

# Into the Deep: Mapping the Ocean Floor

**Author** Genevieve Conn  
**Grade Level** 9-10  
**Duration** 2 class periods

## National Standards

### GEOGRAPHY

#### Element 1: The World in Spatial Terms

1. How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information

#### Essential Element 3: Physical Systems

7. The physical processes that shape the patterns of Earth's surface

#### Element 4: Human Systems

17. How to apply geography to interpret the past  
 18. How to apply geography to interpret the present and plan for the future

## AZ Standards

### ELA

#### Reading

#### Key Ideas and Details

**9-10.RI.2** Determine a central idea of a text and analyze its development over the course of the text, including how it emerges and is shaped and refined by specific details; provide an objective summary of the text.

#### Writing

#### Production and Distribution of Writing

**9-10.W.4** Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

### MATHEMATICS

#### Geometry

**HS.G-SRT.7** Explain and use the relationship between the sine and cosine of complementary angles.

**HS.G-SRT.8** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

## Arizona Social Science Standards

### GEOGRAPHY

**The use of geographic representations and tools help individuals understand their world.**

**HS.G1.1** Use geographic data to explain and analyze relationships between locations of place and regions. Key tools and representations such as maps, remotely sensed and other images, tables, and graphs

**HS.G1.2** Use geospatial tools and related technologies to construct relevant geographic data to explain spatial patterns and relationships. Key tools and representations such as Google Earth, story mapping, wayfinding apps, and other geospatial technologies

**Human-environment interactions are essential aspects of human life in all societies.**

**HS.G2.1** Analyze interactions within and between human and physical systems.

## SIOP Elements

### Preparation

Adapting content  
**Linking to background**  
 Linking to past learning  
**Strategies used**

### Scaffolding

Modeling  
**Guided practice**  
 Independent practice  
**Comprehensible input**

### Grouping Option

Whole class  
**Small groups**  
**Partners**  
 Independent

### Integrating Processes

Reading  
 Writing  
**Speaking**  
**Listening**

### Application

Hands on  
 Meaningful  
 Linked to objectives  
**Promotes engagement**

### Assessment

**Individual**  
**Group**  
**Written**  
 Oral

# Into the Deep: Mapping the Ocean Floor

## Arizona English Language Proficiency Standards

### Stage V

#### Basic

#### Listening and Speaking

**Standard 1: The student will listen actively to the ideas of others in order to acquire new knowledge by:**

B-5: retelling main ideas/concepts and key points/details of presentations using complete sentences.

**Standard 2: The student will express orally his or her own thinking and ideas by:**

B-7: report detailed information on a topic supported by concrete details, commentary, and examples in complete sentences.

## Overview

Mapping the ocean floor tells us a lot about how the Earth's surface has changed and what future changes might mean for organisms living here. Even though largely significant movements of the Earth's plates don't happen in one lifetime, such movements in the past, such as the break-up of Super Continents, did eventually change life on Earth.

## Purpose

In this lesson, students will explore how sonar technology is used to map the ocean floor. They will also calculate ocean depths using other known distances and angle measures. The students will discuss how plate tectonics change the surface of the Earth and discover how these changes might impact life forms. This lesson includes strategies for teaching diverse learners.

## Key Vocabulary

**hypotenuse:** the side of a right triangle opposite the right angle

**legs:** the two sides of a right triangle opposite the non-right angles

**Pangea:** a supercontinent that formed about 300 million years ago and broke apart about 175 million years ago

**pressure:** a force exerted on an object by something in contact with it

**salinity:** amount of salt in a body of water

**sonar:** a way to measure depth under water using sound

## Materials

- Computers or devices that will support the game <http://www.geo.cornell.edu/hawaii/220/PRI/conti>

[mental\\_puzzle.html](http://www.mentalpuzzle.html) OR a few sets of foam cut-outs OR photo copies of the Pangea Cutouts

- Dot Cam or White Board for beginning discussion
- Geography Background Comparing Pangea to Continents Today
- Mathematics Background on Trig Ratios and Sine and Cosine
- Learning about Sonar reading
- Trigonometry Worksheet and Answer Key
- Video Questions Note Sheet
- Pangea Cutouts

## Objectives

The student will be able to:

- Solve triangles using trigonometry.
- Analyze how changes in the Earth's surface impact life on Earth.

## Procedures

Prerequisites: *Students should have basic knowledge of plate tectonics and how the plates cause changes on the surface of the Earth.*

### SESSION ONE

#### Engage:

- Draw t-chart on the board or a paper projected by a dot cam. Label one side "Pangea" and the other "Continents Today". (**Preparation: Linking to Background**)
- Ask students to think about key features of each and write them down. Have students share their ideas and record them on the class model for everyone to see. Leave some space between ideas so more information can be added from the next discussion question. (**Integrated Processes: Listening) Scaffolding: Modeling**)

## Into the Deep: Mapping the Ocean Floor

- c. Next discuss how some of those features could influence organisms living there and what could have changed when the continent broke up. Go back through the ideas recorded earlier and add the new ideas on how organisms would have changed. (See Teacher Notes)
- d. Explain that studying the earth's surface and the ocean floor and plate tectonics helps us understand how the continents drifted apart.

