

Ocean Exploration: Diving Deep into Ocean Science

Developed by:
Sierra Tobiason, Lynn Fujii and Noe Taum

Grade Level: Sixth Grade

Purpose: This curriculum is designed to communicate:

- I. Methods scientist use to study the health of the ocean and research open ocean animals.
- II. The unique behavior and feeding strategies of humpback whales compared to other cetaceans.
- III. The importance of ocean conservation to sustain seafood resources for the future.

Hawaii Content and Performance Standards (HCPSIII):

SC.6.1.1

Formulate a testable hypothesis that can be answered through a controlled experiment
The student: Constructs a hypothesis (e.g., if, then, and because statement) that is tested through a controlled experiment.

SC.6.1.2

Use appropriate tools, equipment, and techniques safely to collect, display, and analyze data
The student: Selects and safely uses appropriate tools, equipment, and techniques to collect, analyze, and display data.

SC.6.2.2

Explain how the needs of society have influenced the development and use of technologies
The student: Describes ways in which the development and use of a specific technology (e.g., wheel, pencil, email, cell phone, satellite) has been influenced by society.

SC.6.3.1

Describe how matter and energy are transferred within and among living systems and their physical environment
The student: Explains the flow of matter and energy in ecosystems (e.g., the total amount of matter and energy remain constant as they are continuously transferred within and among organisms and their environment).

SC.6.6.6

Describe and compare the physical and chemical properties of different substances
The student: Compares and contrasts physical and chemical properties (e.g., mass, melting point, boiling point, magnetism, conductivity, rusting, reactivity) of different substances (e.g., salts, sugars, elements, acids, bases).

SC.6.6.8

Recognize changes that indicate that a chemical reaction has taken place

The student: Observes chemical reactions and identifies the changes (e.g., release of heat, light, gas)

MA.6.1.1

MA.6.3.1

MA.6.11.1

Topic and Driving Question:

How do scientists explore the deep ocean and the animals that live in it? How do we know that our oceans are healthy? What are people doing to try and preserve ocean life and sustain seafood resources?

Rationale:

In this curriculum students dive deep into ocean exploration as they create their own Hawai'i ocean maps, learn how to use navigational tools such as GPS, experience a day in the life of an open-ocean researcher, apply mathematics to calculate the growth and diet of ocean animals, discover the unique characteristics of marine mammals, collect and analyze water samples using water chemistry techniques, research the uses of native limu (seaweed), and learn to communicate the importance of fishing regulations and ocean conservation.

Concept Map for Unit: See below

Formative Assessment:

Students will demonstrate continued learning throughout the unit by successfully completing worksheets, research notebooks and homework assignments for each activity.

Summative Assessment:

In the final project, students research an ocean animal that is commonly fished or collected in Hawai'i. They use the Hawai'i State regulations for their species to find information on the common name, Hawaiian name, scientific name, and restrictions such as closed seasons and bag limits. Students create a poster on their research that includes a life-sized representation of their chosen species. Students also describe the importance of Marine Protected Areas and regulations for the conservation of ocean life. Lastly, students interview an older family member to learn how s/he perceives ocean resources have changed over the years and to brainstorm ideas on how to protect and conserve ocean resources.

Overview of Lessons Chart: See below

Sources:

Activities Integrating Math and Science (AIMS)

