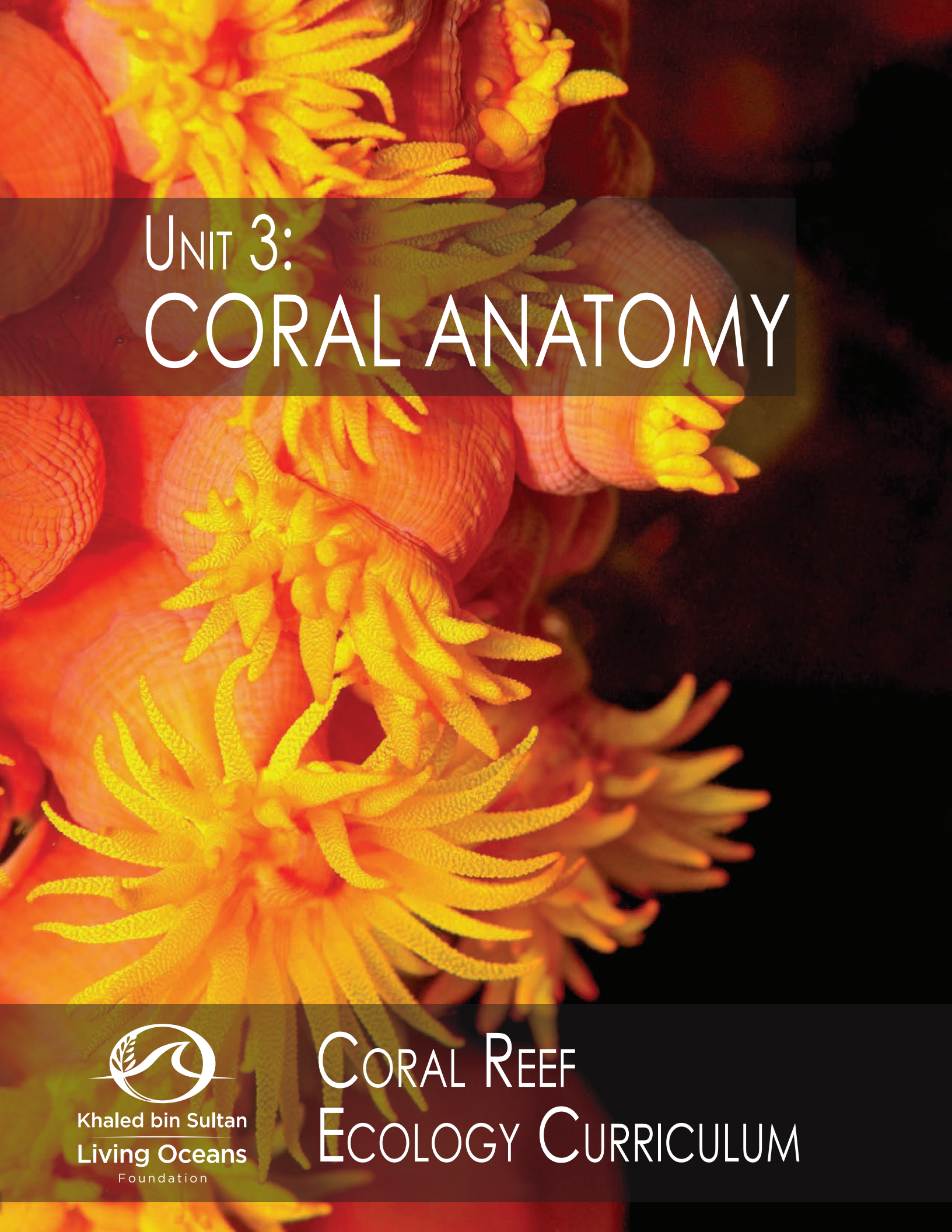

Unit 3:
Coral Anatomy

Khaled bin Sultan Living Oceans Foundation

Coral Reef Ecology Curriculum

Khaled bin Sultan
Living Oceans
Foundation

This unit is part of the *Coral Reef Ecology Curriculum* that was developed by the Education Department of the Khaled bin Sultan Living Oceans Foundation. It has been designed for secondary school students, but can be adapted for other uses. The entire curriculum can be found online at *lof.org/CoralReefCurriculum.*

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The Khaled bin Sultan Living Oceans Foundation (KSLOF) was incorporated in California as a 501(c)(3), public benefit, Private Operating Foundation in September 2000. The Living Oceans Foundation is dedicated to providing science-based solutions to protect and restore ocean health through research, outreach, and education. The educational goals of the Khaled bin Sultan Living Oceans Foundation and development of the *Coral Reef Ecology Curriculum* are generously supported by Prince Khaled bin Sultan of Saudi Arabia. For more information, visit *www.lof.org*.

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SCIENCE WITHOUT BORDERS®

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KEYWORDS

- Aboral
- Anatomy
- Basal Disk
- Basal Plate
- Calcium Carbonate ($CaCO_3$)
- Cnidaria
- Coenosarc
- Corallite
- Eco-art
- Ectodermis
- Endoderm
- Form Fits Function
- Gastrodermis
- Gastrovascular Canals (plural)
- Gastrovascular Cavity
- Invertebrate
- Medusa
- Mesenteries (plural)
- Mesoglea
- Mouth
- Mucus (coral)
- Nematocyst
- Oral
- Oral Disk
- Polyp
- Septa (plural)
- Sessile
- Tentacles (Cnidaria; plural)
- Zooxanthellae

CORAL ANATOMY

This unit explains some of the characteristics and structures of corals, and how they function.

STANDARDS

- **CCSS**: RST.9-10.2, 4, 5, 7, 8, 9, 10; RST.11-12.2, 4, 8, 10; SL.9-10.4; SL.11-12.4
- **NGSS**: HS-LS1-1
- **OLP**: 5.C.22

MULTIMEDIA RESOURCES

- *What are Corals?* YouTube video (*https://youtu.be/Bn2xkIJhte4*)
- *Form Fits Function* YouTube video (*https://youtu.be/oDDaVcTh8ZQ)*
- *Coral Polyp* interactive is located at the bottom of the *Coral Anatomy* tab (*http://www.lof.org/education/portal/course/coral-anatomy/*).

LEARNING OBJECTIVES

- Define anatomy.
- Review the organisms that are in the Phylum Cnidaria.
- Define invertebrate.
- Recall the body forms of organisms in the Phylum Cnidaria.
- Explore the anatomical structures of a coral polyp using an online interactive.
- Define and be able to cite examples of form fits function.

UNIT PROCEDURE

1. Show *What are Corals?* YouTube video.
   a. Complete **Watch It! What are Corals?** student worksheet.
2. Teach *Background Information* section *A) Coral Anatomy.*
   a. Complete **Lesson 1A: Interactive Coral Polyp** student worksheet using the online *Coral Polyp* interactive.
   b. Complete **Lesson 1B: Fitting the Function** and **Lesson 1C: Coral Anatomy Quiz** student worksheets.
   c. Complete **Lesson 2: Coral Polyp Eco-Art** student worksheet.
3. Show *Form Fits Function* YouTube video.
   a. Complete **Watch It! Form Fits Function** student worksheet.
4. Teach *Background Information* section *B) Form Fits Function*.
   a. Complete **Lesson 3: Form Fits Function** student worksheet.
5. Teach students how to read and critique blogs.
   a. Complete **Read It! Swimming Among Soft Corals** student worksheet.
6. Evaluate students using **Unit 3: Coral Anatomy Quiz** (found online at *www.lof.org/education/portal/quiz/coral-anatomy-assessment-1/*).
   NOTE: User must be logged in.

BACKGROUND INFORMATION

A) CORAL ANATOMY

All living things have a specific anatomy. **Anatomy** stems from the Greek words:

ana	***tomia***
up	cutting

Anatomy means to *cut up*. The word is defined as the study of the body including cells, tissue, organs, and systems. In order to study body structures, one must *cut up* the organism.

In this unit, we are going to learn about some of the characteristics and structures of corals, and how they function.

We have discovered that corals are animals that reside in the Phylum **Cnidaria**. They are considered invertebrates. What is an **invertebrate**? Invertebrates are animals that do not have a spinal column or backbone.

