Inquiry Investigation 7-A

Specific Heat Capacity of Earth Materials

The amount of light reflected by different surfaces changes the amount of heat in the Earth system. In this investigation, you will use light to heat materials and test each material's specific heat capacity.

Skill Check

Initiating and Planning

✓ Performing and Recording

✓ Analyzing and Interpreting

✓ Communicating

Safety Precautions

- Use caution when handling the lamp; the light bulb will become very hot.

Materials

- three 600 mL beakers
- scoopula
- 100 mL dark-coloured soil
- 100 mL light-coloured sand
- 100 mL cold water
- 100 W light bulb
- lamp or light bulb socket with clamp
- 3 thermometers or temperature probes
- 3 ring stands (optional)
- 3 thermometer clamps (optional)
- clock, watch, or stopwatch
- graph paper
- coloured pens or pencils (optional)

Question

How do different materials absorb and release electromagnetic radiation?

Procedure

1. In your notebook, draw two tables similar to the ones shown below. Give each table a title.

Table 1

Materials	Starting Time (min)	Starting Tempature (°C)	Warming Temperature at Each Minute (°C)
Soil			
Sand			
Water			

Table 2

Materials	Starting Time (min)	Starting Tempature (°C)	Cooling Temperature at Each Minute (°C)
Soil			
Sand			
Water			

2. Put 100 mL of soil in one of the beakers, 100 mL of sand in a second beaker, and 100 mL of water in the third beaker.
3. Place the beakers on a desk or workbench. Position the lamp about 30 cm above the beakers so that each receives about the same amount of light.
4. Place a thermometer or temperature probe in each beaker. Adjust the position of the thermometers or probes so that they are well covered by the material in the beakers but not in contact with the glass. You may use ring stands and clamps to keep the thermometers in place.

5. In your first data table, record the starting temperature of the material in each beaker.
6. Turn on the lamp and note the time (or start the stopwatch). Record the temperature for each beaker every minute for 10 min.
7. After 10 min, turn off the lamp. In your second data table, record the temperature for each beaker every minute for the next 10 min.
8. Clean up and put away the equipment you have used. Soil and sand should be collected for re-use and should not be placed in the trash or in drains.
9. Use the data from your tables to graph the heating and cooling of each of the materials. Use a different colour or symbol for each material.

Analyze and Interpret

1. Which material absorbed the most thermal energy in the first 10 min? Which material lost the most thermal energy in the last 10 min?
2. Identify any sources of error in this investigation.

Which material absorbs and releases heat most rapidly?

Conclude and Communicate

3. **a.** Of the three materials you used, which would heat up the fastest on a sunny day?
   b. Which would take the longest to cool down at night?
4. How might the type of surface (such as dark rock, water, snow) in an area affect the temperature of the atmosphere above it?

Extend Your Inquiry and Research Skills

5. **Inquiry** Use 50 mL water to moisten the sand and the soil samples. Repeat the temperature measurements. What differences did you observe? How does water affect the rate at which the soil and sand heated up and cooled down?
6. **Research** Research the specific heat capacity of the following Earth materials: granite, water, ice, and asphalt. Predict which material would increase the temperature of the atmosphere above it most rapidly. Design an experiment to test your prediction.

Data Analysis Investigation 7-B

Skill Check

Initiating and Planning

Performing and Recording

✓ **Analyzing and Interpreting**

✓ **Communicating**

Comparing Ecoregions of Canada

Understanding local and global climate concerns starts with understanding your local climate. In this investigation, you will identify the ecoregion and ecozone in which you live. Then, you will compare that ecozone and ecoregion to other areas of Ontario and Canada.

Materials

- map of Canadian ecozones
- map of Ontario ecoregions

Question

How do the ecoregions of Ontario compare to other ecoregions in Ontario and in Canada?

Analyze and Interpret

1. Look at the map of Canada's ecozones on page 287. Identify and record the ecozones that are found in Ontario.
2. Identify the ecozone in which you live.
3. How many ecoregions are located in Ontario? Describe the breakdown of ecoregions by ecozone.
4. Use the map on page 287 to identify the ecoregion in which you live.
5. The table on the next page summarizes the characteristics of each of Ontario's ecozones. Use the table to compare the boreal forest ecozone with the Hudson plains ecozone. Summarize how they are different and how they are the same.
6. Use a Venn diagram and the information in the table to summarize how the mixed-wood ecozone differs from the boreal forest ecozone.

This tree is part of the mixed-wood forest in Algonquin Park, Ontario.

Conclude and Communicate

7. Why have some of the ecozones not attracted much human habitation?

8. All of these ecozones are expected to become warmer and drier as climate changes. Compare how this change will affect life in the ecozones in Ontario.

