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Lab Activity: Heating and Cooling from the Earth Clouds vs. NO Clouds Paper version

Background:

You may have noticed that on a warm summer day, the sand at the beach is often uncomfortably hot, while the water seems cool to the touch as you wade in. If you have ever gone swimming in the evening or early in the morning, you may also have noticed that the reverse seems to be true. The water at those times seems to be warmer than the sand. Temperature differences such as these are not imaginary; they are real and not at all unusual. In fact, observations made with thermometers placed in the air above the water and sand will verify that the air, as well, is cooler above the water during the day and warmer above the water at night. Additionally, careful observation of air movement above the land and water surfaces reveals the existence of convection circulation; warm air rising above the sand in the day with cooler air sinking over the water. This type of air circulation is sometimes referred to as a land or sea breeze. Land breezes occur during the night and sea breezes occur during the day.

Problem:

You will be given some information and data about a laboratory setup designed to help you study land and water temperature changes as land and water are heated and cooled by the process of radiation. How does soil and water compare in their ability to absorb radiant energy?

***Objectives*: you should be able to:**

1. Compare the rates of temperature change of cover soil surface and no covered soil surface when heated and cooled.
2. Describe the effects that land masses have on the temperature of the air above them when one is cover (clouds) and the other is no covered.

Materials:

Lab sheet Writing utensil

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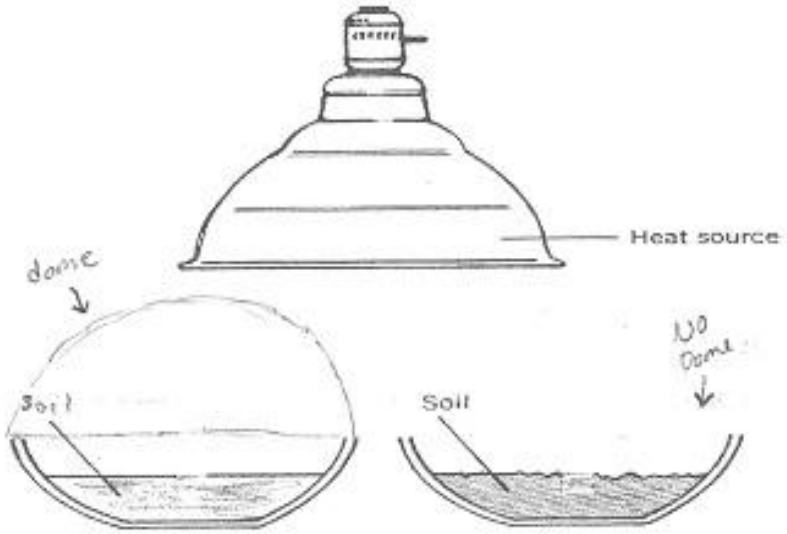
The diagram to the right was the set up to compare temperature changes of covered soil and no covered soil that were warmed by radiation from a heat source. The containers were heated for 10 minutes and then allowed to cool for 10 minutes following the removal of the energy source. A thermometer was placed in each container so that the bulbs were just beneath the surface of the material. The heat source was positioned so that it was the same distance from each container. Temperature readings were recorded each minute during both the heating and cooling periods. The results of the investigation are contained in the Data Table on the next page.



P*ROCEDURE*

DATA TABLES

TIME (min)	0	1	2	3	4	5	6	7	8	9	10
Temperature (°C) No Cover SOIL	20.0	21.0	22.0	23.0	24.0	26.0	27.0	28.5	30.0	31.0	32.0
Temperature (°C) Cover SOIL	20.0	20.5	21.0	21.5	22.0	22.0	22.5	22.5	23.0	23.0	23.0

TIME (min)	11	12	13	14	15	16	17	18	19	20
Temperature (°C) No Cover SOIL	32.0	31.0	30.5	29.5	28.0	27.0	26.0	25.0	23.5	22.0
Temperature (°C) Cover SOIL	22.5	22.5	22.0	22.0	22.0	21.5	21.5	21.0	21.0	20.5