In *Unit 2: Classification*, we learned that organisms in the Phylum Cnidaria can have one of two body forms: **medusa** or **polyp**. Corals have a polyp body form (figure 3-1). Often coral polyps live in colonies where there are hundreds to thousands of polyps present. However, there are solitary corals as well.

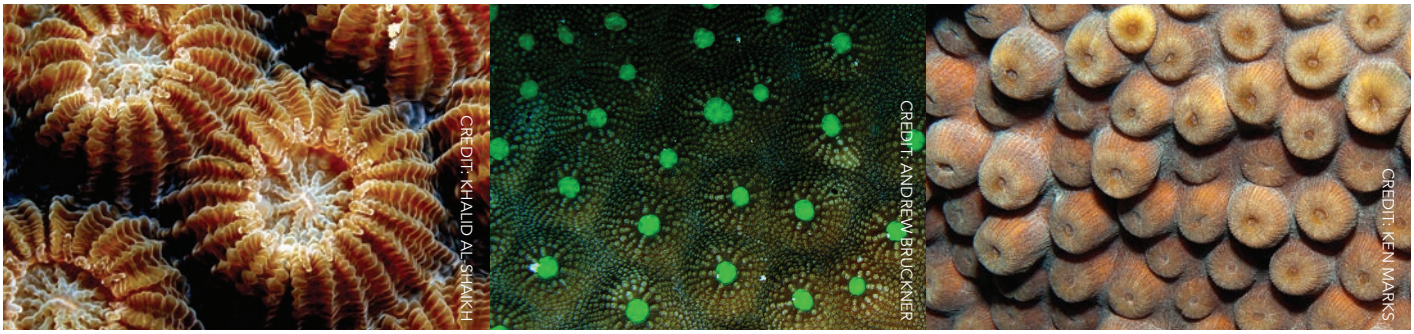

FIGURE 3-1. Photos of different colonial coral polyps where each *circle* is an individual animal.

Let's take a look at a mushroom coral (figure 3-2a). This coral is one giant polyp that can grow up to 20 inches (50 centimeters) or more in diameter. Now let's look at a brain coral (figure 3-2b). There are thousands of colonial polyps on this one coral. Each polyp may range from just millimeters in size to around 4 inches (10 centimeters) in diameter. Needless to say, in any given coral, polyps come in different quantities and sizes.

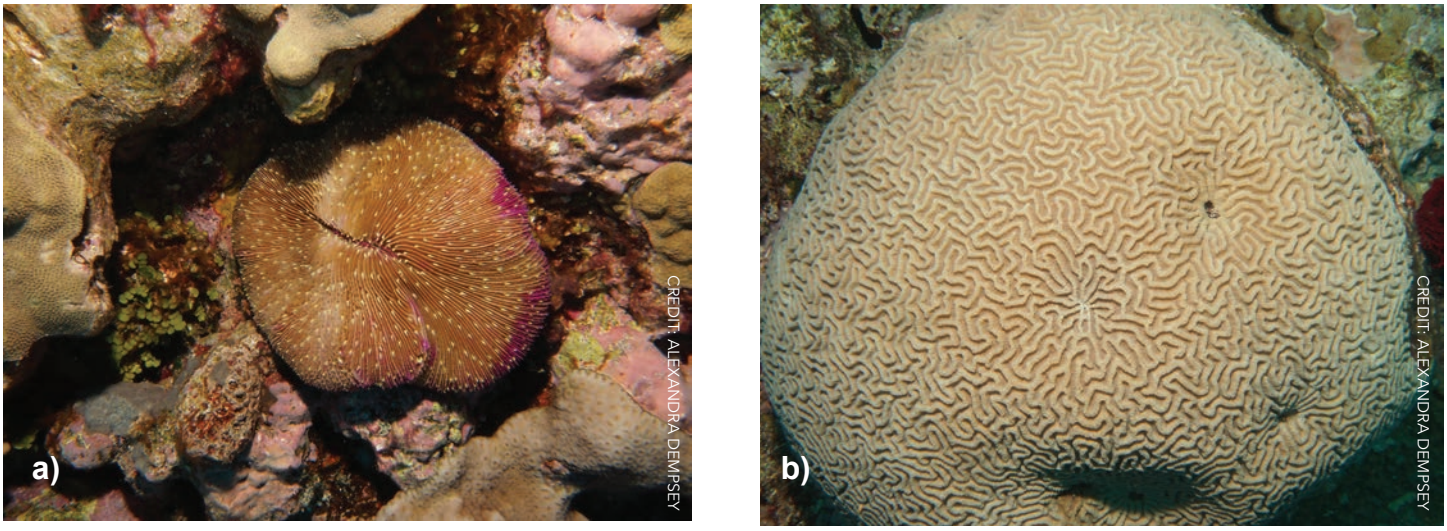

FIGURE 3-2. a) Solitary mushroom coral; b) Colonial brain coral containing hundreds of coral polyps

Use the *Coral Polyp* interactive program to learn and explore more about the anatomy of a stony coral polyp. You can find the interactive at the bottom of the *Coral Anatomy* tab at: http://www.lof.org/education/portal/course/coral-anatomy/.

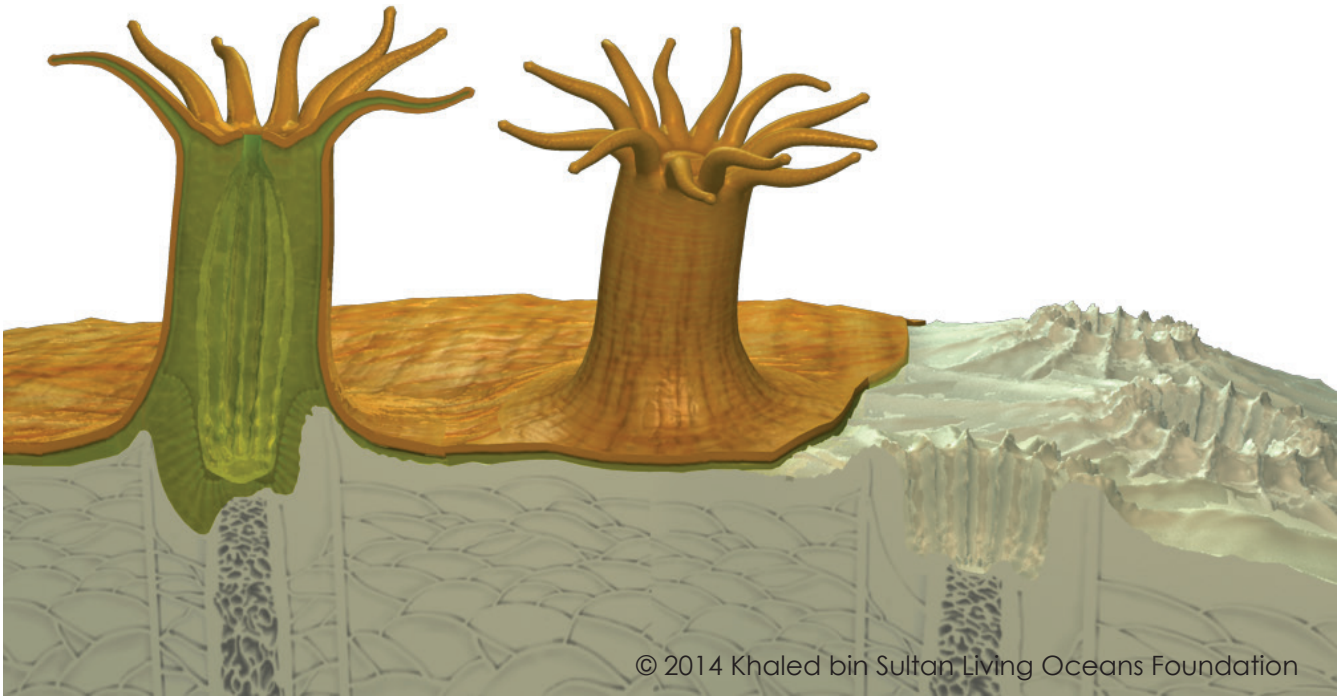

FIGURE 3-3. *Coral Polyp* interactive

B) FORM FITS FUNCTION

Have you ever heard of form fits function? It means that organisms and/or their structures are designed to perform a particular function(s). Let's take a closer look at a coral polyp. Most corals are sessile meaning they can't move, so they can't actively travel to find prey. Do you think it's appropriate that **tentacles** fit the saying form fits function?

