Adult Basic Education

Science

Earth Systems 1109

Weather Dynamics

Study Guide

Prerequisites: None

Credit Value: 1

Text: *Science 10* ; Ritter, Plumb, et al; Nelson, 2001.

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

Table of Contents

To the Student

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 will help you understand why our weather continually changes by exploring how energy from the sun interacts with the atmosphere, land, and hydrosphere. It will explore how forecasters apply their knowledge of global and local factors to improve the accuracy of their forecasts. Finally, it will examine the formation of some extreme weather events and their effects.

If you are planning to do the remainder of the Earth Systems courses in ABE, it is recommended that you complete Earth Systems 1109 first.

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

There is one required lab for this course (your instructor may ask you to do more lab activities). Let your instructor know in advance that you are getting close to being ready to do the lab. The lab requires a written report that will be used as part of your final mark for the course.

There is also one required assignment for the course. The assignment will be marked and the mark will be used as part of your final mark for the course. Your instructor may ask you to do additional assignments.

The text for this course is ***Science 10;*** Ritter, Plumb, et al; Nelson, 2001.

*Note: You cannot get credit for both Earth Systems 1109 and Science 2100B.

To the Student

II. Use of Science Study Guides

Before beginning this course, ensure you have the text and any other resources needed *(see the information in the Introduction to this course for specifics)*.

As you work through the Study Guide, you will see that it is divided according to the Units listed in the Table of Contents. When you open a unit it will have the following components:

Reading for this Unit:
Here you will find the chapters, sections and pages of the text you will use to cover the material for this unit. Skim the sections of the textbook, look at the titles of the sections, scan the figures and read any material in the margins. Once you have this overview of the unit, you are ready to begin. Do not be intimidated by the content. You will work through the text, section by section, gaining knowledge and understanding of the material as you go.

References and Notes	**Work to Submit**
This left hand column guides you through the material to read from the text. Read any highlighted notes that follow the reading instructions. The symbols ⏯⏯ direct you to the questions that you should complete when finished a reading assignment..	You come across three (3) headings in this right hand column. **Writing:** This section comprises your notes for the unit. Here you will find either written questions or references to specific questions or problems from your text. You may want to write out each question followed by the answer. This material should be checked by your instructor before moving on to the next unit. Mathematical problems should have their solutions checked as you go. **Laboratory:** This section indicates if there is a Core Lab that should be completed for the unit. Let the instructor know in advance that you will be ready for the lab. A lab report should be submitted for each Core Lab. Your instructor will provide guidelines as to how s/he wants the report written. **Assignment:** This section indicates if there is an assignment that should be completed for the Unit. The information in the "References and Notes" column will indicate how you obtain the assignment. These assignments frequently relate the science content to technology, society and the environment.

III. 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%.

Unit 1 - Global Weather Dynamics

To fulfill the objectives of this unit, students should complete the following:

Reading for this unit: Chapter 13: Introduction, pages 500 - 501;
Sections 13.1 - 13.13, pages 502 - 537.

References and Notes	Work to Submit
Referring to pages 501 - 502 , write answers for questions 1.1 and 1.2 ▶/▶	**Writing**: 1.1 Define weather dynamics. 1.2 Explain the difference between weather and climate.
Note: *To help you better understand weather dynamics, you should be able to answer the following questions (no need to write out answers):* ***What is rotation and revolution? What causes seasons? Why does it get colder as you move away from the equator?*** *See your instructor to discuss the answers.*	
Referring to pages 504 - 505 , write answers for questions 1.3 and 1.4 ▶/▶	1.3 What is the source of the energy that changes the Earth's weather systems? 1.4 Name and explain the four methods of heat transfer.
Referring to page 506, write answers for questions 1.5 and 1.6 ▶/▶	1.5 (a) Explain what is meant by a heat sink. (b) Which is a better heat sink, water or land? Explain your answer. 1.6 (a) Define heat capacity. (b) Which has a higher heat capacity, water or land?
Note: *You will find the term albedo used in this section.* ***Albedo*** *is a measurement of the percentage of light that an object reflects. The higher the albedo, the greater the object's ability to reflect light.*	

