Your competence will be assessed as you complete the BST2 performance assessment for this course of study. This course may take up to 21 weeks to complete.

Introduction

This course of study is aligned to the BST2 performance assessment. The same study materials are utilized in the BSC2 objective assessment. If you have previously completed the BSC2 assessment, then you should have already completed the required study activities found in this course of study. You may wish to review the assignments here, but you are not required to repeat these activities. If you have not yet completed the BSC2 assessment, then please proceed through this course of study in full.

Overview

Welcome to the exciting topic of Interdisciplinary Geosciences Science, which involves the study of Earth systems, the solar system, the universe, and oceanographic concepts. As a science teacher, you will want to convey the exciting careers related to geological science to your students as well as connect the concepts to their own lives.

Interdisciplinary Geosciences Science covers a vast amount of material. The four main topics include Earth systems, oceanography, the solar system, and the universe. The topics are chunked into manageable sections of activities to complete. Be sure to check your understanding of each section. This practice will help you build on your knowledge.

Outcomes and Evaluation

There are 5 competencies covered by this course of study; they are listed in the "Competencies for Interdisciplinary Geoscience Science" page.

Teaching Dispositions Statement

Please review the Statement of Teaching Dispositions

Performance Assessment

You will complete the following performance assessment in TaskStream:

- BST2

Previews of task instructions and rubrics for this assessment are available in via the 'Assessment Preparation' box in the online course of study.

Preparing for Success

To successfully complete this course of study, you will need the appropriate resources to help with your learning.

Your Learning Resources

Enroll in or order the learning resources for this course as early as possible so as to give them time to arrive and give you enough time to become familiar with them.

Automatically Enrolled Learning Resources

You will be automatically enrolled at the activity level for the following learning resources. Simply click on the links provided in the activities to access the learning materials.

VitalSource E-Texts
The following textbooks are available to you as e-texts within this course of study. You will be directly linked to the specific readings required within the activities that follow.

- Arny, T., & Schneider, S. (2008). *Explorations: An introduction to astronomy* (5th ed.). McGraw-Hill. ISBN-13: 9780072943603.
- Garrison, T. (2007). *Oceanography: An invitation to marine science* (6th ed.). Brooks/Cole. ISBN-13: 9780495112860.
- Tarbuck, E., Lutgens, F., & Tasa, D. (2009). *Earth science* (12th ed.). New Jersey: Pearson Prentice Hall. ISBN-13: 9780136020073.

Note: These e-texts are available to you as part of your program tuition and fees, but you may purchase hard copies at your own expense through a retailer of your choice. If you choose to do so, please use the ISBN listed to ensure that you receive the correct edition.

Enroll in Learning Resources

You will need to enroll in or subscribe to additional learning resources as a part of this course of study.

You may already have enrolled in these resources for other courses. Please check the "Learning Resources" tab and verify that you have access to the following learning resources. If you do not currently have access, please enroll or renew your enrollment at this time.

Note: For instructions on how to enroll in or subscribe to learning resources through the "Learning Resources" tab, please see the "Acquiring Your Learning Resources" page.

LabPaq
The "GeoScience (Geology)" LabPaq from Hands-On Labs is a physical shipment. This lab kit (LabPaq) is covered by your program lab fee and is required to complete the performance assessment. You may have already enrolled for this resource through a different course. This kit includes a lab manual along with the science equipment, specimens, supplies, and chemicals necessary to complete college laboratory experiments at home. The experiments reinforce science content and teach laboratory techniques.

AMNH Seminars (Optional)
The online seminars offered by the American Museum of Natural History (AMNH) uses multimedia and discussions to connect teachers and future teachers from around the world to cutting-edge research, classroom resources, and each other. Participating in the AMNH online seminars develops your understanding of the content, models an appropriate teaching technique, and exposes you to an array of resources that can be used in your classroom or to help with lesson planning. While this is an optional learning resource, you are strongly

encouraged to take advantage of this opportunity. These seminars, which are typically around $450, are covered as part of your WGU tuition.

There are three seminars related to these assessments:

- "Earth Inside and Out"
- "The Ocean System"
- "The Solar System"

Each six-week seminar requires about 8 hours per week of your time. Participating in these seminars does not appear on your WGU transcript. The time required to complete these courses is in addition to the time needed to make progress passing assessments. These seminars have definite start and stop times, so, review the AMNH Calendar to determine when the course is offered, and consult your mentor to coordinate this seminar into your schedule. Discuss the AMNH-WGU FAQ with your mentor to better understand how to successfully use the AMNH course as a WGU learning resource.

Once your mentor approves your enrollment, you will be sent a confirmation e-mail. Please check your e-mail regularly for a registration e-mail directly from AMNH. This message will contain the information you will need to access this online seminar.

Additional Preparation

The following activities and information will help you as you work through this course of study.

Message Boards, Learning Communities, Study Notes, FAQs

Message boards, learning communities, study notes, and FAQs are available in every course of study.

Use the "Additional Learning Tools" document to review these tools.

As you engage in the activities within this course of study, you will be answering questions, completing exercises, sketching out concepts, and so forth. You can take these notes online through the web-enabled course of study or by using a paper or electronic journal. A notebook or study journal makes your learning more active. It also provides an excellent source of important materials to review prior to demonstrating your competence through the assessment.

Course Instructor Assistance

Course instructors are available to help you. Their job is to aid understanding in areas where you need to improve and to guide you to learning resources. Request their help as needed when preparing for assessments.

Course instructors cannot provide reviews of entire assessments. If you fail assessment attempts, review the provided feedback first, then ask the course instructor specific questions about what you can do to meet the competency standard. Request course instructor assistance as necessary in preparing for second attempts at objective assessments or performance task revisions. Mentors cannot guarantee you pass as they do not evaluate assessments; however, they can provide the assistance and advice necessary to help you succeed.