The answer is yes. Unless a coral polyp has an elastic, expandable **mouth**, it's not going to be able to use its tiny mouth to catch prey without its tentacles.

Let's look at another example. Describe the teeth and mouth of a great white shark. Large, serrated, sharp teeth arranged in multiple rows, and a large expandable jaw, right? This must be good for eating seaweed. WRONG! Great white sharks have all those large, serrated, sharp teeth to consume large marine mammals and fish. They are large fish and they need a lot of energy to survive. Seaweed isn't going to cut it for these guys. Just like corals, the mouth on a great white shark follows *form fits function*.

FIGURE 3-4. Great white shark jaw with serrated teeth

ATTRIBUTION

Figure 3-4. By Bone Clones (Bone Clones) [CC BY-SA 3.0 (*http://creativecommons.org/licenses/by-sa/3.0*)], 18 November 2014 via Wikimedia Commons. *https://commons.wikimedia.org/wiki/File%3ABC-095-Great-White-Jaw-r2-Lo.jpg*.

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WATCH IT! What are Corals?

INSTRUCTIONS: Watch *What are Corals?* YouTube video (https://youtu.be/Bn2xkIJhte4) and answer the following questions.

1. Are corals animals? _____

2. What are stony corals?

_____

_____

3. What is the function of being *stony*?

_____

_____

4. What is an individual coral called? _____

5. What structure allows corals to feed? _____

6. What is the structure called that exists in the coral's tentacles and aids in feeding?

_____

7. What do corals eat?

_____

_____

8. Are all corals colonial? If not, provide an example to support your answer.

_____

_____

9. What is the anatomical structure that allows corals to share nutrients?

_____

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WATCH IT! What are corals?

VIDEO TRANSCRIPT:

Corals are animals.

Stony corals are the kind that build coral reefs.

A reef is made in part of calcium carbonate, or limestone, secreted by the corals' bodies.

Every coral has a cup-shaped skeleton, which it sits on top while it's alive.

After it dies, its skeleton adds to the structure of the coral reef.

An individual coral's body, called a polyp, is mostly stomach with a mouth on top.

Its hungry mouth is ringed by tentacles.

And these aren't just any tentacles.

They're lined with stinging cells, some filled with venom, neurotoxins that paralyze their prey.

On the menu for corals are microscopic plankton, tiny fish, and everything in between.

Some, like mushroom coral, live alone and can grow up to 50 centimeters across.

Others, like brain coral, thrive in colonies of thousands of polyps, each measuring up to 10 centimeters in diameter.

Each coral polyp is an animal, but to survive they work like one big organism.

Some species' stomachs are connected by a special tissue called coenosarc, which allows them to share nutrients.

But it's the corals' durable skeletons that holds the colony together in all but the most turbulent seas.

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WATCH IT! What are Corals?

INSTRUCTIONS: Watch *What are Corals?* YouTube video (https://youtu.be/Bn2xklJhte4) and answer the following questions.

1. Are corals animals? **Yes**

2. What are stony corals?

   Corals that build reefs by secreting calcium carbonate or limestone.

3. What is the function of being *stony*?

   Coral polyps sit on top of the stony calcium carbonate layer and when it dies, the calcium carbonate skeleton adds to the structure of the reef.

4. What is an individual coral called? **Polyp**

5. What structure allows corals to feed? **Tentacles**

6. What is the structure called that exists in the coral's tentacles and aids in feeding?

   Nematocysts

7. What do corals eat?

   Corals eat microscopic plankton and tiny fish.

8. Are all corals colonial? If not, provide an example to support your answer.

   No, mushroom corals are an example of corals that are individual polyps that do not form colonies.

9. What is the anatomical structure that allows corals to share nutrients?

   Coenosarc

Name: _____ Date: _____

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WATCH IT! FORM FITS FUNCTION

INSTRUCTIONS: Watch *Form Fits Function* YouTube video (*https://youtu.be/oDDaVcTh8ZQ*) and answer the following questions.

1. In your own words, define form fits function.

_____

_____

_____

2. Give two examples of form fits function from the video.

a. _____

_____

_____

b. _____

_____

_____

3. Give two of your own examples of form fits function.

a. _____

_____

_____

b. _____

_____

_____

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WATCH IT! FORM FITS FUNCTION

VIDEO TRANSCRIPT:

Ever heard the phrase “form fits function?” It’s when the shape of something is designed for the job it’s supposed to do.

When applied to sea creatures, it means their body parts are a good match for their role in the animal’s survival.

Take a coral polyp for instance.

Most corals are sessile. That means they cannot move, so they can’t chase after food.

But they still need to eat.

That’s where tentacles come in.

Tentacles extend the coral polyps’ reach and catch food drifting by in the current.

Their form “fits” their function.

Sea lions are marine mammals whose ancestors lived on land.

Instead of feet, they have flippers, appendages perfectly adapted for life in the water.

Front flippers help propel and steer, while back flippers act as stabilizers.

Claws on the front flippers help make this creature truly amphibious, at home on land too.

In the sea lion’s perfect appendages, form fits many functions.

Now one more example, what marine animal is famous for its fearsome rows of serrated teeth on an expandable jaw?

No, not a clownfish, a great white shark.

A great white’s teeth are precision tools for ripping and cutting the flesh of large mammals and fish.

Sharks can’t chew, so expandable jaws mean they can swallow big bites of their prey.

And the more bites the better because large animals like great whites need lots of energy to survive.

Every part of the animal’s mighty mouth is adapted for its flesh-consuming job.

Its form perfectly fits its function.

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WATCH IT! FORM FITS FUNCTION

INSTRUCTIONS: Watch *Form Fits Function* YouTube video (*https://youtu.be/oDDaVcTh8ZQ*) and answer the following questions.

1. In your own words, define form fits function.

   Form fits function is when an organism's structure(s) are designed to perform a particular function(s).

2. Give two examples of form fits function from the video.

   a. **Corals can't move; however, tentacles (form) allow for corals to capture food (function).**

   b. **Sea lions have flippers (form). Front flippers help propel and steer sea lions through the water (functions).**

   c. **Great white sharks have multiple rows of serrated teeth (form), which helps them to rip and cut the flesh of their prey (functions).**

3. Give two of your own examples of form fits function. Answers may vary.

   a. **Octopi have a tube-like structure called a siphon (form). They push water through their siphon to propel them through the water (function).**

   b. **Lionfish have venomous spines (form) that are used to defend (function) themselves when threatened by predators.**

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LESSON 1 TEACHER'S NOTES

AUTHOR

- Amy Heemsoth, Khaled bin Sultan Living Oceans Foundation

LEARNING OBJECTIVES

- Learn the structures of the coral polyp and corresponding function(s).
- Label the anatomical structures of a coral polyp.

KEYWORDS

- Aboral
- Anatomy
- Basal Disk
- Basal Plate
- Calcium Carbonate ($CaCO_3$)
- Coenosarc
- Corallite
- Ectodermis
- Endoderm
- Gastrodermis
- Gastrovascular Canals
- Gastrovascular Cavity
- Mesenteries
- Mesoglea
- Mouth
- Mucus
- Nematocyst
- Oral
- Oral Disk
- Polyp
- Septa
- Tentacles
- Zooxanthellae

MATERIALS

- Computer or electronic device
- Internet
- **Watch It! What are Corals?** student worksheet
- **Lesson 1A: Interactive Coral Polyp** student worksheet
- **Lesson 1B: Fitting the Function** student worksheet
- **Lesson 1C: Coral Anatomy Quiz** student worksheet
- *Coral Polyp* interactive *http://www.lof.org/education/portal/course/coral-anatomy/*

EVALUATION

- Matching quiz provided.

STANDARDS

- CCSS: RST.9-10.4, 5; RST.11-12.4
- NGSS: HS-LS1-1
- OLP: 5.C.22

PROCEDURE

1. Watch *What are Corals?* YouTube video (*https://youtu.be/Bn2xkIJhte4*) and answer questions on **Watch It! What are Corals?** student worksheet.
2. Teach *Unit 3: Coral Anatomy - Background Information*.
3. Students will need to have access to a computer or electronic device. Hand out **Lesson 1A: Interactive Coral Polyp** student worksheet.
4. Direct students to go the *Coral Polyp* interactive at *http://www.lof.org/education/portal/course/coral-anatomy/.*
5. Explain the terms aboral and oral to students. The definitions can be found in the Glossary.
6. On the computer, have students explore the different anatomical structures and functions of a coral polyp.
7. Go over the instructions on the **Lesson 1A: Interactive Coral Polyp** student worksheet.
8. Ask students to complete **Lesson 1B: Fitting the Function** crossword puzzle. Students will determine the word that is described by its function(s).
9. Assess students' knowledge of the structures and functions of a coral polyp with **Lesson 1C: Coral Anatomy Quiz**.

