Lab Activity – Testing Thermal Storage Materials

Introduction

The purpose of this activity is to test the thermal storage capabilities of several materials that could be used as thermal mass.

Before You Start

Review the vocabulary words from the Reading Passage. Ask your teacher if you are unsure of any of the meanings. Divide up all the steps in the Lab Activity first, so that everyone has a clear job to do.

Materials

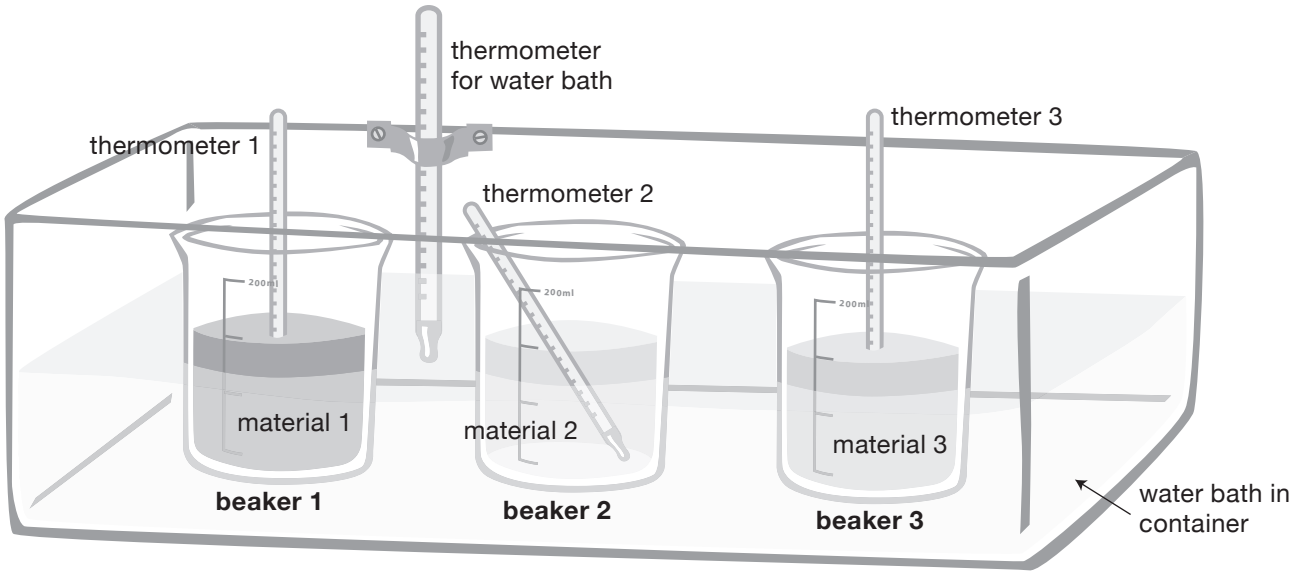
Obtain an equipment kit from your teacher. Check that it contains the following materials:

- 200 ml of any 3 test materials your teacher has prepared
- 3 small thermometers
- 1 lab thermometer
- 3 beakers to hold test materials
- 1 liter of ice water OR
- 1 liter of hot water at 85° C approximate
- container to hold beakers
- goggles
- gloves

Performing the Experiment

(wear goggles, use gloves)

1. As directed by your teacher, obtain 200 ml of each material you will be testing: sand, paper or other material.
2. Place 200 ml of one test material in beaker #1, 200 ml of the second test material in beaker #2, and 200 ml of the third test material in beaker #3. If you are using a more dense material as the teacher instructs, fill the beaker halfway then place the thermometer into the material and finish filling the beaker. You should avoid forcing a thermometer into dense materials because the thermometer may break.
3. Place a small thermometer in each beaker you will test. Be sure the test material covers the bottom of the thermometer.
4. Record the starting temperatures of the test materials on your Data Table.
5. Place your 3 beakers to be tested into the container.
6. Take 1 liter of either hot or cold water as directed by your teacher and pour the water into the container with the 3 standing beakers.
7. Place a separate thermometer in the water bath.
8. Read and record on your Data Table the temperature of the test materials and the water bath every minute for 10 minutes.
9. Dispose of the contents of your beakers as directed by your teacher.



Lab Report Form – Testing Thermal Storage Materials

Date _____

Purpose of this lab is to _____

_____

Instructions:

Follow the instructions listed in the Lab Activity and record your measurements in the Data Table below. Once you have completed all the measurements and calculations, answer the questions at the end of this form and create a graph according to your teacher's instructions.

