

Earth Science 1140

Fundamentals of Earth Science

Student Course Materials

Flexible Learning in the Learning Commons

College of DuPage

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Section 1: Syllabus

Catalog Description Including Prerequisites

Course prefix and number: Earth Science 1140 (IAI P1 905L)

Course title: Fundamentals of Earth Science

Number of credit hours: 4 semester credit hours

Course Description: Fundamentals of Earth Science

An introduction to the study of the Earth as a planet. Topics from the disciplines of astronomy, meteorology, oceanography, and geology are explored to develop an appreciation of our planet as an integrated system. Includes analyses of the dynamic processes of the Earth's interior, surface, oceans, atmosphere, and astronomical surroundings.

Prerequisite: Math 0481 or equivalent qualifying score on math placement test (3 lecture hours, 2 lab hours)

Course Goals & Expected Student Outcomes

The primary goal of Earth Science 1140 is to enable you to comprehend the processes at work in, on, and around the planet Earth and how those processes affect Earth and its inhabitants. Central to your study of Earth Science will be the interrelationships among Earth systems including:

- the solar system
- weather and climate
- solid-earth dynamics
- ocean properties/dynamics
- solar processes
- earth materials
- surficial processes
- global change

Evaluation of Student Performance

Student performance will be evaluated by six tests and 13 laboratories reports. Tests will constitute 60% of the grade and laboratory assignments 40% of the grade.

Course Materials

Textbook: *The Blue Planet: An Introduction to Earth System Science*, 3rd Ed., Skinner and Murck, John Wiley and Sons, Publisher, 2011.

Lab Manual: *Applications and Investigations in Earth Science*, 7th Edition, Tarbuck, Lutgens, and Pinzke, Prentice-Hall.

Note: Rental Laboratory Manuals

Manuals do not allow students to remove the pages that are required to complete the labs. The copyright laws do not allow duplication of pages.

Video Lessons

Planet Earth, Videos 1-7 (Available in the Library and at the Off-Campus Learning Commons at Bloomingdale, Naperville, or Westmont.)

Several options are available for viewing video Lessons.

- View *Planet Earth* programs online with a broadband connection on the Annenberg Media Website <http://www.learner.org/resources/series49.html> for no cost.
- Video Lessons may be available for rental for the entire term from the main campus Library in Glen Ellyn or the Off-Campus Learning Commons for a nominal fee. Most video lessons are in DVD format, some in VHS format. Contact the location from which you are renting for additional information.
- View video lessons at the main campus Library in Glen Ellyn or the Off-Campus Learning Commons.
- For courses requiring feature film viewing, rent from your local video store or contact the main campus Library in Glen Ellyn for availability.
- For courses requiring audio tapes, these are purchased at the bookstore. There may be some availability for on-site listening at the main campus Library in Glen Ellyn or the Off-Campus Learning commons.

For more information about the Library, visit www.cod.edu/library. Visit <http://www.cod.edu/academics/resources/flexlearning/index.aspx> for hours and other information about Flexible Learning.

Delivery System

Earth Science 1140, offered through the Learning Commons, is designed to offer the student a flexible method of completing the course material for an introductory earth science class. This method of learning is different from other methods only in the manner in which the material is presented. The content is the same; however, the student is self-paced and not bound by the regular schedule required by more traditional forms of courses which require attendance at predefined lecture times.

Orientation

You must attend an orientation. Refer to your Orientation and Deadline Dates sheet for the orientation dates and times. This information is posted on Blackboard. After this date, contact an instructor as soon as you register. Check the Contact Information and Availability sheet for instructors' availability. This information is posted on Blackboard. Orientation lasts about 45 minutes.

Course Components

Textbook

Your textbook will prove to be your most invaluable source of material as you complete this course and will provide the information that you will need to learn the course content.

Your course map will provide the reading assignment for the course module you are completing. Follow the course map in detail and in sequence to successfully complete this course. In addition, page eight of this syllabus provides a summary of textbook and study guide assignments for each course module.

Before completing the reading assignment, review the “Summary Statements” at the end of the chapter and the chapter-appropriate “Student Learning Objectives” from the Student Course Material packet to become familiar with its focus. Next, define the “Important Terms to Remember” at the end of the chapter by either finding the definitions within the textbook (the numbers next to the terms are the page numbers in the textbook where those terms are found) or by using the glossary at the back of the textbook.

Read the pages assigned, paying particular attention to tables and figures by reading their captions.

Student Learning Objectives

The student learning objectives can be found **starting on page 101**. There are learning objectives for each chapter that represent specific information that students should know from that chapter.

Textbook Assignments

MODULE	CHAPTER	PAGES
I	1 19	5-28 188-219
II	2 4	31-51 81-107
III	5 6	111-140 143-183
IV	3 7	53-79 188-219
V	8 10	223-255 287-317
VI	11 12	321-346 349-377

Video

The *Planet Earth* video series consists of seven-hour programs. Your course map will provide the video assignment(s) for the course module you are completing.

The list below shows the titles of each video program, the corresponding course modules, and the order in which you will need to complete the viewing.

Module I	Video 7	Fate of the Earth
Module II	Video 4	Tales from Other Worlds
Module II	Video 6	The Solar Sea
Module III	Video 1	The Living Machine
Module IV	Video 5	Gifts From the Earth
Module V	Video 2	The Blue Planet
Module VI	Video 3	The Climate Puzzle

A significant number of exam questions will relate directly to the topics and concepts presented in the video programs. Therefore, viewing the programs is mandatory. A video viewing guide is provided to highlight the most important points of the programs, but additional note taking is strongly encouraged.

Video Viewing Guide

The video viewing guide contains a list of study questions for each video program in the *Planet Earth* video series. Follow the instructions on the first page of the guide before using it. You will not submit your answers to the instructor for a grade, but you should use them to assist you in the review process prior to exams.

Laboratory

Thirteen laboratory assignments constitute 40% of your course grade.

A laboratory in a traditional classroom course in earth science requires two hours per week in the lab plus the time spent outside the lab preparing lab reports and completing required assignments. You will be expected to spend an equivalent amount of time on **your** laboratory activities.

Your responses to the laboratory questions should be **COMPLETE** and **DETAILED**. Do not leave anything unexplained.

You are encouraged to meet with your instructor to discuss any lab exercises that you are in the process of completing so that he or she can make suggestions to improve them and to provide you with appropriate feedback.

Revisions of lab exercises are not permitted. All work that you submit is expected to be in its final form. Instructors retain the right to make exceptions to this policy on an individual basis.

Submit each lab assignment as you complete it at the Learning Commons in Glen Ellyn (SRC 2102) or off-campus in Bloomingdale, Naperville, and Westmont. Your instructor will be able to give you feedback regarding your mastery of the material and eventual course grade if you submit your lab work early in the semester. Written labs become college property and are not returned to students. However, you may request to view your graded labs at the Learning Commons where you are registered. Progress reports which include an itemization of the work that you have completed and the corresponding grades as well as the instructor's comments will be mailed directly to your home address.

Your course map will provide the laboratory assignments for the course module you are completing. In addition, page ten and eleven of this syllabus provides a summary of laboratory assignments for each course module.

Laboratory Study Guide

Instructions for all questions in the laboratory assignment are provided in the laboratory study guide in SCM. It also provides information regarding materials that must be supplied by the student and materials that are provided by the college.

Laboratory Exercises

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<u>LAB NUMBER</u>	<u>EXERCISE NUMBER</u>	<u>LAB TITLE</u>	<u>COURSE MODULE</u>
1	22	LOCATION AND DISTANCE	I
2	23	THE METRIC SYSTEM	I
3	21	EARTH-MOON SYSTEM	II
4	18	PATTERNS IN THE SOLAR SYSTEM	II
5	12	EARTH-SUN RELATIONS	II
6	10	THE DYNAMIC OCEAN FLOOR	III
7	8	EARTHQUAKES AND THE EARTH'S INTERIOR	III
8	1	THE STUDY OF MINERALS	IV
9	2	ROCKS AND THE ROCK CYCLE	IV

10	9	INTRODUCTION TO OCEANOGRAPHY	V
11	11	WAVES, CURRENTS, AND TIDES	V
12	14	ATMOSPHERIC MOISTURE, PRESSURE, AND WIND	VI
13	15	AIR MASSES/MID.-LAT. CYCLONE/ WEATHER MAPS	VI

Extra Credit

No extra credit is available in this course.

Student Folders

Each student will have a folder in which all graded assignments are placed. You are responsible for checking your folder for your lab grades, exam grades, comments, questions, etc. Nothing can be removed from that folder. Your folder is available for viewing at the Learning Commons where you are registered.

Exams and Evaluations

Six exams constitute 60% of your course grade.

Each exam consists of 30 multiple-choice questions and four short-essay questions. Each exam is worth 100 points. Each multiple-choice question is worth 2 points and each short-essay question is worth 10 points. During each exam you will be presented with a four-part short-essay section. Each part will have an option A and option B question. You will be required to answer only one of the two options in each part of this section. The exams are administered in the Testing Center in Glen Ellyn (BIC 2405) and at the Off-Campus Learning Commons in Bloomingdale, Naperville, and Westmont.

Your course map will provide the information regarding what course material is covered for each exam. Essentially, each course module represents a single exam. Example:

Exam 1 = Course Module I

Exam 2 = Course Module II, etc.

To effectively prepare for exams, you will find that, in addition to reviews of the vocabulary and video viewing guide questions, the repeated readings of the text itself, and additional viewings of the video programs, The Student Learning Objectives are extremely helpful. Because they are learning objectives, you are expected to master the information summarized in each. Therefore, to evaluate whether you have mastered the course material, most of the questions in the exams deal with the learning objectives. Be able to meet the learning objectives and you will be virtually guaranteed success.

Mastery of the laboratory material for each exam is also essential. Do not attempt an exam if you have not completed the laboratory assignments within that course module!!

You are permitted to retake any number of your six exams once. You do not need a permit from the instructor to take or retake exams. If you choose to retake any of your exams, request Form B of those exams when checking in at a testing location. The higher of the two scores will be recorded.

Grading Policy

Exams: Six exams for 60% of the course grade
Labs: Thirteen labs for 40% of the course grade

Grading Scale: A = 90-100%
B = 80-89%
C = 70-79%
D = 60-69%
F = Lower than 60%

Grades are submitted to the Records Office before the last week of the term. Take special note of the deadline dates for labs and exams on the Orientation and Deadline Dates sheet provided. This information is posted on Blackboard. These dates are firm and apply to all students. Exceptions can be made with official medical documentation only.