Name: _____ Date: _____

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LESSON 1A

INTERACTIVE CORAL POLYP

OBJECTIVES:

- Learn the structures of a coral polyp and the corresponding function(s).
- Label the anatomical structures of a coral polyp.

MATERIALS:

- Computer with internet connection

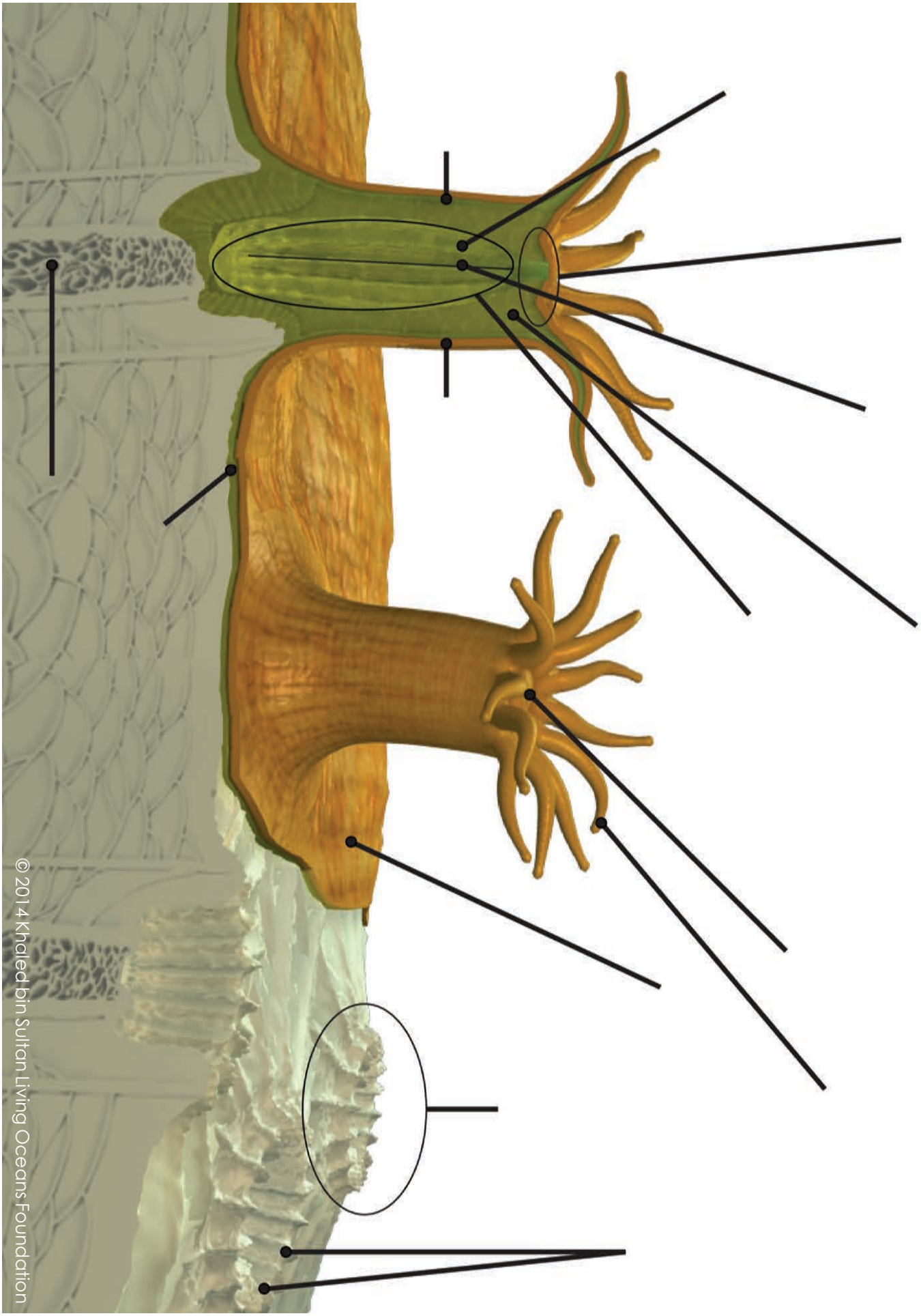
INSTRUCTIONS:

1. Go to the *Coral Polyp* interactive at the bottom of the *Coral Anatomy* tab at: *http://www.lof.org/education/portal/course/coral-anatomy/*.
2. Label the coral polyp below to represent the oral and aboral areas.
3. Write the function of each of the coral polyp's structures.
4. Fill in *Diagram 1* with the coral polyp's anatomical terms that are listed in the table below. The only one that will not be used is mucus.

Structure	Function(s)
Basal Disk or Plate	
Coenosarc	
Corallite	
Ectodermis	

Structure	Function(s)
Endoderm	
Gastrodermis	
Gastrovascular Canals	
Gastrovascular Cavity	
Mesenteries	
Mesoglea	
Mouth	
Mucus	
Nematocysts	
Oral Disk	
Septa	
Tentacles	

DIAGRAM 1:



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LESSON 1A

INTERACTIVE CORAL POLYP

OBJECTIVES:

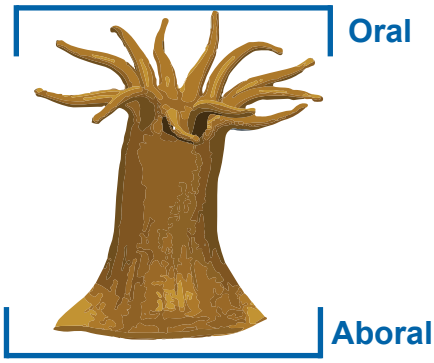
- Learn the structures of a coral polyp and the corresponding function(s).
- Label the anatomical structures of a coral polyp.

MATERIALS:

- Computer with internet connection

INSTRUCTIONS:

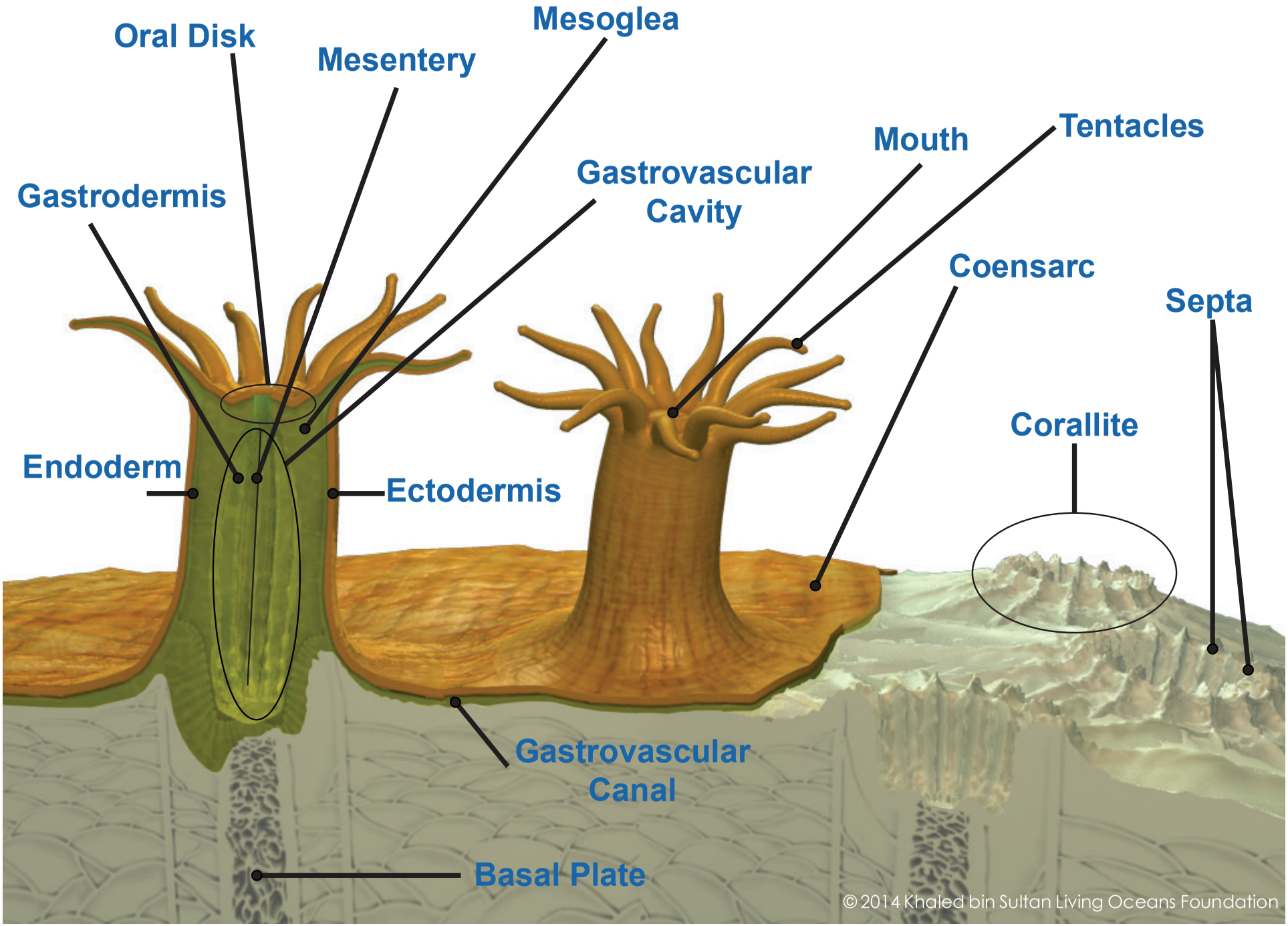
1. Go to the *Coral Polyp* interactive at the bottom of the *Coral Anatomy* tab at: http://www.lof.org/education/portal/course/coral-anatomy/.
2. Label the coral polyp below to represent the oral and aboral areas.
3. Write the function for each of the coral polyp's structures.
4. Fill in *Diagram 1* with the coral polyp's anatomical terms that are listed in the table below. The only one that will not be used is mucus.



Structure	Function(s)
Basal Disk or Plate	**Allows coral to anchor to a substrate and secrete more calcium carbonate, allowing them to grow.**
Coenosarc	**The tissue that connects colonial coral polyps that contains structures that allow corals to share nutrients.**
Corallite	**The structure that holds an individual coral polyp in place allowing for stability.**
Ectodermis	**The outer cell layer that houses nematocysts and secretes mucus.**

Structure	Function(s)
Endoderm	The inner cell layer that houses zooxanthellae.
Gastrodermis	Inner layer of cells that lines the gastrovascular cavity absorbing nutrients, excreting mucus and waste, and allowing for gas exchange and reproduction.
Gastrovascular Canals	Allows polyps to share nutrients and zooxanthellae.
Gastrovascular Cavity	The area that supports the stomach, absorbs nutrients, excretes mucus and waste, and allows for gas exchange and reproduction.
Mesenteries	Allow the stomach to expand and contain reproductive cells.
Mesoglea	Helps maintain the form of the polyp corals.
Mouth	Takes in food and expels waste.
Mucus	Aids in food capture, protection, and removal of sediment and waste.
Nematocysts	Specialized stinging cells located in the ectodermis that aid in predation.
Oral Disk	Soft tissue that supports the mouth and tentacles.
Septa	Support the inner folds of the mesenteries.
Tentacles	Feeding mechanism that surrounds the oral disk and aids in capturing prey.

DIAGRAM 1:



Name: _____ Date: _____

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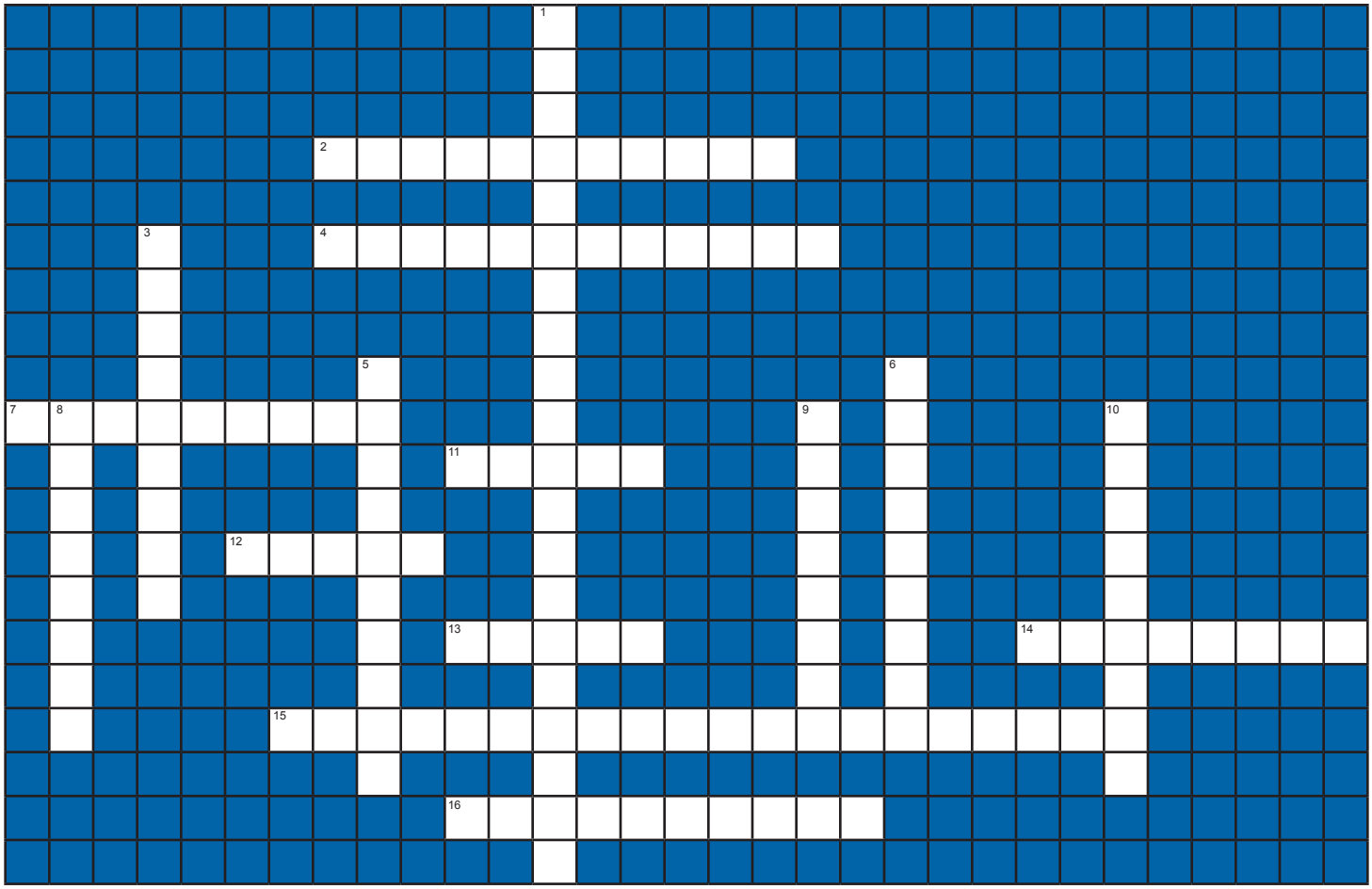
LESSON 1B

FITTING THE FUNCTION

INSTRUCTIONS: Fill in the crossword puzzle using the clues below. You will match the correct coral structure with the function it performs.



ACROSS

2. Allow the stomach to expand and house the reproductive cells.
4. The inner layer derived from the endodermthat lines the gastrovascular cavity absorbing nutrients, excreting mucus and waste, and allowing for gas exchange and reproduction.
7. The structure that holds an individual coral polyp in place allowing for stability. It is sometimes referred to as the cuplike skeleton.
11. Located at the center of the oral disk and expels waste and takes in food.
12. Support the inner folds of the mesenteries.
13. A gelatinous substance that is used to aid in food capture, protection, and remove sediment and waste.
14. The inner layer of cells that houses zooxanthellae.
15. Located in the coenosarc allowing polyps to share nutrients and zooxanthellae.
16. The outer cell layer that houses nematocysts and secretes mucus.

