This course supports the assessments for Earth Science: Content Knowledge. The course covers 10 competencies and represents 7 competency units.

Introduction

Overview

This course covers the advanced content knowledge that a secondary Earth Science teachers are expected to know and understand. Topics include basic scientific principles of Earth and Space Sciences, tectonics and internal earth processes, earth materials and surface processes, history of the Earth and its life-forms, Earth's atmosphere (meteorology) and hydrosphere (oceanography), and astronomy.

Getting Started

Welcome to Earth Science: Content Knowledge. In this course you will review Earth Science content and prepare for the Earth Science (5571) *Praxis*® Subject Assessments tests. This third-party exam, offered by Educational Testing Services (ETS), measures the knowledge of specific subjects that K–12 educators will teach, as well as general and subject-specific teaching skills and knowledge. Individuals entering the teaching profession take the *Praxis*® Subject Assessments tests as part of the teacher licensing and certification process required by many states. As part of this course, you will need to identify a testing center and schedule a date to take this exam.

Welcome Video

Watch the following video for an introduction to this course:

Note: To download this video, right-click the following link and choose "Save as...": download video.

Competencies

This course provides guidance to help you demonstrate the following 10 competencies:

- **Competency 204.5.1: Astronomy**
  The graduate has a broad understanding of the basic concepts of astronomy.
- **Competency 204.5.2: Geology**
  The graduate has a broad understanding of the principles of geology.
- **Competency 204.5.3: Meteorology**
  The graduate has a broad understanding of the concepts of meteorology.
- **Competency 204.5.4: Oceanography**
  The graduate has a broad understanding of the basic concepts of oceanography.
- **Competency 205.2.1: Earth Systems Structure and Function**
  The graduate understands the structure and function of Earth systems, including the

closely coupled subsystems: geosphere, hydrosphere, atmosphere, and biosphere.

- **Competency 205.2.2: Earth Systems Equilibrium**
  The graduate understands the Earth's history and that the Earth exists in a state of dynamic equilibrium that evolves over geologic time.
- **Competency 205.2.3: Solar System**
  The graduate understands the components and properties of the solar system, and understands that the major components are in a state of regular and predictable motion.
- **Competency 205.2.4: The Universe**
  The graduate understands the composition, history, and properties of the earth and the universe, and the scale of the universe in space and time.
- **Competency 205.2.5: Oceanographic Concepts**
  The graduate has a deep understanding of the following oceanographic concepts: global plate tectonics, the origin of the oceans, air/sea interactions, and human interactions with the oceans.
- **Competency 602.6.1: Teaching Methods — Science (Secondary)**
  The graduate understands and provides safe, effective, research-based instruction in science.

Teaching Dispositions Statement
Please review the Statement of Teaching Dispositions.

Course Instructor Assistance

As you prepare to demonstrate competency in this subject, remember your course instructor stands ready to help you reach your educational goals. You should expect to work with your course instructor for the duration of your coursework, so you are welcome to contact her as soon as you begin. Course instructors are fully committed to your success!

Contact Information:
Suzanne Metlay
suzanne.metlay@wgu.edu
geosciences@wgu.edu
1-877-435-7948 ext. 4961
https://metlay.youcanbook.me/

Cohorts and Webinars

Cohorts and WebinarsEarth Science Praxis Cohort sessions are held most Tuesdays at 5:00 pm Mountain Time. Each webinar will address a specific topic and will be open to general questions and answers. View the current cohort and webinar schedule for Earth and Space Sciences.

Preparing for Success

The information in this section is provided to detail the resources available for you to use as you complete this course.

Learning Resources

The learning resources listed in this section are required to complete the activities in this course. For many resources, WGU has provided automatic access through the course. However, you may need to manually enroll in or independently acquire other resources. Read the full instructions provided to ensure that you have access to all of your resources in a timely manner.

Automatically Enrolled Learning Resources

You can access the learning resources listed in this section by clicking on the links provided throughout the course. You may be prompted to log in to the WGU student portal to access the resources.

VitalSource E-Texts

The following textbook is available to you as an e-text within this course of study. You will be directly linked to the specific readings required within the activities that follow.

- Tarbuck, E., Lutgens, F., & Tasa, D. (2014). Earth science (14th ed.). Hoboken, NJ: Prentice Hall. ISBN-13: 978-0321928092.

Note: These e-texts are available to you as part of your program tuition and fees, but you may purchase a hard copy at your own expense through VitalSource or a retailer of your choice. If you choose to do so, please use the ISBN listed to ensure that you receive the correct edition. The following sites provide instruction on how to create a VitalSource account, use features such as downloading your e-texts for offline use, and purchase a print-on-demand option, if available.

VitalSource Navigational Video
Print-On-Demand Option

Geology LabPaq (or Science Methods LabPaq)

Pull out your **mineral & rock sample kit** and become familiar with these samples. There may be only 17 samples per kit; that is OK. If you have not already completed the labs to identify minerals and rocks, please do so now. Ask your Course Instructor for an answer key, if needed.

Cohorts and Webinars

Earth Science Praxis Cohort sessions are held most Tuesdays at 7:00 pm Mountain Time. Each webinar will address a specific topic and will be open to general questions and answers. View the current cohort and webinar schedule for Earth and Space Sciences.

Practice Tests

Practice tests and homework assignments are included as part of this course.

The *Praxis*® Assessment is a third-party exam offered through Educational Testing Services (ETS). In addition to what is provided with this course, ETS provides an **optional, for a fee,** interactive practice test, but it isn't recommended that you purchase it for this course. The practice test consists of a single set of practice questions, **so each time you take the practice test you answer the same questions in the same order.** Retaking or repurchasing the same

practice test more than once does not give you different practice questions or change the order of the questions.

The **ETS Practice Exam** is a full-length practice test that allows you to work through a set of test questions to simulate what you will experience on the actual day of the PRAXIS exam. After a completed attempt, you can view your score and review explanations for the correct answers. You will have unlimited attempts regardless of any notice to the contrary on the ETS website. This practice test includes one set of test questions. Retaking it will not provide different sets of questions or change the order in which they are delivered. If you have any questions please contact your course instructor.

Study Companion

ETS created a free Earth and Space Sciences Study Companion to help you prepare for the *Praxis*®.

Read the following sections of this helpful document:

1. Learn About Your Test
2. Familiarize Yourself with Test Questions
3. Practice with Sample Test Questions
4. Determine Your Strategy for Success
5. Develop Your Study Plan
6. Review Smart Tips for Success
7. Understand Your Scores

The **ETS Practice Exam** is a full-length practice test that allows you to work through a set of test questions to simulate what you will experience on the actual day of the PRAXIS exam. After a completed attempt, you can view your score and review explanations for the correct answers. You will have unlimited attempts regardless of any notice to the contrary on the ETS website. This practice test includes one set of test questions. Retaking it will not provide different sets of questions or change the order in which they are delivered. If you have any questions please contact your course instructor.