Testing Locations

Tests for this course may be taken at the Testing Center in Glen Ellyn (BIC 2405) or one of the Off-Campus Learning Commons in Bloomingdale, Naperville and Westmont. Students are required to comply with the Deadline Dates, posted on Blackboard in the Deadline Dates link and comply with specific testing instructions provided by the instructor. Appointments are not required for testing.

When you are ready to take an exam, sign in at the front desk. You will be expected to write in the date, course name and number, the instructor's name, test number, and time the exam is taken. You must present a photo I.D. as well. You may not use notes or books during the exam. No food, drink, pagers or cell phones are allowed in the testing room.

All tests must be completed in one sitting. All tests will be collected 10 minutes prior to closing. It is important for you to plan sufficient time to complete your test within the Center's hours. No additional time will be given to complete a test. No tests are distributed 30 minutes prior to closing.

Scores of essay exams are available from the instructor. A progress report may be mailed to the student, or the student may view the test results at the location where they are registered. You must show a picture I.D.

Satisfactory/Fail (S/F) Grade Option

If you wish to complete the course with S/F status, contact your instructor regarding S/F grade requirements. You may request this option from your instructor and but you and your instructor must sign an S/F form. The form needs to be submitted to the Registration Office no later than 1 week prior to the end of the course. You should be aware that there are several limitations to S/F grades. Read the S/F form carefully before signing it.

Incomplete Policy

In order to request an incomplete grade, you must obtain permission from the instructor, satisfy minimum completion requirements, and sign an incomplete contract. A minimum amount of completed work will be required to request an incomplete grade. Contact the instructor if you are interested in receiving an incomplete grade. You should be aware that an "I" grade on a transcript may be interpreted by other colleges as an "F." If you do not complete the remaining coursework by the deadline specified in the incomplete contract, then you will earn an F.

Withdrawal Policy

Course Withdrawals

Students are encouraged to consult directly with the instructor when considering a course withdrawal. The student may withdraw from a course by contacting the Registration office up to the mid- term date of the class. Thereafter, a grade will be assigned which reflects the student's actual performance in the class. Exceptions require an agreement with the instructor and the student. Written permission to withdraw signed by the instructor must be presented to the Registration office by the student prior to the end of the term.

Please see your instructor for the specific date.

Medical Withdrawals

Medical Withdrawals: Requests for medical withdrawals should be made to the Dean of Enrollment Services. Send medical forms to Student Registration Services, SSC 2221, (630) 942-2687. Requests should be made in writing and accompanied by documentation from a physician or medical institution to verify the medical condition, date of onset and estimated length of treatment. [Request forms for medical withdrawals](#) are reviewed individually. Refunds are issued when appropriate within the guidelines of the College of DuPage refund policy. You will receive written notification of the decision within three (3) weeks from the office of the Student Registration Services.

Administrative Withdrawals

Students not actively pursuing the completion of course objectives may be withdrawn from the class by the instructor, any time up to two weeks prior to the end of the term and given a grade of "W". Instructors of courses numbered below 1000 may assign a final grade of "W" without an official withdrawal through the Registration office.

Plagiarism/Academic Dishonesty Policy

All work submitted for credit must be completed by the student who is registered for the course. Disciplinary action will be pursued in all instances in which it is determined that academic dishonesty has occurred. Academic dishonesty can include the dishonest use of course materials such as student papers and exams.

Library Information

The College of DuPage Library has a wealth of information in both print and online formats. The Library homepage is found at <http://www.cod.edu/library>. To access the online sources, click on Databases. You may access these databases from within the Library or from Off-Campus Learning Commons with a College of DuPage library card. You will need to come to the Library or at the Off-Campus Learning Commons to get a card.

The Library is located in the Student Resource Center (SRC) building at the Glen Ellyn campus.

Additional information regarding the current Library hours and services can be obtained by visiting their web site at www.cod.edu/library.

Computer Use

The Library computers may be used for more than accessing the Library Catalog and online sources. You can also use Microsoft Word, Excel, PowerPoint, and Access.

Learning Commons computers are intended for all Flexible Learning students; therefore, use must be restricted to tasks that take less than 30 minutes. You may use tutorials and review course materials with your instructor. Access is granted on a first-come, first serve basis.

Academic Computing Center (ACC) is located in the Student Resource Center (SRC) room 3600. The Academic Computing Center is open for use by individuals registered at College of DuPage, as well as, community residents.

Off-Campus Learning Commons welcome Flexible Learning students to use the computers. Access is granted on a first-come, first serve basis. To use computers at the Off-Campus Learning Commons, the person must be currently enrolled at the College of DuPage and have a photo ID.

At all College of DuPage computer labs, you are expected to work independently and bring your own storage media for your work. No peripheral equipment (e.g. calculators, laptop computers, or mice) may be attached to any computer. Students may NOT install software or programs on any computer in the computer labs.

Section 2: Course Map

<i>Number</i>	<i>Required Text</i>	<i>Video Tapes</i>	<i>Lab Exercise</i>	<i>Exam Number</i>
1. Earth Systems	<input type="checkbox"/> Chapter 1, p. 5-28 <input type="checkbox"/> Summary <input type="checkbox"/> Important Terms to Remember <input type="checkbox"/> Learning Objectives	<input type="checkbox"/> 7 Fate of the Earth	<input type="checkbox"/> 22 Location and Distance on Earth	
	<input type="checkbox"/> Chapter 19, p. 573-604 <input type="checkbox"/> Summary <input type="checkbox"/> Important Terms to Remember <input type="checkbox"/> Learning Objectives		<input type="checkbox"/> 23 The Metric System, Measurements, & Scientific Inquiry	<input type="checkbox"/> 1
2. Solar System			<input type="checkbox"/> 21 The Earth-Moon System	
	<input type="checkbox"/> Chapter 2, p. 31-51 <input type="checkbox"/> Summary <input type="checkbox"/> Important Terms to Remember <input type="checkbox"/> Learning Objectives	<input type="checkbox"/> 4 Tales From Other Worlds	<input type="checkbox"/> 18 Patterns in the Solar System	
	<input type="checkbox"/> Chapter 4, p. 81-107 <input type="checkbox"/> Summary <input type="checkbox"/> Important Terms to Remember <input type="checkbox"/> Learning Objectives	<input type="checkbox"/> 6 The Solar Sea	<input type="checkbox"/> 12 Earth-Sun Relations	<input type="checkbox"/> 2
3. Dynamic Earth	<input type="checkbox"/> Chapter 5, p. 111-140 <input type="checkbox"/> Summary <input type="checkbox"/> Important Terms to Remember <input type="checkbox"/> Learning Objectives	<input type="checkbox"/> 1 The Living Machine	<input type="checkbox"/> 10 The Dynamic Ocean Floor	
	<input type="checkbox"/> Chapter 6, p. 143-183 <input type="checkbox"/> Summary <input type="checkbox"/> Important Terms to Remember <input type="checkbox"/> Learning Objectives		<input type="checkbox"/> 8 Earthquakes and Earth's Interior	<input type="checkbox"/> 3

<i>Number</i>	<i>Required Text</i>	<i>Video Tapes</i>	<i>Lab Exercise</i>	<i>Exam Number</i>
4. Earth Materials	<input type="checkbox"/> Chapter 3, p. 53-79 <input type="checkbox"/> Summary <input type="checkbox"/> Important Terms to Remember <input type="checkbox"/> Learning Objectives		<input type="checkbox"/> 1 The Study of Minerals	
	<input type="checkbox"/> Chapter 7, p. 188-219 <input type="checkbox"/> Summary <input type="checkbox"/> Important Terms to Remember <input type="checkbox"/> Learning Objectives	<input type="checkbox"/> 5 Gifts From The Earth	<input type="checkbox"/> 2 Common Rocks	4
5. Water Systems	<input type="checkbox"/> Chapter 8, p. 223-255 <input type="checkbox"/> Summary <input type="checkbox"/> Important Terms to Remember		<input type="checkbox"/> 9 Introduction to Oceanography	
	<input type="checkbox"/> Chapter 10, p. 287-317 <input type="checkbox"/> Summary <input type="checkbox"/> Important Terms to Remember <input type="checkbox"/> Learning Objectives	<input type="checkbox"/> 2 The Blue Planet	<input type="checkbox"/> 11 Waves, Currents, and Tides	<input type="checkbox"/> 5
6. Atmospheric Systems	<input type="checkbox"/> Chapter 11, p. 321-346 <input type="checkbox"/> Summary <input type="checkbox"/> Important Terms to Remember <input type="checkbox"/> Learning Objectives	<input type="checkbox"/> 3 The Climate Puzzle	<input type="checkbox"/> 14 Atmospheric Moisture Pressure, and Wind	
	<input type="checkbox"/> Chapter 12, p. 349-377 <input type="checkbox"/> Summary <input type="checkbox"/> Important Terms to Remember <input type="checkbox"/> Learning Objectives		<input type="checkbox"/> 15 Air Masses, The Middle-Latitude Cyclone, and Weather Maps	<input type="checkbox"/> 6

Section 3: Laboratory Study Guide

Procedure for Completing the Laboratory Exercises

1. Read the Preliminary Instructions **in this study guide** before attempting to answer the laboratory exercise questions.
2. Locate the questions in the laboratory manual (*Applications and Investigations in Earth Science*) and read each one carefully. Refer to the instructions for each question **in this study guide** for additional information to help you answer the questions.
3. Some questions will require that you write or draw on the diagrams in the laboratory manual. If so, you must write on the actual manual pages and tear them out to submit them to your instructor. You may submit the answers to the other questions in the exercise on the original manual pages (if they are neat and legible) or on a separate paper.
4. Note that some questions will require you to use special materials. The instructions in this study guide will provide information regarding the location of those materials. In addition, the following page shows list of the materials provided at the Learning Commons and those that must be provided by the student.
5. If the instructions direct you to omit a question number, skip that question and proceed with the following question. The instructions will indicate the point at which the laboratory exercise has been completed.
6. After you have completed the laboratory exercise, check your answers and make a copy for your records. Submit the completed exercise at the Learning Commons. Photocopies of completed laboratory assignments will not be accepted. All diagrams, graphs, and other exercises must show the original work of the student in pen or pencil. You may FAX a copy of your work to an instructor only to allow the instructor to assess, but not grade, your work. To receive a grade for that work you must submit the original documents.

Laboratory Materials

AVAILABLE FOR USE IN THE CENTERS FOR INDEPENDENT LEARNING	SUPPLIED BY STUDENT
Adding machine tape Meter stick Streak plate Glass plate Steel nail Penny Magnet Vial of dilute hydrochloric acid Hand lens Minerals (use samples A-J) Igneous rocks (use samples 25-35) Sedimentary rocks (use samples 36-43) Metamorphic rocks (use samples 44-51) Drawing compass Goode's World Atlas	Colored pencils Calculator Ruler (metric and English scales) Protractor Drinking glasses Salt Food coloring or dye

You can obtain the 4-meter length of adding machine tape needed for the fourth laboratory exercise in the Learning Commons. You may take this length of adding machine tape with you to complete at home.