DOWN

1. The area that supports the stomach, absorbs nutrients, excretes mucus and waste, and allows for gas exchange and reproduction.
3. Feeding mechanism that surrounds the oral disk.
5. Specialized stinging cells located in the ectodermis that aid in predation.
6. The tissue that connects colonial coral polyps that contains structures that allow corals to share nutrients.
8. Soft tissue that supports the mouth and tentacles.
9. The jelly-like substance in between the ectodermis and gastrodermis that helps maintain the form of the polyp.
10. Allows coral to anchor to a substrate and secrete more calcium carbonate allowing them to grow.

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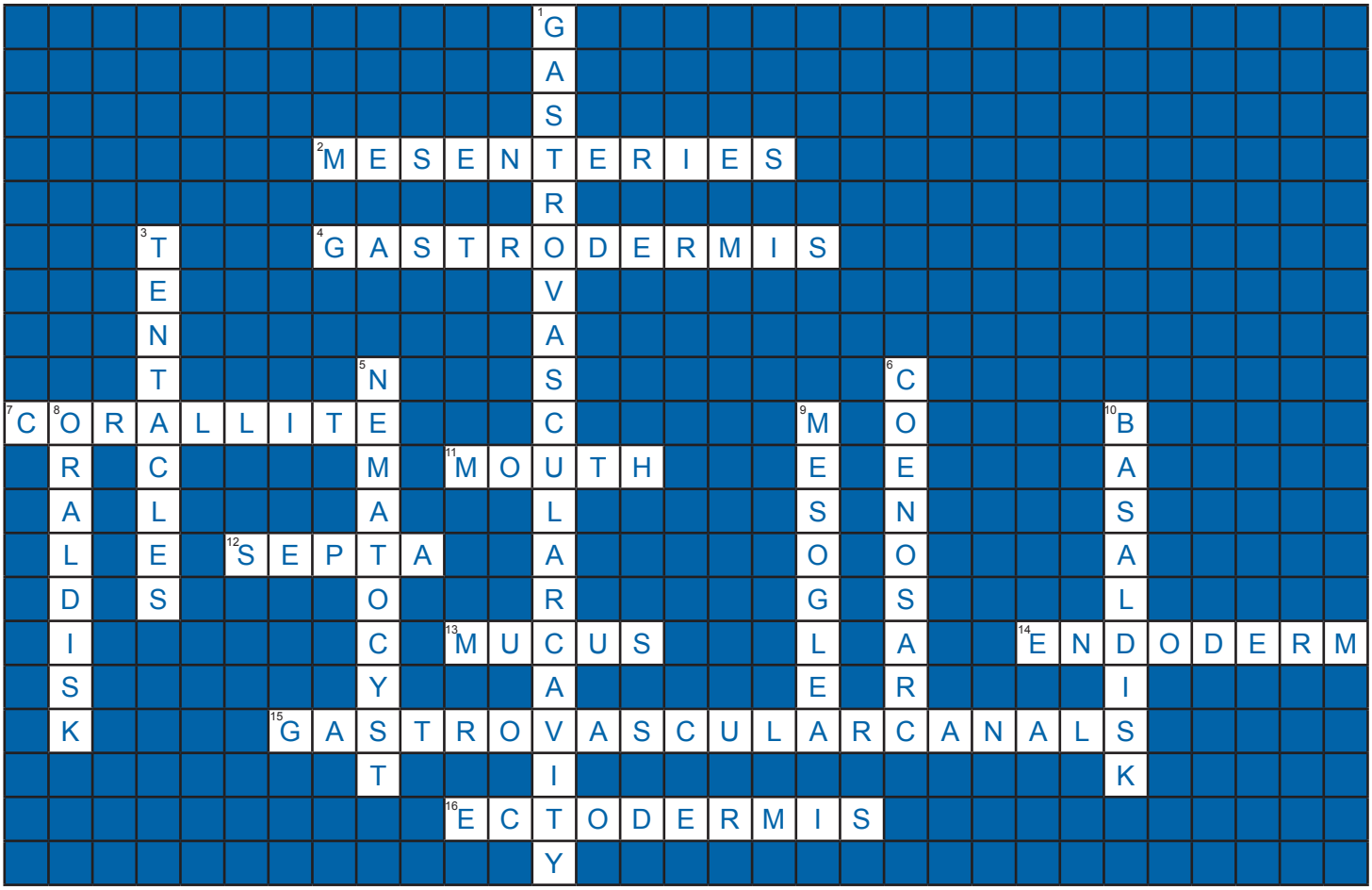
LESSON 1B

FITTING THE FUNCTION

INSTRUCTIONS: Fill in the crossword puzzle using the clues below. You will match the correct coral structure with the function it performs.



ACROSS

2. Allow the stomach to expand and house the reproductive cells.
4. The inner layer derived from the endodermthat lines the gastrovascular cavity absorbing nutrients, excreting mucus and waste, and allowing for gas exchange and reproduction.
7. The structure that holds an individual coral polyp in place allowing for stability. It is sometimes referred to as the cuplike skeleton.
11. Located at the center of the oral disk and expels waste and takes in food.
12. Support the inner folds of the mesenteries.
13. A gelatinous substance that is used to aid in food capture, protection, and remove sediment and waste.
14. The inner layer of cells that houses zooxanthellae.
15. Located in the coenosarc allowing polyps to share nutrients and zooxanthellae.
16. The outer cell layer that houses nematocysts and secretes mucus.

DOWN

1. The area that supports the stomach, absorbs nutrients, excretes mucus and waste, and allows for gas exchange and reproduction.
3. Feeding mechanism that surrounds the oral disk.
5. Specialized stinging cells located in the ectodermis that aid in predation.
6. The tissue that connects colonial coral polyps that contains structures that allow corals to share nutrients.
8. Soft tissue that supports the mouth and tentacles.
9. The jelly-like substance in between the ectodermis and gastrodermis that helps maintain the form of the polyp.
10. Allows coral to anchor to a substrate and secrete more calcium carbonate allowing them to grow.

Name: _____ Date: _____

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LESSON 1C

CORAL ANATOMY QUIZ

INSTRUCTIONS: Match the following coral structures to the correct description and function(s) that it performs. Each term will only be used once.

A. Basal Disk or Plate

B. Coenosarc

C. Corallite

D. Ectodermis

E. Endoderm

F. Gastrodermis

G. Gastrovascular Canals

H. Gastrovascular Cavity

I. Mesenteries

J. Mesoglea

K. Mouth

L. Mucus

M. Nematocysts

N. Oral Disk

O. Septa

P. Tentacles

_____ A gelatinous substance that is used to aid in food capture, protection, and remove sediment and waste.

_____ Allow the stomach to expand and house the reproductive cells.

_____ Allows coral to anchor to a substrate and secrete more calcium carbonate, allowing them to grow.

_____ Feeding mechanism that surrounds the oral disk and aids in capturing prey.

_____ Inner layer of cells that lines the gastrovascular cavity absorbing nutrients, excreting mucus and waste, and allowing for gas exchange and reproduction.

_____ Located at the center of the oral disk and expels waste and injects food.

_____ Located in the coenosarc, allowing polyps to share nutrients and zooxanthellae.

_____ Soft tissue that supports the mouth and tentacles.

_____ Specialized stinging cells located in the ectodermis that aid in predation.

_____ Support the inner folds of the mesenteries.

_____ The area that supports the stomach, absorbs nutrients, excretes mucus and waste, and allows for gas exchange and reproduction.

_____ The inner cell layer that houses zooxanthellae.

_____ The jelly-like substance in between the ectodermis and gastrodermis that helps maintain the form of animals.

_____ The outer cell layer that houses nematocysts and secretes mucous.

_____ The structure that holds an individual coral polyp in place allowing for stability. It is sometimes referred to as the cuplike skeleton.

_____ The tissue that connects colonial coral polyps and allows corals to share nutrients.

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LESSON 1C

CORAL ANATOMY QUIZ

INSTRUCTIONS: Match the following coral structures to the correct descriptions and function(s) that it performs. Each term will only be used once.

