Adult Basic Education

Science

Earth Systems 1109

Weather Dynamics

Curriculum Guide

Credit Value: 1

Earth Systems Concentration
Earth Systems 1109 Earth Systems 3109A Earth Systems 3109B Earth Systems 3109C

Table of Contents

To the Instructor

I. Introduction to Earth Systems 1109

Earth Systems 1109, *Weather Dynamics*, is the first course in the Earth Systems concentration of the Adult Basic Education program. It helps students understand why our weather continually changes by exploring how energy from the sun interacts with the atmosphere, land, and hydrosphere. It explores how forecasters apply their knowledge of global and local factors to improve the accuracy of their forecasts. Finally, it examines the formation of some extreme weather events and their effects.

There is no pre-requisite for this course and the concepts in the course are not necessarily pre-requisite for completion of the other courses in the Earth Systems concentration. However, if students are planning to do the remainder of the Earth Systems courses, it is recommended that they first complete Earth Systems 1109.

Earth Systems 1109 is equivalent to the Earth and Space Science portion of Science 1206 in the current High School program.

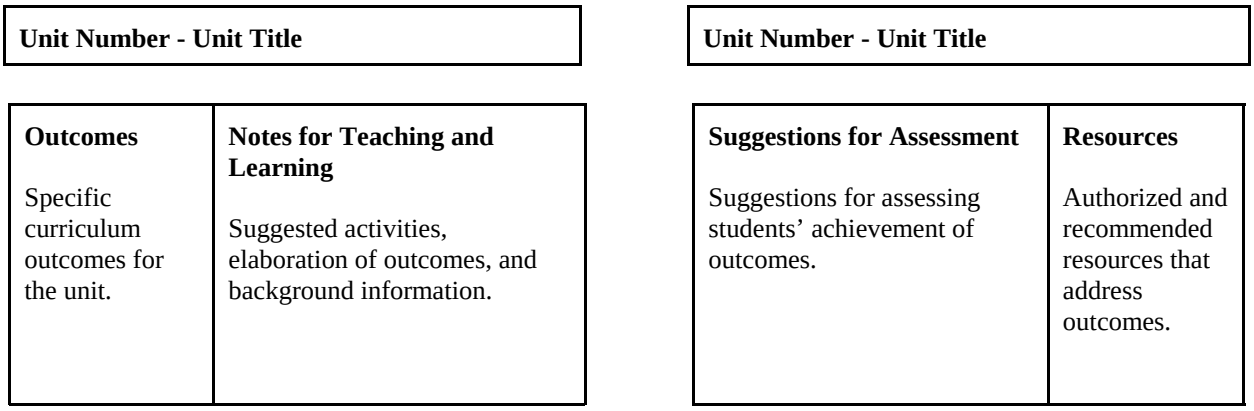
* Note: Students cannot receive credit for both Earth Systems 1109 and Science 2100B since there is too much overlap of content between these two courses.

To the Instructor

II. Curriculum Guides

Each new ABE Science course has a Curriculum Guide for the instructor and a Study Guide for the student. The Curriculum Guide includes the specific curriculum outcomes for the course. Suggestions for teaching, learning, and assessment are provided to support student achievement of the outcomes. Each course is divided into units. Each unit comprises a **two-page layout of four columns** as illustrated in the figure below. In some cases the four-column spread continues to the next two-page layout.

Curriculum Guide Organization:
The Two-Page, Four-Column Spread



III. Study Guides

The Study Guide provides the student with the name of the text(s) required for the course and specifies the sections and pages that the student will need to refer to in order to complete the required work for the course. It guides the student through the course by assigning relevant reading and providing questions and/or assigning questions from the text or some other resource. Sometimes it also provides important points for students to note. (See the *To the Student* section of the Study Guide for a more detailed explanation of the use of the Study Guides.) The Study Guides are designed to give students some degree of independence in their work. Instructors should note, however, that there is much material in the Curriculum Guides in the *Notes for Teaching and Learning* and *Suggestions for Assessment* columns that is not included in the Study Guide and instructors will need to review this information and decide how to include it.