Notes:

Lab 1

Exercise 22: Location and Distance on Earth

Preliminary Instructions

1. Read carefully the information in your laboratory manual.
2. You will need an atlas to complete the laboratory activity. An atlas is available in the Learning Commons for your use.

Question Instructions

1. Instead of a globe, refer to figure 22.2 and figure 22.6, and figure 22.7 in the laboratory manual.
2. Self-explanatory
3. Self-explanatory
4. Self-explanatory
5. Refer to figure 22.7 in the laboratory manual to answer this question.
6. Do two other parallels
7.
 - a. Self-explanatory
 - b. Self-explanatory
8. An atlas is available in the Learning Commons. For home city and college campus use Glen Ellyn, IL for both.
9. An atlas is available in the Learning Commons.
10. Self-explanatory
11. Self-explanatory
12. An atlas is available in the Learning Commons.
13. Self-explanatory
14. Self-explanatory

15. Self-explanatory
16. Refer to figure 22.5 and 22.6 of the laboratory manual to answer this question.
17. Refer to figure 22.5 in the laboratory manual.
18. Use figure 22.7 to answer the question.
19. Self-explanatory
20.
 - a. Self-explanatory
 - b. Place a letter (C through F) next to a dot on figure 22.5 and indicate the longitude on the line in question 20b.
21. An atlas is available at the Learning Commons. For home city and college campus use Glen Ellyn, IL for both.
22. An atlas is available at the Learning Commons.
23. Self-explanatory
24. Self-explanatory
25. Self-explanatory
26. Self-explanatory
- 27. OMIT THIS QUESTION**
28. Self-explanatory
29. Self-explanatory
30. Self-explanatory

STOP AFTER YOU HAVE COMPLETED QUESTION 30

DO NOT COMPLETE THE SUMMARY/REPORT PAGE

Remember to make and keep a photocopy of your laboratory assignment before you submit your originals at the Learning Commons.

Lab 2

Exercise 23: The Metric System, Measurements, and Scientific Inquiry

Preliminary Instructions

1. Read carefully the information in your laboratory manual.
2. You will need a meter stick to complete the laboratory activity. A meter stick is available in the Learning Commons for your use.

Question Instructions

1. A meter stick is available in the Learning Commons.
2. Self-explanatory
3. Self-explanatory
4. **OMIT**
5. **OMIT**
6. **OMIT**
7. Self-explanatory
8. A meter stick is available in the Learning Commons.
9. Questions 9-33 are self-explanatory.
34. **OMIT**
35. **OMIT**
36. Observe people around you or your family to answer this question.
37. Use the data in the table below question 44 of this guide. Transfer this data to Table 23.3.
38. Self-explanatory

39. Have the straight line intersect as many points as possible and have about equal numbers of points above and below the line.
- 40 Self-explanatory
- 41 Self-explanatory
- 42 Self-explanatory
- 43 Self-explanatory
- 44 Self-explanatory

HEIGHT (nearest hundredth of a meter)	SHOE LENGTH (nearest millimeter)
1.69	291
1.95	315
1.59	237
1.60	242
1.67	260
1.76	285
1.74	274
1.63	280
1.71	265
1.68	269
1.65	282
1.71	291
1.80	335
1.87	296
1.69	250

STOP AFTER YOU HAVE COMPLETED QUESTION 44

DO NOT COMPLETE THE SUMMARY/REPORT PAGE

Remember to make and keep a photocopy of your laboratory assignment before you submit your originals at the Learning Commons.

Lab 3

Exercise 21: Motions of the Earth-Moon System

Preliminary Instructions

1. Read carefully the information in your laboratory manual.

Question Instructions

1. Your line will bisect the moon revealing the portion of the illuminated side that will be visible from earth.
2. Self-explanatory
3. Self-explanatory
4. Self-explanatory
5. Place the letter next to the appropriate moon in figure 21.2 as well as completing the chart on the bottom of page 282.
6. Self-explanatory
7. Questions 7-13 are self-explanatory.
14. Note the location of the Sun relative to each moon. See figure 21.2
15. Questions 15-18 are self-explanatory.
19. See reference on page 283 of the laboratory manual.
20. Self-explanatory
21. Self-explanatory
22. See reference on page 283 of the laboratory manual.
23. Self-explanatory
24. Self-explanatory (do a web search for solar eclipse if you are having difficulty visualizing this)

25. Self-explanatory
26. Self-explanatory (do a web search for solar eclipse if you are having difficulty visualizing this)
27. Self-explanatory
28. Self-explanatory

STOP AFTER YOU HAVE COMPLETED QUESTION 28

DO NOT COMPLETE THE SUMMARY/REPORT PAGE

Remember to make and keep a photocopy of your laboratory assignment before you submit your originals in the Learning Commons.

Lab 4

Exercise 18: Patterns in the Solar System

Preliminary Instructions

1. Read carefully the information in your laboratory manual.
2. Adding machine tape for questions 6-17 can be obtained in the Learning Commons.

Question Instructions

1. Table 18.1 is found on page 250. The description of terrestrial and Jovian planets can be found in the Introduction on page 250.

Be sure to submit the completed Table 18.1 with the rest of this lab assignment.

2. Self-explanatory.
3. Self-explanatory.
4. Self-explanatory.
5. See pages 86-88 of your textbook for an excellent opportunity to visualize the solar nebular hypothesis for the origin of the Solar System.
6. Please ask for the adding machine tape in the Learning Commons. Some locations will provide premeasured lengths of tape and others will require you to measure and cut the 4-meter length yourself. Meter sticks are available for use at those locations as well, but you may also use a metric ruler if you have one.

Follow the instructions in Step 1 through Step 4. Mean distance from the Sun is provided in the upper portion of Table 18.1. Simply convert the distances using the scale conversions shown under Step 3.

Example for Mercury:

Mean distance from Sun = 36 million miles

1 millimeter = 1 million miles, so
36 millimeters = 36 million miles, or
3.6 centimeters = 36 million miles

Remember to submit your completed tape showing the scale model of the Solar System with the rest of this assignment.

7. Self-explanatory.
8. In a few simple words, discuss the distances between terrestrial planets versus the distances between Jovian planets.
9. Determine the distances between each adjacent planet and comment on the changes in those distances when proceeding from the Sun outward.
10. Look for planets which change in their spacing **THROUGH TIME** or appear to have unusual spacing compared to the overall pattern of spacing in the solar system.
11. Remember to use the **reverse** side of the adding machine tape which you used in the previous questions.

Follow the instructions in Step 1 through Step 5. Planetary Diameter is provided in the lower portion of Table 18.2. Remember to divide by two to determine the planetary radius. Simply convert the radii using the scale conversion (1 cm = 2000 km).

Example for Mercury:

$$\begin{aligned} \text{Diameter} &= 4854 \text{ km} \\ \text{Radius} &= 4854 \text{ km}/2 = 2427 \text{ km} \end{aligned}$$

$$\begin{aligned} 1 \text{ cm} &= 2000 \text{ km, so } (2427/2000 = 1.2) \\ \mathbf{1.2 \text{ cm}} &= 2427 \text{ km} \end{aligned}$$

Remember to submit your completed tape showing the planetary diameters, as well as your completed Table 18.2, with the rest of this assignment.

12. Determine this directly from the lower portion of Table 18.2, but remember to select a **terrestrial** planet.
13. Determine this directly from the lower portion of Table 18.2, but remember to select a **Jovian** planet.
14. Select the smallest Jovian planet (A). Select the largest terrestrial planet (B).
15. Discuss the relative diameters of the terrestrial planets and the relative diameters of the Jovian planets in a few simple words.
16. Divide the diameter of the Sun by the diameter of the Earth to complete the first part. Then divide the diameter of the Sun by the diameter of Jupiter to complete the second part.
17. Self-explanatory.

18. Because the mass of Earth is 1.0, the number of times greater or less in mass that a planet is compared to Earth is simply the relative mass of that planet (i.e., all mass figures are **relative to Earth**).
19. Self-explanatory.
20. Self-explanatory.
21. Self-explanatory
22. Consider the density of gas versus solid material and the amount of gravitational force required to “hold” each.
23. Be precise in your locations of points on your graph and be sure to submit your graph with the rest of this lab assignment. Don’t forget to color-code the two groups of planets. Be sure to submit the completed Figure 18.2 with the rest of this lab assignment.
24. Note the positions of the planets you plotted on your graph to answer this question.
25. Calculate the average density of **all the terrestrial planets** by summing their densities and then dividing by 4. Compare this value to the density of rocks at the Earth’s surface (3.0 g/cm^3).
26. Self-explanatory.
27. Self-explanatory.
28. The density of water is 1.0 g/cm^3 .
29. The density of water is 1.0 g/cm^3 .
30. Self-explanatory.
31. Hint: The answer lies within the units of density. Density equals mass per unit volume. Therefore, consider the effect of **each of these units** on the density of Jupiter.
32. Discuss the relative densities of the terrestrial planets and the relative densities of the Jovian planets in a few simple words.
33. Self-explanatory.
34. Self-explanatory.

STOP AFTER YOU HAVE ANSWERED QUESTION 34

DO NOT COMPLETE THE SUMMARY/REPORT PAGE

Remember to make and keep a photocopy of your laboratory assignment before you submit your originals in the Learning Commons.

Lab 5

Exercise 12: Earth – Sun Relations

Preliminary Instructions

1. Read carefully the information in your laboratory manual.
2. None of the “Materials Supplied by Your Instructor” will be needed for this exercise.

Question Instructions

1. If you have completed this task successfully, you should have four lines drawn on Figure 12.2. Be sure to submit the completed Figure 12.2 with the rest of this lab assignment.
2. Contact your instructor if you have difficulty using a protractor.
3. This is the width of the beam measured along the Earth’s surface.
4. Self-explanatory.
5. Self-explanatory
6. To convert centimeters to millimeters: $1 \text{ cm} = 10 \text{ mm}$.
7. Divide 100% by the number of centimeters measured in question 6 to calculate the first answer. Divide 100% by the number of millimeters determined in question 6 to calculate the second answer.
8. Measure the distances between the red lines along line **x-y** and use the results from question 7 to calculate your answers.
9. Contact your instructor if you have difficulty using a protractor.
10. Refer to your calculations for questions 8 and 9.
11. Refer to Figure 12.3 on page 175 of the laboratory manual.
12. Review page 84 and figure 84.1 on page 84 of your textbook to help you answer questions 12-31.

Use an atlas to answer this question. A copy of Goode’s World Atlas is available for use in the Learning Commons. Provide three countries for each of the three latitudinal zones indicated.