A. Basal Disk or Plate

B. Coenosarc

C. Corallite

D. Ectodermis

E. Endoderm

F. Gastrodermis

G. Gastrovascular Canals

H. Gastrovascular Cavity

I. Mesenteries

J. Mesoglea

K. Mouth

L. Mucus

M. Nematocysts

N. Oral Disk

O. Septa

P. Tentacles

L — A gelatinous substance that is used to aid in food capture, protection, and remove sediment and waste.

I — Allow the stomach to expand and house the reproductive cells.

A — Allows coral to anchor to a substrate and secrete more calcium carbonate, allowing them to grow.

P — Feeding mechanism that surrounds the oral disk and aids in capturing prey.

F — Inner layer of cells that lines the gastrovascular cavity absorbing nutrients, excreting mucus and waste, and allowing for gas exchange and reproduction.

K — Located at the center of the oral disk and expels waste and injects food.

G — Located in the coenosarc, allowing polyps to share nutrients and zooxanthellae.

N — Soft tissue that supports the mouth and tentacles.

M — Specialized stinging cells located in the ectodermis that aid in predation.

O — Support the inner folds of the mesenteries.

H — The area that supports the stomach, absorbs nutrients, excretes mucus and waste, and allows for gas exchange and reproduction.

E — The inner cell layer that houses zooxanthellae.

J — The jelly-like substance in between the ectodermis and gastrodermis that helps maintain the form of animals.

D — The outer cell layer that houses nematocysts and secretes mucous.

C — The structure that holds an individual coral polyp in place allowing for stability. It is sometimes referred to as the cuplike skeleton.

B — The tissue that connects colonial coral polyps and allows corals to share nutrients.

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LESSON 2 TEACHER'S NOTES

AUTHOR

- Amy Heemsoth, Khaled bin Sultan Living Oceans Foundation

LEARNING OBJECTIVES

- In your own words describe eco-art.
- Demonstrate understanding of coral polyp anatomy.
- Design and build a coral polyp using recyclable materials.

KEYWORDS

- Anatomy
- Basal Plate
- Corallite
- Eco-art
- Ectodermis
- Mouth
- Nematocyst
- Oral Disk
- Polyp
- Tentacles

MATERIALS

- Recyclable materials
- Scissors
- Glue, tape, and/or clay
- Sticky notes
- **Watch It! What are Corals?** student worksheet
- **Lesson 2: Coral Polyp Eco-art** student worksheet

INTEGRATING SUBJECTS

- Art

EXTENSION

- Complete *Unit 4: Coral Feeding* **Lesson 2: Round and Round**.

EVALUATION

- See *Grading Worksheet* for activity evaluation.

STANDARDS

- CCSS: RST.9-10.4, 5, 7, 10; RST.11-12.4
- NGSS: HS-LS1-1
- OLP: 5.C.22

PROCEDURE

1. Watch *What are Corals?* YouTube video (https://youtu.be/Bn2xkIJhte4) and answer questions on **Watch It! What are Corals?** student worksheet.
2. Teach *Background Information* section *A) Coral Anatomy*.
3. Provide students with **Lesson 2: Coral Polyp Eco-art** worksheet and grading rubric.
4. Review *Additional Background Information* on the student worksheet.
5. Discuss the importance of recycling.
6. Discuss different types of eco-art. Give examples.
7. Go over the procedure located on the student worksheet.
8. Review the *Grading Worksheet* with students.
9. After completing the activity, you may want to have students recycle their art work. Students can learn how to sort different types of recyclables.

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LESSON 2 CORAL POLYP ECO-ART

OBJECTIVES:

- In your own words describe eco-art.
- Demonstrate understanding of coral polyp anatomy.
- Design and build a coral polyp using recyclable materials.

MATERIALS:

- Recyclable materials
- Scissors
- Sticky notes

ADDITIONAL BACKGROUND INFORMATION:

What is eco-art? **Eco-art** stands for ecological art. There is no one definition for eco-art. Generally, it's artwork that expresses conservation and education about the environment and helps propose new ways of people co-existing with nature. It can also reveal the environmental problems that we face. Artists use a large range of materials such as found, discarded, recycled, and natural materials.

INSTRUCTIONS:

You just learned about the structures and functions of a coral polyp. This activity will allow you to design and build your own coral polyp out of recyclable materials. Here are the rules:

- You may only construct your coral polyp out of recycled materials. Recyclable materials can include: metal, plastic, glass, paper, cardboard, and Styrofoam.
- You may use glue, tape, clay, or other non-recyclable materials to hold the structures of the coral polyp together.
- You must use a different type of material for each structure.
- Lastly, label the different structures of your coral polyp using sticky notes.

Before you get started, see *Grading Worksheet* for specifications.

Here are the structures that you need to include in your eco-art project:

- Basal plate
- Corallite
- Ectodermis
- Mouth
- Nematocysts
- Oral disk
- Tentacles

Now it's time to get creative and build a coral polyp!

GRADING WORKSHEET:

Name: _____ Date: _____ Score: _____

1. Student included each of the following structures (1 point each):
   - Basal Plate _____
   - Corallite _____
   - Ectodermis _____
   - Mouth _____
   - Nematocysts _____
   - Oral Disk _____
   - Tentacles _____
2. Student correctly labeled each of the following structures (1 point each):
   - Basal Plate _____
   - Corallite _____
   - Ectodermis _____
   - Mouth _____
   - Nematocysts _____
   - Oral Disk _____
   - Tentacles _____

CATEGORY	4	3	2	1	SCORE
Use of materials	Uses different materials for each structure.	Uses 5-6 different materials for structures.	Uses 3-4 different materials for structures.	Uses 1-2 different materials for structures.	

TOTAL _____ /18

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LESSON 3 TEACHER'S NOTES

AUTHOR

- Amy Heemsoth, Khaled bin Sultan Living Oceans Foundation

LEARNING OBJECTIVE

- Understand that structure is directly related to the function that it performs.

KEYWORD

- Form Fits Function

MATERIALS

- 22 inches x 28 inches (56 cm x 71 cm) poster board
- Other materials are dependent on method used to create poster.
- **Watch It! Form Fits Function** student worksheet.
- **Lesson 3: Form Fits Function** student worksheet

INTEGRATING SUBJECTS

- Art
- Public speaking

EVALUATION

- See *Grading Rubric* for activity evaluation.

STANDARDS

- **CCSS**: RST.9-10.4, 5, 7; RST.11-12.4; W.9-10.2, 4, 7, 8; W.11-12.2, 4, 7, 8; SL.9-10.4, 6; SL.11-12.4, 6
- **NGSS**: HS-LS1-1
- **OLP**: 5.C.22

PROCEDURE

1. Watch *Form Fits Function* YouTube video (*https://youtu.be/oDDaVcTh8ZQ*) and answer questions on the **Watch It! Form Fits Function** student worksheet.
2. Teach *Background Information* section *B) Form Fits Function*.
3. Hand out **Lesson 3: Form Fits Function** student worksheet. NOTE: This student guided assignment can be used as a reinforcement activity inside or outside of the classroom or even in a flipped classroom assignment.
4. Explain the procedure located on the student worksheet.
5. Review the grading rubric with students.

Name: _____ Date: _____

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LESSON 3 FORM FITS FUNCTION

OBJECTIVE: Understand that structure is directly related to the function that it performs.

You have learned that form fits function. Now it's your turn to provide examples of form fits function. For this activity you will create a poster.

PART A:

INSTRUCTIONS:

1. Choose a plant or an animal.
2. Create a poster.
3. Graphics can be handcrafted, digitally created, or borrowed from other sources. If you are using graphics from other sources, you need to make sure that they are cited below the borrowed graphic.
4. Label 20 different structures. Remember these can be external or internal structures.
5. Write the function of each structure that you labeled.

See the attached rubric for grading.

PART B:

INSTRUCTIONS:

1. Students will give a short classroom presentation.
2. The student will identify the organism chosen and one fact that they learned.
3. Students will then be asked questions about the poster. See rubric for grading.