DATA TABLE. Temperature Measurements of Thermal Mass In Water Baths

Time	Material: _____ Temperature of Material	Material: _____ Temperature of Material	Material: _____ Temperature of Material	Temperature of Water
Start				
00:01				
00:02				
00:03				
00:04				
00:05				
00:06				
00:07				
00:08				
00:09				
00:10				
Total Temperature Change				

1. Which material retained its initial temperature the longest? _____
2. Which material changed its initial temperature the quickest? _____
3. How did this lab help you determine how thermal storage works? _____

   _____
4. According to your teacher's instructions, create a graph with the data you have collected.

STUDENT DATA SHEET

Assessment Questions

1. What local materials do you think would provide good thermal mass?

   _____

   _____

2. Which material used in the activity kept its starting temperature the longest? _____

   Why? _____

3. How is landscaping used in an energy efficient home design?

   _____

   _____

Multiple Choice Questions

1. Passive solar design:
   a) is useful in all climates
   b) depends on proper house orientation
   c) can save you money
   d) all answers a, b, and c

2. The sun is:
   a) higher in the sky in winter
   b) the same height in winter and summer
   c) lower in the sky in winter
   d) lower in the sky in summer

3. The direct-gain system is dependent on:
   a) south-facing design
   b) correct sun angles
   c) any sun angle
   d) answers a and b

4. An example of thermal mass is:
   a) adobe
   b) styrofoam
   c) shade
   d) glass

5. Landscaping can:
   a) change the sun's position
   b) be thermal storage system
   c) be a direct gain glazing
   d) reduce energy costs

6. The Trombe wall is:
   a) a fire wall
   b) a glass covered thermal mass wall
   c) vented on top and bottom
   d) b and c

7. Deciduous means:
   a) evergreen
   b) indecisive
   c) losing leaves in autumn
   d) a flowering bush

8. Solar contribution is greatest in
   a) Lufkin and Corpus Christi
   b) El Paso and Lubbock
   c) Brownsville
   d) Houston

9. Generally in Texas:
   a) Cooling is more of a problem than heating.
   b) Having east-facing windows is important.
   c) Porches are unnecessary for shade.
   d) a and b

10. In order to keep a home cooler:
    a) shade trees are used
    b) blinds for windows are shut during the day
    c) hot air spaces are allowed to be vented
    d) all answers a, b, and c

Understanding the Reading Passage

1. Solar orientation is locating and positioning a home on a piece of land so that it takes advantage of the sun for its heating and cooling needs.
2. Thermal mass is a material that gains and loses heat slowly. Examples include concrete, brick, tile, etc.
3. They contain a large amount of thermal mass that can help store heat from the sun and can be enhanced by adding a fan to distribute air to different parts of the house.
4. A thermal mass wall on the south side of a home that is covered in glass allows heat to be collected and stored. The heat can be circulated to the home by natural air movement or by vents.
5. Deciduous trees and bushes can prevent the sun from entering and heating a home thereby keeping the home cool. In the winter their bare branches allow sunlight in the home to keep it warm.
6. Accept students' answers. Both Figures show how a house design can impact the amount of solar heat on a home.

Assessment Questions

1. The local materials will vary among concrete, brick, adobe, etc.
2. Answers will vary depending on lab results. In general, more dense materials will retain their starting temperature the longest.
3. Well planned landscaping with deciduous trees can provide shade, especially on the west side of the house in the summer, and can allow sunlight to filter into the home in the winter. Plants and grass around the home are cooler than rocks and concrete, which create thermal mass in the yard, making the house hotter.

Multiple Choice Questions

1 d; 2 c; 3 d; 4 a; 5 d; 6 d; 7 c; 8 b; 9 a; 10 d

Vocabulary Definitions

architect – a person who designs buildings

climate – the weather pattern in a region over a long period of time

deciduous – a tree whose leaves shed each year at the end of the period of growth, often in autumn

dense – thick, packed closely together

direct-gain – solar radiation directly entering and heating living spaces, such as south-facing windows that admit heat from the winter sun and warm the room's air

indirect-gain – storing or trapping heat so that it can be used in other parts of a building, such as a room with a substantial amount of thermal mass (concrete, adobe, brick, water, etc.), with many windows through which the thermal mass captures the heat from the sun and releases the stored heat at night

passive solar – using or capturing solar energy without any external power

solar collector – device that collects solar radiation and converts it into heat energy

thermal mass – a dense material that gains or loses heat slowly; examples are concrete, adobe, stone, brick and water

Trombe wall – a glass covered thermal mass wall on the south side of a home that uses small vents in the top and bottom to allow warm air to flow into the house

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