Note: The Arctic Circle is at 66.5° North latitude.

13. Locate all features except the Antarctic Circle (eight in all) at one of the solstice positions on the diagram and do the same at one of the equinox positions on the diagram. Draw a line which points **PRECISELY** to each item and label the other end of the line with the name of the feature. Be sure to submit the completed Figure 12.5 with the rest of this lab assignment.
14. In other words, what season is it in the Northern Hemisphere on June 21-22? Southern Hemisphere?
15. Self-explanatory.
16. Self-explanatory.
17. Self-explanatory
18. **OMIT THIS QUESTION.**
19. Imagine yourself standing at these two locations as the Earth rotates through a complete, day-long rotation. Use Figure 12.5 (page 176) of the laboratory manual to help you answer this question.
20. In other words, what season is it in the Northern Hemisphere on December 21-22? Southern Hemisphere?
21. Self-explanatory.
22. Self-explanatory.
23. Self-explanatory
24. In order to decide whether to use the data in the Summer Solstice column or the Winter Solstice column in Table 12.1, you must first determine whether it is winter or summer at the indicated latitude on December 21-22.
25. The equinoxes are named as follows:
 - spring/vernal equinox
 - fall/autumnal equinox
26. See instructions for question 25.
27. Self-explanatory.
28. Self-explanatory.

29. Self-explanatory
30. Use Figure 12.5 (page 176) of the laboratory manual to help you answer this question.
31. Table 12.1 (page 177) will provide the information needed to answer this question.
32. Be sure to submit the completed Figure 12.5 with the rest of this lab assignment.
33. Be precise (to the nearest half degree) when providing your answers. Remember to indicate whether the latitudinal location is north or south of the equator (example: 5.5°S latitude)
34. Self-explanatory.
35. Self-explanatory.
36. Your answer will be based on what you have learned within this entire laboratory exercise. This answer may require more space than is allotted in the blank, because you are required to comment on the patterns in duration, intensity, and position of the overhead noon sun as they vary throughout the seasons. Attach a separate page if necessary.

STOP AFTER YOU HAVE ANSWERED QUESTION 36

DO NOT COMPLETE THE SUMMARY/REPORT PAGE

Remember to make and keep a photocopy of your laboratory assignment before you submit your originals in the Learning Commons!!!

Lab 6

Exercise 10: The Dynamic Ocean Floor

Preliminary Instructions

1. Read carefully the information in your laboratory manual.
2. A copy of Goode's World Atlas is available for use in the Learning Commons.

Question Instructions

1. **OMIT**
2. Figure 5.11 on page 125 of your textbook is also helpful. Be sure to submit the completed Figure 10.3 with the rest of this lab assignment.
3. Refer to Figure 5.12 on page 126 of your textbook. Also, refer to pages 10-13 of Goode's World Atlas (available at all Centers for Independent Learning). Draw and label all of the trenches listed in this question except for the Cayman Trench (B). Be sure to submit the completed Figure 10.3 with the rest of this lab assignment.
4. Self-explanatory.
5. Self-explanatory. OMIT Parts B and C
6. Self-explanatory. Omit Part C
7. Self-explanatory.
8. Self-explanatory.
9. Self-explanatory.
10. Self-explanatory.
11. Self-explanatory.
12. Self-explanatory.
13. Self-explanatory
14. Self-explanatory.
15. Read the caption to figure 10.6 carefully

16. Subdivide the interval between the one million year mark and the present mark into 10 equal parts (each part equals .1 million years or 100,000 years) to determine the age of the beginning of the current normal polarity.
17. Self-explanatory
18. Self-explanatory
19. Self-explanatory
20. Compare the duration of the recent normal polarity interval and compare it to others in the figure. Hint: Are we just beginning a normal episode or have we been experiencing it for a long time and, as a result, overdue for a reversal?
21. Self-explanatory
22. Self-explanatory
23. Self-explanatory. Follow directions in question.
24. Self-explanatory
25. Follow the directions and use the South Atlantic example to calculate others.
26. Self-explanatory.
27. Self-explanatory
28. Self-explanatory.
29. Self-explanatory.
30. The minimum age is the lower number and the maximum age is the higher number within the range shown for Kauai on Figure 10.8 of the lab manual.
31. Using the scale on figure 10.8, measure the distance from the center of Kauai to the center of Hawaii in kilometers. Multiply your answer by 100, 000. to determine the distance in centimeters.
32. Maximum velocity = distance (in cm from question 31) divided by minimum age (IN MILLIONS OF YEARS)
Minimum velocity = distance (in cm from question 31) divided by maximum age (IN MILLIONS OF YEARS)

STOP AFTER YOU HAVE ANSWERED QUESTION 32

DO NOT COMPLETE THE SUMMARY/REPORT PAGE

Remember to make and keep a photocopy of your laboratory assignment before you submit your originals at the Learning Commons.

Notes:

Lab 7

Exercise 8: Earthquakes and Earth's Interior

Preliminary Instructions

1. Read carefully the information in your laboratory manual.
2. None of the “Materials Supplied by your Instructor” will be needed for this exercise.

Question Instructions

1. Note that the distance between the lines represents one minute.
2. See question instruction 1.
3. See question instruction 1.
4. Self-explanatory
5. See Figure 8.5
6. The easiest way to determine the time difference is to align the edge of a piece of scrap paper along the vertical line which represents the given distance from the epicenter. Place marks at the edge of the scrap paper where it intersects the S-wave curve and the P-wave curve. Place the edge of the scrap paper along the y-axis of the graph (where the distance to the epicenter equals 0 miles) so that your lowermost mark is aligned with 0 minutes. Simply read the time difference from the upper mark. Be precise to within 0.25 minutes (or 15 seconds).
7. First measure the time difference between the arrival of the S- and P-waves on Figure 8.3 of the laboratory manual. The easiest way to determine the distance to the epicenter is to align the edge of a piece of scrap paper along the y-axis of the graph in Figure 8.5 of the laboratory manual (where the distance to the epicenter equals 0 miles) and make a mark at 0 minutes. Place a second mark at the edge of the scrap paper where it intersects the time difference measured from Figure 8.3 of the laboratory manual. Move the edge of the scrap paper from left to right across the graph until the two marks precisely intersect the S- and P-wave curves. (Make sure the edge of the scrap paper is perfectly vertical!!) Move vertically downward along the edge of the scrap paper to the x-axis to read the distance to the epicenter in miles. Be precise to the nearest 50 miles.
8. Self-explanatory.
9. Subtract your answer in question 10 from 10:39 PM.

10. Follow the method described in question instruction 9 using the seismographs in Figure 8.7 of the laboratory manual.
11. If you do not own a drawing compass, one can be used at the Learning Commons. Place the sharp metal compass point on the station location and draw the circle corresponding to the distance to epicenter determined for each station in question 12. Be sure to submit the completed Figure 8.8 with the rest of this lab assignment.
12. Often the three circles you draw will not intersect exactly at one point. Instead, it is more common to produce a small triangle at the intersection. If this is the case, determine the latitude and longitude of the center of the smallest triangle.
13. Using the distance to the epicenter for the New York station, use the same method used in question instruction 10. Subtract this result from 9:01 to determine the answer to this question..
14. Self-explanatory
15. Self-explanatory.
16. Place them on Figure 8.10.
17. Determine your answers using the graph in Figure 8.10 of the laboratory manual.
18. Interpret the graph in Figure 8.10 of the laboratory manual.
19. Interpret the graph in Figure 8.10 of the laboratory manual.
20. **OMIT THIS QUESTION.**
21. Self-explanatory
22. Check text references on earth layers. pp. 156-157
23. Check text references on earth layers. pp. 156-157
24. Interpret the graph in Figure 8.10
25. Check text references on earth layers. pp. 156-157
26. Self-explanatory
27. Self-explanatory
28. Self-explanatory

- 29. Self-explanatory
- 30. Self-explanatory

STOP AFTER YOU HAVE ANSWERED QUESTION 30

DO NOT COMPLETE THE SUMMARY/REPORT PAGE

Remember to make and keep a photocopy of your laboratory assignment before you submit your originals in the Learning Commons.

Notes:

Lab 8

Exercise 1: The Study of Minerals

Preliminary Instructions

1. Read carefully the information in your laboratory manual.
2. One kit containing mineral samples and another kit containing streak plate, glass plate, steel nail, penny, hand lens, magnet, and dilute hydrochloric acid can be used at the Learning Commons where you are registered. Be sure to blot dry any samples tested with the acid.
3. Use mineral samples A-J from the lab kit for this exercise.

Question Instructions

1. Self-explanatory.
2. Self-explanatory.
3. Self-explanatory.
4. Self-explanatory.
5. Self-explanatory.
6. Determine the specific colors and streak colors of minerals F, G, and H.
7. Self-explanatory.
8. Self-explanatory. Refer to Figure 1-8
9. **OMIT**
10. Assume they have been scratched by a knife blade
11. Determine the hardness values of minerals B, E, and I. Do **not** identify the hardness by a single number (i.e. 3). Instead provide the hardness **range** as is shown in Table 1.1. Write your answer next to the question.
12. Self-explanatory.
13. a. Count the number of flat planes present if you were able to view the sample in three dimensions.

- b. Divide your answer in 13a by two to answer this question.
 - c. Self-explanatory.
14. Describe the cleavage of mineral A.
15. a. Indicate the letter of the three minerals with the highest specific gravity in your set of samples.
- b. Self-explanatory
16. **USE SAMPLES A-J FROM THE LAB KIT FOR THIS ACTIVITY.** Remember to determine hardness as a **range** (use the ranges described in Table 1.2 in the laboratory manual), and specify both the **number** of cleavage directions and the **angles** between them (if the mineral exhibits no cleavage, write “fracture” in the box). Be sure to submit the completed Figure 1.19 with the rest of this lab assignment. Omit the last column on the chart.

For step 4: First, use the luster and general color of the mineral to determine which Group in Figure 1.20 in the laboratory manual to use in your identification. Then, narrow the possibilities by determining hardness and either streak or cleavage. Finally, use the other diagnostic properties to identify the mineral. It is not necessary to check your answer with the instructor, but if you have questions regarding the identification procedure, seek assistance.

1

STOP AFTER YOU HAVE ANSWERED QUESTION 16

DO NOT COMPLETE THE SUMMARY/REPORT PAGE

Remember to make and keep a photocopy of your laboratory assignment before you submit your originals in the Learning Commons.

