Name_____

Changing Planet: Black Carbon – a Dusty Situation

Background

As energy from the Sun reaches the Earth's surface, some of it is reflected and some of it is absorbed. The percent energy reflected or absorbed is defined as albedo, and the greater the reflectivity, the greater the albedo. All of the Earth's surfaces, natural and manmade, absorb and reflect energy differently; generally darker surfaces such as soil will absorb a greater amount of energy than ice or snow, which reflects between 80-90% of incoming solar energy. As surface features change, so will the Earth's planetary albedo. One way that the Earth's surface has changed is from the deposition of black carbon. Black carbon is generated by fossil fuels, as well as through burning biomass. In this investigation, you will explore how the Earth's albedo changes through the deposition of various amounts of black carbon.

Lab Question

How does an increase in black carbon impact surface warming?

Hypothesis

Use this space to create a hypothesis that addresses the above question.

Materials per lab team

4 thermometers
Portable lamp (a flexible desk lamp works well)
100 - 150 Watt incandescent light bulb
Stopwatch
Clear tape
Quarter sheet of 10%, 50%, and 80% dot paper
Quarter sheet of white paper
Graph paper

Procedure

1. Acquire all the lab materials. Create a pocket out of each piece of paper by folding them in half and sealing one side with a small piece of tape. These pockets will hold your thermometers during data collection.

2. Place a thermometer in each pocket so that the bulb is covered and the most numbers above 15°C are visible. Arrange all four pockets under the lamp so they each receive the same amount of energy from the lamp. Do not turn on your lamp! At this point call your teacher over to check your lab set-up.

3. Once you receive approval from your teacher record the initial temperature of each thermometer in the data table below. Decide who will take each of the readings so that the temperatures are read efficiently at each time interval. Caution: do not remove the thermometer from the pocket since this will affect your readings!

4. Turn the lamp on and record the temperature from each thermometer every 2 minutes for 20 minutes.

5. Turn the lamp off, and continue to record the temperature for another 20 minutes.

Data Table

	Time (min)	White Paper Temp (°C)	10% Dots Paper Temp (°C)	50% Dots Paper Temp (°C)	80% Dots Paper Temp (°C)
Starting Temp	**0**				
Heat-Up Time	**2**				
	4				
	6				
	8				
	10				
	12				
	14				
	16				
	18				
	20				
Cool-Down Time	**22**				
	24				
	26				
	28				
	30				
	32				
	34				
	36				
	38				
	40				

6. Create a multi-line graph of temperature vs. time using a different color line for each set of temperatures. Place the independent variable "time" on the x-axis, and the dependent variable

"temperature" on the y-axis. Title your graph "Heating and Cooling Related to the Amount of Black Carbon on the Surface"

7. Clean up your lab station, and answer the questions below.

Analysis

1. Identify what each of your materials represents in the real world.

Lamp: _____

Paper with dots: _____

White paper: _____

2. Study the lines on the graph.

Which surface heated the quickest? _____

Which surface heated the slowest? _____

Which surface cooled the quickest? _____

Which surface cooled the slowest? _____

3. Using the terms absorption, reflection and radiation describe the results of your investigation. Be sure to talk about your data in your response!

4. How does your team's results compare to the results of the other teams? Explain any differences there may be.

Conclusion

1. Explain how well your model works to explain what is found in the real world as related to excess black carbon.

2. Explain any limitations your model has in attempting to explain what happens in the real world.

3. What would you do differently in the future to enhance your model?

Application

1. Is the impact of black carbon a global issue or regional issue? Explain your reasoning.

2. Use references to learn more about this topic. In particular, learn how scientists measure the amounts of black carbon on the Earth's surface, and where they do their research.

3. Use references to learn about ways to reduce the amount of black carbon. Which ones can be "scaled-up" and used around the world? Which ones have a local impact? Be prepared to share your findings with the class.