<http://www.aimsedu.org/>

Hawaii Department of Aquatic Resources

<http://hawaii.gov/dlnr/dar/>

Marine mammal center

<http://www.marinemammalcenter.org/>

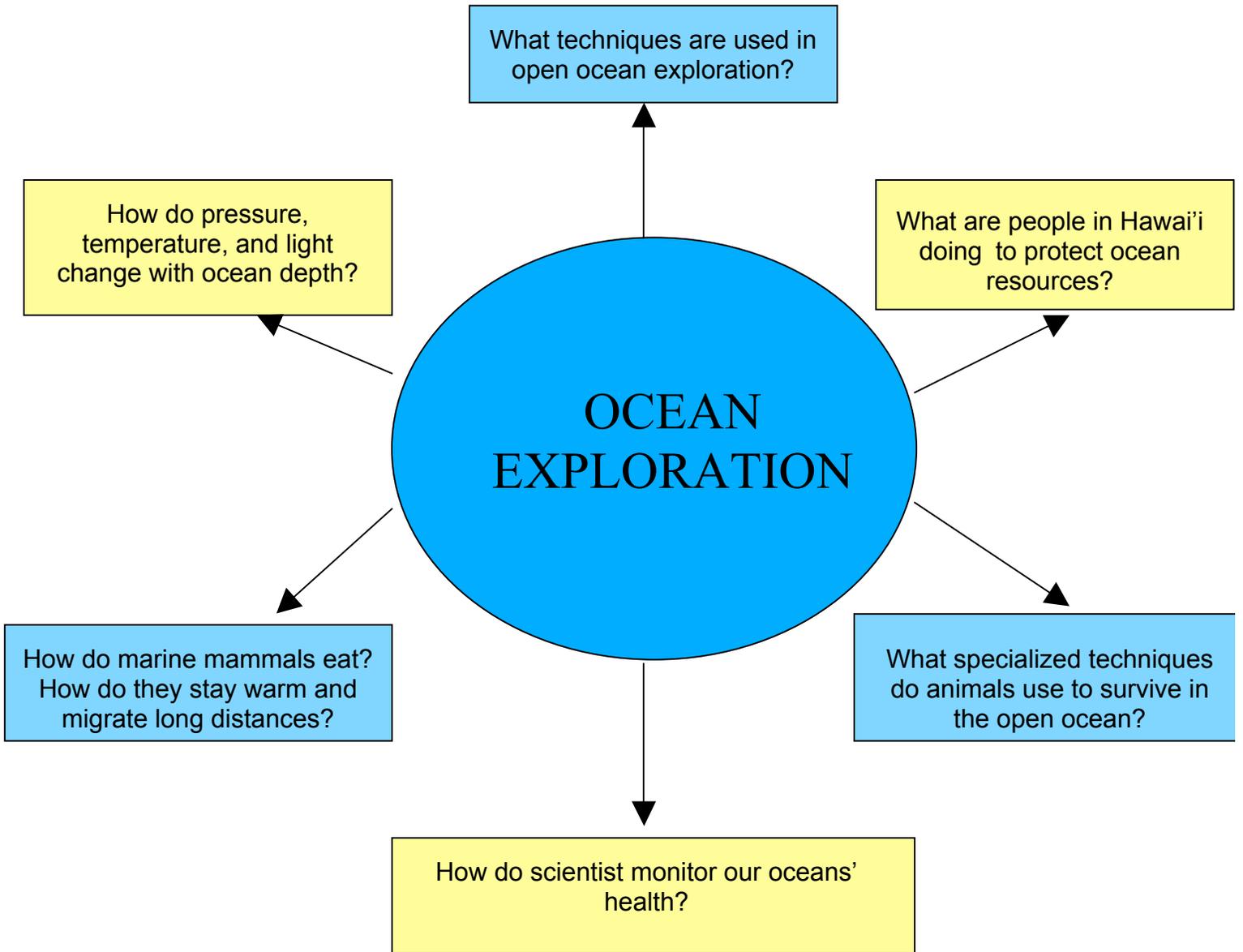
Monterey Bay Aquarium

<http://www.montereybayaquarium.org/>

NOAA fisheries National Marine Fisheries Service (NMFS)

