months). One acre of strawberry plasticulture can produce the equivalent of 2.5 acres of matted row production. The disadvantages of the plasticulture system include higher initial cost and greater management skill.

The other major production system for raising strawberries in the United States, usually called "**matted row,**" is a perennial system that does not use plastic. Most growers in NC have transitioned to plasticulture but there are some smaller growers, especially in northwestern NC, who use matted row. In the matted row system plants stay in the ground for several years. Only 3000-5000 plants are set out per acre (compared to around 15,000 for plasticulture), and the rows fill in and widen out as runner plants from the original plants become established. In the matted row system, growers strive for three to four profitable crops from a single planting.

Light
Colors and Wavelength - White light is the mixture of many different light wavelengths, and each of these wavelengths has its own color. When an object is cast in white light it often reflects different wavelengths back, and these reflected wavelengths give the object its color. If no light is reflected and all of it is absorbed the object will appear black.

Conservation of Energy - The law of conservation of energy states that energy can never be created nor destroyed. It can be transformed into different types of energy, but the sum must always be the same.

Light to Heat - Because darker objects absorb more light, they retain more energy from sunlight. This energy cannot simply disappear, so the darker object releases the extra energy by emitting heat. Thus the more light an object absorbs, the more light energy it must transform to heat, and the warmer it will get in direct sunlight.

Read more: http://www.ehow.com/facts_7615191_dark-colors-absorb-heat.html#ixzz2ZWWLTIpW

Solarization - "Soil solarization is a nonchemical method for controlling soil-borne pests using high temperatures produced by capturing radiant energy from the sun."
www.ipm.ucdavis.edu/PMG/PESTNOTES/pn74145.html

Assessment:

Lesson 1:

Daily journal entries of observations and temperatures. Final journal entry on this lesson should reflect a clear knowledge of absorption and reflection of light. It should also include an explanation of light as a source of energy.

Lesson 2:

Participation in class discussion and research.

Exit ticket stating 2 economic benefits of using plasticulture. An exit ticket can be completed on a note card or sticky note. It should follow the 3-2-1 format - 3 facts the student learned, 2 interesting facts, and 1 question they still have.

This project was supported by the North Carolina Department of Agriculture and Consumer Services Specialty Crop Block Grant Program.