Notes:

Lab 9

Exercise 2: Common Rocks

Preliminary Instructions

1. Read carefully the information in your laboratory manual.
2. One kit containing igneous, sedimentary, and metamorphic rocks and another kit containing streak plate, glass plate, steel nail, penny, hand lens, magnet, and dilute hydrochloric acid can be used at the Learning Commons. Be sure to blot dry any samples tested with the acid.
3. Use samples 25-35 for the igneous rock section of this exercise. (YOU WILL NOT NEED SAMPLE NUMBER 31.)
4. Use samples 36-43 for the sedimentary rock section of this exercise.
5. Use samples 44-51 for the metamorphic rock section of this exercise. (YOU WILL NOT NEED SAMPLE NUMBER 50.)

Question Instructions

1. Questions 1-10 are Self-explanatory. Read pp. 20-24 carefully as you answer Questions 1-10
11. For questions 11-19, refer to p. 25 of the lab book on the textures of igneous rocks
20. **OMIT**
21. **OMIT**
22. **OMIT**
23. Self-explanatory. Hint: look at the proportion of dark minerals in the sample
24. Use samples 25-35 for this activity. **DO NOT ATTEMPT TO IDENTIFY SAMPLE 31.** Use the three steps listed on p. 28 to help you complete the chart. Be sure to submit the completed Figure 2.9 with the rest of this lab assignment.
25. Self-explanatory
26. Self-explanatory

27. Self-explanatory. Refer back to your work with minerals.
28. Self-explanatory. Refer back to your work with minerals.
29. Self-explanatory.
30. Self-explanatory.
31. Self-explanatory. Use Q and O
32. Self-explanatory.
33. Self-explanatory. Refer back to your work with minerals.
34. Self-explanatory. Refer back to your work with minerals.
35. Use samples 36-43 for this activity. It is not necessary to distinguish between siltstone and shale. If it is either it may be classified as mudstone. Be sure to submit the completed Figure 2.12 with the rest of this lab assignment. **Samples 36, 37, 38, and 42 are detrital.**
36. **OMIT**
37. **OMIT**
38. **OMIT**
39. Use samples 44-51 for this activity. **DO NOT ATTEMPT TO IDENTIFY SAMPLE 50.** Be sure to submit the completed Figure 2.19 with the rest of this lab assignment. Use the acid test to detect calcite and the scratch test for quartz.

STOP AFTER YOU HAVE ANSWERED QUESTION 39

DO NOT COMPLETE THE SUMMARY/REPORT PAGE

Remember to make and keep a photocopy of your laboratory assignment before you submit your originals in the Learning Commons!!!

Notes:

Lab 10

Exercise 9: Introduction to Oceanography

Preliminary Instructions

1. Read carefully the information in your laboratory manual.
2. Items found in your home will be substituted for the “Materials Supplied by your Instructor” for this exercise.

Question Instructions

1. Only identify the four oceans on Figure 9.1 (letters A-D). Be sure to submit the completed Figure 9.1 with the rest of this lab assignment.
2. Self-explanatory
3. Self-explanatory.
4. Use the equation given and the figures provided to calculate the answer..
5. Subtract your answer in question 2 from 100.
6. Self-explanatory
7. Locate 40°North latitude on Figure 9.2 of the laboratory manual. Find where the tan “Land Areas” extends farthest to the left at that latitude and follow directly down the graph to the x-axis and read off the millions of square miles. Then find where the blue “Ocean Areas” extends farthest to the right at that latitude and follow directly down the graph to the x-axis and read off the millions of square miles. Now add the two numbers to determine total area. Divide the ocean area by the total area to determine the % ocean at that latitude. Repeat this method for 40°South latitude, 60°North latitude, and 60°South latitude.
8. Self-explanatory
9. Self-explanatory.
10. Self-explanatory.

11. Self-explanatory.
12. Self-explanatory. Use a reference to help locate the trench.
13. Self-explanatory.
14. Self-explanatory..
15. Self-explanatory.
16. Self-explanatory.
17. Self-explanatory.
18. Self-explanatory.
19. Refer back to figure 9.4
20. **DO NOT DO THE EXPERIMENT DESCRIBED IN THE LABORATORY MANUAL.** Instead, follow the instructions below and answer questions a-c on a separate sheet of paper.
 - Step 1: Fill a clear drinking glass halfway with fresh tap water.
 - Step 2: In a separate glass, mix the same amount of tap water with 2-3 teaspoons of table salt and 2-3 drops of food coloring.
 - Step 3: Slowly pour the dyed saltwater down the inside edge of the glass of fresh tap water. (Tilt the glass of fresh tap water so that you pour slowly enough.)
 - Step 4: Note the positions of the contrasting water layers.
 - a. Which of the water samples (fresh tap water or saltwater) was at the bottom of the glass?
 - b. Which was denser, freshwater or saltwater?
 - c. Discuss the relationship between the salinity and density of water.
21. OMIT
22. Read your answers directly from the graph you constructed on Figure 9.9. Be sure to submit the completed Figure 9.10 with the rest of this lab assignment.

23. Self-explanatory.
24. Self-explanatory.
25. Add all numbers in the “Atlantic Ocean” column in Table 9.3 in your laboratory manual and divide by 13. Add all numbers in the “Pacific Ocean” column and divide by 13. Compare these numbers to answer the question.
26. Self-explanatory.
27. Self-explanatory
28. Refer to the Glossary for help with this question. (Note that the halocline is a zone, not a boundary.) Be sure to submit the completed Figure 9.10 with the rest of this lab assignment.
29. Self-explanatory
30. **DO NOT DO THE EXPERIMENT DESCRIBED IN THE LABORATORY MANUAL.** Instead, follow the instructions below and answer questions a-c on a separate sheet of paper.
 - Step 1: Fill a clear drinking glass halfway with fresh, cold tap water.
 - Step 2: In a separate glass, mix the same amount of hot tap water with 2-3 drops of food coloring.
 - Step 3: Slowly pour the dyed hot water down the inside edge of the glass of cold tap water. (Tilt the glass of cold tap water so that you pour slowly enough.)
 - Step 4: Note the positions of the contrasting water layers.
 - a. Which of the water samples (cold or hot water) was at the bottom of the glass?
 - b. Which was denser, cold or hot water?
 - c. Discuss the relationship between the temperature and density of water.
31. Which was denser, cold or hot water?
.
32. Interpret your answers directly from the graphs you constructed on Figure 9.13. Be sure to submit the completed Figure 9.12 with the rest of this lab assignment..

33. Self-explanatory.
34. Self-explanatory.
35. Self-explanatory.

STOP AFTER YOU HAVE ANSWERED QUESTION 35

DO NOT COMPLETE THE SUMMARY/REPORT PAGE

Remember to make and keep a photocopy of your laboratory assignment before you submit your originals in the Learning Commons.

Lab 11

Exercise 11: Waves, Currents, and Tides

Preliminary Instructions

1. Read carefully the information in your laboratory manual.
2. None of the “Materials Supplied by your Instructor” will be needed for this exercise.

Question Instructions

1. Self-explanatory
2. Wave base = wavelength divided by 2.
3. Refer to figure 11.1
4. Refer to figure 11.1
5. Refer to figure 11.1.
6. Refer to figure 11.1
7. Refer to figure 11.1
8. Self-explanatory.
9. Refer to figure 11.1
10. Wave base = wavelength divided by 2

Depth where waves break = wavelength divided by 20
11. Remember that breaking waves are produced by interaction of wave energy with the ocean bottom.
12. Hint: How deep must the water be if the waves are breaking in that area?
13. Relate your answer to the wave base of the waves.
14. Use the same method used in question 8, but make sure to convert minutes into hours (to determine the answer in miles per hour) by dividing the number of minutes by 60.

15. Self-explanatory
16. **OMIT.**
17. **OMIT**
18. **OMIT**
19. **OMIT**
20. **OMIT**
21. Refer to page 298 of your textbook or an atlas for help with this question.
22. Refer to page 298 of your textbook or an atlas for help with this question.
23. Refer to page 298 of your textbook or an atlas for help with this question.
24. Refer to page 298 of your textbook or an atlas for help with this question.
25. Refer to page 298 of your textbook or an atlas for help with this question.
26. Refer to page 298 of your textbook or an atlas for help with this question.
27. Refer to Figure 11.4
28. Consider the climate of the Mediterranean region
29. Self-explanatory
30. Velocity = km/yrs
31. **OMIT**
32. **OMIT**
33. **OMIT**
34. **OMIT**
35. **OMIT**
36. **OMIT**
37. **OMIT QUESTIONS 37-45**

46. **OMIT**
47. Self-explanatory
48. Self-explanatory
49. Self-explanatory
50. Self-explanatory

STOP AFTER YOU HAVE ANSWERED QUESTION 50

DO NOT COMPLETE THE SUMMARY/REPORT PAGE

Remember to make and keep a photocopy of your laboratory assignment before you submit your originals in the Learning Commons.

Lab 12

Exercise 14: Atmospheric Moisture, Pressure, and Wind

Preliminary Instructions

1. Read carefully the information in your laboratory manual.
2. None of the “Materials Supplied by your Instructor” will be needed for this exercise.

Question Instructions

1. Refer to page 336 in your textbook and the information below to help you complete Figure 14.2.
2. After you have entered all information into Figure 14.2, use it to answer questions 2-4.
3. See question instruction 2.
4. See question instruction 2.
- 5-8 **OMIT** these questions
9. After you have plotted all points, connect those points with a smoothly curved line. Be sure to submit the completed Figure 14.5 with the rest of this lab assignment.
10. Read directly from Table 14.2.
11. Determine the corresponding capacities (g/kg) for each temperature from Table 14.2 and then calculate the changes by subtraction.
12. Self-explanatory.
13. Determine the corresponding capacities (g/kg) for each temperature from Table 14.2 and then follow the example for calculating relative humidity on page 199.
14. Note that adding water vapor increases the water vapor content and, therefore, the value in the **numerator** in each of the calculations you completed in question 13.
15. See question instruction 13.
16. Note that changing the temperature also changes the water vapor capacity and, therefore, the value in the **denominator** in each of the calculations you completed in question 15.
17. Use your results from questions 15 and 16 to help you answer this question.