Introduction to Earth Science

As a teacher, you want to relate your students' lives to the topics you teach and provide them with an overview of what they will be learning. Starting on chapter 1 in Earth Science will help you accomplish these goals. As you progress through this section, think about how studying the planet is a scientific endeavor.

Introduction to Earth Science

This section focuses specifically on what Earth systems are and how they are interrelated. It will also discuss other important themes of geoscience, such as the relationship between people and the environment and the nature of scientific inquiry.

What Is Earth Science?

Read the following section in chapter 1 ("Introduction to Earth Science") of *Earth Science*:

- “What is Earth Science?”

In your notebook, provide a general description for the major subdivisions of Earth Science.

Earth Science, People, and the Environment

Read the following section in chapter 1 ("Introduction to Earth Science") of *Earth Science*:

- "Earth Science, People, and the Environment"

As a teacher, you should relate information to your students' lives. In your notebook, write down a few ideas for how you can relate the subject matter within Earth science to your students’ lives.

The Nature of Scientific Inquiry

Read the following section in chapter 1 ("Introduction to Earth Science") of *Earth Science*:

- "Nature of Science Inquiry"

This is a good review of scientific inquiry, which was studied during earlier assessments. In your study notebook, write down definitions for hypothesis and theory, as well as a description of scientific methods.

Introduction to the Geology LabPaq

You will be using the supplies within the LabPaq to apply your understanding of science concepts. Read the lab manual about using this kit, safety, equipment, and lab techniques.

People and the Environment

The Earth and its resources support all known life. In recent years, discussions concerning the interaction between people and the environment have become increasingly important. While it is not the goal of geoscience to make decisions about how these issues should be resolved, it is important that scientists collect and analyze data that can inform the appropriate decision makers.

People and the Environment: Reading

Review the following section in chapter 1 ("Introduction to Earth Science") of *Earth Science*:

- "Earth Science, People, and the Environment"

Accessing Fossil Fuels

Briefly describe the biological, chemical, and geological processes involved in forming and trapping fossil fuels.

Read the following pages of chapter 3 ("Rocks: Materials of the Solid Earth") in *Earth Science*:

- pages 66-67 from chapter 3 for a description of how coal is formed

Read the following pages of chapter 13 ("The Ocean Floor") in *Earth Science*:

- page 385 from chapter 13 for a description of how oil and natural gas are formed

Air Quality

Read the following in chapter 16 ("The Atmosphere: Composition, Structure, and Temperature") in *Earth Science*:

- box 16.1 on page 449
- box 16.2 on page 452
- box 17.1 on page 492

Identify some effects of human activity on air quality.

Earth's System

During this topic, you will see a few examples of items that can only be understood by studying the various spheres (biosphere, geosphere, atmosphere, hydrosphere, pedosphere, etc.) together. The concept of Earth as a system is weaved throughout the remainder of this course of study.

Earth's Cycles

Review the following pages in *Earth Science*:

- pages 12-24 from chapter 1 ("Introduction to Earth Science")
- pages 68-69 from chapter 3 ("Rocks: Materials of the Solid Earth")
- pages 117-118 from chapter 5 ("Running Water and Groundwater")

In your study journal, explain the roles of the solid earth, hydrosphere, atmosphere, and biosphere in cycling carbon and other macro- and micronutrients.

Shielding

Review the following section in chapter 16 ("The Atmosphere: Composition, Structure, and Temperature") of *Earth Science*, starting on page 450:

- "Ozone"

Why is the ozone layer important to the survival of life on Earth?

Read the following section in chapter 5 ("The Earth") in the *Explorations* text:

- section 5.6 ("The Earth's Magnetic Field")

Read the following page in chapter 8 of the *Earth Science* text;

- page 240

What does the magnetic field shield from *reaching* Earth's surface? Which layers of the earth are solid and which are liquid? How do the layers generate Earth’s magnetic field?
Mechanisms of Heat Transfer

Review the following pages of chapter 16 ("Composition, Structure, and Temperature") in *Earth Science*:

- pages 460-462

Add to your study journal a description of each type of heat transfer. Most wind is generated by convection, the movement of the air due to the differences in density. Air is warmed near Earth's surface, causing its molecules to move and the air to become less dense. The warmer air rises, allowing cooler air to take its place. Describe the patterns of convective heat distribution in Earth's atmosphere.

Review the following pages in chapter 7 ("Plate Tectonics: A Scientific Theory Unfolds") in *Earth Science*:

- 194-205
- 212-213

What are the two models for proposed mantle convection? How is mantle-plate convection related to the three plate boundaries?

Review the following pages in chapter 15 ("The Dynamic Ocean") in *Earth Science*:

- 412-418 from chapter 15

How do the oceans' circulation patterns transfer thermal energy around the globe?

Earth's Exterior: Minerals

Planet Earth is one of the four inner rocky planets. Minerals are the building blocks of rocks and can be identified by their chemical and physical properties. The chemical structures of the molecules that make up a mineral determine the mineral's physical properties, such as how it breaks apart. During this section of the course of study, you will learn about what makes up the planet and how to identify minerals.

Minerals

Identifying minerals is challenging, but with practice you will get better. With your new knowledge, you will be able to identify rocks picked up outside. Learning your local minerals will help the process.

Classifying Minerals

Review the following pages in chapter 2 ("Minerals: Building Blocks of Rocks") in *Earth Science*:

- pages 40–44

An anion is an ion with a negative charge. Minerals are classified by their anionic group or by the anion associated with the mineral. For example, the sulfates mineral group all have as their anionic group. Table 2.1 of Earth Science lists common non-silicate mineral groups. In your study notebook, explain the system of classifying minerals by anionic groups.