Recommended Activities

Follow the guidance in sections 1. ("Learn About Your Test"), 4. ("Determine Your Strategy for Success"), and 5. ("Develop Your Study Plan") in the Earth and Space Sciences Study Companion. Be *honest* with yourself—identify areas in which you are comfortable (and continue to check your competence in these areas), areas that you understand but need more practice, and areas in which you still need to learn the content.

Chapter 3 Preassessment

Set aside the time that *you* need to ensure success on this exam. When you feel ready, use the pre-test in Chapter 3 as a pre-assessment to identify areas you need to work on.

Study Plan

The topics in this course include resources and activities categorized as follows:

- *Read and Watch*: if a topic is largely new to you, or if it has been several years since you have studied the topic, carefully read the assigned portion of *Earth and Space Sciences* or other resources and examine the accompanying visuals. Then continue on to *practice*.
- *Practice*: if you have already learned the topic but struggle with details or recalling specific information, select and interact with the listed tutorials, labs, videos, and other resources targeted to your need. Skim the assigned portion of *Earth and Space Science* and examine the accompanying visuals. Then answer the reflective questions before continuing on to the *check*.
- *Check:* complete the quizzes and knowledge checks where provided, even if you already feel confident in your knowledge of a topic. They may highlight areas where you need further *learning* or *practice*.

Homework Assignments

These homework assignments provide additional activities for you to use to check your knowledge on specific topics.

- Week 1
- Week 2
- Week 3
- Week 4
- Week 5
- Week 6
- Week 7
- Week 8 A
- Week 8 B

Pacing Guide

The pacing guide suggests a weekly structure to pace your completion of learning activities.

Week 1:

Basic Principles of Science

- Methodology and philosophy
- Scientific tools
- Safety
- Scientific ideas change over time

Geology (Earth's Composition)

- Minerals
- Rocks

Weekly homework

Week 2:

Geology (Surface Processes)

- Weathering, Soil, and Mass Wasting
- Surface Water and Groundwater
- Glaciers and Deserts

Weekly homework

Week 3:

Geology (Internal Processes)

- Plate Tectonics and Geologic Hotspots
- Earth’s Magnetic Field
- Earthquakes and Seismic Waves
- Volcanoes and Mountains
- Topographic and Geologic Maps

Weekly homework

Week 4:

Geology (History & Life)

- Relative and Radiometric Age-Dating
- Life on Earth

Weekly homework

Week 5:

Oceanography

- Ocean Floor Features

- Ocean Water
- Ocean Circulation, Waves, Tides, and Human-Made Structures

Weekly homework

Week 6:

Meteorology

- Atmosphere Composition and Structure
- Mechanisms of Heat Transfer
- Greenhouse Effect

Weekly homework

Week 7:

Meteorology

- Clouds and Precipitation
- Air Pressure and Winds
- Coriolis Effect and El Nino
- Weather: Air Masses, Fronts, and Storms
- Climate

Weekly homework

Week 8:

Astronomy

- Significant People in Western Astronomy
- Moon Phases, Eclipses, Seasons, etc.
- Solar System Structure and Composition
- Electromagnetic Radiation & Spectroscopy
- Life Cycle of Stars: Hertzsprung-Russell Diagram
- Stellar Remnants
- Cosmology: Big Bang Theory and History of the Universe
- Exam and Study Guide Information

Weekly homework

Preparing for the Praxis? Assessment

Understandably, many people are nervous on exam day. To help reduce any anxiety, you should learn more about the exam experience and the best preparation strategies.

ETS Earth and Space Sciences Content Knowledge Exam

Watch the following videos for better understanding of the assessment. The first is an interactive demonstration of how the exam is administered, the tools available during the exam, and the general format of questions.

- Computer-Delivered Testing Demonstration (Flash) | View Transcript
- What to Expect on the Day of Your Computer-Delivered Test (Flash) (7 minutes)

Watching these videos will help you prepare for the exam experience, allowing you to demonstrate your Earth and Space Sciences content competency.

Receiving WGU Credit for the Assessment

WGU will pay for your first two attempts of the Praxis exam. You will be responsible for paying for third and subsequent attempts. If you need a fee waiver, please see "Fee Waivers" at the ETS Web site. If you qualify, you may receive one waiver per year.

In order to receive a pass on your degree plan, you must pass the exam based upon the WGU cut score (generally 153 or higher; check with course instructor). Additionally, if the state in which you seek licensure requires the Praxis exam, you must pass the exam based on that state's cut score to be admitted into Demonstration Teaching, or allowed to graduate. Please note that it is possible to pass the exam based on either the WGU cut score or your state's cut score, and still need to take it again in order to satisfy the other cut score.

If your state requires you to take a state exam for teacher licensure, you are still required to take the Praxis as a WGU graduation requirement in addition to the state exam you must take for licensure.

What to Bring on Exam Day

- You will have access to a Periodic Table of Elements during the exam and you are strongly encouraged to use it.
- No calculators will be allowed for this exam.
- For more information about what to bring, see the ETS "What to Bring" web page.

Exam Registration

Start planning *now*!

For directions on how to receive access to outside vendor assessments, see the "How to Schedule a Praxis Exam" page.

Please discuss the information found at the following web page with your program mentor to ensure that you have plenty of time to review all relevant content before taking the exam.

- ETS website

Register for your preferred Praxis Subject Assessment dates at least 4 weeks in advance of the test. See exam dates here.

This online exam must be taken at an approved testing center, not from home. It is OK to take the Praxis Subject Assessment in a neighboring state. Please identify the nearest testing center using the Test Center Locator**.**

For disability accommodations, please see Accommodations for Test Takers with Disabilities of Health Related Needs**.** Note that you must make requests for accommodation as well as registration in writing through U.S. Mail (not online). It may take 6–12 weeks to make accommodations, and your range of available testing dates may be restricted.

If you need additional time because English is not your native language, please see Test Takers Needing Other Accommodations**.**

Additional information about registration is available at the ETS Web site: Exam Registration.

Degree Programs

- If you are in the BASCG12 or MASEG12 programs, WGU will pay for your first or second attempt at the Praxis exam. "Earth Science: Content Knowledge" must be in your current term for WGU to pay for your Praxis exam. **You must pay out of pocket for your third attempt**.
- If you are in the PBSC12 or MATSC12 programs, you must pay for the exam yourself. To determine if this is the correct exam for you, please see the Student Handbook article at:
    - Student Handbook Database
- For directions on how to receive access to outside vendor assessments, see "How to Schedule a Praxis Exam".