Unit 1 - Global Weather Dynamics

References and Notes	Work to Submit
Referring to pages 510 - 513 , write answers for questions 1.7 - 1.9 ⏯⏯	**Writing:** 1.7 Define the following terms: a) atmosphere b) altitude c) troposphere d) tropopause e) temperature gradient f) atmospheric pressure g) pressure gradient 1.8 List the 6 main layers of the atmosphere, starting with the one nearest the ground. 1.9 Complete questions 1 - 7 in "*Understanding Concepts*" on page 513.
See your instructor to discuss which part(s) of Activity 13.5 you should complete for question 1.10 ⏯⏯	1.10 Complete the portions of Activity 13.5, on pages 514-515, as outlined by your instructor.
Referring to pages 516 - 519 , write answers for questions 1.11 - 1.13 ⏯⏯	1.11 (a) Define wind. (b) What are prevailing winds? (c) What 2 factors cause prevailing winds? 1.12 What is the Coriolis effect? 1.13 Define jet stream (you may use the glossary).
Referring to pages 522 - 523 , write answers for questions 1.14 - 1.16 ⏯⏯	1.14 Define hydrosphere. 1.15 What percent of the Earth's water is fresh? salt? 1.16 Briefly describe the water cycle.

Unit 1 - Global Weather Dynamics

References and Notes	Work to Submit
Referring to pages 525 - 527, write answers for questions 1.17 - 1.19 ⏯⏯	**Writing:** 1.17 List the factors that affect the patterns of the world's ocean currents. 1.18 Describe the relationship between air temperature and its ability to hold moisture. 1.19 Describe an example of the effects of ocean currents.
Referring to pages 530 - 534 , write answers for questions 1.20 - 1.22 ⏯⏯ ***Note:*** *You should study Section 13.13, "A Global Weather Model" to help you understand how all that you've learned in this unit fits together.* *See your instructor to discuss whether you should complete assigned work on this section.*	1.20 Complete question 1 in "*Understanding Concepts*" on page 534. 1.21 Name the three main categories of clouds and briefly describe how each is formed. 1.22 Complete questions 3 and 4 in "*Understanding Concepts*" on page 534.
Using the copy of the lab, "Heat Absorption and Radiation of Water and Soil", found in Appendix A, do the following ⏯⏯	**Laboratory:** Complete the lab as directed by your instructor. Submit your lab report to your instructor for marking.
Note: *See your instructor to discuss any additional work that may be required for this unit*	

Unit 2 - Forecasting the Weather

To fulfill the objectives of this unit, students should complete the following:

Reading for this unit: Chapter 14: Introduction, pages 542 - 543;
Sections 14.1 - 14.12, pages 542 - 574
Interpreting and Creating Weather Maps, pages 683 - 685.

References and Notes	Work to Submit
Referring to pages 543 and 546 , answer question 2.1 ⏯	2.1 Define: (a) meteorology (b) weather system.
Referring to pages 546 - 548 , write answers for questions 2.2 - 2.6 ⏯	2.2 Define air mass and explain how an air mass forms. 2.3 How do air masses help maintain Earth's energy balance? 2.4 (a) What type of weather does a low pressure system bring? (b) Describe the development of a low pressure system. 2.5 Define cyclone and anticyclone. 2.6 (a) What type of weather does a high pressure system bring? (b) Describe the development of a high pressure system.

