NAME: DATE: class:

Lab Activity: Heating and Cooling from the Earth
Soil vs. Ocean 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 land and water surfaces when heated and cooled.
2. Describe the effects that land and water masses have on the temperature of the air above them.

Materials:

Lab sheet Writing utensil

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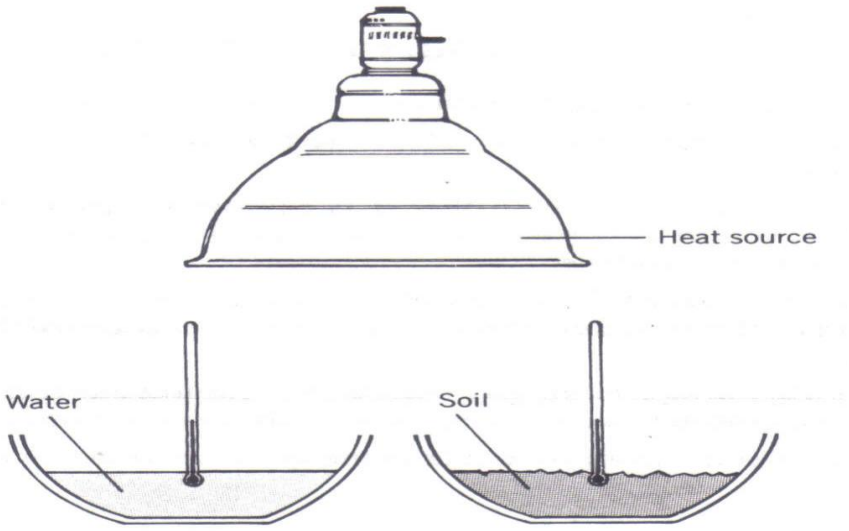
The diagram to the right was the set up to compare temperature changes of dry soil and water surfaces that were warmed by radiation from a heat source. The containers were heated for 10 minutes and then allowed to cool for 10 minutes following the removal of the energy source. A thermometer was placed 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 minutes 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) 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) WATER	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) SOIL	32.0	31.0	30.5	29.5	28.0	27.0	26.0	25.0	23.5	22.0
Temperature (°C) WATER	22.5	22.5	22.0	22.0	22.0	21.5	21.5	21.0	21.0	20.5