To register for the Praxis exam with WGU payment

Please follow the instructions at:

- Praxis Registration Instructions - Science

Week 1: Basic Principles of Science

In this section, you will review the processes involved in safe, effective, research-based instruction in science.

Homework

Access the homework document for this week.

- Week 1

Methodology and Philosophy

Explore the processes involved in scientific inquiry, the disciplines within science, and scientific terms.

Problem Solving

Review:

- Methods of scientific inquiry and how they are used in basic problem solving:
  - How science works: The flowchart

Scientific Inquiry

Watch:

- Science Principles
- Scientific Reasoning
- Scientific Consensus
- Truth & Science
- Scientific Law vs Theory
  - Theory vs. Hypothesis vs. Law…Explained!
  - Dave's Universe: Your theory, my theory
  - Note that **"law" = "principle" = "guiding idea"**. See here also

Read:

- NSTA Position Papers on:
  - Scientific Inquiry
  - Nature of Science
  - Full List

Scientific Tools

In science, data is usually only as good as the measurement tools and the knowledge and skill level of the researcher(s).

Measurement, Data, and Models

Review:

Use the following online library to review processes involved in scientific data collection and manipulation, and how to interpret and draw conclusions from data presented in tables, graphs, and charts:

- Visionlearning Library
    - View the topic "Process of Science" from the library menu on the right.

Math Skills

Review:

- Mathematics Practice Tests
- Scientific Notation
- Science Geek.net: Scientific Notation
- Metric Units and Conversions

The Atom, Atomic Structure, Ionic and Covalent Bonding and the Periodic Table of Elements

Review:

- Unit 1 Review Questions
- Elements: Defined by Their Number of Protons

Safety

Providing a safe learning environment is essential in the classroom.

Review:

- Laboratory Safety

Scientific Ideas Change Over Time

This section covers some of the scientific contributions made by major historical figures.

Keeping Track of the Major Players

As you work through this course, make note of the major historical figures who have contributed to science.

Use the following web pages to become familiar with Historical developments of science and the contributions of major historical figures.

- Famous Astronomers
- Famous Biologists
- Famous Chemists

- Famous Physicists
- Famous Female Scientists

Week 1 (Continued): Geology (Earth's Composition)

This section covers the principles of geology.

Earth's Composition: Minerals, Rocks, and Rock Cycle

Earth's crust and oceans are home to a wide variety of useful and essential minerals.

Identification of Minerals

Read:

- Chapter 2 ("Matter and Minerals")

Definition of a Mineral

Watch:

- Atoms Make Minerals
- Mineral Groups

Practice:

- Minerals Interactive Tutorial

Properties of Minerals

Review:

- Chapter 2 ("Matter and Minerals") in *Earth Science*: Section 2.4 "Properties of Minerals," page 42 and Section 2.5: "Mineral Groups," page 46
- Figure 2.24 ("Common Silicate Minerals"): pay attention to mineral formula (no need to memorize) and silicate structure since non-silicates use these same structures (such as *graphite* and *diamond*).
- Table 2.1 ("Non-Silicate Minerals Groups")

Identification Tools

Hardness Scale

- Hardness Scales Interactive Tutorial

Word Endings

In some cases, the ending of a mineral's name determines its chemical structure. Here are some word endings that you need to know:

- -ate minerals are cations bonded with oxygen
    - For example, sulfate = sulfur + oxygen
- -ide minerals are cations bonded to anything BUT oxygen
    - For example, sulfide = sulfur + something other than oxygen (like lead)

- Oxide minerals are oxygen bonded to anything other than more oxygen
    - For example, iron oxide = oxygen bonded to iron

Practice:

Using the following resource, identify mineral samples 5, 10, 15, and 20:

- Mineral Physical Properties and Identification

Check:

- Geology Matter and Minerals quiz

The Rock Cycle: Characteristics and Formation of Igneous, Sedimentary, and Metamorphic Rocks

This section covers information you need to know about the rock cycle.

Rock Identification and Classification

Read:

- The Rock Cycle

Watch:

- Rock Cycle Interactive Tutorial
- Rock Cycle
- Most Rocks are Aggregates of Minerals

Formation and Characteristics of Intrusive and Extrusive Igneous Rocks

Read:

- Section 3.2 ("Igneous Rocks: Formed by Fire") in Chapter 3 ("Rocks: Materials of the Solid Earth") in *Earth Science*
- Figure 3.12 ("Bowen's Reaction Series")
    - This is one of the most important diagrams in geology. It will help you relate mineral composition to rock type, and magma source to tectonic environment.

Watch:

- Igneous Rock Textures
- Bowen's Reaction Series
- Igneous Rocks: Interactive Tutorial
- Figure 3.7 ("Igneous Rock Classification Chart,") on page 67 in Chapter 3 ("Rocks: Materials of the Solid Earth") in *Earth Science*
- Classification of Igneous Rocks, Based on their Mineral Composition and Texture: Interactive Tutorial
    - Igneous Rock Textures Interactive Tutorial

Practice:

- Be able to identify at least six common igneous rocks.
- Be able to determine which minerals are contained within each rock type. Note grain size and rock textures:
    - coarse-grained (phaneritic)
    - fine-grained (aphanatic)
    - porphyritic
    - glassy
    - vesicular
    - pyroclastic

Formation and Characteristics of Clastic, Chemical, and Biological Sedimentary Rocks

Read:

- Section 3.3 ("Sedimentary Rocks: Compacted and Cemented") on page 71 in Chapter 3 ("Rocks: Materials of the Solid Earth") of *Earth Science*
- Sedimentary Rocks: Clastic (Detrital)
- Sedimentary Rocks: Chemical

Watch:

- Sedimentary Environments
- Clays
- Sedimentary Rocks Interactive Tutorial

Practice:

- Memorize sedimentary rock names based on grain size and composition
- Know the differences between clastic (detrital) and chemical sedimentary rocks.
- Note that chemical sedimentary rocks include:
    - precipitates (from chemical reactions, often involving water)
    - evaporates
    - rocks of biological origin

Formation and Characteristics of Regional and Contact Metamorphic Rocks

Read:

- Section 3.4 ("Metamorphic Rocks: New Rock from Old") on page 77 in Chapter 3 ("Rocks: Materials of the Solid Earth") of *Earth Science*
- Figure 3.28: Foliation
- Figure 3.29 Classification of Common Metamorphic Rock of *Earth Science*

Watch:

- Metamorphic Rocks, Processes, and Facies
- Foliation Process Interactive Tutorial

- Metamorphic Rocks Interactive Tutorial

Practice:

- Be able to identify five common metamorphic rocks.
- Memorize the sequence of foliation.
- Explain why foliation occurs as a result of regional metamorphism.
- Discuss non-foliated rocks. Know the relationship of calcite (mineral) to limestone (sedimentary rock) to marble (metamorphic rock).