Identifying Mineral Groups

In your study notebook, list the mineral groups as shown in figure 2.21 and Table 2.1 in chapter 2 ("Minerals: Building Blocks of Rocks") of *Earth Science*. Practice identifying examples of minerals for each major mineral group (e.g., graphite is a native element, quartz is a framework silicate, and calcite is a carbonate.). You need to know common silicate and non-silicate mineral groups. You also need to know the key atoms that define a silicate group and the ion(s) that represent each of the non-silicate mineral groups

Mineral: Check for Understanding

Using the Earth Science learning resource, take the chapter quiz to check your understanding of the concepts from chapter 2. Post any questions on the message board.

Crystal Growing Lab

Complete the following in the Geology LabPaq:

- laboratory 1 (“Crystal Growing and the Rock Cycle”)

After completing the lab, contact your course instructor for an answer key. If you have already completed this lab when working with the Science Methods LabPaq, you may decide whether to redo the experiment.

Identification Lab

Complete the following in the Geology LabPaq:

- laboratory 2 (“Mineralogy and Identification”)

After completing the lab, contact your course instructor for an answer key. Your goal is to identify samples of common minerals that form rocks.

Earth's Exterior: Rocks

During this section of the course of study, you will study the three different types of rocks and the rock cycle, which describes how each rock type can be transformed into the others. After completing the activities in this section of the course of study, you will be able to describe the rock cycle and the human impact on Earth's resources.

Rocks

When standing on a basalt boulder or staring at a granite countertop, it might be difficult to imagine what conditions created such a formation. Varying degrees of temperature, pressure, and weathering are needed to change the form of rocks.

Review of Rocks

Review the following chapter in *Earth Science*:

- chapter 3 ("Rocks: Materials of the Solid Earth")

Review your notes from previous courses of study that explain the general details of the processes involved when one type of rock (igneous, metamorphic, or sedimentary) is transformed into any other.

Igneous Rock Lab

Complete the following in the Geology LabPaq:

- laboratory 3 (“Igneous Rock Identification”)

After completing the lab, contact your course instructor for an answer key. You should be able to name common igneous rocks.

Igneous Rocks Review

Review the following section in chapter 3 ("Rocks: Materials of Solid Earth") of *Earth Science*:

- "Igneous Rocks: Formed by Fire"

Review your notes from previous courses of study on igneous rocks. Granite has a coarse, grained texture. How is this related to its appearance, and where it was made? In your study notebook, explain the formation of different kinds of igneous rocks in terms of available parent material and fast or slow cooling through Bowen's reaction series.

Sedimentary Rock Lab

Complete the following in the Geology LabPaq:

- laboratory 4 (“Sedimentary Rock Identification”)

After completing the lab, contact your course instructor for an answer key. You should be able to name common sedimentary rocks.

Types of Sedimentary Rock

Create a table that compares and contrasts the different kinds of sedimentary rocks (e.g., large and small-grained clastic rocks, chemical and biogenic rocks) in terms of their parent materials and environment of deposition.

Sedimentary Rock Formation Lab

Complete the following in the Geology LabPaq:

- laboratory 5 (“Sedimentary Rock Formation”)

After completing the lab, contact your course instructor for an answer key.

Formation of Sedimentary Rock

Review the following section in chapter 3 ("Rocks: Materials of the Solid Earth") of *Earth Science*:

- "Sedimentary Rocks"

In your study notebook, explain the following steps in the formation of sedimentary rocks:

- weathering
- erosion
- transportation
- deposition
- burial (cementation and/or compaction)
- diagenesis (lithification)

Metamorphic Rock Lab

Complete the following in the Geology LabPaq:

- laboratory 6 (“Metamorphic Rock Identification”)

After completing the lab, contact your course instructor for an answer key. You should be able to name common metamorphic rocks.

Metamorphic Rock Review

Review the following section in chapter 3 ("Rocks: Materials of the Solid Earth") of *Earth Science*:

- "Metamorphic Rocks"

In your study notebook, explain the formation of different types of metamorphic rocks in terms of available parent material and increased temperature, lithostatic or directed pressure, and various amounts of time in different geological settings.

Weathering and Soils

In this section, you will learn about the processes involved in breaking rocks into smaller particles and how those particles combine with organic matter, water, and air to form soil.

Weathering

Weathering is the process of breaking rocks into smaller particles. In this topic, you will study two kinds of weathering. One is the physical breaking apart of rocks and the other is the chemical reactions that change the makeup of rocks.

Mechanical Weathering

Begin reading the following chapter in *Earth Science.* Read through the "Mechanical Weathering" section

- chapter 4 ("Weathering, Soil, and Mass Wasting")

Explain in your study notebook the mechanisms involved in the mechanical weathering of rocks (e.g., frost wedging, exfoliation, abrasion).

Chemical Weathering

While reading the “Chemical Weathering” section in chapter 4 of *Earth Science*, explain in your study notebook (with examples and chemical formulas) the chemical weathering of rock by dissolution, hydrolysis, and oxidation. How does the climate affect the rate of weathering?

Weathering Lab

Complete the following in the Geology LabPaq:

- laboratory 7 (“Weathering”)

After completing the lab, contact your course instructor for an answer key.

Soils

Soil is produced by weathering. Soil is mostly a mixture of particles of broken rocks, but it also contains organic matter, water, and air. The type of soil that forms depends on the rocks, landforms, vegetation, animals, and climate of an area.

Soil Formation

While reading the sections on soil in chapter 4 ("Weathering, Soil, and Mass Wasting") in *Earth Science*, explain in your study notebook in general terms the process of soil formation, including the influence of differing climates. Why would the A Horizon likely be the thickest horizon to form in a humid climate.