IV. Resources

Essential Resources

Nelson Science 10
Nelson Science 10 Teacher's Resource for Unit 4 - Weather Dynamics

Recommended Resources

Science 1206 Curriculum Guide:

http://www.ed.gov.nl.ca/edu/sp/sci_1206.htm

Nelson Publishing Web Site:

http://www.science.nelson.com

Computerized Assessment Bank for Nelson Science 10, Nelson.

Science 10 Teacher's Resource, Applied Supplement.

Other Resources

Center for Distance Learning and Innovation: http://www.cdli.ca/

V. Recommended Evaluation

Written Notes	10%
Labs/Assignments	20%
Test(s)	20%
Final Exam *(entire course)*	50%
	100%

The overall pass mark for the course is 50%.

Weather Dynamics

Unit 1 - Global Weather Dynamics

Outcomes

1.1 Differentiate between weather and climate.

1.1.1 Explain what is meant by weather dynamics.

1.1.2 Explain the difference between weather and climate.

1.2 Explain how energy can be transferred.

1.2.1 Identify the sun as the source of Earth's energy.

1.2.2 Describe radiation, conduction, convection and advection.

1.3 Explain the reflection and absorption of energy on the Earth's surface.

1.3.1 Define heat sink and heat capacity.

1.3.2 Recognize that the hydrosphere and atmosphere are the Earth's main heat sinks.

Notes for Teaching and Learning

In order to understand global weather patterns, instructors should ensure that students are familiar with some of the basic facts about the orientation of the Earth relative to the sun, the conventions of longitude and latitude and why more solar energy reaches areas close to the equator, the ways in which the Earth moves (rotation and revolution), and the reasons for the annual cycle of the seasons. Students who have recently completed the ABE Level II course, *IS2015 - Planet Earth*, will have some familiarity with these concepts.

Some background in energy transfer is required before investigating its role in weather. Students should briefly review the kinetic molecular theory, page 260, and apply this theory to explain heat energy transfer. Students should understand that radiation, conduction, convection and advection all contribute to the Earth's weather.

It would be useful to have a globe and a world map in the classroom as students work through this course. Instructors should ensure that students understand why the globe is tilted.

Students should identify the sun's energy as the source of all life and the cause of changing weather systems on a global scale. They should understand that although the sun is our primary energy source, we do not absorb all incoming solar energy.

Instructors should ensure that students understand the albedo effect and explain the important role that it plays in the reflection and absorption of solar radiation.

Unit 1 - Global Weather Dynamics

Suggestions for Assessment

Students should answer all questions in the Study Guide for this unit, and their written work should be assigned a mark to be used as part of the final evaluation for the course.

Students will be introduced to many new terms throughout this course. Instructors could suggest that students start a vocabulary list and add to it regularly as they work through the unit.

There are many opportunities for links between the Science and English courses in ABE. For example, students could be asked to write a paragraph describing normal climatic conditions for their area and compare that to the actual weather condition that they are experiencing.

Blackline Master 13.2, "*How Much Do I Know*",* can be used for assessment of students' understanding of some of the concepts in this section (question 2 could be omitted).

Students could be assigned questions from "*Understanding Concepts*" on page 503 and 507.

Students could complete Investigation 13.3, "*Seasons and the Angle of Sunlight*".

* The Blackline Masters referred to in this Curriculum Guide can be found in the *Science 10 Teacher's Resource*.

Resources

Science 10 , Chapter 13, pages 500 - 541, covers the outcomes for Unit 1.

Science 10, Teacher's Resource, Unit 4, Weather Dynamics.

Science 10, Teacher's Resource, Applied Supplement.

Science 10, Computerized Assessment Bank.

The Center for Distance Learning and Innovation website: http://www.cdli.ca/

Textbook web site: http://www.science.nelson.com/

Unit 1 - Global Weather Dynamics

Outcomes

1.4 Investigate the effects of solar radiation on water and land surfaces.

1.5 Using scientific theory, describe and explain heat transfer and its consequences in both the atmosphere and hydrosphere, relating this science to natural phenomena.