Environmental Impact of Resource Extraction

Read:

- "Energy Resources: Fossil Fuels" and "Oil and Natural Gas" in the "Resources from Rocks and Minerals" section (3.5) in Chapter 3 ("Rocks: Materials of the Solid Earth") of *Earth Science*
- SmartFigure 3.35 ("Common Oil Traps") on page 88 in Chapter 3 ("Rocks: Materials of the Solid Earth") of *Earth Science*

Practice:

- The fossil fuel sequence is worth memorizing. Note that all solid fossil fuels are sedimentary, except for anthracite coal (metamorphic).
- Which geologic structures trap oil and natural gas?
- What is hydraulic fracturing (fracking)?

Check:

- Rock Cycle and Rocks quiz

Week 2: Geology (Surface Processes)

Earth's surface is constantly changing. Rock disintegrates and decomposes, moves to lower elevations by gravity, and is carried away by water, wind, or ice.

Homework

Access the homework document for this week.

- Week 2

Earth's Surface Processes: Weathering

Weathering, mass wasting, and erosion are called external processes because they occur at or near Earth's surface, and are powered by energy from the Sun.

Weathering, Soil, and Mass Wasting

Read:

- Figure 4.10 ("Acid Rain Accelerates the Chemical Weathering of Stone Monuments and Structures") on page 104 in Chapter 4 ("Weathering, Soil, and Mass Wasting") of *Earth Science.*

Watch:

- Rock Types Influences Weathering Interactive Tutorial
- Weathering and Soil Interactive Tutorial
- Weathering

Practice:

- Explain what happens with acid precipitation.

Check:

- Geology, Weathering, Soil, and Mass Wasting Quiz

Earth?s Surface Processes: Water, Wind & Ice (Chemical and Physical Weathering)

Water is almost everywhere on Earth—in the oceans, glaciers, rivers, lakes, air, soil, and living tissue.

The Water Cycle

Read:

- Chapter 5 ("Running Water and Groundwater") of *Earth Science*

Watch:

- The Hydrologic Cycle Interactive Tutorial

Surface Water: Meandering and Braided Streams

Watch:

- Running Water Interactive Tutorial
- Sediment Transport by Streams Interactive Tutorial
- Formation of Cut Banks and Point Bars Interactive Tutorial

Groundwater: Aquifers and Artesian Wells

Watch:

- Groundwater Interactive Tutorial
- Water Table Formation Interactive Tutorial
- Artesian Systems Interactive Tutorial

Check:

- Geology Running Water and Ground Water Quiz

Ice and Glaciers

Read:

- "Glaciers and Glaciation" in Chapter 6 ("Glaciers, Deserts, and Wind") of *Earth Science*

Watch:

- Glaciers and Glaciation Interactive Tutorial
- Glacial Processes Interactive Tutorial
- Pine Island Glacier in Antarctica

Wind and Deserts

Watch:

- Deserts and Winds Interactive Tutorial
- Sediment Transport by Wind Interactive Tutorial
- Cross-Bedding Interactive Tutorial

Check:

- Geology Glaciers Deserts and Wind quiz

Week 3: Geology (Internal Processes)

The idea that continents, particularly South America and Africa, fit together like pieces of a jigsaw puzzle came about during the 1600s, as better world maps became available.

Homework

Access the homework document for this week

- Week 3

Earth's Internal Processes

Earth's Internal Processes

Earth's Internal Processes

Read:

- Chapter 7 ("Plate Tectonics: A Scientific Theory Unfolds") of *Earth Science*

Plate Tectonics

Watch:

- Plate Tectonics Interactive Tutorial
- Rigid Lithosphere Overlies the Weak Asthenosphere
- Continental Rifting Interactive Tutorial

Practice:

- Explain oceanic lithosphere vs. continental lithosphere.
- What is the difference between lithosphere and crust?
- What is and where is the Moho?

Plate Boundaries

Read:

- Figure 7.12: Plate boundaries

Watch:

- Divergent Boundary Formation Interactive Tutorial
- Sea Floor Spreading and Plate Boundaries Interactive Tutorial
- Three Types of Convergent Plate Boundaries Interactive Tutorial
- Transform Plate Boundaries Interactive Tutorial
- Plate Boundary Features Interactive Tutorial
- Motion at Plate Boundaries Interactive Tutorial

Practice:

- Note the types of plate boundaries (i.e., divergent, convergent, and transform)
- Become familiar with the names of tectonic plates.

Geologic Hot Spots

Geologic hot spots are a fundamental planetary process; hot spots are still active on Venus and clearly occurred on Mars.

Watch:

- Convection and Tectonics Interactive Tutorial
- Hot Spot Volcano Tracks Interactive Tutorial
- Figure 7.28: ("Hot Spot Tracks")
- Figure 9.35: ("Hot Spots and Mantle Plumes")

Practice:

- Note geologic hot spots (sometimes called mantle plumes or intraplate volcanism)
- Know these three hot spots: Hawaii, Yellowstone, Iceland.

Magnetic Stripes on the Ocean Floor

Magnetic stripes in the ocean floor are definitive proof that seafloor spreading occurs and that plate tectonics has a distinct mechanism. Earth's magnetic field is induced by rapid rotation of Earth's outer & inner core; both move in the same direction but at different speeds, which creates a dynamo effect.

Read:

- Figure 7.32 ("Ocean Floor as a Magnetic Recorder")

Watch:

- Paleomagnetics – Magnetic Polarity and Polarity Timescales Interactive Tutorial
- Time Scale of Magnetic Reversals Interactive Tutorial

Check:

- Geology Plate Tectonics Scientific Revolution Quiz

Earthquakes and Interior Structure

The slippage that occurs along faults can be explained by the plate tectonics theory, which states that large slabs of Earth's lithosphere are continually grinding past one another.

Earthquakes

Read:

- Chapter 8 ("Earthquakes and Earth's Interior") of *Earth Science*

Watch:

- Earthquakes Interactive Tutorial
- Tsunami Interactive Tutorial

Seismology

Watch:

- Body Waves (P and S Waves) versus Surface Waves Interactive Tutorial
- Seismic Wave Motion Interactive Tutorial
- Seismographs Interactive Tutorial
- Earth's Interior Interactive Tutorial

Check:

- Geology Earthquakes and Earth Interior Quiz

Volcanoes, Mountains, Folds, Faults, and Maps

Because volcanoes extrude molten rock that formed at great depth, they provide our only means of directly observing processes that occur many kilometers below Earth's surface.