GRADING RUBRIC:

Name: _____ Date: _____ Score: _____

Category	4	3	2	1	Score
Graphics – Clarity	Graphics are all in focus and the content easily viewed and identified from 6 feet (1.8 m) away.	Most graphics are in focus and the content easily viewed and identified from 6 feet (1.8 m) away.	Most graphics are in focus and the content is easily viewed and identified from 4 feet (1.2 m) away.	Many graphics are not clear or are too small.	
Graphics – Relevance	All graphics are related to the topic and make it easier to understand. All borrowed graphics have a source citation.	All graphics are related to the topic and most make it easier to understand. All borrowed graphics have a source citation.	All graphics relate to the topic. Most borrowed graphics have a source citation.	Graphics do not relate to the topic OR several borrowed graphics do not have a source citation.	
Labels	All structures are clearly labeled with labels that can be read from at least 3 feet (.9 m) away.	15-19 structures are clearly labeled with labels that can be read from at least 3 feet (.9 m) away.	8-14 structures are clearly labeled with labels that can be read from at least 3 feet (.9 m)away.	Labels are too small to view OR less than 8 structures are labeled.	
Content – Accuracy	All structures have accurate functions displayed on the poster.	15-19 accurate functions are displayed on the poster.	8-14 accurate functions are displayed on the poster.	Less than 8 accurate functions are displayed on the poster.	
Knowledge Gained	Student can accurately answer all questions related to facts in the poster and processes used to create the poster.	Student can accurately answer most questions related to facts in the poster and processes used to create the poster.	Student can accurately answer about 75% of questions related to facts in the poster and processes used to create the poster.	Student appears to have insufficient knowledge about the facts or processes used in the poster.	
Delivery	Excellent and clear verbal articulation of ideas.	Explained ideas well.	Ideas were well stated, but lacked some clarity.	Ideas were difficult to understand.	
Attractiveness	The poster is exceptionally attractive in terms of design, layout, and neatness.	The poster is attractive in terms of design, layout and neatness.	The poster is acceptably attractive, though it may be a bit messy.	The poster is distractingly messy or very poorly designed. It is not attractive.	
Grammar/ Spelling	There are no mistakes on the poster.	There are 1-3 mistakes on the poster.	There are 4-6 mistakes on the poster.	There are more than 6 mistakes on the poster.	
TOTAL				**Out of 32:**	

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READ IT! Teacher's Notes

AUTHOR

- Melinda Campbell, Khaled bin Sultan Living Oceans Foundation

LEARNING OBJECTIVES

- Read, interpret, and comprehend a blog.
- Determine how to responsibly use the internet for collecting and responding to information.

MATERIALS

- Internet access
- *Swimming Among Soft Corals* blog (*http://www.lof.org/swimming-among-soft-corals-great-barrier-reef/*)
- **Read It! Swimming Among Soft Corals** student worksheet

INTEGRATING SUBJECTS

- English Language Arts

PRIOR KNOWLEDGE

- Students will have prior knowledge about bias and how to critique the validity of websites.

STANDARDS

- **CCSS**: RST.9-10.2, 4, 5, 8, 9, 10; RST.11-12.2, 4, 8, 10
- **NGSS Practices**: 6, 7, 8

PROCEDURE

1. Have students read *Swimming Among Soft Corals* blog (*http://www.lof.org/swimming-among-soft-corals-great-barrier-reef/*).
2. While reading, instruct students to take notes, connecting the information to their prior knowledge. They can note things that they agree and disagree with. A space, called *Notes*, is provided for this on the **Read It! Swimming Among Soft Corals** student worksheet.
3. Ask students to analyze the blog to determine the elements (like tone or visual design) and content that they like and dislike. Remind students to explain why they like or dislike each element they mention. There is also a space provided for these answers on the student worksheet.
4. Have students answer the questions on their worksheet. When they are looking for definitions, they should use the context from the blog, our glossary, or other online resources. You may want to set rules distinguishing other websites or resources that they are allowed to access.
5. If you set up an online community for your class, have the students post their comment(s) from the last question and allow them to respond to each other. If you do not have an online community, have the students share their comment(s) with each other, either orally or by passing their written responses around the classroom.

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READ IT!

SWIMMING AMONG SOFT CORALS

INSTRUCTIONS:

1. Read *Swimming Among Soft Corals of the Great Barrier Reef*, a blog from our Great Barrier Reef, Australia mission (*http://www.lof.org/swimming-among-soft-corals-great-barrier-reef/*).
2. While reading the blog, take notes and connect it to your prior learning. Note things that you agree or disagree with. There is a space, below, for this.
3. Next, document what you like and dislike about this blog in the space below. Be sure to pay attention to things like style and tone, along with the content and visual design. Be sure to *explain* what it is that you do or do not like about each element.
4. Answer the questions.

NOTES

LIKES

DISLIKES

1. What is the central idea of this blog?

2. On what area of the reef are most soft corals found? Why do you think this is? Cite specific textual evidence to support this.

3. Did the author fully support his claim? Explain why you think this.

4. *Sclerites*, *proteinaceous*, and *turbidity* are specific vocabulary for the topic of this blog. Define them below.

5. Write a sentence of your own creation that connects the three words from #4, above.

6. Is this blog a reliable source for scientific information? Why or why not?

7. Do you notice any bias in this writing? If so, what?

8. Compare and contrast the information in this blog to what you have learned about the anatomy of stony corals (hexacorals).

9. Describe three things that you learned while reading this blog entry (they do not have to relate to the central idea).

10. Construct a comment to post in response to this blog. Remember that a good comment makes connections, asks a question, or gives an opinion in a respectful manner. You might want to quote the part of the blog that you are specifically referring to. Don't be afraid to disagree with another writer, but be sure to explain yourself and remain polite.

1. What is the central idea of this blog?
   Soft corals are diverse and they play important roles in coral reefs.

2. On what area of the reef are most soft corals found? Why do you think this is? Cite specific textual evidence to support this.
   Mid-shelf reefs have the greatest abundance of soft corals. It is the best of both worlds, so it can support both extremes of these organisms. Students should have specific quotes to back up this claim, which may vary but might include the following:
   - **"…species that prefer clear nutrient-poor water coexist with soft corals that inhabit turbid waters…"**
   - **"Soft corals of every growth form… competed for space among the stony corals…"**
   - **"…changes in the abundance of species along gradients…"**
3. Did the author fully support his claim? Explain why you think this.
   Answers may vary. Be sure they explain their reasoning.

4. *Sclerites*, *proteinaceous*, and *turbidity* are specific vocabulary for the topic of this blog. Define them below.
   - **Sclerites: microscopic shards composed of calcium or aragonite that help to support the structure of the corals and anchor them to the substrate.**
   - **Proteinaceous: relating to proteins.**
   - **Turbidity: a measure of the clarity of water.**

5. Write a sentence of your own creation that connects the three words from #4, above.
   Soft corals, who prefer low *turbidity* like most other corals, are supported by skeletal elements like *sclerites* and *proteinaceous* material.

6. Is this blog a reliable source for scientific information? Why or why not?
   Yes. This is a first-hand account of what the author has seen. It is from a reputable organization that is based on scientific research. It also links you to the author's credentials.

7. Do you notice any bias in this writing? If so, what?
   Answers may vary, but might mention that this scientist clearly thinks that soft corals are beautiful.

8. Compare and contrast the information in this blog to what you have learned about the anatomy of stony corals (hexacorals).
   Answers may include some or all of the following:

Soft Corals	Both	Hard Corals
8 tentacles **Lack a hard skeleton** **Sclerites**	**Made of polyps**	**6 tentacles** **Hard skeleton**

9. Describe three things that you learned while reading this blog entry (they do not have to relate to the central idea).
   Answers may vary.

10. Construct a comment to post in response to this blog. Remember that a good comment makes connections, asks a question, or gives an opinion in a respectful manner. You might want to quote the part of the blog that you are specifically referring to. Don't be afraid to disagree with another writer, but be sure to explain yourself and remain polite.
    Answers may vary.

Coral Reef Ecology Curriculum

The Coral Reef Ecology Curriculum is a comprehensive educational resource designed to educate people about life on coral reefs. Developed by educators and scientists at the Khaled bin Sultan Living Oceans Foundation, this curriculum strives to increase ocean literacy by creating awareness about coral reefs, the threats they face, and how people can help to preserve these diverse ecosystems.

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The Khaled bin Sultan Living Oceans Foundation is a US-based nonprofit environmental science organization. The Foundation was established to protect and restore the world's oceans through scientific research, outreach, and education.