1.5.1 Identify and describe the principal characteristics of layers found in the atmosphere.

1.5.2 Identify the distribution of common gases (oxygen, nitrogen, water vapour, and carbon dioxide).

1.5.3 Investigate the relationship between altitude, temperature, and atmospheric pressure.

1.6 Describe the development of winds in the atmosphere.

1.6.1 Identify the different prevailing winds around the Earth.

1.6.2 Explain the importance of convection and the Earth's rotation in causing prevailing winds.

Notes for Teaching and Learning

Outcome 1.3 will be achieved through completion of **Core Lab # 1**, *"Heat Absorption and Radiation of Water and Soil"*, found in Appendix A.

Project Atmosphere Canada (PAC) is a collaborative initiative of Environment Canada and the Canadian Meteorological and Oceanographic Society (CMOS) to foster the teaching of atmospheric sciences and related topics in Canada. This collection of introductory papers and learning activities may be used as a resource to provide additional reference material.

The emphasis is on description rather than explanation of the factors related to the rotation of the Earth and their effects on the movement of air masses and the variation in temperature.

Try This Activity, "*Twisting Winds*", page 517 could be done to help students understand why winds twist the way they do. Blackline Master 13.6b, *"How Do I Hit a Moving Target"*, could be used to supplement this activity.

Unit 1 - Global Weather Dynamics

Suggestions for Assessment

Students should submit a Lab Report for the Core Lab. This report should be used as part of the evaluation for the course. Instructors could use Skills Handbook Q, Lab Reports, in the text as a guide for the preparation of student reports.

Students could be asked to complete all or selected parts of Activity 13.5, "*Pressure of the Atmosphere*", pages 514 - 515. Students may be asked to submit a lab report.

Resources

Core Lab #1, "*Heat Absorption and Radiation of Water and Soil*", Appendix A.

Blackline Master 13.6b, "*How Do I Hit a Moving Target*".

Skills Handbook Q, Lab Reports.

Project Atmosphere Canada (PAC)
www.msc-smc.ec.gc.ca/education/teachers_guides/index_e.html

Unit 1 - Global Weather Dynamics

Outcomes

1.7 Identify and describe the principle characteristics of the hydrosphere.

1.7.1 Describe the water cycle.

1.7.2 Describe water distribution in the hydrosphere.

1.7.3 Identify the importance of oceans in weather dynamics.

1.7.4 Describe the causes and effects of ocean currents.

1.8 Describe and explain the development of clouds in the atmosphere.

1.8.1 Identify and define the three main categories of clouds: convective, frontal, and orographic.

1.8.2 Classify clouds into their separate types.

1.8.3 Describe the conditions necessary to form fog.

Notes for Teaching and Learning

So far in this unit students have studied the various components of weather and climate. In order to understand how these components work together and to help prepare for the rest of the course, students should study Section 13.13, "*A Global Weather Model*".

Students should focus on the four major steps of the water cycle: evaporation (page 501, 535), condensation (page 530-534), precipitation (page 556-557), and runoff. This will provide the basic understanding of the water cycle to allow students to investigate more advanced topics throughout this unit.

In defining cloud classification, students should understand the environmental conditions under which clouds form.

Cloud classification should include the use of prefixes such as nimbus - holding rain, alto - medium height, and cirrus - high level clouds. Blackline Master 13.11a, "*Classification of Clouds*", could be used to explain cloud names and types.

Parts of Newfoundland have a distinct reputation as having "*foggy weather*". Students could examine local weather conditions that contribute to fog production. Instructors could ask students to explain examples of weather-related phenomena which are illustrations of heat storage (of water): e.g., (I) fog formed by warm moist air over snow cover; (ii) fog formed by cold air over warm water; (iii) cloud formation in the atmosphere producing rain or freezing into ice/snow. Refer to page 532.