Volcanoes

Read:

- Chapter 9 ("Volcanoes and Other Igneous Activity") of *Earth Science*

Watch:

- Volcanoes and Other Igneous Activity Interactive Tutorial
- Igneous Features and Landforms Interactive Tutorial
- Anatomy of a Volcano Interactive Tutorial
- Volcano Types Interactive Tutorial
- Tectonic Settings and Volcanic Activity Interactive Tutorial

Check:

- Geology Volcanoes and Other Igneous Activity Quiz

Mountains, Folds, & Faults

Read:

- Chapter 10 ("Crustal Deformation and Mountain Building") of *Earth Science*

Watch:

- Maintain Building Interactive Tutorial
- Common Types of Folds Interactive Tutorial
- Faults Interactive Tutorial

Accreted Terranes

Accreted terranes are the only way a continent can grow significantly larger. Remember that continents are ancient crust cooled after formation of Earth's Moon more than 4 billion years ago. In contrast, ocean floor is made from relatively young rock (no more than 200 million years old) from plate tectonic processes, and oceanic crust is continuously made at divergent plate boundaries (seafloor spreading centers).

Read:

- Figure 10.27: ("Terranes of North America")

Watch:

- Terrane Formation Interactive Tutorial
- Collision and Accretion of Small Crustal Fragments to a Continental Martin Interactive Tutorial

Isostasy

Isostasy occurs whenever overburden is removed. Overburden can be ice (like a glacier that retreated) or rock (such as mountains eroding–see the Appalachian Mountains).

Watch:

- Isostasy Interactive Tutorial

Check:

- Geology Crustal Deformation Mountain Build Quiz

Topographic and Geologic Maps

Topographic maps allow you to see a three-dimensional landscape on a two-dimensional surface. A geologic map shows the distribution and arrangement of rock types.

Topographic Maps

Read:

- How to Read a Topographic Map

Watch:

- Topographic Maps

Geologic maps

Read:

- Geologic Maps: What Are You Standing On?

Watch:

- Geologic Maps

Explore:

- USGS Geologic Maps

Week 4: Geology (History and Life)

The nature of our Earth—its materials and processes—has been a focus of study for centuries.

Homework

- Week 4

Age-Dating and History of Life on Earth

Like the pages in a long and complicated history book, rocks record the geologic events and changing life-forms of the past.

Fossils

Read:

- Section 11.3 ("Fossils: Evidence of Past Life") on page 355 in Chapter 11 ("Geologic

Time") of *Earth Science*

Watch:

- Fossil Assemblage Interactive Tutorial

Practice:

- Know the five main principles of relative age-dating and three kinds of unconformities.

Relative Age-Dating

Read:

- "Applying Relative Dating Principles," on page 354 in Chapter 11 ("Geologic Time") of *Earth Science*
- SmartFigure 11.13 ("Applying Principles") on page 355 in Chapter 11("Geologic Time") of *Earth Science*
- Figure 11.16 ("Correlation")

Watch:

- Relative dating-Key Principles Interactive Tutorial
- Relative Geologic Dating Interactive Tutorial
- Angular Unconformities, Nonconformities, and Disconformities Interactive Tutorial
- Applying Principles Interactive Tutorial

Practice:

- Determine the best rock layer to use to correlate locations.

Radiometric (Absolute or Isotopic) Age-Dating

Read:

- Section 11.5: Dating with Radioactivity, on page 360 in Chapter 11("Geologic Time") of Earth Science
- Figure 11.19 ("Types of Radioactive Decay")
- SmartFigure 11. 21 ("Radioactive Decay Curve") on page 362 in Chapter 11("Geologic Time") of Earth Science

Watch:

- Dating With Radioactivity Interactive Tutorial
- Radioactive Decay Interactive Tutorial
- Radioactive Decay Curve

Practice:

- The ratio of parent to daughter atoms tell you how old the sample is.
    - Age of sample = # half-lifes x decay rate
- Why do # protons and # neutrons change as a result of alpha decay, beta decay, and electron capture?
- Memorize the radioactive decay curve.
- Know how to convert from fraction (1/8) to ratio (1:7) to percent (12.5%) of parent isotope.

Geologic Time Scale

Read:

- Chapter 12 ("Earth's Evolution through Geologic Time") of *Earth Science*
- Figure 12.3 ("Geologic Time Scale")
- Click on every graphic at Deep History of Life on Earth

Watch:

- Oort Kuiper rap
- Geologic Time Scale Interactive Tutorial
- Precambrian
- Paleozoic
- Mesozoic
- Cenozoic

Practice:

- Know the Geologic Time Scale. You do not need to memorize all the names and dates, but be very familiar with key periods.

Check:

- Geology Geologic Time Quiz
- Geology Earth Evolution Geologic Time Quiz

Week 5: Oceanography

Outgassing of gases and fluids through volcanic vents provided the raw materials to form Earth's oceans (hydrosphere) and atmosphere. Geologic and biologic processes, including human activities, continue to modify the planet's water and air.

Homework

Access the homework document for this week

- Week 5

Ocean Features

Oceans are a major part of our planet. In fact, Earth is frequently called the water planet or the blue planet.

The Ocean Floor

Read:

- Chapter 13 ("The Ocean Floor") of *Earth Science*
- Figure 13.7 ("Major features of the seafloor")
- Figure 13.11 "(Turbidity Currents and Canyons")
- SmartFigure 13.12 ("Active Continental Margins")

Watch:

- Floor of the Ocean Interactive Tutorial

Practice:

- Pay attention to curved features (tectonic origin) versus straight-line features (hot spot origin)
- Curved ridges and trenches indicate plate boundaries.
- Locate the **Mariana Trench & Aleutian Trench**.
- "Active" means tectonic activity is occurring now!

Research the following:

1. accretionary wedge
2. forearc basin
3. backarc basin

Ocean Water

Read:

- Chapter 14 ("Ocean Water and Ocean Life") of *Earth Science*
- SmartFigure 14.2 ("Variations in Surface Temperature and Salinity with Latitude")
- SmartFigure 14.12 ("Benthos")
- Figure 14.13 ("Marine Life Zones") on page 442 in Chapter 14 ("Ocean Water and Ocean Life") of *Earth Science*

Watch:

- Variations in Surface Temperature and Salinity with Latitude Interactive Tutorial
- Benthos Interactive Tutorial

Practice:

Note the following conversions for the composition of seawater: 35 grams/liter = 35 parts per

thousand = 35‰ = 3.5 parts per hundred = 3.5% salinity (mostly NaCl)

Understand the difference between thermocline and pycnocline, low latitudes versus high latitudes.