<http://www.nmfs.noaa.gov/>

Unit Concept Map



| Timeline | Lesson and Topic | Concepts | Student Objectives | Activity description | Assessment |
|-----------------|--|---|---|---|---|
| <i>Week 1</i> | Pre-Assessment and Introduction to scientific method | Scientific method | Students will complete the pre-assessment and then be able to describe the steps of the scientific method | Each student will independently fill out the pre-assessment. Then the class will be introduced to the unit lessons and will learn about the scientific method | Completed pre-assessment |
| <i>Week 2</i> | Exploring the deep blue | Studying the ocean can often be a challenge as it is so large and so deep. Over 70% of our Earth is covered in ocean water and the deepest trench in the ocean is 10,934 meters (35,840 feet) below sea level | Students will use math to find the probabilities (expressed in fractions and percentages) of landing on water. They will use latitude and longitude coordinates to design their own map and plot their position in the Pacific Ocean. They will understand the advances and technological developments in navigation. | They will work together to predict what the probability is of landing on a spot on the globe that is water, versus a spot that is land? Students will make a map and discuss different types of ocean vessels. | Beach ball bounce worksheet, plot your position map and ocean exploration word search |
| <i>Week 3</i> | Global Positioning Systems, Ocean Navigation and Treasure Hunt | Global Positioning System (GPS) is used in ocean research and voyaging | Students will use GPS technology to find waypoints and be able to describe latitude and longitude. Students will discuss how technology has had an impact on society | In this activity students will learn step by step how to use a GPS, then they will go on a treasure hunt to learn how to use a GPS to find waypoints. | Class discussion after lesson, Ability to navigate to treasure with GPS |
| <i>Week 4</i> | Under Pressure | Pressure, temperature and light change as you increase in depth in the ocean. Specialized technology (like ROVs and submarines) allow scientists to study the deepest parts of the ocean. | Students will identify and describe the different ocean zones and will be able to identify the environmental factors that change as the depth increases (temperature, pressure, light). Students will test their theories on what will happen as you dive deeper in the ocean and describe different ocean exploration technology | In this activity students will get their hands wet as they learn about the environment of the deep ocean. The students will construct a pressure tower that will provide a visual representation of how pressure increases with depth. They will also learn about the different ocean zones and how temperature, pressure and light will change as you increase with depth. | Students complete group project on deep diving equipment, Class discussion of results after the experiment. |

| | | | | | |
|---------------|------------------------------|---|---|---|---|
| <i>Week 5</i> | How big is a humpback whale? | The biggest animal on Earth can survive by eating the smallest animal alive. How is this possible? | Students will be able to calculate the actual size of whales and other open ocean animals and identify the major features of a humpback whale | In this lesson students will predict the size of a whale and other ocean animals, then they will measure the actual size of a humpback whale outside. The students will predict how many students they think can fit inside a whale and then test their prediction. This is the first of four whale lessons which will take four classes to complete. | Completed “How big is a humpback whale?” Whale Research Notebook |
| <i>Week 6</i> | How do whales eat? | There are two major groups of cetaceans the baleen and the toothed whales. They each have unique feeding strategies. | Students will be able to identify the different types of whales and their feeding methods. Students will be able to test and compare different methods of feeding in the two groups of cetaceans (baleen versus toothed whales) and be able to understand the adaptations of whales (sensory system, buoyancy, communication) | Did you know the biggest animal alive survives by eating the smallest animal alive? A Humpback eats a ton of plankton (literally) to get the energy they need to grow, migrate, and reproduce. Students will learn about the two major groups of cetaceans (baleen and toothed whales) and experiment with the different feeding strategies. | Completed “How do whales eat?” in whale research notebook |
| <i>Week 7</i> | How do whales stay warm? | Blubber is a layer of fat that helps whales stay warm in cold waters. During the winter Humpback whales feed and store enough energy in their blubber so that they don’t even have to eat after they migrate from Alaska to Hawaii. | Students will be able to identify the biological benefits of having blubber Students conduct an experiment, collect data, measure and monitor water temperature Students will describe energy use and storage in whales | Why would a whale need six inches of fat? In this activity students will explore the importance of blubber and determine how whales use blubber to stay warm. They will design an experiment with “blubber” to test the benefits of having a layer of fat to keep warm as the whales migrate and live in the cold waters off Alaska. | Completed the “How do whales stay warm?” in whale research notebook |