Unit 1 - Global Weather Dynamics

Suggestions for Assessment

Blackline Master 13.8, "*The Saga of the Water Molecule*", could be used to review the water cycle. Instructors should note that this is a group activity.

Applied Blackline Master 13.8, "*The Water Cycle*", can be used for review and assessment.

Blackline Master 13.11 b, "*Classification of Clouds*", could be used for practice and testing purposes.

There are no questions assigned in the Study Guide on Section 13.13, "*A Global Weather Model*". Instructors may design questions or use questions from the "*Understanding Concepts*" section on page 537 and give as an assignment.

Blackline Master 13.13, " *What's the Weather Factor?*", can be used for review.

Instructors could assign questions from Chapter 13 Review on pages 540 -541.

Instructors should assess the student's level of understanding of the unit by reading student answers to questions from the Study Guide and providing feedback.

Instructors should ensure that all necessary terms are being added to the student's vocabulary list and provide students with ideas about how to successfully remember definitions.

This is the end of Unit 1 which covers the material in Chapter 13 of the text. Instructors could give a unit test that is used as part of the course evaluation. Suggested test items can be found in the assessment bank that accompanies the text and on the CDLI site.

Resources

Blackline Master 13.8, "*The Saga of the Water Molecule*".

Applied Blackline Master 13.8, "*The Water Cycle*"

Blackline Masters 13.11 a and b, "*Classification of Clouds*".

Blackline Master 13.13, "*What's the Weather Factor?*".

Science 10, Computerized Assessment Bank.

The Center for Distance Learning and Innovation website: http://www.cdli.ca/

Unit 2 - Forecasting the Weather

Outcomes

2.1 Define meteorology.

2.2 Define a weather system.

2.3 Describe and explain how moving air masses affect weather.

2.3.1 Identify air masses (tropical, polar, maritime, continental).

2.3.2 Identify weather conditions associated with maritime polar, maritime tropical, continental polar, and continental tropical air masses.

2.3.3 Define air mass and explain how it forms.

2.3.4 Describe the development of low pressure (cyclone) and high pressure (anticyclone) systems.

2.3.5 Define front and distinguish between the four types of fronts formed along pressure systems.

Notes for Teaching and Learning

The CDLI site has a very useful lesson on *"Air Masses, Frontal Systems, and Weather Systems*" that instructors could use to help explain these concepts.

Students should understand that air masses originate at the North and South of the Northern Hemisphere. Prevailing winds (westerlies) cause the air masses to move primarily from the west to the east.

Students should know and understand why low pressure systems carry stormy weather while high pressure systems carry fair weather. They should also understand that most fronts are found at mid-latitudes where air masses meet. Students should identify the four major types of fronts that occur: warm front, cold front, occluded front and stationary front.

Unit 2 - Forecasting the Weather

Suggestions for Assessment

Students should answer all questions in the Study Guide for this unit and their written work should be assigned a mark to be used as part of the final evaluation for the course.

Resources

Science 10 , Chapter 14, pages 542 - 574, and "*Interpreting and Creating Weather Maps*", pages 683-685, cover the outcomes for Unit 2.

Unit 2 - Forecasting the Weather

Outcomes

2.4 Use print and/or electronic sources to collect weather data from regional and national weather observational networks.

2.4.1 Prepare a report showing local weather data collected for a three-day period.

2.4.2 Recognize and explain weather symbols seen on weather maps.

2.5 Analyze meteorological data for a given time span and predict future weather conditions, using appropriate technologies and methodologies.

2.6 Investigate localized air movement (thermals, sea breezes and land breezes) and its effect on regional weather.

2.6.1 Explain what is meant by a thermal.

2.6.2 Distinguish between sea breeze and land breeze.

Notes for Teaching and Learning

Instructors should introduce the students to various symbols often seen on weather maps. Students should be able to read a basic weather map. Instructors will need to provide students with a current weather map in order to complete question 2.8 in the study guide. Environment Canada's website is a good source for a weather map. Alternately, the local newspaper could be used.