Surface Currents and Thermohaline Circulation

Read:

- Chapter 15 ("The Dynamic Ocean") of *Earth Science*
- 15.1 ("The Ocean's Surface Circulation")
- Figure 15.1 ("Gulf Stream")
- Figure 15.2 ("Major Surface-Ocean Currents")
- Section 15.2 ("Coastal Upwelling")
- Figure 15.3 ("The Chilling Effect of a Cold Current")
- SmartFigure 12.16 ("Connection between Ocean Circulation and Climate of Antarctica")
- Section 18.7 ("El Nino and La Nina and the Southern Oscillation")

Watch:

- Ocean Circulation Patterns
- Connection between Ocean Circulation and Climate of Antarctica
- Coastal Upwelling

Practice:

- Follow the Gulf Stream into the North Atlantic Drift. Why is this current important to people who live in northern Europe?
- Know the five major surface gyres. What drives surface currents? How does this link to deep Thermohaline Circulation?
- Tie coastal upwelling into El Nino and La Nina scenarios.

Coastal Processes and Tides

Read:

- Chapter 15 ("The Dynamic Ocean") of *Earth Science*
- Section 15.3 ("The Shoreline: A Dynamic Interface")
- Figure 15.11 ("Wave basics")
- Figures 15.24 ("Jetties")
- Figures 15.25 ("Groins")
- SmartFigure 15.12 ("Passage of a Wave")

Watch:

- Passages of a Wave Interactive Tutorial
- Beach Drift and Longshore Current Interactive Tutorial
- Tidal Patterns Interactive Tutorial

Practice:

- Know the characteristics of ocean waves. How would a rubber ducky move when caught in a wave?
- Relate longshore current to wave refraction and coastal (shoreline) features. High energy waves erode sediment, low energy waves deposit sediment.
- Know the terms and end results of human efforts to modify shorelines. Where will sediment collect around a breakwater?
- Remember that the Sun contributes 40% of the gravitational pull that causes tides. Straight-line alignment=spring tide, ninety degree angle=neap tide. What are high & low tides?

Local landscapes Enhance Tidal Ranges

Read:

- Tides in the Bay of Fundy- look at links on "Fundy Tides" tab.
- Figure 15.34 ("Spring and Neap Tides")
- SmartFigure 15.35 ("Tidal Patterns")

Week 6: Meteorology

Earth's atmosphere is unique. No other planet in our solar system has an atmosphere with the exact mixture of gases or the heat and moisture conditions necessary to sustain life as we know it.

Homework

Access the homework document for this week.

- Week 6

Atmosphere Composition and Structure

The gases that make up Earth's atmosphere and the controls to which they are subject are vital to our existence.

Introduction to the Atmosphere

Read:

- Chapter 16 ("The Atmosphere: Composition, Structure, and Temperature") of *Earth Science*:
- Figure 16.2 ("Composition of Earth's Atmosphere")
- Figure 16.10 ("Thermal Structure of Atmosphere")
- Layers of the Atmosphere

Watch:

- Introduction to the Atmosphere Interactive Tutorial
- Heating Earth's Surface and Atmosphere

- The Three Mechanisms of Heat Transfer

Practice:

- Memorize the composition of Earth's modern atmosphere.
- Know the percentages of: N_2, O_2, Ar. Note that H_2O is 0.5% while CO_2 reaches 0.4% fairly often now.
- Note that exosphere is not shown in the diagram of the atmosphere's thermal structure in Figure 16.10.
- Note the locations of the ionosphere and ozone layer and ionosphere.
- Explain why there are differences between conduction, convection, and radiation.

The Greenhouse Effect

Read:

Note that Canada, Russia, and northern European countries are paying attention to mineral resources north of the Arctic Circle as Earth's albedo lowers from reduced sea ice cover. Read the following:

- We're Still Losing Ice at the Poles
- "Russia to boost military presence in Arctic as Canada plots north pole claim"

Watch:

- Paths Taken by Solar Radiation Interactive Tutorial
- Temperature Data and the Controls of Temperature

Practice:

- For the greenhouse effect, albedo is crucially important.
- Know:
  - absorb
  - emit
  - transmit
  - scatter

- Explain how clouds interact with sunlight from above and surface heat from below.

- Explain how does sea surface temperature indicate an El Nino event.
- Explain seasonal change.
- Explain climate change.

Check:

- Geology Atmosphere Comp Structure Temp Quiz

Clouds, Air Pressure, and Weather

The gases that make up Earth’s atmosphere and the controls to which they are subject are vital to our existence.

Clouds

Read:

- Chapter 17 ("Moisture, Clouds, and Precipitation") of *Earth Science*
- Use the National Weather Service Online School for Weather
    - **Complete**: Rows 1–5 (through Synoptic Meteorology=weather maps) and Tropical Weather for El Nino

Watch:

- Changes of State Involve an Exchange of Heat Interactive Tutorial
- Moisture and Cloud Formation Interactive Tutorial
- Atmospheric Conditions That Result in Absolute Stability Interactive Tutorial
- Classification of Clouds, Based on Height and Form Interactive Tutorial

Practice:

- What makes an air mass stable? Unstable? Absolute? Conditional? Frontal? Aloft?
- What is latent heat?
- Which changes in the hydrologic cycle are exothermic and which are endothermic?
- Which chemical bonds hold water molecules together in ice?
- What bonds hold water molecules together in their liquid state?

Dew Point and Relative Humidity

Read:

- Figure 17.9 ("Sling Psychrometer")
- How to read Tables for Relative Humidity and Dew Point

Practice:

- How does a sling psychrometer measure dew point?
- How does a sling psychrometer measure relative humidity?

The Basis of Cloud Formation

Read:

- Table 17.3 ("Forms of Precipitation")
- Figure 17.10 ("Dry Versus Wet Adiabatic Rates of Cooling")
- Figure 17.11 ("Orographic Lifting")

Practice:

Consider the rain shadow effect and define the following:

- Adiabatic
- condensation level
- environmental lapse rate
- Which areas get rained on or stay dry?
- The names of different types of precipitation.

Check:

- Geology Moisture Clouds Precipitation Quiz

Air Pressure and Wind

Read:

- Chapter 18 ("Air Pressure and Wind") of *Earth Science*
- Figure 18.12 ("Cyclonic and Anticyclonic Winds")
- Figure 18.24 ("El Nino")
- Figure 18.25 ("La Nina")
- "Jet Stream and Rossby Waves"
- Section 18.5 (" Local Winds")
- SmartFigure 18.19 ("Sea and Land Breezes")

Read and explore:

- Local and Regional Wind Systems
- NOAA El Nino Portal

Watch:

- Air Pressure and Wind Interactive Tutorial
- Isobars on a Weather Map Interactive Tutorial
- Coriolis Effect
- Atmospheric Circulation
- Storms &Vortices
- Idealized Global Circulation Proposed for the Three-Cell Circulation Model of a Rotating Earth

Practice:

- What drives the Coriolis Effect?
- Why is latitude relevant?
- How does surface friction complicate wind flow?
- High pressure air is high elevation, dry, rotates clockwise, and flows down and out. Low pressure air is low elevation, moist, rotates counterclockwise, and flows in and up. That's why storms like hurricanes and tornadoes are low pressure systems.

