Unit 4: Oceanography

Content Area: **Science**
Course(s):
Time Period: **Marking Period 1**
Length: **4 Weeks**
Status: **Published**

Brief Summary of Unit

Students will conduct a rigorous exploration of oceanography to evaluate how marine systems regulate Earth's global climate, biogeochemical cycles, and surface geology. Students will investigate the evolutionary history of Earth’s ocean basins, analyzing the primordial outgassing and extraterrestrial impacts that led to ocean formation. The unit examines the unique physical and chemical characteristics of seawater—including salinity dynamics, density stratification, thermal capacity, and ocean acidification—and their influence on global thermohaline circulation. Furthermore, students will analyze bathymetric features and coastal dynamics, evaluating how wave energy, tidal forces, and longshore transport drive coastal erosional and depositional processes while shaping marine infrastructure and human populations.

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Standard

1	Make sense of problems and persevere in solving them Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.
L.SS.11–12.1	Demonstrate command of the system and structure of the English language when writing or speaking.
HS-PS1-3	Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
L.KL.11–12.2	Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
5	Use appropriate tools strategically

	Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.
6	Attend to precision Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.
L.VI.11–12.4	Demonstrate understanding of figurative language, word relationships, and nuances in word meanings, including connotative meanings.
HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative position of particles (objects).
HS-ESS2-1	Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.
HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-ESS2-5	Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.
HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Essential Questions / Enduring Understandings

Essential Questions

1. How do the unique chemical and physical properties of seawater driver large-scale ocean circulation,

and why are these dynamics critical for stabilizing Earth's global climate?

2. In what ways do the coupled forces of ocean formation, tectonic activity, and coastal fluid dynamics continuously construct and reshape Earth's surface topography over time?

3. How do human populations both rely on and disrupt dynamic marine systems, and what engineering approaches can mitigate risks from coastal erosion and ocean chemistry shifts?

Enduring Understandings

1. The ocean is Earth's primary climate regulator and geochemical buffer, utilizing seawater's high thermal capacity, density-driven circulation, and chemical composition to distribute heat globally and drive planetary biogeochemical cycles.

2. Earth's ocean basins and coastal landforms are dynamic, evolving features created through a combination of planetary origins (outgassing and impacts), plate tectonics, and relentless fluid energy from waves, tides, and longshore transport.

3. Human societies are inextricably linked to ocean health and coastal mechanics, requiring sustainable management strategies to address evolving natural hazards, coastal degradation, and global shifts like ocean acidification.

Objectives: Students will know/Students will be skilled at

- Analyze how wave action affects shorelines and produces erosional and depositional features.
- Compare the different ocean basins on Earth.
- Compare the properties of salt water to fresh water.
- Demonstrate how oceanographers use sonar to map the ocean floor.
- Demonstrate the density of a liquid can be altered when other substances dissolve in them.
- Describe the history and the study of oceanography.
- Determine how water pressure, salinity, and temperature changes with increasing depth.
- Explain how buoyancy is the upward force exerted by a fluid on an object submerged in it.
- Identify the major features and sediments located on the ocean bottom.

Learning Plan

- Activity/Assessment/Presentation - Differentiating coastlines and beaches of the United States
- Assessment - United Streaming video and assessment questions
- Compare and contrast oceans and seas.
- Describe how water moves as a wave passes.
- Differentiate among rocky shorelines and flat shorelines.
- Discuss the effects of human impact along shorelines.

- Discuss the factors that control wave height.
- Discuss the formation and origin of oceans.
- Explain how the salinity and temperature of seawater affects its density.
- Explain what causes tides and differentiate among the different types of tides.
- Explore the content of oceanography - What do oceanographers study?
- Illustrate and discuss the various features of the seafloor.
- Lab/Activity - Creating of ocean temperature profiles
- Lab/Activity - Density salt water
- Lab/Activity - Mapping the seafloor
- Lab/Activity - Wave dynamics
- Meaningful participation in guided question/answer sessions, individual/group discussions, demonstrating an understanding of the purpose of the unit lesson(s), key terms, and concepts
- Preview the essential questions, provide answers, and connect to learning throughout the unit
- Quiz/Assessment - Physical and chemical properties of seawater
- Quiz/Assessment/Concept Map - Seafloor features
- Student's research methods for oil spill cleanup.
- Unit Assessment – Oceanography

Assessment

Formative:

Do Now Questions

Exit Ticket Questions

Whole Class Discussion Participation

Small Group Discussion Participation

Individual Student Questions/Responses

Independent Tasks

Lab Experiments

Quizzes

Summative:

Lab Report

Unit Test

Benchmark:

Midterm/Final Exam

Alternative Assessments:

Guided Formal Lab Report

Unit Study Guide

Materials

- Earth Science, Merrill, and ancillary resource materials
- Earth Science, Prentice-Hall, and ancillary resource materials
- Marine Science, Amscoe, and ancillary resource materials
- marine sediment and water samples
- Oceanography, Merrill
- quantitative/qualitative lab equipment for activities, experiments
- related geologic, oceanographic maps
- sedimentary rock sample sets
- supplementary interactive multimedia, internet websites, videos
- Textbook, Physical Science with Earth Science, Glencoe, and ancillary resource materials