| | | | | | |
|----------------|--|--|--|---|---|
| <i>Week 8</i> | Whale watching | Humpback whales display a variety of behavior and signs of communication such as signing and pec slaps. Scientists use specialized technology to observe the behavior and listen to the songs of the Humpback whales | Students will be able to observe and describe different types of humpback whale behavior. Students will be able to identify types of equipment use to observe and study humpback whale behavior | In this activity students will learn field techniques to observe Humpback whales and collect data on their behavior. In Hawaii, humpback whales can be seen November through April with peak viewing season in January or February. | Completed the whale watching page in the whale research notebook |
| <i>Week 9</i> | Ocean water chemistry and ocean acidification | Water chemists formulate a testable hypothesis and use appropriate techniques to collect data. One common water chemistry test measures pH (this will identify how acidic, neutral or basic the water sample is). | Students will be able to test the pH level of a water sample, compare acids and bases and understand the effect of pH level(s) on ocean life | This lesson is part of a series of water quality lessons that will explore the chemical properties of the ocean. Students will learn 3 different methods to test pH including visual color changes (using cabbage juice), pH test stripes and a hand held pH meter. | Completed lab worksheets, Formative assessment Can you think of anything in the ocean that might break down when the pH becomes more acidic? |
| <i>Week 10</i> | Native limu uses and identification (optional) | Algae is seaweed and seaweed is limu. Algae is an important part of the ocean food web and is also very important for medicine and nutrition in humans. | Students will be able to identify the three different classification groups of algae (chlorophyta, phaeophyta and rhodophyta), research the morphology (structure) and uses of the algae available | Not only do fish and turtles eat limu, humans do too! Did you eat your algae today? In this lesson students will learn about the various types of algae (or limu in Hawaiian) that are found in Hawaii. Additionally, students will research species in the three different groups of limu (red, green and brown). They will also learn about the native limu and uses such as for food and medicine. They will also learn about limu morphology and be able to draw and identify species from each group (red, green and brown). | Correct identification of different products containing algae Completion of the limu notebook |

| | | | | | |
|----------------|------------------------|---|---|--|--|
| <i>Week 11</i> | Fishing for the future | There are protective laws in the State of Hawaii that help prevent overfishing of ocean resources. As responsible members of society students can communicate through science and experience the importance of conserving ocean species for future generations. | Students will learn how to measure fish and invertebrates and be able to use the Hawaii state fishing regulations pamphlet to determine the legal sizes and bag limits of certain species. Students will be able to research an important ocean species to find out its common, scientific and Hawaiian names. Students will be able to explain the importance of marine protected areas (MPAs) and fishing regulations | Hawaii loves seafood! Ahi, opihi and limu are just some of the favorite seafood items that are caught, collected and gathered in Hawaiian waters of the Pacific Ocean. In this lesson students will learn how to follow the Hawaii State fishing regulations and methods on how to properly catch and measure important fish and invertebrate species. Before they can measure the organism they must be able to identify major body parts that will be measured for example: fish measurements are taken in fork lengths, this is the measurement from the tip of the fishes mouth to the fork in the inside of the tail. | Completed research poster Completed homework assignments #1 and #2 (optional) |
|----------------|------------------------|---|---|--|--|

Pre-Assessment Ocean Exploration – PRISM

6th Grade Marine Curriculum

NAME _____

TEACHER _____

1. List 5 things that humans use the ocean for: An example of a good answer is “To get food”, and an example of an answer that is not good is “ To go to the bathroom when you have an emergency”

1. _____
 2. _____
 3. _____
 4. _____
 5. _____
-

2. What happens to the pressure, temperature and light when you dive deeper in the ocean? Do they **increase** or **decrease** the deeper you go down? Circle (one)

| | | |
|--------------|-----------|-----------|
| Pressure: | Increases | Decreases |
| Temperature: | Increases | Decreases |
| Light: | Increases | Decreases |

3. Circle True or False for the following statements:

True or False The largest animal alive (whale) eats the smallest animal alive (plankton)

True or False There are two major groups of whales, toothed whales & baleen whales

True or False Humpback whales eat when they are in Hawaii.