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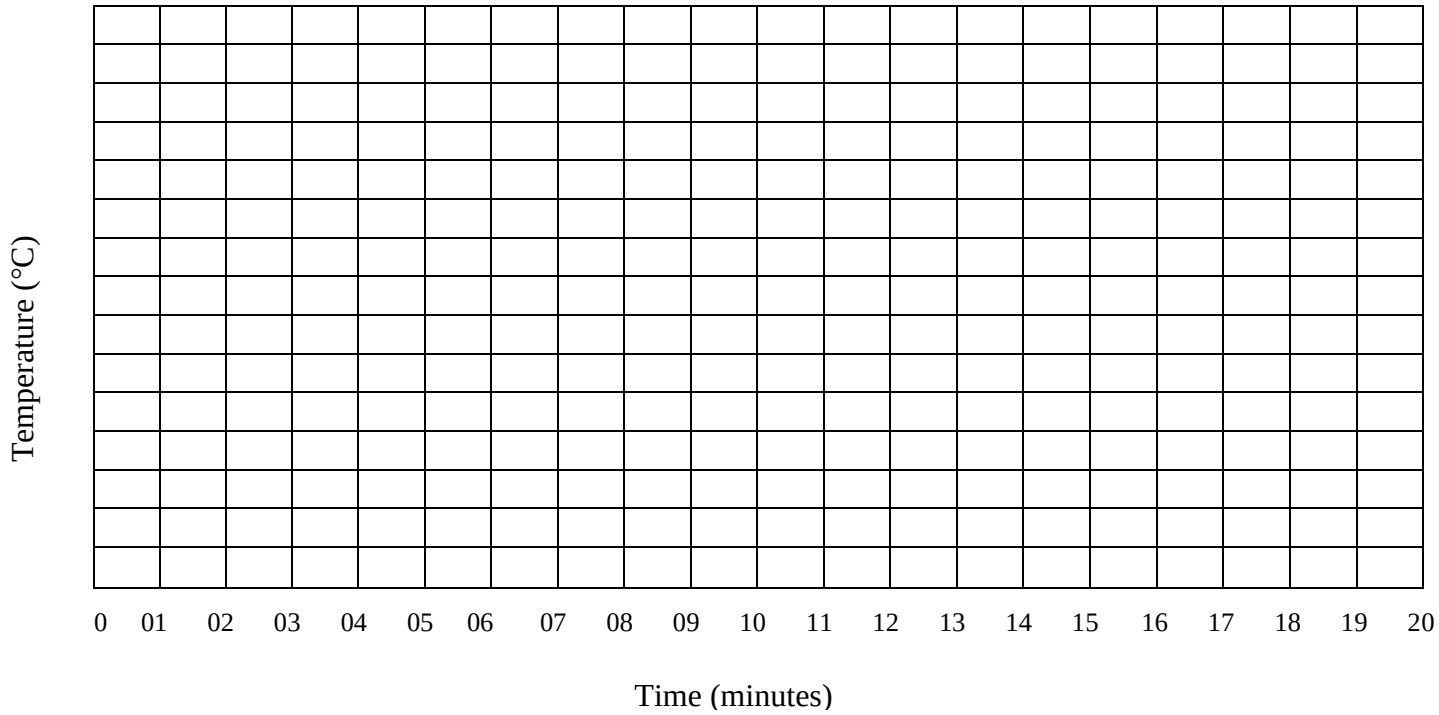
Using the information in the Data Table, construct a graph on the grid provided. Your graph should show the relationship between temperature changes and time for the materials in both containers. Plot a single curve for each substance. Graph should include your name, date, title, axis, & key



Summing up SOIL vs OCEAN Conclusion

1. **Why was it important to remove the lamp after it was turned off?**
   a. **Heat lamp will continue to radiate heat**
   b. **Heat lamp will NOT radiate heat but draw the heat to it**
   c. **Heat lamp will cause a problem with reading the temperature**

SELECT the best representation for each object

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

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

5. **Which material received more energy from the lamp?**
   a. **SOIL** b. **WATER** c. **NEITHER**
6. **Which material heated more rapidly?**
   a. **SOIL** b. **WATER** c. **NEITHER**
7. **Which material cooled more rapidly?**
   a. **SOIL** b. **WATER** c. **NEITHER**

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8. **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** b. **WATER**

9. **How would the differences in the heating and cooling rates of land and water surfaces affect atmospheric conditions above them?**
    a. **The air mass above the land or water DOESN'T takes on the characteristic of that area**
    b. **The air mass above the land or water DOES takes on the characteristic of that area**
    c. **The air mass above the land or water has no effect on it**

10. **How would temperature variations in soil and water surfaces affect air pressures in the atmosphere above them?**
    a. **The temperature above the land/water DOESN'T takes on the air pressure**
    b. **The temperature above the land/water DOES takes on the air pressure**
    c. **The air pressure above the land/water has no effect**

11. **How would pressure variations affect the way the wind blows from a land breeze?**
    a. **Pressure would change from high to low or from land to sea**
    b. **Pressure would change from low to high or from sea to land**
    c. **Pressure would NOT change**

12. **How would pressure variations affect the way the wind blows from a sea breeze?**
    a. **Pressure would change from high to low or from land to sea**
    b. **Pressure would change from low to high or from sea to land**
    c. **Pressure would NOT change**

13. **On land, how would temperature vary from day to night?**
    a. **Temperature would increase**
    b. **Temperature would decrease**
    c. **Temperature would remain the same**

14. **On land, how would temperature vary from night to day?**
    a. **Temperature would increase**
    b. **Temperature would decrease**
    c. **Temperature would remain the same**

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**