SciTech Activities: Energy Efficient Homes

Time: 4 hours (broken down into 4-1 hour classes)

Standards:
4th Grade Science Content Standards:

PS1g. Students know electrical energy can be converted to heat, light and motion.
I&E6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations.

5th Grade Science Content Standards:
ES4a. Students know uneven heating of Earth causes air movements (convection currents).
ES4c. Students know the causes of effects of different types of severe weather.
ES5a. Students know the Sun, an average star, is the central and largest body in the solar system and is composed primarily of hydrogen and helium.
I&E6. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations.

Topical Objectives:

- Students use infrared thermometers to explore the temperatures of various surrounding materials (car, school buildings, etc…)
- Students conduct experiments to identity how color affects the absorption of radiant energy.
- Students will be presented a **CHALLENGE** to use recyclable materials to build an energy efficient house
- Students design, construct and test energy efficient houses that will not increase/decrease temperatures rapidly in the sun/shade (The house challenge is to remain at a relative constant temperature).

Safety Rules:

Instruct student to handle infrared/ regular thermometers with care. If investigating temperature of cars, instruct students to be careful around the parking lot/cars.
When using heat lamps they will become hot. Caution the students not to touch the bulbs.

Materials:

(per group of 3-4 students):

Infrared thermometers
Blow dryer
Ping-pong balls
Wire basket
Regular thermometers
Stop watch
Heat lamps
Extension cords
Bookends
Duct tape
Various colored sleeves (white, black, silver and white)
Various fabric materials
Card stalk
Cardboard
Recycled plastic materials (bottles, meat trays etc…)
Construction paper
Foam board
Bubble wrap
Low temperature glue gun
Glue sticks
Scissors
Markers
Masking tape

Day one

Thermal Exploration

Preparation:

1. Find appropriate locations for the students to investigate thermal exploration (Black Top, inside the classroom, parking lot, grass field, rubber mat, cement, carpet etc…)

Procedure:

** Don't forget to take pictures of the students in action!**

1. Ask the students what they know about heat or temperature. How do you know if something is Hot/Cold? What instruments do you use to measure temperature?
2. Accept all answers and explain to the students that they will go on a Thermal Exploration. Have the students come up with at least 10 various locations (inside/outside) to conduct their experiments. Write the agreed locations on the board and in their notebooks.

3. Instruct the students on the proper procedure and handling of the infrared thermometers. Students will measure the temperature of various surfaces and record their findings. While the students are performing this activity, have them think about why some surfaces are at a higher temperature than others (Blacktop verse Grass).
4. When you come back to the classroom, briefly discuss the difference between heat and temperature. **Temperature** is a measurement of the average kinetic energy (movement) of the molecules in a substance. Temperature is measured in degrees. **Heat** is the total energy of molecular motion in a substance. It is heat that will increase or decrease the temperature. If we add heat, the temperature will become higher. If we remove heat the temperature will become lower. Higher temperatures mean that the molecules are moving, vibrating and rotating with more energy.
5. Using a blow dryer and an enclosed basket of ping-pong balls, you can demonstrate the molecular movement of a substance. First, you will show the students the basket of ping-pong balls and tell them that this represents molecules. The blow dryer represents the presence of heat. When you barely move the basket, the molecules (ping-pong balls) barely move as well. At this solid state the molecules have some movement, but very little energy. The next step is to turn on the hair dryer to a low level and observe the motion of the molecules. At this liquid state, the molecules are moving around faster and have more energy. The last step is to increase the hair dryer to the highest level and observe the motion of the molecules. At the gaseous state, the molecules are moving very quickly and have a lot of energy. Theoretically, the temperature of the 3 states would remain the same, but the heat (total energy of molecular motion) would increase with each step of the demonstration.
6. The thermal thermometers helped us to gauge the relative temperature of the various surfaces.

Science Notebooks Ideas:

Students will generate a list of 10 places/materials they will test with there infrared thermometers. Students will predict which items will have a higher/lower reading with their thermometers.
Students should bring their science notebooks on the Thermal Exploration and record the temperature of various object/materials.

Day Two

Testing absorbency of different colors and Planning for House Challenge

Preparation:

1. Set up tables with 1 heat lamp and 1 bookend. Secure the bookend with duct tape. Extension cords may be needed.

2. Set out samples of different colored sleeves (Black, white, brown, silver and fabric)
3. Locate thermometers

Procedure:

1. Show the students the different samples of paper sleeves and fabric samples. Have students write their 2 top choices to test in their notebooks.
2. Have one student from each table come up and choose their materials (paper samples and thermometers)
3. Before you start the investigation, have the students predict which paper sample/fabric will increase in temperature the most.
4. Demonstrate where the thermometers should be placed and how far they should be arranged under the heat lamp (thermometers should be placed ¾ into the paper sleeves and about 5-6 inches away from the heat lamps.
5. **Caution! Heat lamps can get hot**. Instruct the students not to touch the bulbs.
6. Record the student's results every 2 minutes (illustrated in the chart below). What is the temperature of the paper samples or fabric? Is the temperature increasing gradually? Does the color of your sample have an effect on the temperature? How does this relate to the Thermal Scanners from last class?
7. Think about the clothes you wear for the different seasons. You wear light or bright colors in the summer to reflect the sunlight and keeps you cool. In winter, you wear dark colors to absorb the sunlight and helps to keep you warm.