Water, Glaciers, and Wind

This section will look at how moving water, wind, and glaciers shape the landscape by moving weathered particles from one location to another. As you progress through this section, think about the observations you can make to verify the constant movement of sediment on the Earth's surface.

Water, Glaciers, and Wind

As discussed in previous topics, weathering, mass wasting, and erosion are the external processes that cause the surface of Earth to change. In this topic, you will discuss the forces (i.e., water, glaciers, and wind) that cause these external processes.

Review Ground and Surface Water

Read the following in *Earth Science* to review the water cycle and the benefits of running water.

- chapter 5 ("Running Water and Groundwater")

While looking at figure 5.3, notice the movement of water through the hydrologic cycle. What can humans do to slow down the erosion caused by streams? What are the geologic results of groundwater?

Floods and Flood Control

Review the following section in chapter 5 ("Running Water and Groundwater") of *Earth Science*:

- "Floods and Flood Control"

In your study notebook, recreate the table below. While reading, fill in the table to explain the risks and benefits of common engineering practices designed to alter the natural courses of streams and control flooding (e.g., dams, artificial levees).

	Benefits	**Risks**
Artificial Levees		
Flood-Control Dams		
Channelization		
Nonstructural Approach		

Groundwater

Review the following section starting on page 136 in chapter 5 of *Earth Science*:

- "Distribution and Movement of Groundwater"

In your study notebook, explain the movement of groundwater through the zone of aeration into aquifers, considering the importance of rock porosity and permeability. What factors influence the storage and movement of ground water?

Changes in the Landscape

Read the following chapter in *Earth Science* to understand glaciers, deserts, and wind:

- chapter 6 ("Glaciers, Deserts, and Wind")

While reading, describe the landforms indicative of glacial erosion and deposition. What landforms are created by wind?

Earth's Interior

In this section, you begin your discussion of what lies below the surface. After completing the activities in this section of the course of study, you will be able to explain the theory of plate tectonics, describe the consequential effects of plate tectonics, such as volcanoes and earthquakes, and describe Earth's magnetic field.

Plate Tectonics

In the early 1900s, there were no planes to circumnavigate Earth, no satellite imagery, and no submersibles to view ocean ridges. Despite lacking these technological advances, Wegener was able to propose the idea of continental drift. During your Earth and space science studies, you learned of the evidence Wegener used to develop his theory of plate tectonics.

Plate Boundaries

Read the following chapter in *Earth Science*:

- chapter 7 ("Plate Tectonics: A Scientific Theory Unfolds")

There are three types of boundaries: divergent, convergent, and transform. While reading about these types, write down what is occurring. Describe the geologic structures and landforms commonly found at each plate boundary. Review figure 7.10 and know how specific important geological features around the globe were formed.

Modern Evidence

While reading the following section in chapter 7 ("Plate Tectonics: A Scientific Theory Unfolds") of *Earth Science*, describe in your study notebook the modern evidence that supports the theory of plate tectonics (e.g., marine magnetic anomalies and paleomagnetic-apparent polar wander curves, age and topography of the ocean floor, and geodetic measurements).

- "Testing the Plate Tectonics Model"

Plate Tectonics: Measurements

While reading the following section in chapter 7 ("Plate Tectonics: A Scientific Theory Unfolds") of *Earth Science*, describe in your study notebook how seafloor spreading is used to measure the rate of plate motion.

- “Measuring Plate Motion”

Earthquakes

A fault is a fracture in rock in which the rocks have or are sliding past each other. As the rocks slide past each other, they often catch. As the pressure of the moving rocks build, they break free. This sudden movement of rocks is what creates the phenomena you know as an earthquake.

Earthquake Waves

Begin reading the following chapter in *Earth Science*:

- chapter 8 ("Earthquakes and Earth's Interior")

Recreate the table below in your notebook. While reading about earthquakes, fill in the table, describing the properties of the different kinds of waves generated by earthquakes.

Surface Waves:
Body Waves:
1. Primary Waves (P waves)
2. Secondary Waves (S waves)

Destruction From Earthquakes

Read the following section in chapter 8 ("Earthquakes and Earth's Interior") of *Earth Science*:

- "Destruction from Earthquakes"

In your notes, describe the characteristics of a tsunami, including the cause and what happens as one approaches the shore.

Earth's Magnetic Field

A magnet is an object that produces a magnetic field that attracts other ferromagnetic materials.

Magnetic Field

Read the following page in chapter 8 ("Earthquakes and Earth's Interior") of *Earth Science*:

- page 240

Read the following section in chapter 5 ("The Earth") in the *Explorations* text:

- section 5.6

In your study notebook, make a drawing of Earth with its magnetic field. Describe the geometry and probable source of Earth's magnetic field. Describe the role of the magnetosphere in deflecting electrically-charged particles and producing polar auroras.

Magnetic Field Lab

Complete the following in the Geology LabPaq:

- laboratory 8 (“Mapping a Magnetic Field”)

After completing the lab, contact your course instructor for an answer key.

Changes in the Magnetic Field

Read the following section in chapter 7 ("Plate Tectonics: A Scientific Theory Unfolds") of *Earth Science*, and

- "Paleomagnetism"

Read the following section in chapter 3 ("Earth Structure and Plate Tectonics") in *Oceanography*.

- section 3.24

Magnetic north is slightly different than true north. Compasses point to magnetic north. There have been times when the magnetic poles reverse. Evidence for this is found by studying rocks. In your study notebook, briefly describe the pattern of changes in Earth's magnetic field over time.

Mountains and Volcanoes

You will continue your study of the changing Earth by exploring volcanoes and mountains. Mountains typically form at the boundary between two plates. A mountain that has been built from molten rock and gases escaping the interior of Earth is called a volcano. Volcanoes are typically classified by their shape, which is determined by how they form.

