Soaking Up Solar Energy

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Grade 8 – Enriched and modified lab

**Note, I am a special education teacher in 8th grade Science using an inclusionary model. This lab has also been re-designed to differentiate for the different levels of students within the grade, but following the lesson plan and style of the regular education teacher.

Time frame: 2 days – 1 day for Engagement, Exploration, Explanation of lab, 1 day for Elaboration and Evaluation of lab

Concept: Solar energy is the radiant energy produced by the Sun. It is both light and heat. It, accounts for the majority of the renewable energy on Earth. Examples of solar energy include: space heating and cooling, distillation, disinfection, lighting, hot water, and cooking. Many houses, businesses, and schools are using solar panels, which help the environment as well as utility costs.

Wisconsin Science State Standard D: Physical Science Performance
Transfer of Energy:

D.8.8 Describe and investigate the properties of light, heat, gravity, radio waves, magnetic fields, electrical fields, and sound waves as they interact with material objects in common situations
D.8.9 Explain the behaviors of various forms of energy by using the models of energy transmission, both in the laboratory and in real-life situations in the outside world

Objective: Determine whether color has an effect on the absorption of solar energy and to relate the concept of whether color affects absorption to other applications.

Evaluation Questions:

1. Which soil had the greatest temperature change? Explain why this change occurred.

2. Explain why the curves on the graph flatten?

3. Why do flat-plate solar collectors have black plates behind water pipes?

4. Explain how the color of material affects its ability to absorb energy?

5. Why is most winter clothing darker in color than clothing in the summer?

Expand your Thinking:

6. What are ways we use solar power today?

Materials:

Dry black sand	3 250 ml beakers
Dry brown sand	3 thermometers
Dry white sand	Lamp with reflector
Ring Stand	Watch or Clock
Colored Pencils	Styrofoam cups
Graph Paper	Metric rulers

ENGAGEMENT

What will Teacher Do	**Eliciting Questions/Student Responses**	**What the Students Will Do**
After previous days discussions, examples, videos, write on board the following question: What do you know about solar energy? What are ways we can use this type of energy?	List on board responses from students about what they know about solar energy. Making sure they understand the relationship between the light from the sun to produce energy. Prompt students by asking more specific questions. What type of energy is solar energy – renewable or non-renewable? Why? …renewable source of energy, meaning it does not run out, it is continually being made.Illicit responses such as solar energy can be used for heating and cooling, running electricity in your house – such as lights, television, computer, being able to cook with solar energy.	Answer questions by reviewing notes, pictures, and diagrams from previous day's work/assignments.
Write on the board prediction question - Does the color of sand affect how much "heat" or energy will be absorbed through solar energy? Will there be a change in temperature? Students will be given their lab sheet and graph paper.	Students will write about which sand will heat up the quickest and the relationship between heat and temperature.	Write their prediction on lab sheet

EXPLORATION		
What Will Teacher Do?	**Eliciting Questions/Student Responses**	**What the Students Will Do?**
Students will break up to their 2 person lab groups and report to their assigned lab table (this is not the first lab of the year, students have already completed many labs thus far). Students will notice the lab stations are set up with the following material – ring stand, 3 Styrofoam cups, 3 thermometers, lamp, and lab protocol/directions. Students will follow along reading while teacher reads procedure for lab – fill each beaker with each colored sand to 25cm depth – sand is in buckets at front of room. Pour sand in the 3 styrofoam cups. Arrange the cups close together and place the thermometer in each cup until the bulb is covered completely with soil but only about a ½ cm deep. Take the temperature before you turn on the light at 0 minutes. Turn on your lamp and record the temperatures in all 3 cups every 30 seconds for 20 minutes. After 20 minutes, turn off the light and record your temperature for 10 minutes every 30 seconds. You will need to design a table for your observations. You will need to design your table to include the time intervals, temperature readings for each type of sand. **For students that have great difficulty in math	Ask students what they are noticing with the sand temperatures? What is causing this difference? Is the cup warming up? What can that be compared to? – ground, a pot with soil in it? What are you noticing once the light is turned off? Temperature is dropping. Which sand is dropping temperature the fastest? Explain that sand and sandy soils absorb heat more quickly but also lose it more quickly. Conversely, darker soils absorb but also release heat more slowly. Basically, why dark colored cars tend	Students will complete the lab following the outlined procedures on lab sheet with partner.

and processing concepts the table is modified to assist them in their data collection. Walk around the room listening to the student's discussions and questions.	to be hotter when you get in then light colored cars.	