4. Limu (seaweed) can be found in: (Circle the best answer)

- A. Ice Cream
 - B. Toothpaste
 - C. Whipped cream
 - D. Spam musubi/sushi
 - E. All of the above
-

5. What is a Marine Protected Area? (Circle the best answer)

- A. An area set aside for Marines
- B. A area with protective rules and regulations about fishing and collecting
- C. An area where no swimming is allowed
- D. An area with a lifeguard
- E. A whale sanctuary designed to protect marine mammals

6. Fill in the blanks below by using one of the liquids in the table:

| | |
|--------------|-------------|
| Soda | Soap |
| Orange Juice | Lemon juice |
| Ocean water | Tap Water |
| Bleach | Vinegar |

_____ is acidic (pH Less than 7, Hint: Acids can sting skin or taste sour)
_____ is neutral (a pH of 7, Hint: not a base or an acid, doesn't hurt skin)
_____ is basic (a pH greater than 7, Hint: opposite of an acid)

7. What effect do you think an acid will have on ocean life such as the shell of a crab?

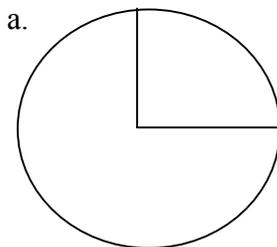
(Circle the best prediction)

- A.) Makes the shell dissolve
 - B.) Makes the shell grow
 - C.) No effect
 - D.) Makes the shell blue**
-

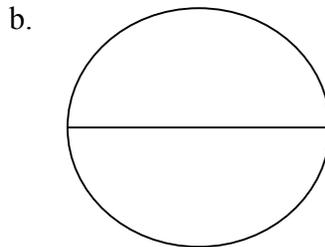
8. Put the following steps of the Scientific method in the correct order (1-6) write out the step

- 1. _____
 - 2. _____
 - 3. _____
 - 4. _____
 - 5. _____
 - 6. _____
- A. Analyze data
 - B. Choose a topic/subject to study
 - C. Form a hypothesis (testable prediction)
 - D. Present results
 - E. Collect data
 - F. Design and perform experiment
-

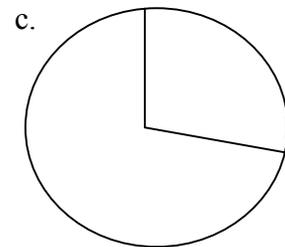
9. Select the circle that you think represents the percent of ocean that covers the Earth: & shade the region of the circle that represents the percent that the ocean covers the Earth



25%

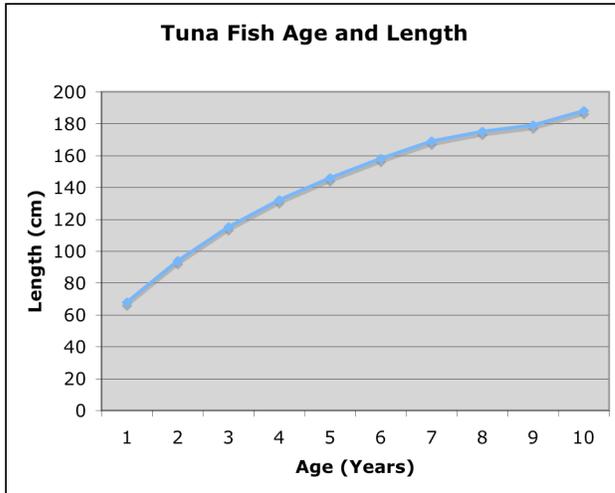


50%



70%

10. As a tuna fish grows bigger both the weight and length increases. Use this graph to answer the questions.



a.) About how long will the tuna be when is three years old? (Circle the best one)

