Grade Level: 3-5
Time Estimate: 2-3 days

INTRODUCTION TO OCEANOGRAPHY / INSTRUCTOR INFO

Summary

This lesson includes vocabulary, content, and creative activities to help students learn about basics of oceanography. Students will learn about what oceanography is, the different types of bodies of saltwater, topography of oceans, and the importance of studying the ocean.

Part 1. Bodies of Saltwater & Salinity
Part 2. Topography of Oceans
Part 3. Importance of Oceans
Activity 1. Drawing the Ocean Floor

Goals & Objectives

The students will:
• Learn what oceanography is;
• Learn about the different bodies of saltwater and salinity;
• Learn the different terms and structures of ocean topography;
• Learn the importance of studying the Earth's oceans.

Helpful Tips

1. The content in this lesson is related to OCEARCH and the Global Shark Tracker. Spend a few minutes getting familiar with the website and the tracker if you have not done so already. The Global Shark Tracker is also available as an app for iPhone and Android.
2. This lesson plan is designed to be adaptable to suit your specific needs. Use the entire lesson plan or just parts of it. This material can be expanded to be an entire unit or condensed for just one day in the classroom.
3. Vocabulary words will be underlined as they appear in the lesson plan. A complete list of vocabulary words is included as well.
4. Answers to questions and prompts for discussions will appear in italics.
5. Optional activities and content (side notes) will appear in a box. Use these to enhance your lesson and adapt it to suit your needs!
6. Have questions for OCEARCH Expedition Leader, Chris Fischer? Email info@OCEARCH.org to schedule a Skype session and let your students/child talk directly to Chris and the OCEARCH crew!
7. Email all questions about this lesson to info@OCEARCH.org.

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// STANDARDS

This lesson aligns with the following TEKS:
Grade 3 Science: ~7C, ~9A
Grade 4 Science: ~3C
Grade 5 Science: 1B, ~2G, 9C

This lesson aligns with the following Next Generation Science Standards:

Framework

1. Asking questions and defining problems.
2. Planning and carrying out investigations.
3. Analyzing and interpreting data.
4. Constructing explanations.
5. Engaging in argument from evidence.
6. Obtaining, evaluating, and communicating information.

Earth's Systems: Processes that Shape the Earth

Science and Engineering Practice
Analyzing and Interpreting Data
• Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.
• Analyze and interpret data to make sense of phenomena using logical reasoning. (4-ESS2-2)

Disciplinary Core Ideas
ESS2.B: Plate Tectonics and Large-Scale System Interactions
• The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)

Crosscutting Concepts
Patterns
• Patterns can be used as evidence to support an explanation. (4-ESS1-1),(4-ESS2-2)

STEM
This lesson plan aims to assist teachers in implementing a STEM-based program into their classroom while inspiring the next generation of explorers, scientists, and stewards of the ocean. Based on real science and the Global Shark Tracker™, this lesson is intended to promote environmental awareness and to prepare students for STEM careers.

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INTRODUCTION TO OCEANOGRAPHY / VOCABULARY

Abyssal Plain – The flat bottom of the deep ocean found at depths between 3,000 m and 6,000 m (~10,000 ft. – 20,000 ft.).

Bay – A large body of water that is surrounded by land and has only one opening larger than a gulf.

Continent – Land.

Continental Rise – Area at the bottom of a continental slope that is composed of accumulated sediments.

Continental Shelf – Flat part of the continent that is covered by water and gradually slopes toward the end of the shelf.

Continental Slope – The edge of a continental shelf that sharply drops off into a steep slope.

Gulf – Large body of water that is surrounded by land and has only a narrow opening that opens to a larger body of water.

Halophile - An organism that lives in environments with high salt concentrations.

Mid-Ocean Ridge – A chain of underwater mountains that wraps around the Earth more than 65,000 km (2.13 E+8 ft.).

Oceanography - The study of the Earth's oceans.

Ocean – A large, vast body of salt water.

Plate Tectonics – Process by which tectonic plates interact by colliding, moving away, or sliding past each other, resulting in disturbances or new land structures.

Salinity - The measure of all the salt that is dissolved in the water.

Seamount – An underwater volcanic mountain.

Trenches – Deepest parts of the ocean.

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INTRODUCTION TO OCEANOGRAPHY / PRE-LESSON ASSESSMENT

Use the following true/false and multiple-choice questions as an introduction/warm-up to the lesson topics. You can do this in a verbal or written format, as a game, individually, or as a whole class! A handout is provided if you wish to hand the questions out in a quiz format.

The questions do not need to be graded. They are intended to give the students an idea of what they will be learning and to see what they already know.

1) True or False
Oceanography is just the study of the locations of bodies of salt water.
Answer: False

2) True or False
All oceans have high concentrations of salt.
Answer: False

3) The term for an organism that lives in environments with high salt concentrations is:
- **a.** Saltphiles
- **b.** Halophiles
- **c.** Oceanphiles
- **d.** Seaphiles

Answer: b

4) Which of the following are ways to help protect oceans and marine life?
- **a.** Do not litter.
- **b.** Help clean beaches.
- **c.** Do not overfish.
- **d.** All of the above.