18. Use your results from questions 15 and 16 to help you answer this question.
19. Hint: what two controlling variables, when changed in questions 13 and 15, produced corresponding changes in relative humidity?
20. First determine the water vapor capacity using the given temperatures and Table 14.2. Then, using the formula for relative humidity, solve for water vapor content:

$$\text{water vapor content} = \text{relative humidity} \times \text{water vapor capacity}$$

Remember that relative humidity is a percent and should be expressed as a decimal in the calculation (i.e., 40% = 0.40)

21. You should discuss the relationship between temperature, water vapor capacity, and water vapor content in your answer. Use the results from question 20 to support your response.
22. Hint: Dew-point temperature is the temperature at which the relative humidity is 100%. That is, water vapor content and water vapor capacity are the same. Therefore, if the water vapor content is 7 grams, determine the water vapor capacity which would produce 100% relative humidity, and from your result determine the dew-point temperature using Table 14.2.
23. Determine the relative humidity using the same method as in questions 13 and 15. Then determine dew-point temperature using the same method as in question 22.
24. Follow the instructions in the footnote of Table 14.3 to determine relative humidity.
25. Self-explanatory.
26. Follow the instructions in the footnote of Table 14.4 to determine dew-point temperature.
27. **OMIT THIS QUESTION.**

28. **OMIT THIS QUESTION.**
29. Hint: How many grams of water vapor can 10°C air hold? How many grams of water vapor can 5°C air hold?
30. Hint: How many grams of water vapor can 5°C air hold? How many grams of water vapor can -10°C air hold? Remember that the **initial** water vapor content was 10 grams!
31. Determine your answers directly from the graph in Figure 14.7.
32. Self-explanatory
33. Self-explanatory
34. Compare the red and dotted curves on Figure 14.7.
35. Hint: What must be true of the air temperature in order for dew or frost to form?
36. Use the same method used in question instruction 20 to determine water vapor capacity and content. Use the same method used in question instruction 22 to determine dew-point temperature.
37. Review the definitions of saturated and unsaturated.
38. Refer to the “Adiabatic Processes” section of the laboratory manual as well as your textbook to help you with this question.
39. Refer to the “Adiabatic Processes” section of the laboratory manual as well as your textbook to help you with this question.
40. How many degrees Celsius does the temperature still need to decrease to reach the dew-point temperature determined in question 36? Using the appropriate adiabatic lapse rate, determine the altitude at which condensation will occur.
41. Refer to the “Adiabatic Processes” section of the laboratory manual as well as your textbook to help you with this question..
42. Using the appropriate adiabatic lapse rate, determine the decrease in temperature from the altitude determined in question 42 to the summit at 3000 meters. Subtract this figure from the dew-point temperature determined in question 37 to obtain your answer.
43. Refer to the “Adiabatic Processes” section of the laboratory manual as well as your textbook to help you with this question.

44. Refer to the “Adiabatic Processes” section of the laboratory manual as well as your textbook to help you with this question.
45. Refer to the “Adiabatic Processes” section of the laboratory manual as well as your textbook to help you with this question.
46. Refer to the “Adiabatic Processes” section of the laboratory manual as well as your textbook to help you with this question.
47. Refer to the “Adiabatic Processes” section of the laboratory manual as well as your textbook to help you with this question. OMIT dew point calculation
48. Self-explanatory
49. Refer to Figure 14.11
50. Use figure 14.11 to answer questions 50-52
53. **OMIT**
54. **OMIT**
55. **OMIT**
56. Interpret the diagram in Figure 14.15 of the laboratory manual.
57. Place the L or H in the center
58. Draw arrow on Figure 14.15 on p. 207
59. Stronger winds are where the isobars are close together
60. Weaker winds are where the isobars are farther apart.

STOP AFTER YOU HAVE ANSWERED QUESTION 60

DO NOT COMPLETE THE SUMMARY/REPORT PAGE

Remember to make and keep a photocopy of your laboratory assignment before you submit your originals in the Learning Commons.

Notes:

Lab 13

Exercise 15: Air Masses, The Middle-Latitude Cyclone, and Weather Maps

Preliminary Instructions

1. Read carefully the information in your laboratory manual.
2. None of the “Materials Supplied by your Instructor” will be needed for this exercise.

Question Instructions

1. Refer to pp. 357 of your textbook for ore information.
2. Refer to pp. 357 of your textbook for ore information
3. Self-explanatory. See Figure 15.1.
4. Self-explanatory. See Figure 15.1.
5. Self-explanatory. See Figure 15.1.
6. Self-explanatory. See Figure 15.1.
7. Refer to Figure 15.2 and p. 339 of your text book.
8. Self-explanatory.
9. Self-explanatory.
10. Self-explanatory.
11. Self-explanatory.
12. Focus on the change in air mass characteristics from the time before to the time after the front passes.
13. Refer to Figure 15.2 and p. 339 of your text book.
14. Refer to Figure 15.2 and p. 339 of your text book.
15. Study the sequence on Figure 15.3 carefully.
16. Refer to Figure 15.4

17. Refer to Figure 15.4.
18. Review the definitions of convergence and divergence. Note that the question refers to **surface** winds.
19. Self-explanatory.
20. Note the trend of the isobar values on Figure 15.4 of your laboratory manual.
21. Note the trend of the isobar values on Figure 15.4 of your laboratory manual.
22. Refer to Figure 15,4
23. Hint: Contrast the air mass types on both sides of the warm front.
24. Hint: Contrast the air mass types on both sides of the warm front.

STOP AFTER YOU HAVE ANSWERED QUESTION 24

DO NOT COMPLETE THE SUMMARY/REPORT PAGE

Remember to make and keep a photocopy of your laboratory assignment before you submit your originals in the Learning Commons!

Section 4: Video Viewing Guide

Planet Earth Video Series

The *Planet Earth* series consists of seven video programs that cover such earth science topics as the solar system, earth-sun relationships, global climate, mineral and energy resources, plate tectonics, and ocean dynamics. Each program is one hour long and corresponds to one of the six modules which comprise this course. The list below summarizes the coordination of the video programs and the modules in the course.

MODULE I	EPISODE 7	FATE OF THE EARTH
MODULE II	EPISODE 4	TALES FROM OTHER WORLDS
MODULE II	EPISODE 6	THE SOLAR SEA
MODULE III	EPISODE 1	THE LIVING MACHINE
MODULE IV	EPISODE 5	GIFTS FROM THE EARTH
MODULE V	EPISODE 2	THE BLUE PLANET
MODULE VI	EPISODE 3	THE CLIMATE PUZZLE

Note that the episodes should be viewed in the sequence listed and that the corresponding course modules should be completed in that same sequence.

The questions included in this viewing guide packet should be answered while you view the video programs. However, we recommend that you read the questions before viewing, view the program once before attempting to answer the questions, and complete each question during a second viewing of the program. This will allow you to first familiarize yourself with the general interrelationships present in the topics discussed during the program and then to focus on the specific details that are analyzed in the viewing guide questions.

The answers to the viewing guide questions will be given in order as you view the video programs. If you hear the answer to a question, but did not hear the answer to the preceding question(s), then you missed that information, and you should rewind the videotape until you find the appropriate segment. The answers to the viewing guide questions will be relatively short (1-3 sentences), will help you to meet the course objectives provided in your course materials, and will consequently allow you to successfully complete your exams.

Notes:

VIDEO #1

EPISODE 7: FATE OF THE EARTH

1. What are the lingering effects on the coral reef environment thirty years after the detonation of a hydrogen bomb in the western Pacific Ocean?
2. What is the name of the theory that proposes that the atmosphere, oceans, rocks, and all living things function in harmony with one another in a tightly coupled system to produce a “living” planet?
3. At the beginning of earth’s history 4.5 billion years ago, what cosmic process was predominant in shaping the earth’s surface?
4. What earth process also dominated during this time period?
5. When the surface of the earth began to cool, what atmospheric event occurred?
6. What were the four major kinds of molecules that contributed to the origin of life and what were their functions?
7. What process, common in tide pools, can produce structures similar to the membranes of cells in which other chemicals needed for life could collect?

8. What 3.5 billion-year-old organism had been preserved in the black chert of the North Pole region of Australia?
9. What organism caused stromatolites to grow in Shark's Bay, Australia?
10. How do stromatolites form?
11. How did the development of photosynthesis in plants help to produce animal life?
12. What may explain why earth's temperatures have stayed within a range of liquid water and its oceans have never frozen or boiled away?
13. According to James Lovelock, why is the mixture of gases in earth's atmosphere so ideally suited to sustain life?
14. What cycle is crucial to life on earth?
15. What are the steps in this cycle?
16. What living structures form the fringes of atolls?
17. What organisms are slowly eating away the small islands of Palau?
18. What percentage of the world's living species will disappear if deforestation of the rain forests continues unchecked?

19. How many species of trees does a typical section of tropical rain forest contain compared to a typical section of North American forest containing 60 species of trees?
20. What practical purpose do the many species of trees in the rain forests serve to mankind?
21. About how long can rain forest soils support the cattle grazing before soil erosion occurs?
22. What would be the most significant by-product of a nuclear holocaust that would alter the earth's climate in global proportions?
23. What is the term to describe cold climatic conditions following a nuclear holocaust?
24. How many days without sunlight would it take following a nuclear holocaust to drop temperatures below freezing?
25. Why would billions not affected by the actual bomb blasts in a nuclear holocaust perish as well?
26. How has India attempted to solve the problem of food provisions for a large population?
27. What technological technique may determine whether the Sahara Desert is expanding or contracting?
28. What two motivations have caused man to alter his global environment?

Notes:

VIDEO #2

EPISODE 4: TALES FROM OTHER WORLDS

1. About how long ago did the solar system begin to form?
2. What part of the earth's rock record (in years) is missing?
3. Why are there so few remnants of meteorite impacts on earth?
4. What two metals composed the meteorite that created Meteor Crater in Arizona?
5. What are the clumps of material that radiate from the center of an impact crater called?
6. What part of the moon's rock record (in years) is missing?
7. What composes the atmosphere of Venus?
8. How many times greater is the atmospheric pressure on Venus compared to earth?
9. What two geologic features can be seen on Venus using high resolution images?

10. What evidence suggests that Martian icecaps were at one time melted to form liquid water?
11. What probably caused the huge valleys and scablands on Mars?
12. What do the different colored areas on Jupiter represent?
13. What is the Great Red Spot on Jupiter?
14. What geologic process has been witnessed on Io, one of Jupiter's moons, by scientists?
15. How wide are Saturn's rings?
16. What is peculiar about the rings around Uranus?
17. What lies just beyond the edge of the Solar System?
18. What cosmic forms reside in this region?
19. How long ago did earth begin to produce life?
20. How long ago did dinosaurs become extinct?

21. What time interval is represented by the clay layer that separates the rocks from the Cretaceous and Tertiary time periods in Gubio, Italy?
22. What element, present in cosmic dust, was found to be overly abundant in the clay layer at the Cretaceous/Tertiary boundary?
23. What was the implication of the overabundance of this element in the clay?
24. What would have been the global effect of such an event?
25. What characteristics did quartz grains from clay at the Cretaceous/Tertiary boundary in Montana possess that supported the occurrence of this event?
26. Every how many years does a mass extinction appear to occur?
27. What could explain the cyclicity of these mass extinctions?
28. What substances were partly derived from comets that collided with earth in its early history?