- A. 85 cm
- B. 118 cm
- C. 130 cm
- D. 90 cm
- E. 175 cm

b.) If you catch a tuna that is 180 cm long. How old do you think it is? _____

11. Aquaculture is: (circle the best one)

- A. A way to grow plants in pots
 - B. A type of fishing
 - C. A culture based around water
 - D. A type of farming in water used to grow fish, shellfish and algae
 - E. The study of surfing
 - F. Other: _____
-

12. Which ocean animal do you think needs to eat more in order to get enough daily energy? (Circle the best one)

- A. A whale feeding on plankton
- OR
- B. A dolphin eating fish
-

13. List one way that you can determine your location when you are on a boat in the open ocean (Hint: this may be a type of equipment or use of technology)

14. Select the appropriate equipment that you would use to go the deepest in the ocean:
(Circle the best one)

- A. SCUBA
 - B. Remote Operated Vehicles
 - C. Submarine
 - D. Snorkel
-

15. Use the space below to draw yourself as marine biologist. Include at least 3 pieces of equipment that you will need to study the open ocean (Label any equipment)

Pre-Assessment Ocean Exploration – PRISM

6th Grade Marine Curriculum

NAME _____

TEACHER _____

1. List 5 things that humans use the ocean for: An example of a good answer is “To get food”, and an example of an answer that is not good is “ To go to the bathroom when you have an emergency” (5 points)

This question is meant to be an open answer question however there are acceptable answers and none acceptable answers (See example above) Listed are some possible good answers with great flexibility they might list a combination of all or get specific on one. All are allowed as long as they list 5 and those 5 are acceptable.

1. get food and resources _____
 2. transport goods _____
 3. recreational: to surf, swim, snorkel, kayak etc _____
 4. travel _____
 5. learn about the earth and the earths animals _____
-

2. What happens to the pressure, temperature and light when you dive deeper in the ocean? Do they **increase** or **decrease** the deeper you go down? Circle either increase or Decrease for each one. (3 points)

| | | |
|--------------|------------------|------------------|
| Pressure: | <u>Increases</u> | Decreases |
| Temperature: | Increases | <u>Decreases</u> |
| Light: | Increases | <u>Decreases</u> |

3. Circle True or False for the following statements: (3 points)

True or False The largest animal alive (whale) eats the smallest animal alive (plankton)

True or False There are two major groups of whales, toothed whales & baleen whales

True or False Humpback whales eat when they are in Hawaii.

4. Limu (seaweed) can be found in: (Circle the best answer) (1 point)

This could be difficult to grade because if they circle any of them they are right...but the corrent answer is all of the above. ***

- A. Ice Cream
 - B. Toothpaste
 - C. Whipped cream
 - D. Spam musubi/sushi
 - E. All of the above
-

5. What is a Marine Protected Area? (Circle the best answer) (1 point)

- A. An area set aside for Marines
 - B. A area with protective rules and regulations about fishing and collecting
 - C. An area where no swimming is allowed
 - D. An area with a lifeguard
 - E. A whale sanctuary designed to protect marine mammals
-

6. Fill in the blanks below by selecting one of the liquids in the table: (3 points)

| | |
|--------------|-------------|
| Soda | Soap |
| Orange Juice | Lemon juice |
| Ocean water | Tap Water |
| Bleach | Vinegar |

There are multiple answers to each, they only need to put one in the blank spot to get it correct. The possible answers are filled in:

Orange juice, lemon juice, Vinegar is acidic (pH Less than 7, Hint: Acids can sting skin or taste sour)

Tap water _____ is neutral (a pH of 7, Hint: not a base or an acid, doesn't hurt skin)

Ocean water and bleach _____ is basic (a pH greater than 7, Hint: opposite of an acid)

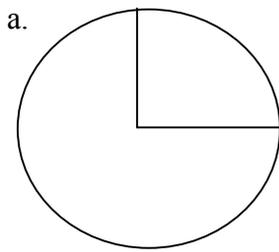
7. What effect do you think an acid will have on ocean life such as the shell of a crab? (Circle the best prediction) (1 point)

- A.) Makes the shell dissolve
 - B.) Makes the shell grow
 - C.) No effect
 - D.) Makes the shell blue
-