9. Why is understanding the different ecoregions and ecozones of the world important? How do humans use this information?

Extend Your Inquiry and Research Skills

10. Research Some scientists predict that the ecozones of Canada will shift as a result of global warming. Research these predictions and create a map that shows how Canada's ecozones may be distributed in the future if current climate trends continue.

11. Research The location of major cities hasn't changed much in Ontario since humans began building permanent housing, but throughout world history cities have been founded and abandoned based on climate changes. Research this phenomenon and make a multimedia presentation that describes how a warmer, drier climate may affect where Ontario's big cities are likely to be located in 2100.

Characteristics of Ecozones in Canada

Ecozone in Ontario	Mean Temperatures and Location	Vegetation	Landscape	Defining Features
Hudson plains	• summer high +15°C or below • winter –30°C or below • on south edge of Hudson Bay	• scrub above the tree line • bushes, flowers, aquatic vegetation below the tree line	• flat, wet clay plains drained by many rivers • mostly swamps and bogs, some rocks	• endless black flies and mosquitoes • animals not used to human presence • this region is very lightly settled by humans
Boreal forest	• summer high below +20°C • winter low –20 to +40°C • north of a line from Sudbury to North Bay (the north half of the road map)	• primarily forest–mostly coniferous, some birch and beech • shrubs and grass	• flat, swampy clay plains with rivers in north • hilly with many lakes and rivers, but little soil in south	• most of the forest is second or third growth • large animals exist but are comfortable with human presence • settlements are areas near highways, on rivers for lumber and paper mills, or at mines
Mixed-wood forest	• summer high 15–25°C • winter low above –20°C • south of a line from Sudbury to North Bay (the south half of the road map)	• mixed coniferous and deciduous trees–maple, pine, originally oak • mostly logged and developed as farms or cities, though forest has reclaimed the northern portions	• thin soils and lots of lakes and rivers in north • well-drained, fertile soils in south with few rivers or lakes • gentle hills	• human population is not restricted to areas near major highways • little original vegetation remains • most large, native animals have been extirpated • farming is possible

Data Analysis Investigation 7-C

Skill Check

Initiating and Planning

Performing and Recording

✓ **Analyzing and Interpreting**

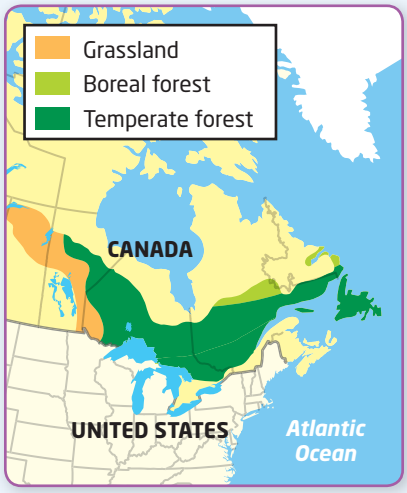
✓ **Communicating**

Comparing the Effects of Climate Change on Vegetation in Canada

Predictions made by climate scientists suggest that significant warming will occur in Canada over the next century as a result of global warming. How could this warming trend affect the living things in southern Canada? In this activity, you will evaluate the change in land cover that could occur in Ontario as a result of these climatic and ecological changes.

Present Land Cover

Projected Land Cover in 100 Years



Organize the Data

1. Use the map labelled "Present Land Cover" to answer the following questions:
   - **a.** Which vegetation zones are represented in Ontario?
   - **b.** Which vegetation zone currently covers the largest area of the boreal shield?
2. Use the map labelled "Projected Land Cover in 100 Years" to answer the following questions:
   - **a.** What vegetation zones do scientists predict will exist in Ontario a century from now?
   - **b.** What vegetation zone is projected to cover the largest area of the boreal shield in 100 years?

Analyze and Interpret

1. Why didn't the boreal forest biome move northward in the second map?
2. What human activities may lead to the expansion of grasslands in western Canada?

Conclude and Communicate

3. The economy of communities in the boreal shield region is based heavily on natural resources. The forestry industry of Québec and Ontario produces nearly $20 billion in exports each year. How might the projected shift in vegetation affect this industry?
4. If all of Canada's vegetation zones shift northward as a result of climate change, how would the permanent ice biome be affected?

Extend Your Inquiry and Research Skills

5. **Inquiry** In the Niagara fruit belt in southern Ontario, farmers grow cherries, peaches, strawberries, and grapes for harvest in June through September. How do you think the projected shift in climate and vegetation will affect the Niagara fruit belt?