Notes:

VIDEO #3

EPISODE 6: THE SOLAR SEA

1. How many hydrogen bombs are equivalent to the amount of energy released in one solar flare?
2. Name four civilizations that worshipped the sun.
3. What are four influences that the sun has on earth processes?
4. What is the duration of a single sunspot cycle?
5. Where do sunspots originate?
6. How often does the polarity of the sun's magnetic field reverse itself?
7. During what century did the sun undergo major changes according to the study of tree rings?
8. What characteristic of the tree rings indicated periods of drought?
9. What solar and climatic cycles appear to be linked by tree ring analyses?
10. What is the approximate duration of each of these cycles?

11. What evidence indicates that solar cycles over a billion years ago were much the same as they are today?
12. What is the distance from the sun to earth?
13. Where is the largest solar telescope in the world located?
14. What is the sun's outer atmosphere called?
15. What instruments separate light into the colors of the spectrum?
16. What solar phenomena did continuous, 24-hour-per-day observations of the sun in Antarctica reveal?
17. What thermonuclear reaction occurs in the core of the sun?
18. How are gases transported to the photosphere of the sun?
19. What are the charged particles emanating from the sun between the sun and earth called?

20. Why do the tails of comets always trail away from the sun regardless of the direction in which they travel?
21. What happens to the earth's magnetic field when it interacts with the solar wind?
22. What is the origin of the aurora?
23. What happens when billions of watts of energy are pumped into earth's atmosphere and a proton event occurs?
24. Why did Skylab reenter earth's atmosphere prematurely?
25. What disease is primarily caused by excessive exposure to invisible ultraviolet radiation from the sun?
26. What is the ozone layer?
27. What effect does a violent outburst of solar activity have on the ozone layer?
28. What chemical compound, produced in the atmosphere during a solar storm, causes this effect?
29. What three types of atmospheric emissions produced by man threaten the ozone layer?

Notes:

VIDEO #4

EPISODE 1: THE LIVING MACHINE

1. What does the Greek word *tekton* mean?
2. What fundamental earth science concept is evidenced by the rock that makes up the walls of the Grand Canyon?
3. What type of environments do horizontal rock layers record?
4. What do the contorted rocks in the deepest part of the Grand Canyon represent?
5. Who was the “Father of Geology?”
6. How old is the earth according to radiometric dating?
7. What was the significance of Siccar Point, Scotland?
8. What meteorologist suggested that continents were once joined into one large supercontinent?
9. What is the name of this ancient supercontinent?

10. What did the drilling ships that charted the Atlantic Ocean find?
11. Which theory was prompted by the analysis of core samples of sediments from the sea floor?
12. What did the magnetic analysis of volcanic rocks on land reveal about the earth's magnetic field?
13. How was this information used to confirm the theory referred to in question 11?
14. In 1968, did the Glomar Challenger drilling ship find the sea floor away from the spreading centers to be older or younger than the sea floor at the spreading center?
15. What is the relationship between the locations of earthquakes and plate boundaries?
16. After seeing the analogy of chunks of lava floating on molten lava, name the four ways that plates interact.
17. Why does Japan have so many earthquakes and volcanoes?
18. How did marine fossils get on top of the 29,000 foot Himalayas?
19. What is the cause of the high-intensity earthquakes that occur in China?

20. Which fault is among **the most studied** faults in the world?
21. What appears to be driving plate tectonics?
22. In the chain of the Hawaiian Islands and Emperor Seamounts, where are the oldest located?
23. What is the thermal plume of molten rock which has created the Hawaiian Islands and Emperor Seamounts called?
24. Where did the earthquake which was 27 times more powerful than the San Francisco earthquake of 1906 and which hit within a plate in 1812 occur?
25. Why can't we see the evidence of this massive quake today?
26. How long ago did a rift begin to develop in this area?
27. What do the radiolaria tell us about the origin of the San Francisco area and the Marin Headlands?
28. How many years ago did the supercontinent referred to in question 9 exist?
29. Besides lack of predators, why do Green Turtles migrate 1,200 miles to Ascension Island to lay their eggs?

Notes:

VIDEO #5

EPISODE 5: GIFTS FROM THE EARTH

1. What six metals are mined extensively for economic and industrial reasons?
2. From what materials are fossil fuels formed?
3. What three substances represent the fossil fuels?
4. What metal was mined in ancient Cyprus?
5. For which historical period did these mines provide the metal?
6. What features formed on the sea floor were associated with the rich, layered metal deposits in Cyprus?
7. In what type of plate tectonic boundary did the metal deposits of Troodos, Cyprus form?
8. What type of plate tectonic boundary forced the former sea floor upward into mountains that expose the metal deposits which exist in Cyprus today?
9. What ancient environment produced the rich metal deposits in Japan?

10. What evidence off the coast of Mexico confirmed that such environments created the metal deposits in Cyprus and Japan?
11. What do scientists look for to lead them to ancient metal deposits similar to those found in Cyprus and Japan?
12. How much are the metal deposits at the Kidd Creek mine in Canada worth?
13. What is mined from the Bushveld Complex in southern Africa?
14. How did these deposits form?
15. What metal, mined from the Bushveld Complex, is used to make lasers, coat razor blades, create jewelry, and construct rocket engines?
16. What does a fraction of the sun's energy produce on earth that becomes pitted against the earth's internal forces?
17. What important natural resource is produced by the breakdown of the earth's crust by weathering combined with the incorporation of organic material?
18. What is weathering and erosion?
19. What is the origin of the 100 million year old gray clay in Hawaii?

20. From what type of deposit is the windblown material that composes loess derived?
21. What is the rate of soil erosion in the loess deposits in Tennessee?
22. What is the maximum amount of soil erosion that can be tolerated in order for agriculture to remain productive?
23. What is the feature produced when a large river meets the sea where coal, oil, and natural gas are often created?
24. How is the amount of weight necessary to provide adequate pressure to change organic material to coal, oil, and natural gas produced in this type of feature?
25. What must be present in oil fields in order to trap the oil underground?
26. What material is produced during the first step in the formation of coal?
27. What element is present in only small amounts in clean-burning coal?
28. What material must underlie and overlie the organic material in order for coal formation to occur?
29. Where is oil held in rocks?

30. Of the 600 known sedimentary basins around the world, how many actually produce oil or gas?

31. What type of studies, using a technique similar to sonar, uses reflected sound waves from explosive charges to determine the structure of rock layers beneath the earth's surface?

32. What is the use of instruments that "see" beyond the range of human vision called?

33. What does the Airborne Imaging Spectrometer do?

VIDEO #6

EPISODE 2: THE BLUE PLANET

1. How much of the earth's surface is above water?
2. What are the spiraling waters in the oceans called?
3. What part of the earth's system is said to behave analogously to the behavior of the ocean?
4. Where does the body of warm current flow in relation to the surrounding water?
5. What happens to the spiraling waters in a moving ocean current?
6. What are the oceanic counterparts of atmospheric storms and hurricanes?
7. What is the oceanic counterpart of an atmospheric tornado?
8. What is the velocity of the Gulf Stream and how much water does it carry?
9. Who produced the first chart of the Gulf Stream?

10. What is the temperature of the Gulf Stream water relative to the surrounding water (warmer/colder)?
11. To what type of feature found on land can the Gulf Stream be compared?
12. In the yacht race, what slowed the boats that attempted to ride the Gulf Stream for an extra “push?”
13. Identify two variables that produce the major surface currents on earth.
14. What variable drives deep-ocean currents?
15. How long does it take for some deep-ocean currents to travel across an ocean basin?
16. When deep-ocean currents resurface, what are they called?
17. What do these resurfacing currents bring with them?
18. On what type of organism at the base of the food chain are all aquatic animals dependent?
19. Where are the highest concentrations of this organism found?
20. What is El Niño?

21. Does El Niño occur in a cyclic time pattern so that its occurrence can be predicted?
22. What are some of El Niño's effects?
23. How much of global weather patterns can be disrupted by El Niño?
24. What is the average depth of the oceans?
25. What allows incredibly delicate organisms of the deep ocean, which would easily disintegrate at the surface, to survive?
26. What does echo sounding allow scientists to record?
27. What mountain, when measured from the sea floor, is the tallest in the world, even taller than Mt. Everest?
28. What is the largest geological feature on earth?
29. What do magnetic particles found in cores drilled from the ocean floor tell us about those rocks?
30. What do the dark-colored layers of ocean sediments represent? The light-colored layers?

31. What can the analysis of tiny microfossils from the ocean tell us?

32. Name three organisms that thrive in the hot water around vent areas on the ocean floor.

Notes:

VIDEO #7

EPISODE 3: THE CLIMATE PUZZLE

1. At any moment on earth, how many times will lightning strike per second?
2. In Antarctica, where is the only habitat in which microorganisms can be found?
3. List some ways that animals (including humans) adapt to climate change.
4. When do the monsoons occur in India?
5. What type of organic material provided evidence of an ancient drought in India?
6. What type of rock, collected in caves, can be analyzed to determine climatic conditions for a particular time period?
7. Who suggested that large areas were once covered by ice?
8. What evidence did he use to support this theory?
9. What are glaciers?

10. What features are created by the variations in flow rates within a glacier?
11. How are ice ages produced?
12. What three phenomena, according to Milankovitch, contributed to the onset of an ice age?
13. What do the marine terraces in Barbados indicate?
14. How do microorganisms like radiolaria from sea floor sediments provide evidence of ancient ice ages?
15. Which of Milankovitch's astronomical cycles correlates with the evidence gathered from deep-sea sediments and, therefore, appears to cause ice ages?
16. According to Milankovitch cycles, when should the next ice age occur?
17. How many years of earth's history does the mile-long Vostok ice core from Antarctica record?
18. What did the Vostok ice core indicate about carbon dioxide levels in the atmosphere during the last ice age compared to the present?
19. Why, during its early history, was earth not a frozen planet when the sun was thought to have been smaller and to have released less solar energy than today?

20. How has man increased the amount of carbon dioxide released into the atmosphere?
21. By what percentage have carbon dioxide levels increased since 1958, according to measurements recorded at the Mauna Loa Observatory in Hawaii?
22. How many degrees Fahrenheit may such increases raise the mean temperatures on earth during the next century?
23. If western Antarctica's ice sheet were to collapse and melt due to global warming associated with the greenhouse effect, how many feet would sea level rise globally?
24. What would be the results of such a sea level rise?
25. What other effects, besides sea level rise, could result from global warming?
26. Why are mathematical models run by computers better to simulate global warming on earth than to experiment on earth itself?
27. According to computer modeling, what caused the earth's climate during the Cretaceous time period (about 100 million years ago) to be warmer than today's climate?
28. What is the amount of area of rain forest that has been removed each year on earth?