Answer: d

5) Which of the following is not a part of the ocean floor?
- **a.** Continental shelf
- **b.** Mid-Ocean Ridge
- **c.** Abyssal slope
- **d.** Trench

Answer: c

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Name: _____

Date: _____

Introduction to Oceanography

Select the correct answer(s) to each of the following questions.

1) True or False

Oceanography is just the study of the locations of bodies of salt water.

2) True or False

All oceans have high concentrations of salt.

3) The term for an organism that lives in environments with high salt concentrations is:

a. Saltphiles

b. Halophiles

c. Oceanphiles

d. Seaphiles

4) Which of the following are ways to help protect oceans and marine life?

a. Do not litter.

b. Help clean beaches.

c. Do not overfish.

d. All of the above.

5) Which of the following is not a part of the ocean floor?

a. Continental shelf

b. Mid-Ocean Ridge

c. Abyssal slope

d. Trench

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INTRODUCTION TO OCEANOGRAPHY / LESSON PLAN

INTRODUCTION **3-5 mins**

Oceanography is the study of the Earth's oceans. To better understand the oceans, the study of oceanography brings together many fields such as biology, geography, chemistry, physics, and astronomy, among others. The Earth's surface has both land and water portions. The ocean covers 70% of the Earth's surface and 97% of all the water on Earth is saltwater that is contained in the oceans. Out of all of the oceans that cover Earth there is still about 90% of it that is unexplored!

Studying the ocean will help us better understand many things such as human effects on the ocean, organisms' interactions in the oceans and their affects or influence on other organisms, geography and topography of the ocean floor, the oceans temperature and effects on climate, and much more!

PART 1. BODIES OF SALT WATER & SALINITY **5-10 mins**

An ocean is a large, vast body of salt water. There are five oceans on Earth: *Atlantic Ocean, Arctic Ocean, Pacific Ocean, Indian Ocean, and Southern Ocean*. Sections of oceans that are partially enclosed by land are called seas. Seas are smaller than oceans, but are still large and vast. The phrase "Sail the Seven Seas" was coined in ancient times and referred to the bodies of water along trade routes. Smaller portions of seas, that are still relatively large bodies of water, surrounded by land and have only a narrow entrance to a sea is called a gulf. Bays are similar in size to gulfs, differing only in the size of the opening. Bays have a wider opening to a larger body of water compared to the narrow opening of a gulf. Regardless of the size of the area that holds salt water, the salt content is what makes these bodies of water distinguishable from those that are freshwater.

We know that there is salt in the ocean due to its salinity. Salinity is the measure of all the salt that is dissolved in the water. Salt water has a salinity of 35 parts per thousand (ppt) or 3.5% salt. This means that for every 1,000 grams of water there are 35 grams of salt. Though most bodies of salt water are 35% salt, there are some enclosed bodies of water that have salinity levels over 30%. Don Juan Pond in the South Fork of Upper Wright Valley, Antarctica is the world's most saline natural body of water. Don Juan Pond has a salinity level of >40%, so its salt content is >400 ppt! The high salinity of bodies of water is caused by precipitated salt that is left behind when water evaporates or by high mineral runoff from nearby areas carried by rivers that flow into enclosed bodies of water. You might not think that organisms can live in bodies of water with high salinity, but there are some that can. Organisms living in high salt concentrations are mostly microbes called halophiles. Halophile means "salt loving" in Greek.

PART 2. TOPOGRAPHY OF OCEANS **10-15 mins**

Much of the ocean floor is flat, but it does have some features that are not so flat at all. The shape of the ocean floor was molded by a process called plate tectonics. Tectonic plates are large sections of solid rock in the Earth's outer layer that constantly move on top of partially melted rock. The movement of the plates can cause one to collide with another, move away from another, or slide past another. Though plate tectonics played a role in the formation of the ocean floor, each of the structures are different.

When talking about the ocean floor, the land is referred to as the continent. Parts of a continent that are flat and covered by water are continental shelves. Continental shelves gradually slope toward the end. At the edge of a shelf, a continental slope sharply drops off toward the bottom of the ocean. The area at the bottom of a continental slope that is composed of accumulated sediments is the continental rise. After the continental rise is abyssal plain, flat bottom of the deep ocean found at depths between 3,000 m and 6, 000 m (~10,000 ft. – 20,000 ft.). The abyssal plain may be in the deep ocean, but it is not the deepest part of the ocean. Trenches are the deepest parts of the ocean. The deepest trench is the Mariana Trench that is 10,994 meters deep (36,070 ft.).

Not all structures in the ocean slope down to trenches. Some structures are elevated on the ocean floor. A seamount is a submarine volcanic mountain. Seamounts are not always standing alone. The mid-ocean-ridge is a chain of underwater mountains that wraps around the Earth more than 65,000 km (2.13 E+8 ft.). More than 90% of the mid-ocean range lies in the deep ocean.