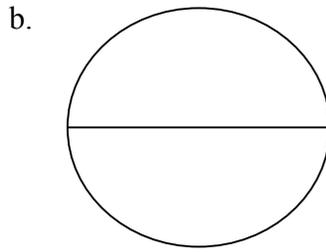
8. Put the following steps of the Scientific method in the correct order (1-6) write out the step (6 points) One point for the correct answer in the proper order

- 1. **B** Choose a topic/subject to study
 - 2. **C** Form a hypothesis
 - 3. **F** Design and perform experiment
 - 4. **E** Collect data _____
 - 5. **A** Analyze data _____
 - 6. **D** Present data _____
 - A. Analyze data
 - B. Choose a topic/subject to study
 - C. Form a hypothesis (testable prediction)
 - D. Present results
 - E. Collect data
 - F. Design and perform experiment
-

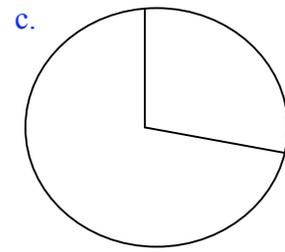
9. Select the circle that you think represents the percent of ocean that covers the Earth: & shade the region of the circle that represents the percent that the ocean covers the Earth (2 points) Did they select the right one? Did they shade the right portion?



25%

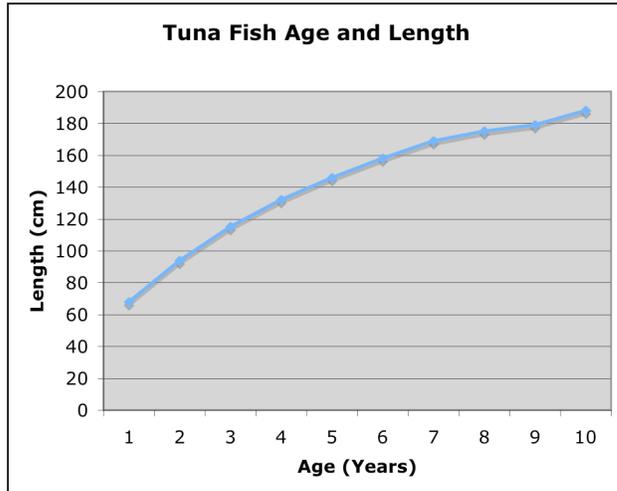


50%



70% should be shaded

10. As a tuna fish grows bigger both the weight and length increases. Use this graph to answer the questions. (2 points)



a.) About how long will the tuna be when is three years old? (Circle the best one)

- A. 85 cm
- B. 118 cm
- C. 130 cm
- D. 90 cm
- E. 175 cm

b.) If you catch a tuna that is 180 cm long. How old do you think it is? 9 years old

11. Aquaculture is: (circle the best one) (1 point)

- A. A way to grow plants in pots
- B. A type of fishing
- C. A culture based around water

- D. A type of farming in water used to grow fish, shellfish and algae
 - E. The study of surfing
 - F. Other: _____
-

12. Which ocean animal do you think needs to eat more in order to get enough daily energy? (Circle the best one) (1 point)

- A. A whale feeding on plankton

OR

- B. A dolphin eating fish

13. List one way that you can determine your location when you are on a boat in the open ocean (Hint: this may be a type of equipment or use of technology) (1 point)

14. Select the appropriate equipment that you would use to go the deepest in the ocean: (Circle the best one) (1 point)

- A. SCUBA
- B. Remote Operated Vehicles
- C. Submarine
- D. Snorkel

15. Use the space below to draw yourself as marine biologist. Include at least 3 pieces of equipment that you will need to study the open ocean (Label any equipment) (4 points) (1 point for drawing a marine biologist and 3 points for the equipment)

The pre-assessment is 35 points total.
I am not sure how to grade #4 because most of them will know and circle that limu is in a spam musubi or sushi but the answer I am looking for is all of the above! HELP PLEASE! ☺

The Scientific Method