Unit 2 - Forecasting the Weather

References and Notes	Work to Submit
Read "Interpreting and Creating Weather Maps" on pages 683 - 685. Referring to Figure 12 on page 684, complete 2.7 ⏯⏯	2.7 For each station model shown, describe what is indicated for each symbol.
Using the weather map provided by your instructor, complete 2.8 ⏯⏯	2.8 Select one area of the weather map and describe the weather conditions in that locality.
Read carefully through Case Study 14.3, pages 550 - 551. Then complete Part A of the Assignment ⏯⏯	**Assignment:** **<u>Part A</u>** Answer the questions that are asked as you work through the Case Study. **Note**: You will need the "*Map for Tracking Weather Patterns*", found in Appendix A of this study guide.
Complete Part B of the Assignment ⏯⏯ ***Note:*** *You may use various sources to get the information needed for Part B, including newspapers, television, and/or the internet.*	**<u>Part B</u>** Observe the weather conditions for 3 consecutive days and predict what the weather will be like for the following 2 days. Then record the actual weather conditions for those 2 days. Record your data in the table, *"Developing a Forecast"*, found in Appendix A of this study guide. Then answer the following questions: 1. Which of the factors that you recorded was the most useful in forecasting the weather? Explain your answer. 2. How did your forecast compare to the actual weather?

Unit 2 - Forecasting the Weather

References and Notes	Work to Submit
Referring to pages 553 - 555 , write answers for questions 2.9 - 2.10 ▶▶	**Writing:** 2.9 Explain what is meant by a thermal. 2.10 Explain what is meant by a sea breeze and a land breeze and what causes each.
Referring to pages 556 - 557 , write answers for questions 2.11 - 2.12 ▶▶	2.11 Define precipitation. 2.12 Briefly describe the formation of each of the following: *drizzle, rain, freezing rain, snow, sleet, hail, dew, frost.*
Referring to pages 558 - 561 , write answers for questions 2.13 - 2.15 ▶▶	2.13 Explain what is meant by humidity and relative humidity. 2.14 What does it mean when we say the relative humidity is 100%? 2.15 What instrument is used to measure relative humidity?
Referring to pages 567 - 570 , write answers for questions 2.16 - 2.18 ▶▶	2.16 (a) Describe a weather satellite. (b) Describe a weather balloon. 2.17 List 5 instruments used at ground-based weather stations and tell what each is used for. 2.18 How has computer technology contributed to weather forecasting?
Note: *See your instructor to discuss any additional work that may be required for this unit.*	

Unit 3 - Extreme Weather Events

To fulfill the objectives of this unit, students should complete the following:

Reading for this unit: Chapter 15: Introduction, pages 578 - 579
Sections 15.1 - 15.12, pages 580 - 615