Volcanoes and Mountains

If you climb to the top of many mountains, you can find evidence of ocean animals. How did those ocean remains get to the top of a mountain? How can mountain ranges assist in mapping the presence of plate boundaries?

Volcanoes Review

Read the following chapter in *Earth Science*:

- chapter 9 ("Volcanoes and Other Igneous Activity")

In your notes, describe igneous activity, convergent and divergent plate boundaries, and intraplate igneous activity. Include in your notes the cause of the major volcanoes mentioned in this chapter.

Rock Deformation

Read the following section of chapter 10 ("Mountain Building") in *Earth Science*:

- "Rock Deformation"

Stress and Deformation Lab

Complete the following in the Geology LabPaq:

- laboratory 9 (“Stress and Deformation”)

After completing the lab, contact your course instructor for an answer key. In your study notebook, describe the properties of elastic, plastic, and brittle strain. Also, describe what happens when rocks fail in brittle strain.

Folding Rock

Read the following section of **chapter 10 ("Mountain Building")** in *Earth Science*:

- "Folds"

While reading, recognize the geologic structures formed by folding rock strata (e.g., anticline, syncline, dome, basin, overturned structures). In your study notebook, draw simple pictures so that you can recognize each feature.

Faults

Read the following section of chapter 10 ("Mountain Building") in *Earth Science*:

- "Faults"

In your study notebook, recreate the table below, describing the movement of the earth for each fault type.

	Dip-Slip Faults:
1.	Normal Fault
2.	Reverse Fault
3.	Thrust Fault
	Strike-Slip Fault:
1.	Transform Fault

Vertical Movement

According to Archimedes' principle, an upward force is exerted on a floating object that is equal to the weight of the displaced fluid. Apply Archimedes' principle to the uplift and support of crustal features (e.g., mountains) by isostasy. Review the vertical movements of the crust section of chapter 10 ("Mountain Building") in *Earth Science*. Write an explanation in your study notebook.

The Bottom of the Ocean

From Earth's surface you can only see the ocean's top layer exposed to the sun. Using instruments such as sonar, scientists can detect the structures that are at the bottom of the ocean. Sea level is always the starting point, whether measuring the height of a mountain or the depth of an abyss. Some regions of the ocean are more than 36,000 feet deep. After completing the activities in this section of the course of study, you will be able to describe the ocean's basins and describe ocean layering.

Ocean Floor

As you work through the activities within this topic, consider what is known about the ocean floor, what still remains to be discovered, and why it is important to map the ocean floor.

Ocean Floor: Earth Science Reading

There are four main ocean basins: Pacific, Atlantic, Indian, and Arctic. Review the first section of chapter 13 ("The Ocean Floor") in *Earth Science* to begin documenting in your study notebook the descriptions of these basins.

Ocean Floor: Oceanography

Read the following chapter of *Oceanography*:

- chapter 4 ("Continental Margins and Ocean Basins")

In your study notebook, describe the geomorphic features of the continental margins and ocean floors (e.g., margins, ridge system, trenches, abyssal floor, and seamounts).

Ocean Temperature and Salinity

As you move deeper into the ocean, the temperature decreases and the salinity increases. Why is this temperature trend more prevalent in low latitudes? What factors affect the salinity of ocean water? What impacts do these variables have on the movement of ocean water, such as the surface currents and underwater currents?

Ocean Properties

The salinity of water affects its density and freezing point. The temperature of water also affects its density. As you move deeper into the ocean, the temperature decreases and the salinity increases. Why is this temperature trend more prevalent in low latitudes? What factors affect the salinity of ocean water? What impacts do these variables have on the movement of ocean water, such as the surface currents and underwater currents?

Processes Affecting Seawater Salinity

Review the following section in chapter 6 ("Water and Ocean Structure") of *Oceanography* starting on page 167 to understand what affects water's density.

- "The Ocean is Stratified by Density"

Review your previous notes on how temperature and salinity affect the density of seawater. Ocean water masses organize by density.

Describe the vertical stratification of the oceans in terms of temperature, density, and salinity of water.

The Movement of Oceans

Waves are just one example of the movement of oceans. Currents move water great distances on the surface as well as deep in the ocean. While wind plays an important role in the movement of water, there are other factors that contribute, such as the Ekman transport and phenomena such as El Niño and La Niña. After completing the activities in this section of the course of study, you will be able to describe ocean waves and describe ocean circulation.

Surface Circulation

The ocean contains many currents including surface and deep currents as well as local and global currents. Many of the currents are predictable and the ocean currents are often divided into five large circular currents known as gyres. In this topic, you will discuss the causes and effects of surface currents.

Surface Circulation: Earth Science Reading

Read the following section in chapter 15 ("The Dynamic Ocean") of *Earth Science*:

- "Surface Circulation"

In your study notebook, describe what gyres are and how the Coriolis effect and geostrophic winds contribute to creating gyres.

Surface Circulation: Oceanography

Begin reading the following of *Oceanography*:

- chapter 9 ("Circulation of the Ocean")

Read through the section on the six great surface circuits. In your study notebook, define Ekman spiral and Ekman transport to understand the movement of water with respect to the wind.

Ocean Waves

Ocean waves are a form of energy moving through the water. Most waves are caused by winds, which create waves that have wavelengths of around 300 feet and heights of around six feet. However, large displacements of water, like during an earthquake, can create a tsunami. A tsunami may have a wavelength of more than 100 miles and move at speeds of more than 500 mph. While the amplitude of these waves is small in deep water, about three feet, they can pile up as they reach shallow water and create enormous and destructive waves

Wave Energy

Review the following section in chapter 10 ("Waves") of *Oceanography* starting on page 265. Describe how ocean waves carry energy.