Planning for House Challenge

8. How do you think color or materials relates to our **House Challenge?** Discuss the different materials students may use to build a house (1 ft square-about the size of a single tile on the floor) similar to the Flood Challenge. In the case of the **House Challenge**, students must maintain a constant temperature when place in both a hot/cold environment.
9. Remind students the difference of the House Challenge and the Flood Challenge. The selected materials for their house need to keep a constant temperature (insulated materials-cotton, foam, bubble wrap, card board etc…) will help maintain an even temperature. In the Flood Challenge, students wanted materials that would keep the water out. Materials that were waterproof are not necessarily materials needed for insulating houses.
10. House materials can be several layers thick! Think about how houses are made- You have wood frames, stucco, sheeting, insulation, roofing materials, carpets and wallpaper.
11. Have the students come up with a House plan and the materials they intend to use.

Science Notebooks Ideas:

Students will discuss with their table and record their 2 top choices of paper sleeves or fabric samples. Generate questions on why there choices might have an impact on temperature. Have the students think about the Thermal Scanners

from last class. Did the surface, location or materials have an impact on temperature? Have the students make a chart with their 2 color choices at the top and 2 minute increments on the left side of their chart.

	Black paper	**Floral fabric**
Starting Temp.		
2 minutes		
4 minutes		
6 minutes		
8 minutes		
10 minutes (if time permits)		

Where their predictions correct? Does color have an effect on temperature? How will your results affect your house?
In their notebooks, each group of students should record what materials they will need for this challenge and draw what their structure will look like. (They can investigate the types of materials to help complete this segment of the challenge)

Day Three

House Challenge (Planning and Construction)

Preparation:

1. Provide various construction materials for the **House Challenge** (card stalk, foam board, bubble wrap, construction paper, low temp glue guns, extra glue sticks, tape, etc…)
2. Plug in glue guns
3. Cut foam board into smaller "workable" pieces

Procedure:

1. Remind the students of the "RULES" that were established for the **House Challenge.** Day 2 and 3 should be a planning and constructing phase.
2. After students have recorded and predicted if their building will maintain a constant temperature in hot/cold environments the, they will begin constructing and testing their houses.
3. Remind students the glue guns can become **hot** if plugged in too long!
4. Have students put names on their structures.
5. By the end of class, most groups should have a fair amount of work completed on their houses.

Science Notebooks Ideas: Students will record their material list and a construction plan of their house. If time permits, students can build a 2-story house.

Day Four

Testing and conclusion

Preparation:

1. Provide construction material and any other requested materials for student's houses.
2. Plug in glue guns
3. Scout out appropriate locations to test houses. For the hot temperature, an outside location might include the cement walkway or black top. For the cold temperature, an inside location might include the classroom or under a shade tree.

Procedure:

1. For the first part of the class, have the students continue working on their houses. Give them roughly 30 minutes to complete this project.
2. When the 30 minutes are up, record the starting temperature in their notebooks.
3. Have the students place a thermometer ½ of the way into the roof.
4. Place Houses in a **Sunny (HOT)** location for 15 minutes-recording the temperature every 2 minutes.
5. Place Houses in a **Shady (COLD)** location for 15 minutes-recording the temperature every 2 minutes.
6. Have the student return to the classroom. Where their house designs able to maintain a constant temperature in a Sunny/Shady location?

Notebook: Students should bring their notebooks when recording temperature changes. Have the students make predictions about the construction of their houses. Will their houses maintain a constant temperature? Will the materials of the house predict where the house might be built? What kind of materials are houses in the desert/mountains/islands made from?

Extensions:

- The absorbency of colors, thermal radiation and insulating materials could be further topics of student investigations on the effects of Global Warming. How does the effect of construction and depletion of natural resources play into this process?
- Solar Power-challenge students to use solar power to cool or heat up appliances in your home.

- Saving Energy-Have students come up with ways to save electricity in your home. What simple things can students change to make their house more energy effeicient?

Synthesis:

Everything in this universe is made up of matter and energy. Matter is made up of tiny building blocks- atoms. Atoms can be joined together to form molecules. The motion of atoms and molecules creates a form of energy called heat or thermal energy.

Energy can take on many forms and can change from one form to another. Many different types of energy can be converted into heat energy. Light (like our circuits), electrical, mechanical, chemical, sound etc…

Sometimes people interchange the words heat and temperature. There is a difference between the words and meanings. Temperature is the measurement of the average kinetic energy (movement) of the molecules in a substance. Temperature is measured in degrees. Heat is the total energy of molecular motion in a substance. It is heat that will increase or decrease the temperature. If we add heat, the temperature will become higher. If we remove heat the temperature will become lower. Higher temperatures mean that the molecules are moving, vibrating and rotation with more energy.

Research:

Heat and Energy:
http://coolcosmos.ipac.caltech.edu/cosmic_classroom/light_lessons/thermal/heat.html

Energy Quest (background information on energy source/projects)
http://www.energyquest.ca.gov/projects/index.html

Can the Color of Your House Reduce Your Energy Bill?
http://www.sciencebuddies.org/science-fair-projects/project_ideas/EnvEng_p012.shtml?from=Home