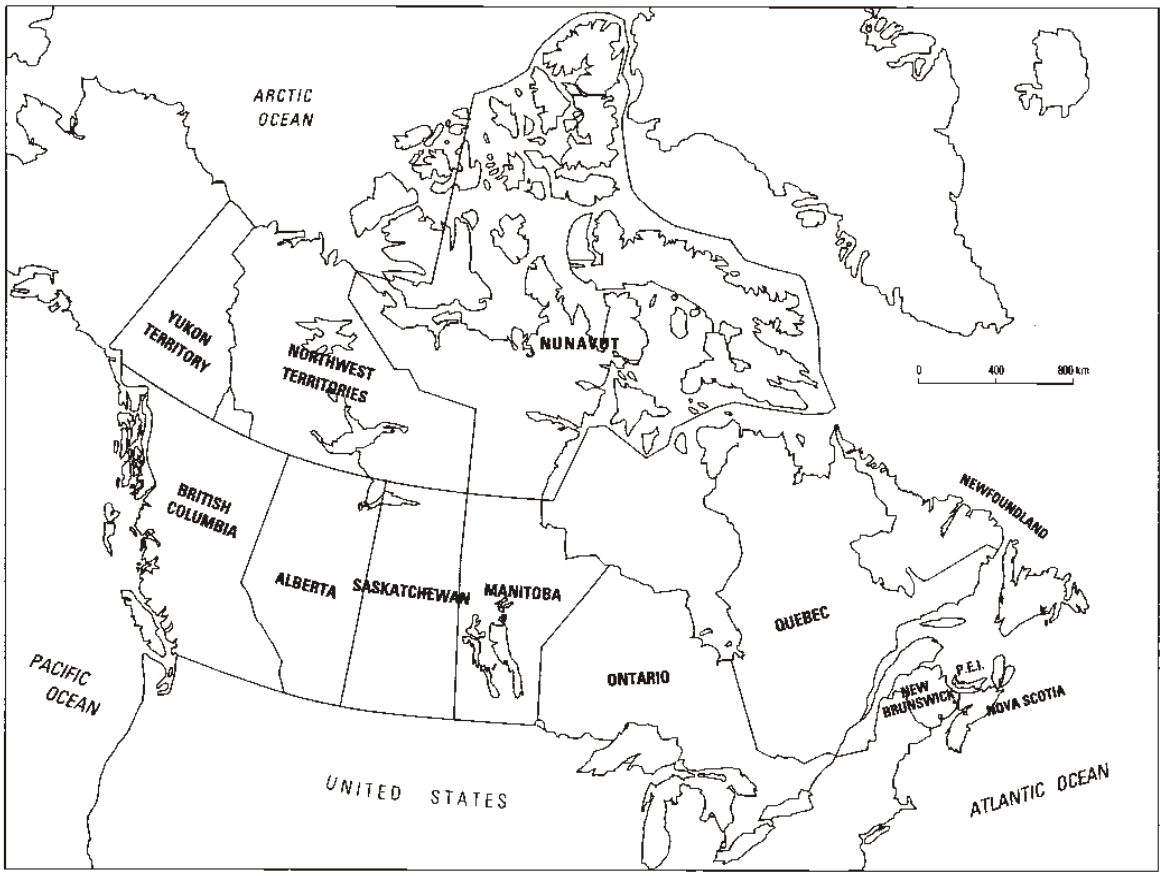
References and Notes	Work to Submit
Note: *Before you start the questions for this unit, take a look at Figure 1 on page 580 to see some examples of extreme weather events.*	**Writing:**
Referring to page 582, write an answer for question 3.1 ⏩⏩	3.1 Explain the difference between the three types of extreme weather alerts: *watch, advisory,* and *warning.*
Referring to pages 584 - 588 , write answers for question 3.2 ⏩⏩	3.2 (a) Define thunderstorm. (b) What conditions are necessary for a thunderstorm to form?
Referring to pages 589 - 591 , write answers for questions 3.3 - 3.5 ⏩⏩	3.3 (a) Define flood. (b) Explain the difference between flash and broadside floods. 3.4 Define drought. 3.5 Explain why some areas can experience both droughts and floods.
Referring to pages 594 - 597 , write answers for questions 3.6 - 3.7 ⏩⏩	3.6 Describe each of the following: *hurricane, typhoon, tropical cyclone*. 3.7 Briefly describe the effects of hurricanes.

Unit 3 - Extreme Weather Events

References and Notes	Work to Submit
Referring to pages 598 - 599 , write an answer for question 3.8 ▶/▶	3.8 (a) Define blizzard. (b) What conditions are necessary for a blizzard to occur? (c) Briefly describe the dangers of blizzards.
Referring to pages 604 - 607 , write answers for questions 3.9 - 3.12 ▶/▶	3.9 What is a heat wave? 3.10 (a) What 2 factors are combined in the humidex scale? (b) How is the humidex scale useful? 3.11 (a) What 2 factors combine to give wind chill factor? (b) What are the major problems caused by exposure to extreme cold? 3.12 Complete question 2 in "Understanding Concepts", page 607.
Note: *See your instructor to discuss any additional work that may be required for this unit.*	

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:

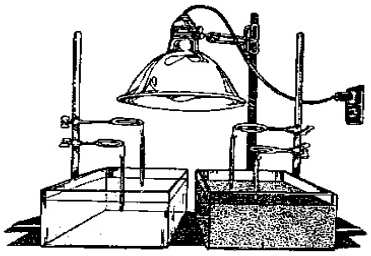


Table 1 - Light On				
	Temperature (°C)			
Time (min)	Above Water	Within Water	Above Soil/Sand	Within Soil/Sand
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

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?