- "Ocean Waves Move Energy across the Sea Surface"

Wind-Driven Waves

Review the following section in chapter 10 ("Waves") of *Oceanography* starting on page 270

- "Wind Bowing over the Ocean Generates Waves"

Review your previous notes on ocean waves. Explain the formation of wind-driven waves and the factors affecting their development. What are the steps to create a wind wave?

Shallow Water Waves

Review the following section in chapter 10 ("Waves") of *Oceanography* starting page 276. Describe what happens as waves approach the shore.

- "Deep-Water Waves Change to Shallow-Water Waves as They Approach Shore"

Coasts

The ocean coasts support a variety of plants and animals. This intersection of land, sea water, fresh water, and varying tides create a diverse environment. The coasts are also a place with large populations of people. The interactions between human activity and the ocean are important in your study oceans.

Stabilizing Beaches

Review the following section in chapter 15 ("The Dynamic Ocean") of *Earth Science*:

- "Stabilizing the Shore"

Explain the risks and benefits of common engineering practices designed to increase or stabilize beaches (e.g., building jetties or seawalls, sand replenishment).

Sea Level

After reading the beginning of the following chapter in of *Oceanography*, define eustatic sealevel change, and list the factors responsible for it.

- chapter 12 ("Coasts")

Introduction to Astronomy

As technology improves, so does the information you can gather about the solar system. After completing the activities in this section of the course of study, you will be able to list Galileo's discoveries and define retrograde motion.

Origin of Modern Astronomy

Your understanding of the solar system began when early people tried to explain what they could observe in the sky. They had no instruments and many misconceptions about the world that made it difficult to develop correct models of the universe. However, using scientific thinking and logic, they began to create models that explained what they saw.

Origins of Modern Astronomy

Read the following section in chapter 21 ("Origins of Modern Astronomy") of *Earth Science*:

- "Ancient Astronomy"

What were the seven heavenly bodies known to the Greeks? How was the circumference of Earth measured?

Retrograde Motion

Figure 21.6 in chapter 21 ("Origins of Modern Astronomy") in *Earth Science* shows why Mars might appear to be traveling backwards at times. Earth passes Mars on the inside, creating this illusion. In your study notebook, define retrograde motion.

Early Astronomers

Read the following section in chapter 21 ("Origins of Modern Astronomy") of *Earth Science*:

- "Birth of Modern Astronomy"

Read the following section in chapter 1 ("History of Astronomy") of *Explorations*:

- section 1.3 ("Astronomy in the Renaissance")

In your study notebook, describe the contributions of Nicolaus Copernicus, Tycho Brahe, Johannes Kepler, Galileo Galilei, and Isaac Newton. What are Kepler's laws? What did Galilei discover with the telescope? What is Newton's law of universal gravitation?

Astronomical Observations

Telescopes are the most notable tool for observing the sky. They are a perfect example of how advances in technology provide a means for increasing understanding of science. In turn, advances in science have allowed technologies to be improved.

Positions in the Sky

To observe the night sky, you need to be away from city lights. Read the following section in chapter 21 ("Origins of Modern Astronomy") of *Earth Science*, which describes the celestial sphere.

- "Positions in the Sky"

Right Ascension (RA) starts from the vernal equinox position. You can chart along the celestial equator where the summer solstice, autumnal equinox, and winter solstice would be placed. Declination indicates how far the star is from the celestial equator. For example, summer solstice would be at 90 degrees RA, and declination of 0 degrees. The star pictured in figure 21.20 is at approximately 80 degrees RA and declination +45 degrees.

For more information on latitude and longitude please review the following appendix in *Earth Science*:

- Appendix B

Read the following pages in chapter 1 ("History of Astronomy") of *Explorations*:

- pages 69-70 on Celestial Coordinates

Describe the celestial sphere and the coordinate systems astronomers use to locate objects in the sky. Describe the effect of the observer's latitude on the position of an object in the sky. Figure E1.8 describes how to calculate a position and should be reviewed for understanding.
Constellations

Identify the origins and uses of constellations. Figure 21.C on page 612 in chapter 21 of *Earth Science* shows the placement of the constellations in relation to Earth.
Calculating Distance

Chapter 12 of *Explorations* describes how the distances to stars are calculated. Since planets are closer and also orbiting the sun, the movements of planets can be measured more easily than the movements of stars. In your study notebook, describe the evidence that the planets are closer to Earth than the stars.
Telescopes

Read the following section in chapter 23 ("Light, Astronomical Observations, and the Sun") of *Earth Science*:

- "Light Collection and Detection"

Review the following chapter of *Explorations*:

- chapter 4 ("Telescopes")

In your study notebook, name the basic parts of reflecting and refracting telescopes with their functions. Draw a simple version of each telescope, labeling their basic parts.

Our Solar System

The solar system consists of the sun, eight planets, and countless other astronomical objects, including asteroids, meteorites, comments, dwarf planets, and moons. The density of the solar system is concentrated at the center; the sun contains more than 99.8% of the mass in the solar system. The planets contain most of the remaining mass. While all the planets share certain characteristics, they also have a wide variety of properties. For example, the planets have periods of revolution around the sun ranging from 88 days to 165 years. They also have densities ranging from 5.4 g/cm^3 to 0.7 g/cm^3. Remember, water has a density of 1.0 g/cm^3, so Saturn, which has the smallest density, would float in water.

The Solar System

As you will learn in this topic, there are many characteristics that the four inner planets (i.e., terrestrial planets) share with each other, which are in contrast to some of the characteristics of the four outer planets (i.e., Jovian planets). As you take a look at each planet and study how they formed, consider why the planets seem to fall in one of these two categories.