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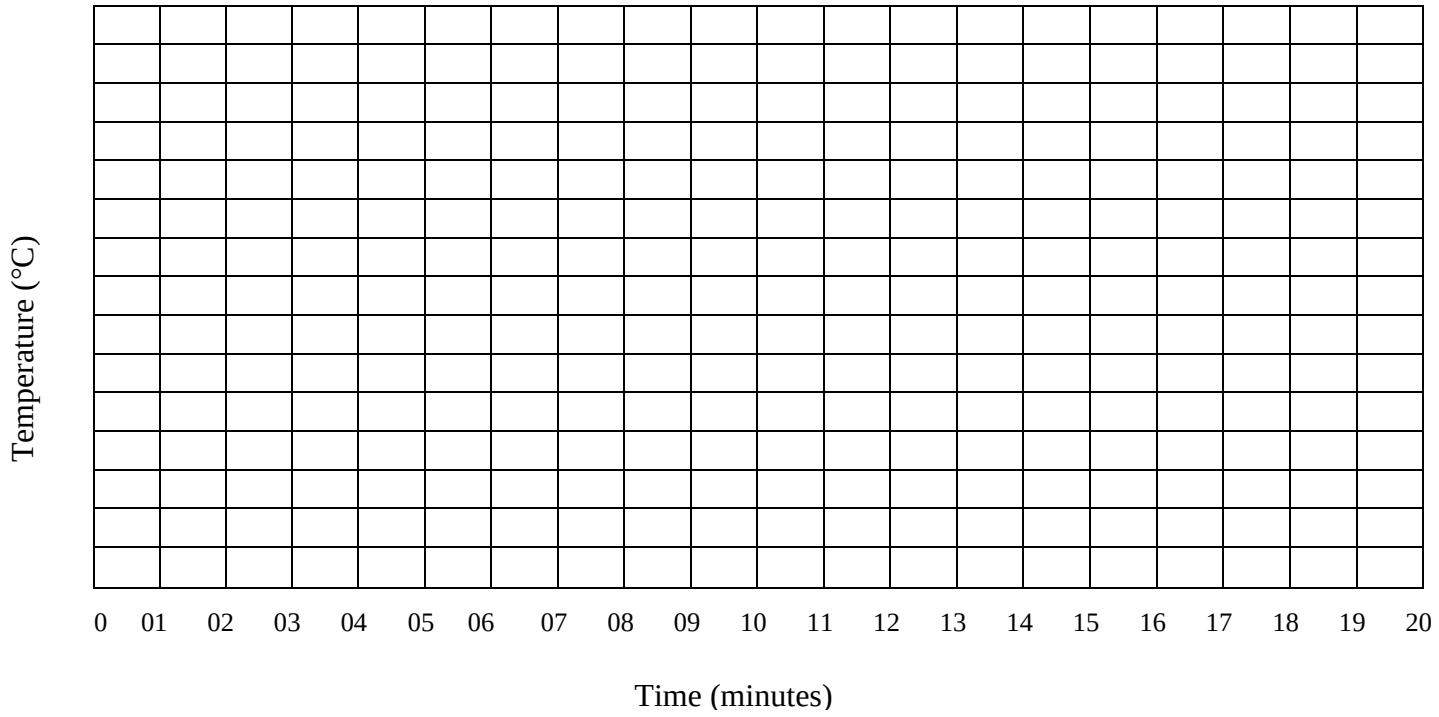
Using the information in the Data Table, construct a graph on the grid provided. Your graph should show the relationship between temperature changes and time for the materials in both containers. Plot a single curve for each substance. Graph should include your name, date, title, axis, & key



Analysis: Summing up Cloud vs NO cloud Conclusion

1. **Which container showed the greatest temperature change during the 20-minute cooling period?**
   - **a. Covered**
   - **b. Uncovered**

SELECT the best representation for each object

2. **Heat Lamp**
3. **Bowl of soil**
4. **Dome Bowl**

   - **a. The land**
   - **b. The ocean**
   - **c. The sky**
   - **d. The Sun**

5. **Which material received more energy from the lamp?**
   - **a. Domed SOIL**
   - **b. No cover SOIL**
   - **c. NEITHER**
6. **Which material heated more rapidly?**
   - **a. Domed SOIL**
   - **b. No cover SOIL**
   - **c. NEITHER**
7. **Which material cooled more rapidly?**
   - **a. Domed SOIL**
   - **b. No cover SOIL**
   - **c. NEITHER**

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8. **SELECT the best answer for which rate of temperature change that occurred above the soil in each of the two containers.**
   a. **Both started about the same temperature but neither cooled quickly**
   b. **Both started about the same temperature but the covered cooled more quickly**
   c. **Both started about the same temperature but the uncovered cooled more quickly**

9. **What object on the earth produces the same effect as the plastic cover produced on the soil?**
   a. **The atmosphere**
   b. **The clouds**
   c. **The oceans**
   d. **The Sun**

10. **What might have happened if you had used nontransparent cover?**
    a. **Light enters, and inside temperate would rise**
    b. **No light enters, but the inside temperate would rise**
    c. **No light enters, and the inside temperate would fall**

11. **How does the model help to explain why very cold nights often occur when the sky is completely clear?**
    a. **Clouds act "like" a blanket releasing the heat and keeping cooler air out**
    b. **Clear skies allow heat to escape and cooler air rushes in**
    c. **Clear skies allow heat to escape but the ozone layer traps warm air in**

12. **The specific heat of a substance is the quantitative measure of its heat capacity. It is defined as the ratio of the heat capacity of a substance to the heat capacity of water. Materials having high specific heat show relatively little temperature change when heated. Which material, water or soil, appears to have a higher specific heat?**
    a. **SOIL with no cover**
    b. **SOIL covered**

13. **On the non-dome soil, how would the temperature vary when the lamp is turned off?**
    a. **Temperature would increase**
    b. **Temperature would decrease**
    c. **Temperature would remain the same**

14. **On the dome covered soil, how would the temperature vary when the lamp is turned off?**
    a. **Temperature would increase slowly**
    b. **Temperature would remain the same**
    c. **Temperature would decrease slowly**

15. **Was the Graph done correctly? The Student:**
    a. **Plotted the lines but did not include: Title, Author of graph, Date, Key**
    b. **Plotted the lines but did not include: Author of graph**
    c. **Plotted the lines but did not include: Key**
    d. **Plotted the lines but did not include: Date**
    e. **Plotted the lines & include: Title, Author of graph, Date, Key**