To reinforce the concepts learned, students will complete Case Study 14.3, "*Three Days of Canadian Weather*", on page 550 of the text as part of the assignment for this unit.

Instructors could copy Applied Blackline Master 13.1, "*Looking at Weather Maps*", to help explain how to read weather maps.

The assignment for this unit can be carried out individually or in groups. Students will collect the following weather data over a three-day period: maximum and minimum temperature, humidity, air pressure, wind speed and direction, type of cloud cover and the type and amount of precipitation.

Instructors could encourage students to identify weather trends and make predictions based on them. For example, decreases in temperature usually occur with northeasterly winds.

Instructors could have students use diagrams to explain the cause and consequences of sea breezes, land breezes, and the relative motion of air currents.

Applied Blackline Master 14.4, "*Drifting With the Breeze*", can be used as a transparency or photocopy to explain thermal updrafts.

Unit 2 - Forecasting the Weather

Suggestions for Assessment

In order to assess the student's ability to read weather maps and to better identify weather patterns and make predictions, instructors should have students complete the assignment as outlined in the Study Guide. Additional factors for tracking could be included.

The "*Map for Tracking Weather Patterns*" and the data sheet, "*Developing a Forecast*", are both needed for the assignment and are included in Appendix A. Students could also be asked to graph the data collected for the assignment.

The assignment should be marked and the mark used as part of the evaluation for this course.

Resources

Environment Canada's imaging database: http://weatheroffice.ec.gc.ca/satellite/

Environment Canada: http://www.weatheroffice.ec.gc.ca/canada_e.html

Appendix A, "*Map for Tracking Weather Patterns*" and "*Developing a Forecast*".

Applied Blackline Master 13.1, "*Looking at Weather Maps*".

Applied Blackline Master 14.4, "*Drifting With the Breeze*".

Unit 2 - Forecasting the Weather

Outcomes

2.7 Understand the various forms of precipitation.

2.7.1 Define precipitation.

2.7.2 Explain the formation of various types of precipitation (drizzle, rain, freezing rain, snow, sleet, hail, dew, frost).

2.8 Understand humidity and its effects.

2.8.1 Define humidity and relative humidity.

2.8.2 Identify the instrument used to measure relative humidity.

2.9 Describe examples of technologies that contribute to the field of meteorology. (Include weather satellites, weather balloons, ground-based technology, and computer technology.)

Notes for Teaching and Learning

Blackline Master 14.5, "*Forms of Precipitation*", can be used as a transparency or photocopy to explain how precipitation forms.

Students could be asked to explain POP (probability of precipitation) and why it is included on forecasts.

If available, students should use a psychrometer to measure relative humidity.

Students should be aware that the forecasting of weather has progressed from local observations made by individuals to a co-ordinated worldwide effort. Students should examine some of the technologies that have made this possible.

Unit 2 - Forecasting the Weather

Suggestions for Assessment

Instructors could have students individually, or as groups, research a technology that has improved the collection and/or analysis of data related to weather forecasting. Such technologies might include Doppler Radar, infrared and visible imaging from satellites, fog detectors, precipitation detectors, remote sensing and transmission data stations. This activity provides a good opportunity for a link with the English program.

Students could be asked to complete Investigation 14.7, "*Measuring Relative Humidity*".

Instructors could assign questions from Chapter 14 Review on pages 576-577.

Instructors should assess the student's level of understanding of the unit by reading student answers to questions from the Study Guide and providing feedback.

Instructors should ensure that all necessary terms are being added to the student's vocabulary list and provide students with ideas about how to successfully remember definitions.

This is the end of Unit 2 which covers the material in Chapter 14 of the text. Instructors could give a unit test that is used as part of the course evaluation. Suggested test items can be found in the assessment bank that accompanies the text and on the CDLI site.

Resources

Blackline Master 14.5, "*Forms of Precipitation*".

Investigation 14.7, "*Measuring Relative Humidity*", pages 562 - 563.