An Overview

Read the following section in chapter 22 ("Touring Our Solar System") of *Earth Science*:

- "Planets: An Overview"

Also read the following chapter in *Explorations*:

- chapter 7 ("Survey of the Solar System")

Describe some plausible reasons for the very different compositions of the terrestrial and Jovian planets. How does the size, composition, mass, atmosphere, and rotation speed of the terrestrial planets compare to the Jovian planets? How does the atmosphere affect surface cratering of a planet?

Earth's Moon

Read the following section in chapter 22 ("Touring Our Solar System") of *Earth Science*:

- "Earth's Moon"

Also read the following chapter in *Explorations*:

- chapter 6 ("The Moon")

As you read, think about the following questions:

- How does the size, mass, and gravitational pull of the moon compare to that of Earth?
- What features are used to describe the surface of the moon, and how were they formed?
- How does the inner core and magnetic field of the moon compare to Earth?
- What is the atmosphere and water content of the moon?
- What is the collision theory of the formation of the moon, and what evidence is there to support it?

The Planets

Read the following section in chapter 22 ("Touring Our Solar System") of *Earth Science*:

- "Planets: A Brief Tour"

Also read the following chapters in *Explorations*:

- chapter 8 ("The Terrestrial Planets")
- chapter 9 ("The Outer Planets")

For each planet, describe its type (rocky or gaseous); size; relative distance from the sun; surface features; gravity; and special features (e.g., rings of Saturn and moons of Jupiter). The chart at the beginning of chapter 22 ("Touring Our Solar System") in *Earth Science* is also helpful. Figure 22.2 shows the relative sizes of the planets to each other. Which planets are the denser, rockier planets?

Describe the orbital radius, size, geology, composition, internal structure, density, atmosphere, and magnetic field of each planet in the solar system. How were Uranus, Neptune, and Pluto discovered?

Moons in Your Solar System

Review the following chapter in *Explorations*:

- chapter 9 ("The Outer Planets")

Describe important features of the principal moons of the planets in the solar system.

Minor Members of the Solar System

Read the following chapter of *Explorations*:

- chapter 10 ("Meteors, Asteroids, and Comets")

As you read, write down answers to the following questions:

- What is the asteroid belt?
- How are asteroids and comets distributed within our solar system?
- What is the Kuiper belt?
- What is the Oort cloud, and what evidence is there to support its existence?
- What is the composition of a comet?
- How is the coma of a comet produced?
- Compare the terms meteor, meteoroid, and meteorite.
- What sources do most meteoroids originate from?
- Describe iron, stony-iron, and stony meteorites. Relating these types to Earth's composition, from which of Earth's layers would these types most likely have originated?
- What are the differences between an asteroid, comet, and meteor?
- How do asteroids, comets, and meteors compare to each other in size?

Asteroid Classification

Review the following section in chapter 10 ("Meteors, Asteroids, and Comets") in *Explorations*:

- section 10.2 ("Asteroids")

Add to your notes how asteroids are distributed and classified. You should know the common types of classifications based on the orbit of an asteroid.

The Sun

Scientists and laypersons have been observing and studying the sun for years. While it is more than 93,000,000 miles away, scientists know an amazing amount of information about the sun. In this topic, you not only discuss some of the sun's properties but you also consider how scientists are able to determine the properties.

The Sun: Reading

Read the following section in chapter 23 ("Light, Astronomical Observations, and the Sun") of *Earth Science*:

- "Sun"

Make a labeled drawing describing the sun's structure and its surface, including sunspots and the solar cycle. Include the six layers of the sun in your drawing (inner core, radiative zone, convection zone, photosphere, chromospheres, and corona). In your study notebook, describe its process for moving energy. Explain the cycle of sunspots in terms of changes in the sun's magnetic field geometry.

Beyond the Solar System

The sun is just one of millions of stars in the galaxy, and the galaxy is just one of millions of galaxies in the universe. In this section, you will study the general characteristics of stars, galaxies, and other astronomical objects that exist outside of the solar system. The measurements you will consider are so large that it becomes difficult to really comprehend what they mean. For that reason, Earth, the sun, and the Milky Way galaxy will be used to put these measurements into context. For example, it is difficult to comprehend that a Red Supergiant, such as Antares, radiates 4×10^{35} joules of energy per second and has a diameter of 1.35 billion kilometers. However, that can be put into context by saying it is about 1 million times brighter than your sun and has a diameter that is about 1,000 times greater than the diameter of your sun, which has a diameter that is about 109 times larger than the diameter of Earth.

Stars

Each star has a unique set of characteristics that you can observe and study. For example, each star is a certain distance from Earth and has a measurable brightness, diameter, temperature, and color, and sometimes you can even measure its mass. In this topic, you will discuss what these measurements mean, how scientists can computes these values, and how you use an H-R diagram (Hertzsprung-Russell diagram) to easily communicate this information about stars. You will also study the evolution of stars, stars with interesting characteristics (e.g., pulsating stars), the interstellar matter that lies between stars, and stellar remnants (i.e., white dwarf, neutron star, black hole) that are left after a star consumes all of its energy.

Properties Determined by Light

In this activity you will review basic properties of light and then explore how those properties can be used to analyze stars.

Read the following sections of chapter 3 ("Light and Atoms") in *Explorations* to review basic properties of light:

- section 3.1 ("Properties of Light")
- section 3.2 ("The Electromagnetic Spectrum: Beyond Visible Light")

How is the color of light related to wavelength? What is infrared radiation and how is it related to visible light? Why does Wien's law not contradict the fact that a hotter object radiates more energy at all wavelengths than a cooler object?