We may know about the topography of the Earth's oceans that has been mapped to a resolution of ~5 kilometers (16,404 ft.), but it is estimated that ~ 95% of the oceans are still unexplored. We may know the structures of the ocean based on the mapping, but what exactly is in every section of the ocean is still unknown. There are many reasons why there is still so much not known about the oceans. Temperature and pressure change as one dives deeper into the depths of the ocean. Human bodies would not be able to swim down to the very depths without being harmed. Specialized equipment is being produced to take samples and imaging from the depth of the ocean, so that we can better understand what is below us on land. New information is learned every day, so keep an eye out to learn more about what lies beneath.

PART 3. IMPORTANCE OF OCEANS **10-15 mins**

We may live on land, but we must not overlook the oceans, that make up 70% of the Earth's surface, for they are of high importance to us. Temperature and rainfall are highly influenced by oceans, as the oceans absorb and source heat. Climate is not the only way that the ocean impacts us. It is thought that most of the oxygen we breathe comes from plants. It is true that plants release oxygen as a by-product of photosynthesis, but much of the oxygen is produced by single-celled algae in the ocean. There are many marine creatures that are consumed by humans and other marine life. Any disturbances to the food chain in the ocean directly affect humans. It is key to know the topography of oceans when navigating. If a seamount is just below the surface, it is good to know how far down the tip is, so that sea vessels do not crash into them. What is previously mentioned are not all, but just a few reasons why it is important to study and take care of the Earth's oceans.

Just as there are countless reasons why it is important to study oceans, there too are numerous ways to take care of the oceans. We all may have heard *Reduce, Reuse, and Recycle*. Reducing the amount of product we use lowers the amount of waste that enters landfills and may potentially enter the oceans. Reusing too lowers the amount of waste that can be dropped into the oceans. Recycling takes the materials that are reusable and reforms them for different purposes, which also minimizes the amount of waste that may enter the oceans. A lot of waste that does enter oceans can be mistaken for

food by marine life. The consumption of garbage has the effects that you would think if you ate garbage; marine life can suffocate and die or get no nutrition from garbage. There is a gigantic patch of garbage that is floating in the Pacific Ocean that is estimated to be larger than the size of the state of Texas. The garbage is not biodegradable and only brings harm to the ocean waters and marine life. To help our oceans and save marine life, we can clean beaches and water systems and not litter.

Not only can marine life be harmed by human waste, but also by overfishing. Some humans consume marine animals, but not all that is caught is eaten, since humans can be wasteful. The overfishing of marine life takes away from the organisms in the oceans that rely on what is removed for food and slows down the reproduction rates of marine life. If a lot of marine life is caught, then there are fewer numbers left in the oceans to maintain sustainable populations. There are many other ways what we can help protect our oceans and marine life. What are some other ways that you can think of? Together, we can influence change and rally more people to help our cause!

As a class or individually go to **http://www.ocearch.org/** to learn about the sharks that we can help save by taking care of our oceans.

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INTRODUCTION TO OCEANOGRAPHY
Activity 1.Drawing the Ocean Floor

INTRODUCTION

During this activity, students will listen to descriptions of the geographical characteristics of the ocean floor to create their own model of the ocean floor from the perspective of standing on the beach.

MATERIALS

- Drawing paper
- Pencils
- Markers/crayons
- Modeling clay
- Toothpicks
- Shoe boxes (one per student)

INSTRUCTIONS

Each student will be given a sheet of drawing paper and access to pencils/markers. The teacher will ask the students to listen to a spoken description of the geographical characteristics of the ocean floor (below in quotations). As the students listen to the description, they will draw a diagram of what they just heard.

"You are walking on a beautiful beach referred to as the *continent* toward the water. As you put a foot in the water and continue to walk, you are moving along the *continental shelf* that is the flat, first part of the ocean floor that is covered by water. It gently slopes with each step. You have reached the edge where it slopes off steeply into deep water and have finally reached the *continental slope*. As you sink down, you notice the slope is not as steep and you feel the sediments deposited by ocean currents between your toes. The soft sediment marks the *continental rise*. There is still more to see. The deepest, flat bottom of the ocean is the *abyssal plain*. You explore the *abyssal plain* and find that it is dark and cold. As you continue, you do not feel a bottom anymore. You sink once again into a *trench*, the deepest part of the ocean. The trenches are even colder and darker that before, until you reach the bottom where it is very hot. As you keep venturing, you feel a structure that you can climb on; it is a *seamount*. A seamount is an underwater volcanic mountain. You keep climbing and get back to the abyssal plain. You notice that there are more mountains and begin to follow them. You are walking along the *mid-ocean ridge* now. The journey continues and you learn more about the ocean and its inhabitants. The ocean is vast and quite varied. "

After drawing a diagram, the students will be given each a shoe box and access to craft materials. The students will construct their own ocean floor model using the diagram they made as a guide. The model should include the features that were mentioned in the description: *continent, continental shelf, continental slope, abyssal plain, trench, seamount, and mid-ocean ridge*. After the models are complete, have the models on display so each student can share the model he/she created with the rest of the class. Even though the students are all using the same terms as requirements for the models, this activity gives the students the ability to express their creativity.

TIPS

Have the students' research and add organisms that can be found in each part of the ocean floor.