Unit 3 - Extreme Weather Events

Outcomes

3.1 Examine the causes and effects of severe weather systems.

3.1.1 Describe and explain the development of extreme weather events such as thunderstorms, tornados, floods, droughts, hurricanes, and blizzards.

3.1.2 Describe and explain the effects of extreme heat and cold

3.1.3 Identify the impact of severe weather systems on economic, social and environmental conditions.

Notes for Teaching and Learning

At any given time there will likely be an opportunity for students to recognize extreme weather events somewhere in the world, perhaps even here in their own province. Instructors could discuss such events with students.

There are many websites that provide current and historical information about extreme weather events. Some of these are listed in the Resources for this unit. Instructors should direct students to explore some of these websites.

Blackline Masters 15.6a and b, "*The Formation of Hurricanes*", can be used to help explain cyclone formation and the transformation into a hurricane.

Unit 3 - Extreme Weather Events

Suggestions for Assessment

Instructors should assess the student's level of understanding of the unit by reading student answers to questions from the Study Guide and providing feedback.

While there is no additional assignment in the Study Guide for this unit, there are many opportunities for research and presentation. This allows for links with the English program.

Blackline Master 15.6c, "*Hurricanes in Canada*", can be used as an assignment to examine the economic effects of hurricanes in Canada.

This is the end of Unit 3 which covers the material in Chapter 15 of the text. Instructors could assign questions from Chapter 15 Review on pages 618 - 619.

A final exam that covers the entire course should be given and the mark used as at least 50% of the final mark for the course.

Resources

Science 10 , Chapter 15, pages 578 - 617, covers the outcomes for Unit 3.

Some websites for severe weather:

http://severewx.atmos.uiuc.edu/

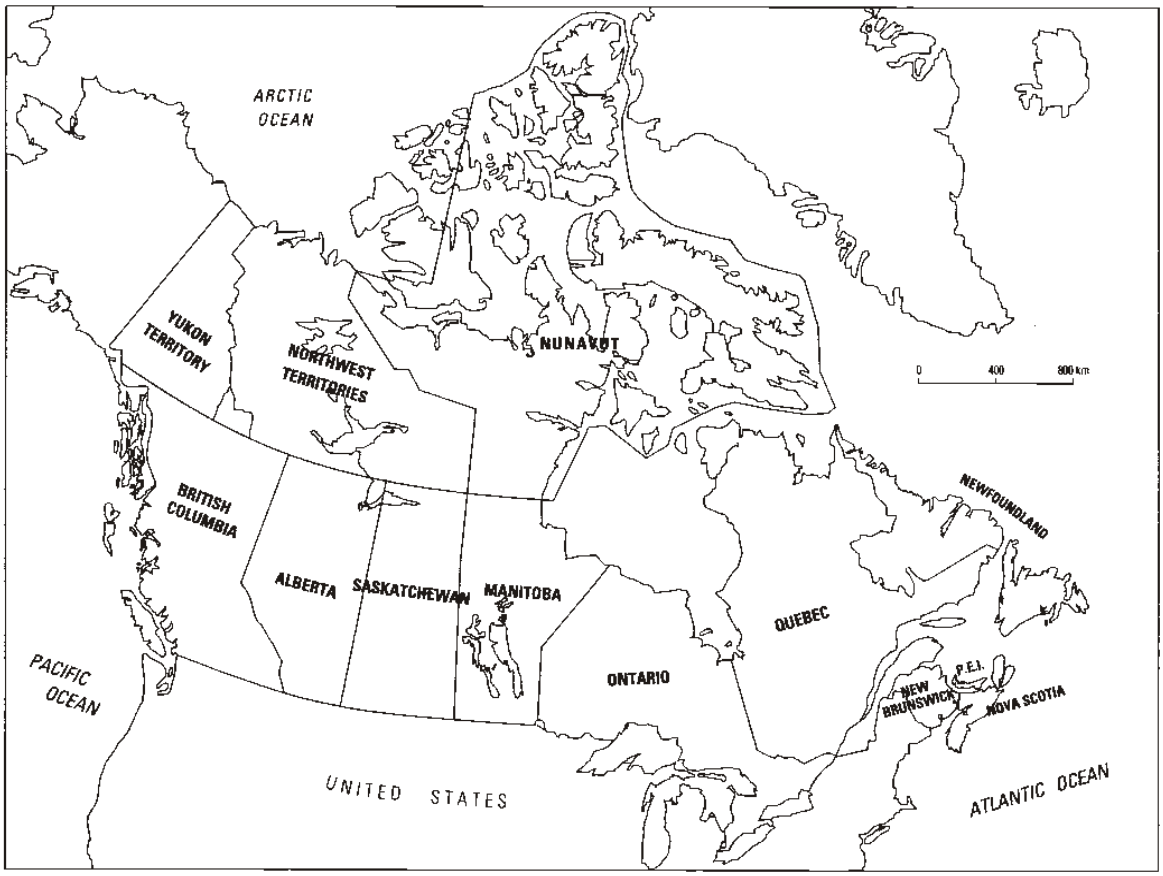
http://australiasevereweather.com/

Blackline Masters 15.6a and b, "*The Formation of Hurricanes*".

Blackline Master 15.6c, "*Hurricanes in Canada*".

Appendix A

Map for Tracking Weather Patterns



Developing a Forecast

Factor	Day 1	Day 2	Day 3	Forecast: Day 4	Actual: Day 4	Forecast: Day 5	Actual: Day 5
Maximum Temperature							
Minimum Temperature							
Cloud Cover							
Precipitation							
Wind (Speed/Direction)							
Other Factors (UV Index, Air Quality, etc.)							

Core Lab #1

Heat Absorption and Radiation of Water and Soil

In this investigation, you will set up the materials listed below to investigate heat flow in soil and water. Recall that different materials have different heat capacities and this will influence heat flow.

Hypothesis: State a hypothesis in the space below.

Purpose: To investigate heat capacities associated with different materials.

Materials:
2 containers for soil and water (small aquariums work well)
dry soil/sand
water
200 watt lamp with reflector
ring stand
four thermometers

Procedure: Set up the materials as seen in the diagram below. During the set up keep the following points in mind;

- The light source should be no higher than 30 - 40 cm above the containers.
- The light source is to be located between the two containers.
- Two thermometers are to be positioned approximately 1 - 2 cm above the soil/sand and water.
- The remaining two thermometers should be positioned approximately 2 - 3 cm below the surface of the soil/sand and water.

Turn the lamp on and start recording temperatures from the four thermometers and record this data on Table 1. Temperature readings are to be taken every minute for ten minutes. After the tenth reading, turn the lamp off and continue recording temperatures every minute for an additional ten minutes. Record this data in Table 2.

Diagram:

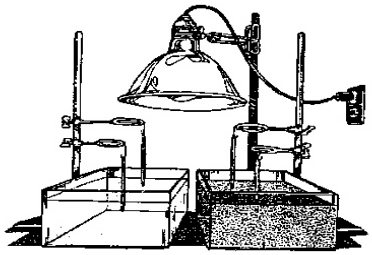


Table 1 - Light On				
	Temperature (°C)			
Time (min)	Above Water	Within Water	Above Soil/Sand	Within Soil/Sand
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Table 2 - Light Off				
	Temperature (°C)			
Time (min)	**Above Water**	**Within Water**	**Above Soil/Sand**	**Within Soil/Sand**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Analysis and Conclusions:

1. Graph your data.

2. What do you notice about the temperature of the air above the soil/sand and water for the 20 minute duration? Briefly explain.

3. Which material received more heat from the lamp during the first 10 minutes, the water or the soil/sand? Explain why?

4. Explain why the temperature change in the water and soil/sand occurred at different rates.

5. Which material lost heat the quickest? Explain.

6. Define **heat sink** and **heat source** and explain how the terms relate to the experiment. From your results, which material would be the better heat sink?