Stellar Properties

Read the following chapters from *Explorations*:

- chapter 12 ("Measuring the Properties of Stars")
- chapter 13 ("Stellar Evolution")

Answer the following questions in your notebook:

- How does the temperature of a star affect its color? Note that while the temperature of a black body increases, the wavelength of maximum energy output shortens; however, according to Planck's law, the energy output of all wavelengths increases.
- How is parallax used to measure the distance to stars?
- How is the method of standard candles used to measure the distance to a star?
- How is Wien's law used to determine the temperature of a star?
- How do we determine the luminosity of a star from its apparent brightness?
- What is the Stefan-Boltzmann Law and how could you use it and Wien's law together to determine the radius of a star?
- Explain how to find the mass and radius of a star using binary stars. How was the formula discovered?
- Describe the characteristics of the different types of pulsating stars from section 13.5.
- What is an HR Diagram?

Describe the characteristics of each stage in the evolution of a star. Pay particular attention to the balance between gravity and thermal expansion. This is an area that many students struggle with, so spend the time necessary to understand these stages.

Look at section 16.2 of chapter 16 ("Galaxies") in the same textbook. Why are pulsating stars, supergiant stars, planetary nebulas, and supernovas used when determining the distance to galaxies?

Stellar Remnants

Read the following chapter in *Explorations*:

- chapter 14 ("Stellar Remnants: White Dwarfs, Neutron Stars, and Black Holes")

Why are the more massive neutron starts smaller than the less massive white dwarfs? What is a black hole, and how do astronomers hope to detect one? Describe how a star becomes a white dwarf, neutron star, or a black hole.

Galaxies

The solar system is just one of billions of solar systems that exist within the Milky Way galaxy. Your galaxy is a giant rotation plane of solar systems. If you look at the sky on a clear night, and away from city lights, you will see a milky looking band that stretches across the sky. You are looking along the plane of the galaxy, and the milky appearance was the cause for the name of the galaxy.
In this topic, you will begin by studying this galaxy. You will then use what you learn as context for studying the different types of galaxies within the universe

Milky Way Galaxy

Read the following chapter in *Explorations*:

- chapter 15 ("The Milky Way Galaxy")

As you read, think about the following questions:

- What is the shape of the Milky Way?
- How is the shape known?
- What is the size of the Milky Way?
- What is the age of the Milky Way?
- What types of stars does the Milky Way contain?

Properties of Galaxies

Read the following sections of chapter 16 ("Galaxies") in *Explorations*:

- section 16.1 ("Discovering Galaxies")
- section 16.2 ("Measuring the Properties of Galaxies")

Create a table in your notebook to compare and contrast spiral, elliptical, and irregular galaxies. Which galaxy type has relatively few new stars? How is this related to the low amount of interstellar gas?

A galaxy is a massive system of stars. Scientists use the Doppler effect of light rays to determine the movement of stars in relation to Earth. Light travels in waves. Different wavelengths determine the different colors. If a star is moving away from Earth, the waves will be stretched and create a particular color. If a star is moving toward Earth, the light waves will be compressed and create a different color. Therefore, scientists can use the colors of stars to determine their movements in relation to Earth. Explain how the distance to a galaxy can be determined from its red shift.

Cosmology

Cosmology is a branch of astronomy that studies the characteristics of your universe. This includes if, when, and how the universe began; the shape of the universe; how galaxies are spread across the universe; how galaxies are moving; and if, when, and how the universe will end. In this topic, you will also discuss an area that sometimes falls within cosmology: are you alone in the universe?

Big Bang Theory

Read the following section in chapter 24 ("Beyond Our Solar System") of *Earth Science*:

- "Big Bang and the Fate of the Universe"

What is cosmology? In cosmology, isotropy refers to the uniform expansion of the universe. How does the raisin bread analogy describe how objects farther from Earth appear to be moving faster? What is critical mass (or critical density), and how does it help describe the eventual fate of the universe?

Observations of the Universe

Read the following sections of chapter 17 ("Cosmology") in *Explorations*:

- section 17.1 ("Observations of the Universe")
- section 17.4 ("The Origin of the Universe")

In your study notebook, write down the stages in the history of the universe according to the standard big bang theory

What is the age of the universe? How does the “light travel time distance” influence your calculations of the age of the universe? Describe the movement of galaxies within the universe. Describe properties of the cosmic microwave background. Which observations provide evidence for the big bang theory?

Shape of the Universe and General Relativity

Read the following section of chapter 17 ("Cosmology") in *Explorations*

- section 17.3

Review the following website:

- Two Body Problem in General Relativity

What is the theory of general relativity? How can curved space be visualized? What evidence supports the general theory of relativity? What is apsidal precession, and how is this explained?

Life in the Universe

Read the following pages in chapter 17 ("Cosmology") of *Explorations*:

- pages 533-537

What is the Drake equation? What is SETI? What is the Gaia hypothesis? What is the anthropic principle?

Final Steps

Congratulations on completing all of the sections of the Interdisciplinary Geosciences Science Course of Study! Share this experience with your students. What strategies helped you learn the material? You now need to demonstrate your competence in interdisciplinary geosciences by passing the performance assessment.

Assessment Information

The activities in this course of study have prepared you to complete the BST2 performance assessment. The following activities will guide you through the assessment process.

Accessing Performance Assessments

You should have completed the following tasks as you worked through this course of study. If you have not completed the tasks in TaskStream, do so now.

- BST2: Early Astronomers
- BST2: Early Atmosphere
- BST2: Earth Components
- BST2: Global Oceans
- BST2: Star Properties
- BST2: The Future

For directions on how to receive access to performance assessments, see the "Accessing Performance Assessments" page.

Feedback

WGU values your input! If you have comments, concerns, or suggestions for improvement of this course, please submit your feedback using the following form:

- Course Feedback

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- Policies and Procedures for Students with Disabilities