29. What insect has exploded in population as a result of rain forest deforestation?

30. What gas does this insect produce and emit that may affect global climate?

Notes:

Appendix A

Student Learning Objectives Module 1: Earth System/Global Change

Chapter 1: The Earth System

1. Define “Earth system science.”
2. Identify and describe the four Earth “spheres” that function as reservoirs of matter and energy.
3. Explain the relationship between the rate of movement of matter between Earth’s reservoirs and the volume of matter in those reservoirs.
4. Describe the scientific method.
5. Distinguish among the three types of systems: isolated, closed, and open.
6. Describe the “energy cycle” and distinguish between solar and geothermal energy sources.
7. Explain the differences between matter and energy.
8. Describe the hydrologic cycle.
9. Give examples of biochemical cycles and explain how they are essential to living organisms.
10. Differentiate between negative and positive feedback in a system.
11. Distinguish between a hypothesis and a theory
12. Identify the causes and effects of global change.

Chapter 19: The Changing Earth System

1. Identify earth system changes that have resulted because of human activity.
2. Describe the rate of human population growth and its environment effect.
3. Describe the process of desertification and its consequences.
4. Describe the effects modern civilization has had on the rivers of the world.
5. Identify and describe problems humans have induced in groundwater systems.
6. Identify and describe the disposal problems involved with radioactive and toxic wastes.
7. Describe the relationship between CFC gases and the earth’s ozone layer.
8. Describe the carbon cycle and the effect of human activity on the distribution of carbon and carbon compounds.
9. Describe the greenhouse effect including its formation and trends in gas concentration.
10. Identify physical and biological effects on global warming including estimates of future warming.

Student Learning Objectives Module 2: The Earth In Space

Chapter 2: Energy

1. Distinguish between potential and kinetic energy.
2. Describe the fundamental laws of thermodynamics.
3. Identify and describe the forms of electromagnetic radiation generated by the Sun.
4. Compare the rate of solar energy released from the Sun with the rate of solar energy received by the Earth.
5. Explain how nuclear fusion generates energy in the Sun's core.
6. Identify and describe the structural zones of the Sun's interior.
7. Describe blackbody radiators and the factors that influence their colors.
8. Describe the Earth's energy cycle.

Chapter 4: Space and Time

1. Describe the planetary and interplanetary composition of the solar system from both a historical and modern perspective.
2. Distinguish between the rotational and revolutionary motions of the planets and their moons.
3. Describe the scientific theory of the origin of the solar system particularly with respect to the development of the planetary patterns observed today.
4. Describe the differences between the terrestrial and Jovian planets.
5. Identify and describe the composition and behavior of the internal zones of the terrestrial planets.
6. Identify and describe the composition and behavior of the internal zones of the Jovian planets.
7. Explain the causes of seasonal variations on Earth.
8. Define galaxy and identify the galaxy in which our solar system is located.
9. Describe the relationship between the Sun and life on the planets.
10. Describe the scale and motions of the Sun and Earth.
11. Describe the characteristics and significance of a Hertzsprung-Russell (H-R) plot.
12. Distinguish among the stages of stellar evolution in small, average, and large mass stars.
13. Describe the origin of the moon.
14. Describe the role that Uniformitarianism and catastrophes play in the evolution of Earth.

Student Learning Objectives Module 3: The Earth Beneath Our Feet – Part I

Chapter 5: Plate Tectonics

1. Describe the strengths and weaknesses of Alfred Wegener's hypothesis of continental drift.
2. Describe the movement of heat energy inside the Earth.
3. Explain how studies of paleomagnetism led to the development of the plate tectonic theory.
4. Describe seafloor spreading and its relationship to paleomagnetic studies.
5. Identify the major plates that make up the lithosphere.
6. Distinguish between the lithosphere and the asthenosphere and describe how their interaction permits plate motion to occur.
7. Identify and describe the three relative motions associated with each of the plate margin types.
8. Describe the processes and features associated with divergent, convergent, collision, and transform plate margins.
9. Explain the physical mechanism that scientists believe is responsible for driving plate motion.

Chapter 6: Earthquakes and Volcanoes

1. Explain the elastic rebound theory as it relates to the generation of earthquakes.
2. Describe the nature of seismic vibrations and their measurement by seismographs.
3. Distinguish among the attributes and behaviors of P-, S-, and surface waves.
4. Describe how the behavior of body waves has been used to determine Earth's internal structure.
5. Identify Earth's internal zones and describe the behavior and composition of each.
6. Describe how scientists locate the epicenter of an earthquake using seismograph data.
7. Distinguish between the Richter magnitude and Mercalli intensity scales.
8. Identify and describe six causes of earthquake damage.
9. Describe the scientific factors that can be used in earthquake prediction.
10. Compare and contrast the igneous materials magma, lava, pyroclasts, and tephra.
11. Contrast the geological environments and processes that are responsible for the generation of basaltic, andesitic, and rhyolitic magma.
12. Identify and describe the three volcanic cone types.
13. Describe the geologic conditions that lead to the development of calderas.
14. Identify the beneficial and detrimental effects of volcanic activity.
15. Identify and describe four igneous intrusions.

NOTES:

Student Learning Objectives Module 4: The Earth Beneath Our Feet – Part II

Chapter 3: Matter

1. Describe the different states of matter.
2. Differentiate between organic and inorganic matter.
3. Describe the atomic structure of elements and compounds.
4. List the criteria that identify substances as minerals.
5. Describe the structural characteristics of silicate minerals.
6. Use physical and chemical properties to identify common minerals.
7. Describe the differences in texture, mineral composition, and origin of igneous, sedimentary, and metamorphic rocks.
8. Describe the composition and internal structure of the Earth.
9. Distinguish between regolith and sediment.
10. Provide examples of variability in the rates of geological processes throughout Earth history.

Chapter 7: The Rock Cycle

1. Explain how the rock cycle can cause rocks of one type to change into rocks of another type.
2. Describe the interactions between the rock cycle and the plate tectonic cycle.
3. Explain how physical and chemical weathering transform rock into sediment.
4. Provide several examples of mass wasting.
5. Describe lithification.
6. Use textural and structural properties to interpret the depositional conditions of a sedimentary rock
7. Identify and explain the principles of stratigraphy.
8. Define metamorphism and identify the factors that transform rock into metamorphic rock.
9. Distinguish between contact and regional metamorphism with respect to their conditions and effects and provide geographical examples of each.
10. Describe the origins of igneous rock and the associated textures.

NOTES:

Student Learning Objectives Module 5: The Earth's Blanket of Water

Chapter 8: The Hydrologic Cycle

1. Explain the relationship of streams to the hydrologic cycle.
2. Define "drainage basin."
3. Describe the interrelationship among stream discharge, velocity, and cross-sectional shape.
4. Distinguish between meandering and braided stream channels.
5. Identify and describe the three types of stream sediment load.
6. Describe the downstream changes in the size and composition of sedimentary particles.
7. Describe the depositional and erosional features produced by changes in stream energy.
8. Explain the causes and effects of stream flooding.
9. Describe the formation and behavior of groundwater.
10. Identify and describe all subsurface zones of the groundwater system.
11. Explain the effects of groundwater removal on the water table.
12. Describe the characteristics of a productive aquifer.
13. Distinguish among confined, unconfined, and artesian aquifers.
14. Describe the process of dissolution of carbonate rocks and its resultant Earth features.

Chapter 10: The World Ocean

1. Describe the geographic distribution of ocean water on Earth.
2. Compare average and maximum ocean depths.
3. Describe the most accepted scientific theory for the origin of ocean water and the geologic evidence for the existence of ancient oceans.
4. Describe the composition and sources of the ions that contribute to an ocean's salinity.
5. Explain the relationship between latitude and sea-surface temperature.
6. Identify the factors that influence sea-surface salinity.
7. Distinguish among the pycnocline, halocline, and thermocline in a typical subsurface ocean profile.
8. Identify and describe the factors that effect the motion and temperature of surface ocean currents.
9. Describe how Ekman transport affects the processes of upwelling and downwelling.
10. Describe the biotic zones and sediment compositions of oceans.
11. Describe the causes and behavior of ocean waves.
12. Explain how waves break to create a surf zone along a coastline.
13. Relate the process of wave refraction to the development of longshore currents along coastlines.
14. Identify and describe the formation of geologic features produced by coastal processes.

15. Describe the origin and composition of ocean sediments.
16. Explain the causes and behavior of ocean tides.
17. Identify and describe the factors that produce relative changes in sea level.

Notes:

Student Learning Objectives Module 6: The Earth's Gaseous Envelope

Chapter 11: The Atmosphere

1. Identify the atmospheric criteria for a biologically habitable planet.
2. Identify the two energy sources driving atmospheric processes.
3. Compare the relative proportions of the most abundant gases in the atmosphere.
4. Identify five minor gases and the roles they play in the absorption or filtering of solar energy.
5. Identify the structural zones of the atmosphere and describe the temperature changes that occur in each zone with an increase in altitude.
6. Describe the interaction between solar radiation and the atmosphere.
7. Explain how air pressure changes with increasing altitude.
8. Identify six ways that H₂O changes states and indicate whether the change involves an absorption or release of latent heat.
9. Describe the relative humidity of the air.
10. Explain how adiabatic temperature changes occur.
11. Describe the process of cloud formation.
12. Compare the two methods that increase the masses of cloud particles to produce precipitation.
13. Distinguish among the four atmospheric lifting mechanisms.
14. Identify and describe the three cloud families.
15. Identify and describe two stratospheric cloud types.
16. Identify and describe three types of atmospheric fronts.

Chapter 12: Wind and Weather Systems

1. Describe the atmospheric conditions that lead to the development of wind.
2. Explain the concept of “windchill factor.”
3. Identify the three factors that influence wind behavior.
4. Explain how isobars can be used to measure the speed and direction of the wind.
5. Explain how the Earth’s rotation affects the direction of the wind.
6. Compare the magnitude and direction of the Coriolis effect at different latitudes.
7. Describe the relationship among friction, wind speed, and the Coriolis effect.
8. Describe the behavior of geostrophic winds.
9. Distinguish among the characteristics associated with cyclones and anticyclones.
10. Identify the global pressure belts and describe their effects on global wind patterns.
11. Distinguish between the occurrence of the polar and subtropical jet streams.
12. Explain the behavior of Hadley Cells and their significance to the development of latitudinal belts of high and low precipitation.
13. Identify and describe the four methods of desert formation.
14. Describe monsoonal circulation.
15. Distinguish among local wind systems such as land vs. sea breezes, mountain vs. valley winds, katabatic winds, and chinooks.
16. Identify and describe the four types of airmasses.

17. Explain the processes associated with thunderstorm development.
18. Compare tornadoes and hurricanes with respect to their causes and effects.

Notes:

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