- What is the El Nino Southern Oscillation (ENSO)?
- How will the weather in the US Midwest change during an El Nino?
- How will the weather in the US Midwest change during a La Nina?

Weather Patterns and Severe Storms

Read:

- Chapter 19 ("Weather Patterns and Severe Storms") of *Earth Science*

Watch:

- Basic Weather Patterns Interactive Tutorial
- Idealized Structure of a Large, Mature Midlatitude Cyclone Interactive Tutorial

Practice:

- Know your weather fronts:
  - Warm
  - Cold
  - Stationary
  - Occluded
- Explain continental vs maritime
- Explain tropical vs polar

Air Masses and Fronts

Read:

Flow aloft concerns divergence and convergence high in the troposphere.

- Figure 19.3 ("Air Mass Regions")
- Figure 19.10 ("Occluded Front")
- Figure 19.14 ("Flow Aloft")

Watch:

- Idealized Structure of a Large, Mature Midlatitude Cyclone Interactive Tutorial

Read and explore:

- National Weather Service Online School
- Read the weather maps in your local area with the following interactive:
  - Today's Weather

Climate and Anthropogenic Climate Change

Read:

- Chapter 20 ("World Climates and Global Climate Change") of *Earth Science*

- Figure 20.5 ("Climates of the World")
- Section 20.2 ("World Climates")
- Section 20.8 ("Human Impact on Global Climate Change")
- Figure 20.20 ("CO_2 Concentrations Over Time")

Read and explore:

- World Climates
- Climate Feedbacks

Practice:

- See summary on page 610 in *Earth Science.*
- There is no need to memorize the Koppen classification system.
- Can you see any latitude patterns?

Check:

- Geology Air Pressure and Wind Quiz

Week 7: Space Sciences

The science of astronomy provides a rational way of knowing and understanding the origins of Earth, the solar system, and the universe.

Homework

Access the homework document for this week.

- Week 7

Astronomy

The science of astronomy provides a rational way of knowing and understanding the origins of Earth, the solar system, and the universe.

Planetary Motion

Read:

- Chapter 21 ("Origin of Modern Astronomy") in *Earth Science*
- Figure 21.5 ("Retrograde Motion of Mars, as Seen against the Background of Distant Stars")
- SmartFigure 21.6 ("Ptolomy's Explanation of Retrograde Motion")

Watch:

- Interactive Tutorial: Ptolemy's Explanation of Retrograde Motion Interactive Tutorial

Practice:

Know your ancient European astronomers:

- Copernicus
- Brahe
- Kepler
- Galileo
- Newton

Ptolemy had the longest-running explanation of retrograde motion but Copernicus reasoned out the correct one.

Tycho Brahe

Read:

- Tycho Brahe

Please correct the misconception that it is hot in summer because Earth is closer to the Sun. Earth is actually moving swiftly at perihelion in early January while we are moving most slowly at aphelion around July 4th. Explain why the speeds change over the course of a year and what actually causes seasons.

What is an ellipse?

Read:

- Figure 21.10 ("Drawing Ellipses with Various Eccentricities")
- Figure 21.11 ("Kepler's Law of Equal Areas")

Watch:

- Orbital Motion of Earth and Other Planets
- Using a Telescope, Galileo Discovered That Versus Has Phases Like Earth's Moon Interactive Tutorial

Practice:

The eccentricity of an ellipse is dependent on the distance between the foci. If the distance between the foci were zero, what shape would the ellipse have?

Earth's path around the sun is almost a circle, but not quite. Asteroids and comets have more eccentric paths around the sun than the earth does.

A comet far from the sun at aphelion moves slowly. Conversely, when the comet is close to the sun at perihelion, it moves quickly. It also has a tail, as the sun burns off some of the comet's ice.

Earth's Tilt Axis

Earth is tilted with respect to the Sun. Two main results of that tilt angle are seasons and precession.

Read:

- SmartFigure 16.12 ("The Changing Sun Angle")
- SmartFigure 6.27 ("Orbital Variations")

Watch:

- Characteristics of the Solstices and Equinoxes Interactive Tutorial
- Interactive Tutorial: The Changing Sun Angle
- Procession of Earth's Axis Interactive Tutorial
- Interactive Tutorial: Orbital Variations

Earth-Moon-Sun Relationships

As the moon orbits the earth and the earth orbits the sun, the lineup of these three bodies cause phases of the moon as well as eclipses.

Read and Explore:

- Moon Phases
- What is a Total Solar Eclipse?
- What is a Total Lunar Eclipse?
- Figure 21.21 ("Synodic (Solar) vs Sidereal")
- Figure 21.24 ("Synodic vs. Sidereal Month")

Watch:

- Phases of the Moon Interactive Tutorial
- Lunar Eclipse Interactive Tutorial
- SmartFigure 21.27 ("Lunar Eclipse")

Practice:

- Synodic/Solar means "with respect to the Sun" –what does an observer see from Earth?
- Sidereal means "with respect to the stars" –what does an observer beyond Earth see (what is really happening)?
- How do moon phases affect eclipses (solar vs lunar) and tides (spring vs neap)?
- Know:
    - ?waxing vs. waning
    - gibbous vs. crescent

Solar System

This section reviews information about the solar system.

Evolution of Earth and Moon

Read:

- Table 21.1 ("Period of Revolution and Solar Distances of Planets") on page 645 in chapter 21 ("Origins of Modern Astronomy") of *Earth Science* to see the distance of the planets from the sun
- Section 1.3 ("Early Evolution of the Earth") on page 12 in chapter 1 ("Introduction to Earth Science") of *Earth Science*

Watch:

- The Planets: An Overview Interactive Tutorial
- Earth's Moon Interactive Tutorial

- Formation and Filling of Large Impact Basins

Solar System Tour

Read:

- Chapter 22 ("Touring Our Solar System") in *Earth Science*
    - **?Jovian Planets**
        - ?Magnetic Field of the Earth and the Dynamo Effect
        - Figure 22.2 ("Planetary Interiors")
    - **?Dwarf Planets**
        - New info about Ceres
        - New info about Pluto

Watch:

- A Brief Tour of the Planets Interactive Tutorial
- Orbital Motion of Earth and Other Planets

Practice:

Memorize the correct order of the eight planets. Heres a mnemonic that will help: "My Very Educated Mother Just Served Us Nachos."