EXPLANATION

What Will Teacher Do	**Eliciting Questions/Student Responses**	**What the Students Will Do**
Ask student groups to select a spoke person to present their data to answer which color of sand absorbed the most heat and quickest? Groups may have variation in times, teacher will ask and record the different times from each group that the temperature was the greatest. Give reasons why groups have different rates of temperature increase? Teacher will elaborate on how slight changes in the procedure could affect heat absorption.	Students will respond that the dark sand absorbed the heat the most and quickest. Students will explain why temperature rates might be different from each group – responses should include, amount of soil in cup, distance of light from soil, how far the thermometer bulb is in the soil with explanations.	Give responses orally to questions asked.
ELABORATION		

What the teacher Will Do	**Eliciting Questions/Student Responses**	**What will Student Do**
Students will now use data table to construct a graph. Attached to student's lab sheet is a graph. **modified graph is also attached for students who need assistance. Teacher reminds them the graph needs to be labeled correctly for X-axis and Y-axis as well as a title. Think	What should be plotted on the x-axis – time, and What should be plotted on the y-axis – temperature. What time intervals should be used on the x-axis – count by minutes – Why? – to clearly show the temperature increasing and decreasing. What temperature interval	Students will create graph.

about what time and temperature intervals should be used on each axis. Use different colored pencils to plot the data for each type of soil or use a computer to design a graph that illustrates your data.	should be used on y-axis? – some students will think by 1,2,3 – Teacher needs to explain that the graph is not big enough for that interval. Some will hope to say, count by 5's. That would be fine but if what if we skipped every other line? – the graph would be easier to read.	

EVALUATION

What the teacher Will Do	**Eliciting Questions/Student Responses**	**What will Student Do**
Administer a Summative Assessment - the Conclusion of the lab (found at end of lesson plan)		Students will answer the conclusion questions and turn in their completed lab report, showing all their data on their table and graph.

Soaking up Solar Energy Lab

Use the information below to complete lab and create your lab report, table, graph, and conclusion to be all turned in upon completion of lab and discussion.

Objective: Determine whether color has an effect on the absorption of solar energy and to relate the concept of whether color affects absorption to other applications.

Materials:

Dry black sand	3 250 ml beakers	Colored Pencils
Dry brown sand	3 thermometers	Graph Paper
Dry white sand	Lamp with reflector	Metric Rulers
Ring Stand	Styrofoam cups	Watch or Clock

Procedure:

- Fill each beaker with each colored sand to 25cm depth and our sand in the 3 styrofoam cups.
- Arrange the cups close together and place the thermometer in each cup until the bulb is covered completely with soil but only about a ½ cm deep.
- Take the temperature before you turn on the light at 0 minutes. Turn on your lamp and record the temperatures in all 3 cups every 30 seconds for 20 minutes.
- After 20 minutes, turn off the light and record your temperature for 10 minutes every 30 seconds.

Data and Observations:

- Design a table for your observations.
- Use the data from your table to construct a graph. Time should be plotted on X-axis and temperature should be plotted on Y-axis.
- Use different colored pencils to plot the data for each type of soil or use a computer to design a graph that illustrates your data.

Conclusion:

1. Which soil had the greatest temperature change? Explain why this change occurred.
2. Explain why the curves on the graph flatten?
3. Why do flat-plate solar collectors have black plates behind water pipes?
4. Explain how the color of material affects its ability to absorb energy?
5. Why is most winter clothing darker in color than clothing in the summer?
6. What are ways we use solar power today?

Name: _____
Date: _____
Class/Hour:_____

Title of Lab: _____

I. **Objective**: (What is the purpose of the lab?)

II. **Data and Observations**: (information you collect – drawings, data tables, graphs, and calculations)

Title of Data Table: _____

Time (min.)	Temperature (˚C) Dish Number		
:00			
:30			
1:00			
1:30			
2:00			
5:00			
10:00			
15:00			

Time (min.)	Temperature (˚C) Dish Number		
15:30			
16:00			
20:00			
Turn Light Off			
20:30			
25:00			
30:00			

III Conclusion (What did you do, learn, or find out in this lab?)