### Explore:

- a. Have students access the game at [http://www.geo.cornell.edu/hawaii/220/PRI/continental\\_puzzle.html](http://www.geo.cornell.edu/hawaii/220/PRI/continental_puzzle.html) or hand out a foam continents set to pairs or small groups. (You can also make photo copies of the continents and have students cut them out.) Let them try to piece together Pangea from the modern day continents. If using the online game, discourage them from turning on the Pangea outline. The game can be played in partners if there is limited access to technology. (**Grouping Option: Small Groups**) and (**Application: Promotes engagement**)
- b. Ask groups to share out their strategies on how they played the game. (**Integrating Process: Listening, Speaking**)
- c. Let students know that over the next couple days they will be studying how the ocean floor is mapped. Our ocean floor gives us clues to our plate boundaries and is constantly changing as a result of plate tectonics.
- d. Ticket Out the Door: Have students answer the following question on a sheet of notebook paper: Explain how Pangea is an example of how changes in the natural environment can increase or diminish its capacity to support life. Be sure to give at least two changes and their consequences. (**Assessment: Written**)

## SESSION TWO

### Explain:

- a. Have one or two students summarize what happened in the class yesterday. Introduce today's class as learning more about our Earth's surface and tools that we can use to measure changes. (**Integrating Process: Listening, Speaking**)
- b. Pass out Video Questions Note Sheet. Let students read over the questions before the video. (**Scaffolding: Comprehensible Input**)
- c. Play video from beginning to 2:55 [https://www.youtube.com/watch?v=ZTEjt\\_m2RLc](https://www.youtube.com/watch?v=ZTEjt_m2RLc)
- d. Have students pair up and retell the important details about using sonar to map the ocean floor

and any ideas they had about the links to trig. They may use their Question Sheet to discuss and record additional ideas from a classmate.

**(Grouping Option: Partners)**

### Elaborate:

- a. Set up and explain how to use trig ratios and the laws of sine and cosine. (See Teacher Notes)
- b. Show students the song about the laws. (**Application: Promotes Engagement**) <https://www.youtube.com/watch?v=-wsf88ELFkk>
- c. Hand out article about the effects of temperature, salinity, and depth. Have them read independently and underline in pencil their opinion on the 10 Most Important Sentences in the article. (**Preparation: Strategies Used**)
- d. Have a full group discussion on what parts of the article they decided were most important. Now have the students highlight in color the agreed upon 10 sentences. (**Integrating Process: Listening, Speaking**)

### Evaluate:

- a. Students will complete a worksheet. For the purposes of this activity, they will not take into account the temperature and salinity they read about in the article. They will just be given the time it took for the sound waves to reach the receiver. They will work in pairs to solve the first problem and individually on the second. (**Grouping Option: Partners**) and (**Assessment: Individual, Group**) The third question will ask students to describe how sonar (technology) assists us in solving problems. Students who are not done may finish this worksheet for homework.

## Assessment

### Geography and Writing/Reading

Session One Ticket Out can be graded for Ideas and Content. Two correct changes and their consequences will be considered mastery.

### Geography and Math

A score of 80 points out of 100 on the Trigonometry Worksheet will be considered mastery.

## Extensions

Students can calculate depths that incorporate the salinity and temperature effects.

## Into the Deep: Mapping the Ocean Floor

Students can write their own songs to remember the laws of sine and cosine.

Students can write a paper or draw a map of how they think the surface of the Earth might look in the next 200 million years. They could share these ideas with the class.

Measuring water depth by Crowdsourcing

<https://en.wikipedia.org/wiki/OpenSeaMap>

## Sources

Pangea Puzzle Game

[http://www.geo.cornell.edu/hawaii/220/PRI/continental\\_puzzle.html](http://www.geo.cornell.edu/hawaii/220/PRI/continental_puzzle.html)

How Sonar Works

[https://www.youtube.com/watch?v=ZTEjt\\_m2RLc](https://www.youtube.com/watch?v=ZTEjt_m2RLc)

Article: How Fast Does Sound Travel?

<http://www.dosits.org/science/soundmovement/speedofsound/>

Article: The first Studies of Underwater Acoustics: the 1800s <http://www.dosits.org/people/history/1800s/>

Law of Sine and Cosine Song

<https://www.youtube.com/watch?v=-wsf88ELFkk>

Teacher Notes

<http://www.livescience.com/38218-facts-about-pangaea.html>

Clip art provided copyright free from

<http://office.microsoft.com/en-us/images/>

Pangea Puzzle

[http://alex.state.al.us/lesson\\_view.php?id=30754](http://alex.state.al.us/lesson_view.php?id=30754)