Know the five zones:

- Terrestrial planets
- Asteroid belt
- Jovian planets
- Oort cloud

Comets are icy & lumpy.

Asteroids are rocky & lumpy.

Dwarf planets are rocky & round, with moons, atmospheres, and density-differentiated interiors (like Earth).

Large moons of Jovians planets are surprisingly terrestrial too, with hydrospheres and atmospheres of their own.

Look up "cryovolcano."

Every planet has a solid core. Near the Sun, metal & rock dominate; beyond the frost line, rock and ice dominate.

Jovian planets have liquid/slushy mantles that generate very strong magnetic fields. Compare that to how Earth makes its own magnetic field.

Dwarf planets are found in both the Asteroid Belt and the Kuiper Belt. Eris is a dwarf planet that is more massive than Pluto and further away from the Sun.

Check:

- Geology Touring Solar System Quiz

Beyond Our Solar System

Since astronomers cannot study the universe by bringing it into the laboartory, and because the vast majority of celestial objects are too far away to visit, astronomers collect and study those things that come to Earth from space.

Spectroscopy

Read:

- Chapter 23 ("Light, Astronomical Observations, and the Sun") in Earth Science
- Figure 23.2 ("EM Spectrum")

Watch:

- Formation of the Three Types of Spectra Interactive Tutorial
- The Doppler Effect Interactive Tutorial

Practice:

Memorize the seven parts of the spectrum from longest to shortest wavelength: radio, microwave, infrared, visible, ultraviolet, x-ray, gamma. Note opacity/transparency of Earth's atmosphere to specific wavelengths.

Know about absorption (dark-line) and emission (bright-line) spectra. Spectroscopy provides info about chemical composition of atmospheres/surfaces (but not interiors) and through Doppler Effect, the speed, direction, and rotation rate of objects.

Stars and Stellar Evolution

Read:

- Chapter 23 ("Light, Astronomical Observations, and the Sun") in *Earth Science*

Watch:

- Diagram of the Sun's Structure Interactive Tutorial

Practice:

Thermonuclear fusion occurs in a star's core. Granules facilitate convection to bring the energy to the surface. Sunspots are relatively cool areas trapped by tangled magnetic field lines. The Sun's atmosphere is called the corona. Coronal mass ejections (CMEs) and solar flares create space weather and make auroras.

Note that **aurora is an atmospheric phenomenon**. You need three things to make an aurora:

(1) **Space weather (solar wind, etc.)** to provide high-speed electrically-charged particles like solar protons;

(2) **Magnetic field** (with corresponding electrical field) – auroras often follow a planet's magnetic field lines;

(3) **Thick atmosphere** to have enough atoms to get hit by the fast particles–when an atom is hit, some of its electrons briefly absorb the extra energy and get excited, then drop down to their original energy states and emit the extra energy as light. That's when the Northern Lights (aurora borealis) glow.

Spectroscopy and Stars

Watch:

- Hertzsprung-Russell Diagram Interactive Tutorial
- Evolutionary Stages of Stars Having Various Masses Interactive Tutorial

Practice:

Luminosity (brightness) is directly correlated with mass; as one goes up, so does the other. Therefore, low-mass dwarf stars are at the bottom and high-mass giants/supergiants are at the top. Note that the temperature scale is backward, so hot blue-white stars are on the left and cool red stars are on the right.

When a star that has enough mass uses up all the hydrogen in its core, it jumps off the main

sequence, starts burning helium, and becomes a red giant. As the helium fuses to carbon, then silicon & other elements to iron, the star contracts through variable stages. Some stellar remnants create nebulas, novas, or supernovas. Depending on initial mass, a star dies to become a white dwarf, a neutron star, or a black hole.

Check:

- Geology Light Astronomical Observation Sun Quiz

Galaxies and the Universe

Read:

- Chapter 24 ("Beyond Our Solar System") in *Earth Science*
- Figure 24.3 ("Evolution of the Universe")
- Cosmic Microwave Background

Watch:

- Spiral Galaxies Interactive Tutorial
- Big Bang Cosmology
  - Since the Big Bang, the rate of expansion of the universe has been fast (inflation), slowed until about 7 billion years ago, and then sped up again (getting faster today). Dark energy might explain this but no one understands what it is yet.
- ?Raisin Bread Analogy for an Expanding Universe Interactive Tutorial
  - This Redshift video discusses the raisin bread analogy nicely, then gets into the more important discussion of how the universe might die: Big Crunch or Big Rip (Big Chill)

Check:

- Geology Beyond Our Solar System Quiz

Week 8 ? Review

Spend this week reviewing the notes you have taken and the homework you've completed. Then complete the two-week eight practice test homework documents.

Homework

Access the homework document for this week.

- Week 8 A
- Week 8 B

Final Steps

Congratulations on completing the activities in this course! This course has prepared you to complete the assessments associated with this course. If you have not already been directed to complete the assessments, schedule and complete your assessments now.

Exam Requirements

In order to receive a "Pass" on your degree plan, you must pass Earth and Space Sciences: Content Knowledge (5571) Praxis **Subject Assessment** based upon the WGU cut score. Additionally, if the state in which you seek licensure also requires the Praxis exam, you must pass the exam based on that state's cut score before you will be admitted into Demonstration Teaching or allowed to graduate.

Note: It is possible to pass the exam based on either the WGU cut score or your state's cut score and still need to take it again in order to satisfy both cut scores.

Please review the following article in the WGU Student Handbook:

- Article 2834 WGU Cut Scores for Assessments That Require Praxis Examinations

Payment

WGU will pay for your first two attempts at the Earth and Space Sciences: Content Knowledge (5571) Praxis **Subject Assessment**. You will be responsible for paying third and subsequent attempts. WGU will not pay for extended or emergency registration, so be sure to plan ahead when scheduling the exam. Please see the following web page for detailed information on test and service fees:

- Test and Service Fees

Scheduling

The Earth and Space Sciences: Content Knowledge (5571) Praxis Subject Assessment is only offered as a computer–delivered test. Please visit the following web page for a list of available sites and testing windows.

- Praxis Test Centers and Dates

These tests are offered only during certain time frames and not all test centers are open on all test dates, so plan accordingly. Once you have selected a testing center and date, use the following directions to schedule your exam:

- How to Schedule a Praxis Exam

Note: You must schedule your Praxis exam through WGU in order to have WGU pay for the exam.

Follow the ETS guidelines on what to bring on exam day by accessing the following web page:

- What to Bring

Submit Your Score

You will need to submit your scores to WGU after completing this exam. Once you have submitted your passing score, you will receive a "Pass" on your Degree Plan for the assessment.

After completing an outside vendor assessment, follow the directions for submitting a score report on the Following Outside Vendor Assessments page.