1. Which soil had the greatest temperature change?

2. Why do the curves on the graph flatten?

3. Why do flat-plate solar collectors have black plates behind the water pipes?

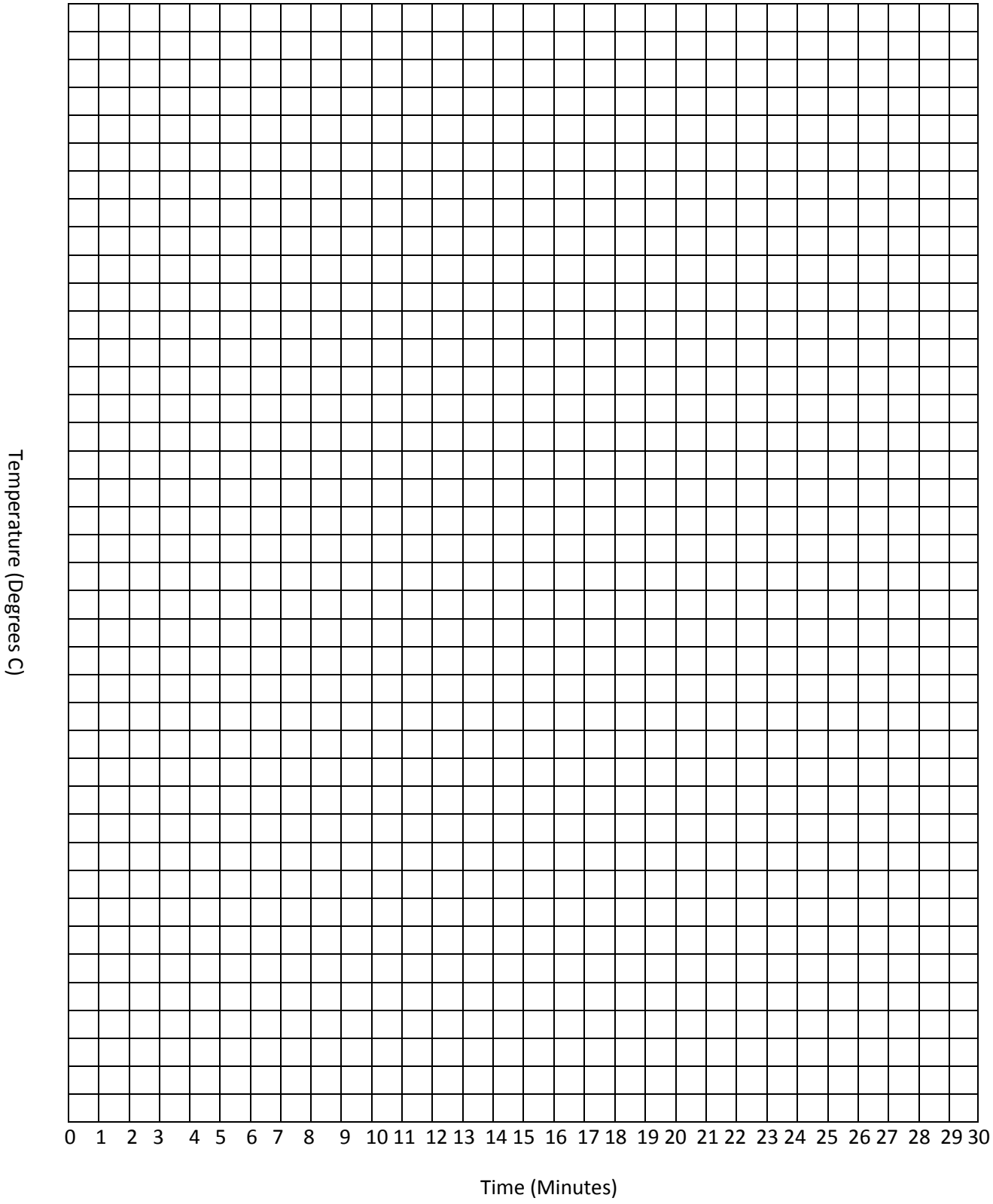
4. How does the color of a material affect its ability to absorb energy?

5. Why is most winter clothing darker in color than summer clothing?

Expand your thinking:

List ways we use solar power today.

Title of Graph: _____



KEY: