Khaled bin Sultan Living Oceans Foundation

STANDARDS

- **CCSS**: RST.9-10.1, 3, 4, 5, 7, 8, 10; RST.11-12.1, 3, 4, 10; SL.9-10.1, 2, 3, 4, 6; SL.11-12.1, 2, 3, 4, 6; HSN.Q.A.1; HSS.IC.A.1
- **NGSS**: HS-LS1-2, HS-LS2-6
- **OLP**: 1.B, 5.B.1, 5.B.5

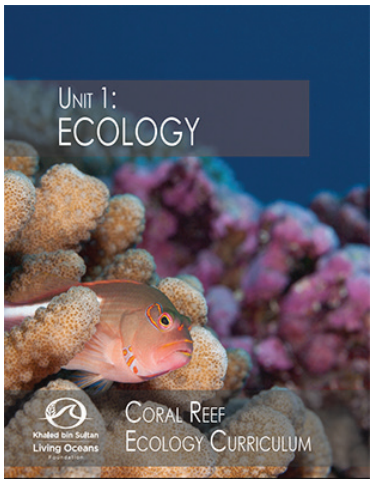
ONLINE CONTENTS

- Ecology Quiz
- *What Is Ecology?* Video
  Ecology explores living things, plus the way they interact with one another, and their physical surroundings. A coral reef is a very special type of home, it provides nourishment and shelter to an amazing range of living creatures. They interact with non-living things like rocks and sand, ocean currents, temperature, and much more. A vast web of living and non-living things makes up the ecology of coral reefs.

ECOLOGY

This lesson is a part of the *Ecology* unit, which explains what ecologists study and how it applies to coral reefs. Below is a summary of what is included in the entire unit.

UNIT CONTENTS



A. Background Information
   - Ecology
   - Biological Hierarchy of Life
   - Ecological Levels of Organization

B. Lessons

Watch it! What is Ecology?
- A worksheet to accompany the *What is Ecology?* video

Factors of the Reef
- A lesson to differentiate between inference and observation

Backyard Ecosystem
- An activity to perform a biological survey of an outdoor area

Read It! Lionfish: Scourge of the Caribbean
- A worksheet to accompany the *Lionfish: Scourge of the Caribbean* field blog

Khaled bin Sultan Living Oceans Foundation

LESSON 2 Teacher's Notes

AUTHOR

- Amy Heemsoth, Khaled bin Sultan Living Oceans Foundation

LEARNING OBJECTIVES

- Draw an ecosystem.
- Identify and record the abiotic and biotic factors that make up an ecosystem.
- Record observations and inferences.
- Identify plants and animals.
- Graph data and draw conclusions based on evidence.

KEYWORDS

- Abiotic Factor
- Biotic Factor
- Ecosystem
- Inference
- Observation
- Organism

MATERIALS

- 33 feet (10 meters) string
- Ruler or measuring tape
- Pencil or colored pencils
- Camera (optional)
- Binoculars (optional)
- Magnifying glass (optional)
- Microscope (optional)
- Internet/library
- **Watch It! What is Ecology?** student worksheet
- **Lesson 2: Backyard Ecosystem** student worksheet

PRIOR KNOWLEDGE

- Students will have prior knowledge about adaptations and invasive species.
- For more information about invasive species, have students read *Lionfish: Scourge of the Caribbean* blog (*http://www.livingoceansfoundation.org/lionfish-ccourge-of-the-caribbean/*) and complete student worksheet.

EXTENSIONS

- If there is time and materials, collect samples such as soil and water and look at the samples under a microscope.
- With the data collected, calculate biodiversity.

STANDARDS

- **CCSS**: RST.9-10.3, 4, 5, 7; RST.11-12.3, 4; SL.9-10.1, 2, 6; SL.11-12.1, 2, 6
- **NGSS**: HS-LS1-2, HS-LS2-6
- **OLP**: 5.B.1, 5.B.5

PROCEDURE

1. Teach *Unit 1: Ecology - Background Information*.
2. Watch *What is Ecology?* YouTube video (*https://youtu.be/TGR-QGdH3QU*) and answer questions on **Watch It! What is Ecology?** student worksheet.
3. Explain the difference between observation and inference. Ask students to provide examples. See **Lesson 1: Factors of the Reef** for more information.
4. Discuss with students what type of tools they would use to make observations.
5. Ask students, "What types of observations might you collect? List the answers on the board. Possible answers:
   a. Size, color, shape of leaves, trees, bark, fruit, animals
   b. Animal tracks, nests, feathers, and calls
   c. Soil type
   d. Temperature, time of day, season
   e. Animal behavior (i.e. predation, competition, symbiosis, etc.)
6. Explain the difference between abiotic and biotic factors. Ask students to provide examples of abiotic and biotic factors.
7. Discuss how scientists collect data.
8. Review safety procedures for working in the field.
9. Hand out **Lesson 2: Backyard Ecosystem** student worksheet.
10. Go outside to perform experiment.
11. In class, allow students to research the organisms they found in their ecosystem. Provide identification books and/or access to a computer. **NOTE**: It may be helpful to teach *Unit 2: Classification - Background Information*.
12. Students will then make a bar graph and answer the questions on the student worksheet. **NOTE**: Students can also use Excel to create bar graphs.

Name: _____ Date: _____

Khaled bin Sultan Living Oceans Foundation

LESSON 2 BACKYARD ECOSYSTEM

OBJECTIVES:

- Draw an ecosystem.
- Identify and record the abiotic and biotic factors that make up an ecosystem.
- Record observations and inferences.
- Identify plants and animals.
- Graph data and draw conclusions based on evidence.

MATERIALS:

- 10 meter string
- Ruler or measuring tape
- Pencil or colored pencils
- Camera or drawing materials (colored pencils and sketchpad)
- Other tools (binoculars, magnifying glass)

PROCEDURE:

1. Choose an outdoor ecosystem. This can be your backyard, a park, a forest, pond, beach, etc.
2. Using your 10 meter string, create a circle around your chosen ecosystem.
3. Second, sketch the ecosystem in the space provided. On the following page name your ecosystem. Be as accurate as possible.
4. Record all of the abiotic and biotic factors of your ecosystem in *Table 1*. When recording the biotic factors list how many of each are present by using tally marks. If you cannot identify certain organisms, take detailed notes about them (color, shape, size, sound it makes, habitat, physical characteristics, etc.), so that you can identify them later. **NOTE**: When possible take photos of the abiotic and biotic factors as well as any observations and inferences that you make. This will come in handy later, especially if you can't identify an organism. It is suggested that you record all of the fast moving organisms first in *Table 1*.
5. Sit down and be as quiet as possible. List all of your observations in *Table 2*. These interactions can occur outside of the circle. Don't forget to include any interactions that you see including organisms interacting with their environment or other organisms.
6. Now based on your observations, make inferences about what you are observing. When making inferences, use your prior knowledge to explain what you are seeing. For example, you observe that the leaves on a maple tree are red, orange, and yellow. Your prior knowledge tells you that the reason that the leaves are changing colors is because it's fall. This is an inference. Write your inferences next to the corresponding observation in *Table 2*. You may not be able to make inferences for all observations.
7. In class, identify each of the organisms (plants and animals) that you found in your ecosystem. Identify each organism to the lowest classification level possible and include the common name. Use your photos or drawings to help you identify these organisms. You may use guide books and the internet to help you. In *Table 3*, make a list of the organisms that you identified including the common name and the lowest classification. Transfer your tallies from *Table 1* to *Table 3*.
8. Label the drawing with the corresponding number for each organism from *Table 3*. For example, if #1 is a shark, then in the drawing, place a 1 next to the shark. Circle the number. If there are more than one of the same types of organism, write the same number next to each one.
9. Create a bar graph including all of the organisms that you listed in *Table 3*. Make sure to label each axis, create a title, and create a scale on each axis.
10. Answer the questions.
11. If you took photos, include your photos in a document and turn them in with your student worksheets.

INSTRUCTIONS: Sketch your ecosystem.

Title:_____

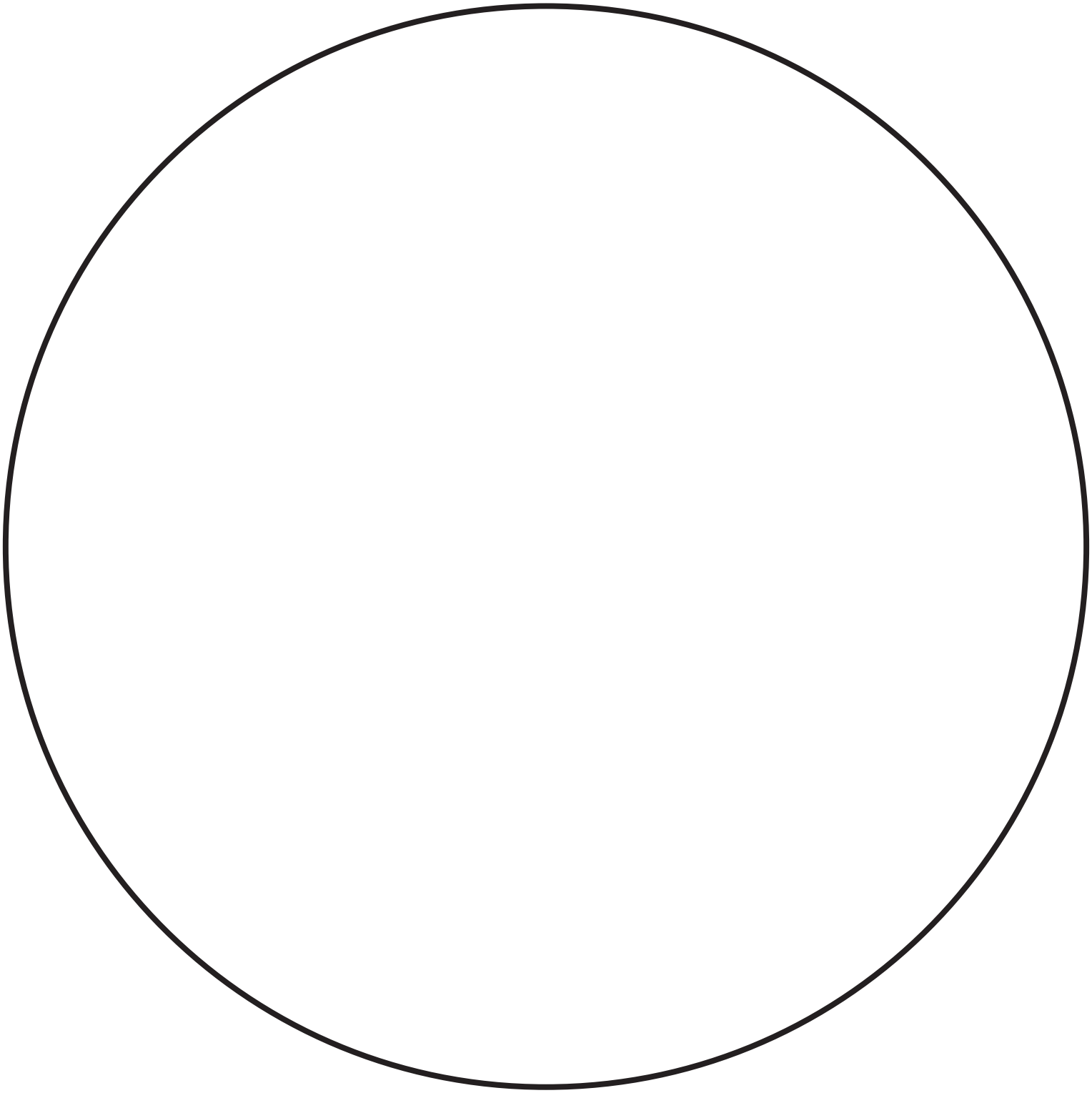


Table 1:

Abiotic Factors	Biotic Factors	Biotic Tally
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		
21.		
22.		
23.		
24.		

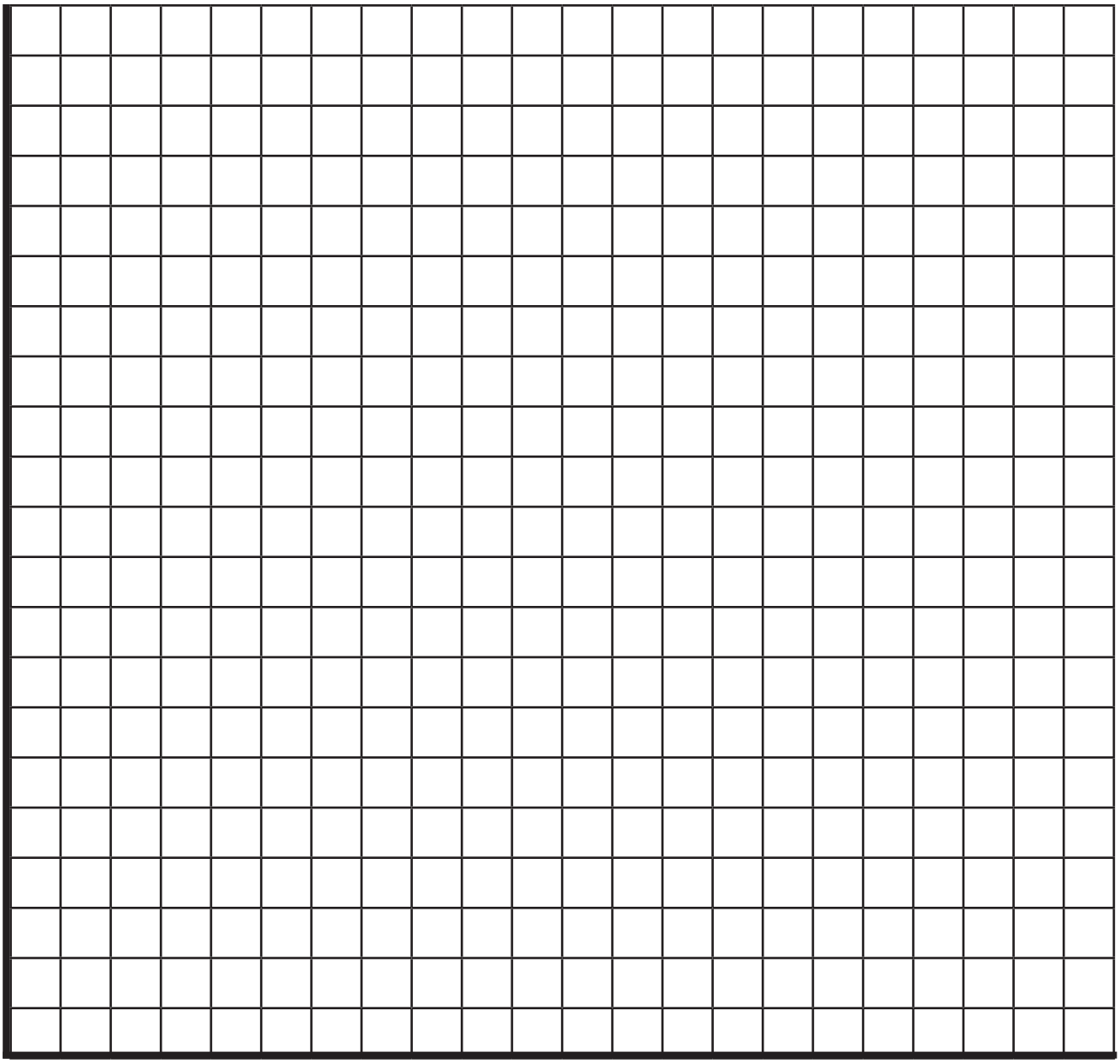
Table 2:

Observation	Inference
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	

Table 3:

Organism	Number
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	
21.	
22.	
23.	
24.	

INSTRUCTIONS: Create a bar graph using the data from Table 3.



INSTRUCTIONS: Answer the following questions:

1. Looking at the bar graph, do you think that your ecosystem is diverse? Why or why not? Explain how you came to these conclusions.

2. List three abiotic factors that would exist in most ecosystems.

   a. _____

   b. _____

   c. _____

3. Do you think that the time of day would change the animal and plant interactions? Why?

4. Do you think that the time of year would change the animal and plant interactions? Why?

5. Do you think that there were organisms that you couldn't see? If so, where would you expect to find them?

   a. Do you think that they are important? Explain.

6. Choose two organisms found in your ecosystem. Describe an adaptation that allows these organisms to live in their ecosystem.

   a. Would they survive if you moved them to a different ecosystem? Explain your answer.

7. Did you find any invasive species in your ecosystem? How do you think that invasive organisms affect ecosystems?

8. Did you notice any human interactions? Explain your answer.

9. How do you think that human interactions affect ecosystems? Provide two examples to back up your claim.

INSTRUCTIONS: Sketch your ecosystem. **Answers may vary on pages 19-23.**

Title: Pacific Coral Reef Wonderland

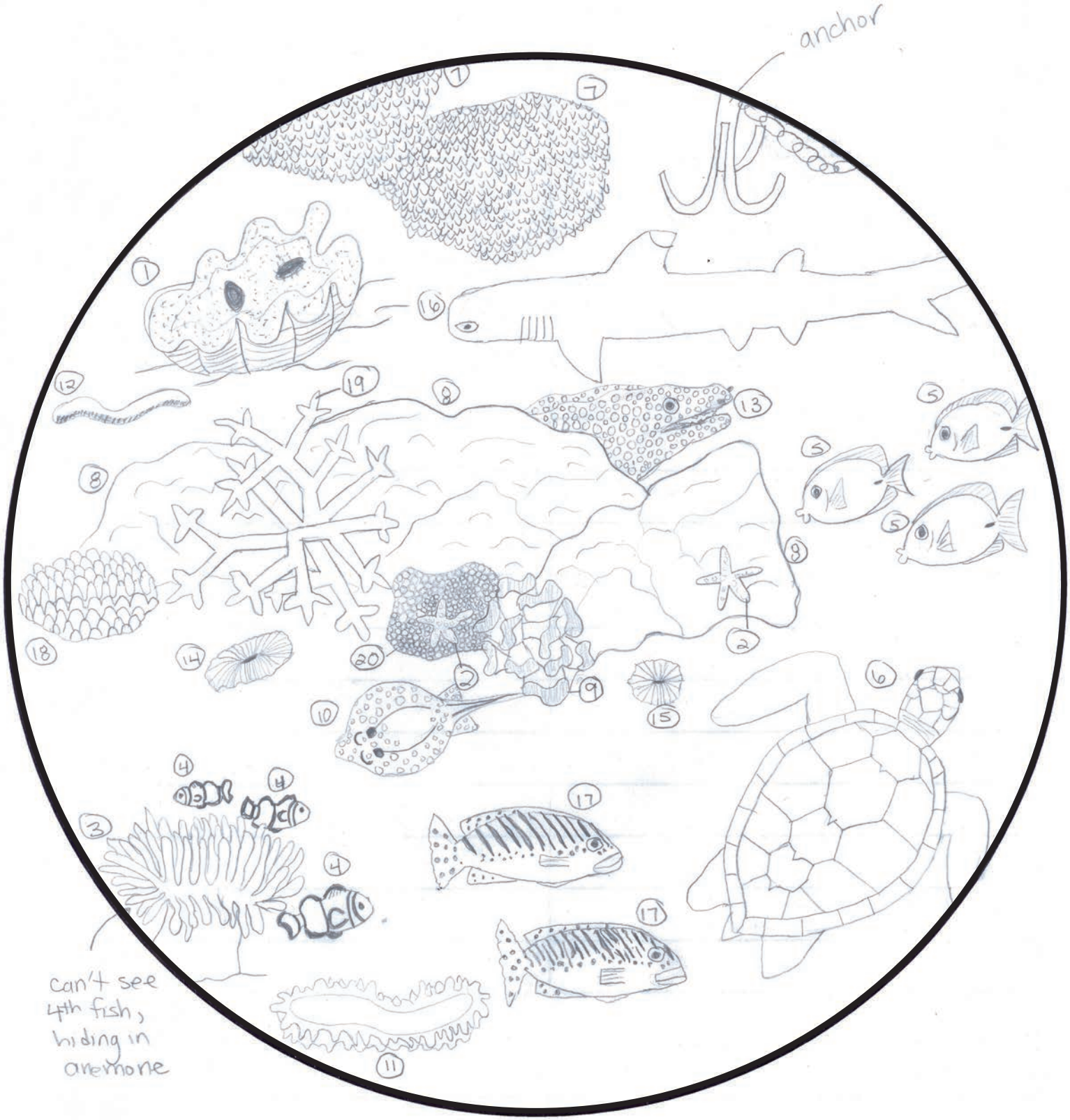


Table 1:

Abiotic Factors	Biotic Factors	Biotic Tally
1. Sand	Giant clam	|
2. Rocks	Stringray	|
3. Sunlight	Sea turtle	|
4. Water temperature	Shark	|
5. Rocks	Blue surgeonfish with yellow pectoral fin	| | |
6. Salinity	Clownfish	| | | |
7. Weather	Anemone	|
8. Waves	Blue starfish	| |
9. Current	Black sea cucumber with frilly edges	|
10. Ocean depth	Small, round coral in sand	|
11. Light	Purple coral with large branches	|
12. Buoyancy	Roundish coral with small circles all over it	|
13. Turbidity	Large rock-like corals that are yellow-brown in color	| | |
14. Nutrients	Sea cucumber with pink underside	|
15. Substrate	Table corals	| |
16. Dissolved gases in water	Coral has small knobs or fingers all over it	|
17. pH	Oblong, small coral in sand	|
18. Wind	White fish with yellow fins and tail with black spots; diagonal black bars; large lips	| |
19. Water density	Brown eel with white spots	|
20.	Pink coral that has branches and the tips are shaped like lima beans	|
21.		
22.		
23.		
24.		

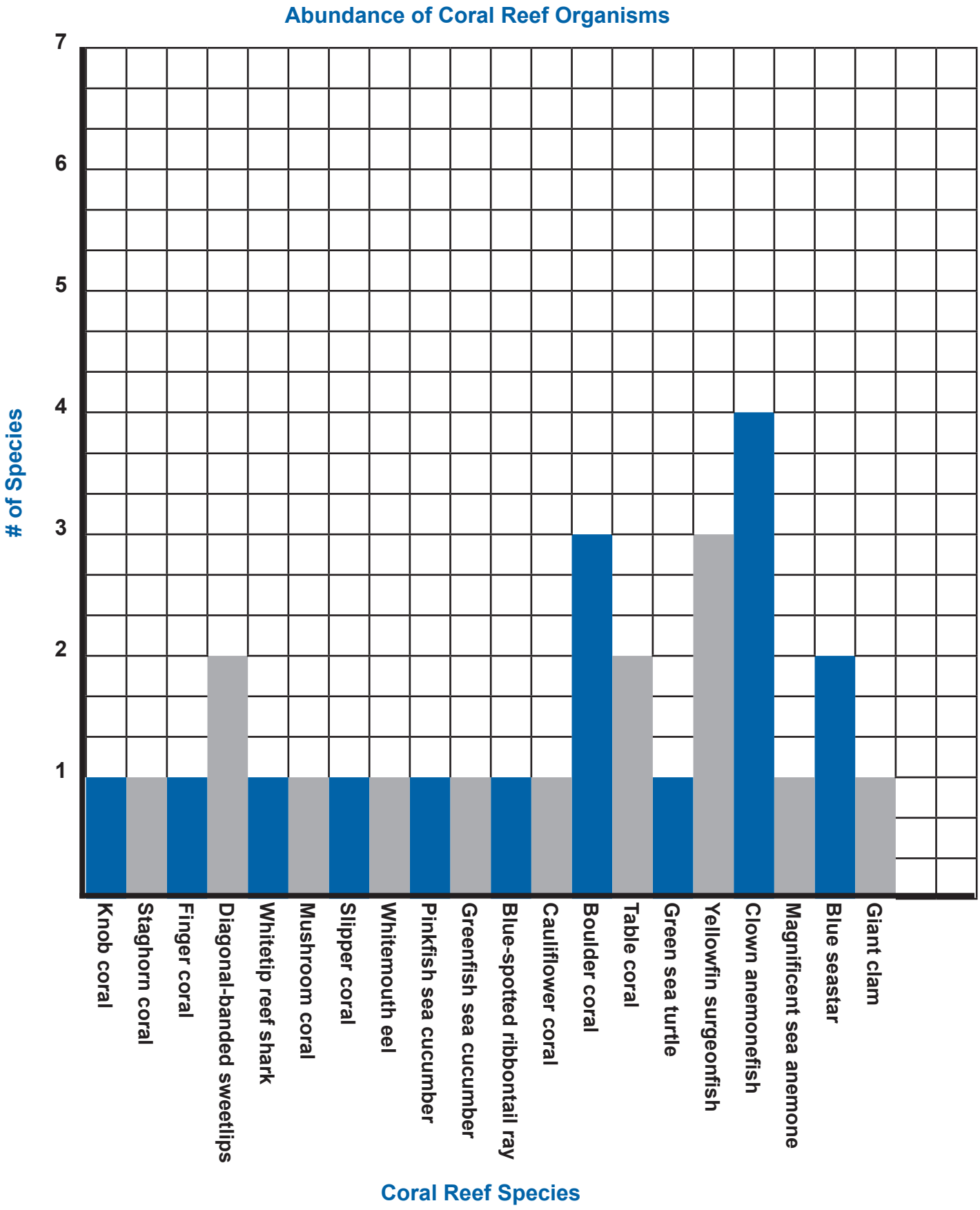
Table 2:

Observation	Inference
1. Sea turtle goes to the surface of the water.	Sea turtles need air to breathe.
2. Clownfish hide in the anemone.	Anemones have stinging cells. Clownfish hide in the anemone to gain protection against predators.
3. Both of the sea cucumbers are in sandy areas.	Sea cucumbers consume sand and eat different things in the sand.
4. The whitetip shark has a white notch on the end of its dorsal fin.	
5. The whitemouth eel's mouth keeps opening and closing.	Eels open and close their mouths in order to pass water over their gills, so that they can breathe.
6. When I put my ears in the water, I can hear crunching.	
7. The blue surgeonfish and sweetlips have different shaped mouths.	Different shaped body part provide different functions.
8. The stingray is sitting on the sandy bottom.	Sting rays' mouths are on the underside of their body and they feed on invertebrates in the sand.
9. The shark's tail moves from side to side.	The tail helps the shark to move forward through the water.
10. The water is salty.	The ocean consists of salt water.
11. Many animals are hiding in the corals.	Coral reefs provide shelter and food for many different organisms.
12. The blue surgeonfish have a white notch near their tails.	

Table 3:

Organism	Number
1. Giant clam, *Tridacna gigas*	1
2. Blue seastar, *Linckia laevigata*	2
3. Magnificent sea anemone, *Heteractis magnifica*	1
4. Clown anemonefish, *Amphiprion percula*	4
5. Yellowfin surgeonfish, *Acanthurus xanthopterus*	3
6. Green sea turtle, *Chelonia mydas*	1
7. Table coral, *Acropora* sp.	2
8. Boulder coral, *Porites* sp.	3
9. Cauliflower coral, *Pocillopora* sp.	1
10. Blue-spotted ribbontail ray, *Taeniura lymma*	1
11. Greenfish sea cucumber, *Stichpus chloronotus*	1
12. Pinkfish sea cucumber, *Holothuria edulis*	1
13. Whitemouth eel, *Gymnothorax meleagris*	1
14. Slipper coral, *Ctenactis* sp.	1
15. Mushroom coral, *Fungia* sp.	1
16. Whitetip reef shark, *Triaenodon obesus*	1
17. Diagonal-banded sweetlips, *Plectorhinchus lineatus*	2
18. Finger coral, *Acropora* sp.	1
19. Staghorn coral, *Acropora* sp.	1
20. Knob coral, *Favia pallida*	1
21.	
22.	
23.	
24.	

INSTRUCTIONS: Create a bar graph using the data from Table 3.



INSTRUCTIONS: Answer the following questions. **Answers may vary depending on the ecosystem.**

1. Looking at the bar graph, do you think that your ecosystem is diverse? Why or why not? Explain how you came to these conclusions.

   Yes, the ecosystem is diverse. There are many different types of organisms (in different amounts; abundance) living in the coral reef. There are also many other organisms that were constantly moving around the reef and many others that I couldn't see that were not documented. Additionally, after some research I found that coral reefs are one of the most diverse ecosystems in the world.

2. List three abiotic factors that could exist in most ecosystems.

   a. **Oxygen**

   b. **Water**

   c. **Temperature**

3. Do you think that the time of day would change the animal and plant interactions in an ecosystem? Why?

   Yes, many organisms perform different interactions during different times of the day. For instance, some animals are nocturnal. They are most active at night. Nocturnal organisms feed at night and they sleep during the day. Other animals such as plants create food during the day because they need sunlight in order to photosynthesize.

4. Do you think that the time of year would change the animal and plant interactions in an ecosystem? Why?

   Yes, throughout the year, the length of day changes due to the tilt of the Earth's axis. During different times of the year there are seasons. Seasons bring a change in the number of hours in the day, weather, and ecology. Animals respond to the changing seasons. In colder climates, some animals hibernate during the winter. Trees and plants shed their leaves and shunt nutrients to their branches, storing them during the winter. Areas near the equator remain relatively warm during the winter months; however, they may receive very little precipitation. Organisms must adapt to these dry conditions. All plants and animals have adapted to living in certain areas. For instance, animals that need to stay warm grow thicker fur. These changes may also bring about differences in feeding, reproduction, migration, and life cycles.

5. Do you think that there were organisms that you couldn't see in your ecosystem? If so, where would you expect to find them?

   Yes, there were organisms that I couldn't see. There were organisms that were hiding in the cracks and crevices of the reef. There are also organisms that were buried in the sand. After doing some research, I also found that there are microscopic organisms that are not visible to the naked eye. They include bacteria, phytoplankton, zooplankton, and zooxanthellae.

   a. Do you think that they are important? Explain.

   Yes, these organisms are all very important to the food web including the microscopic ones. Many of these microscopic organisms recycle nutrients and are a food source or provide a food source for many other organisms in the food web. Without these organisms, the food web would be out of balance. For example, a symbiotic algae known as zooxanthellae lives inside corals. Zooxanthellae are believed to provide up to 95% of the food that corals need to survive. Without them, most stony corals would die. Without corals, the coral reef would not exist.

6. Choose two organisms found in your ecosystem. Describe an adaptation that allows these organisms to live in their ecosystem.
   1. **Giant clams cannot move to get food and therefore, they have adapted to these conditions. One of the ways that they get food is by filtering seawater, siphoning out small organisms such as plankton.**
   2. **Clownfish form a symbiotic relationship with anemones. Anemones have stinging cells that harm predators. Clownfish have adapted to living in the anemone. Scientists believe that they produce mucus that protects them from the anemone's sting.**

   a. Would they survive if you moved them to a different ecosystem? Explain your answer.
   Unless you moved these organisms to an ecosystem that had the same environmental conditions, the organisms would not be able to survive. Organisms have different adaptations that they have acquired over time. It can take hundreds to thousands of years for them to adapt to certain conditions. For example, if you took a stony, warm-water coral and placed it in an area without light, the coral would eventually die, because the zooxanthellae would not have light to photosynthesize, which provides food to the coral. The coral cannot choose to go to an area with light; most corals cannot move.

7. Did you find any invasive species in your ecosystem? How do you think that invasive organisms affect ecosystems?
   No, there were not any invasive species in the coral reef ecosystem; however, coral reefs in the Atlantic have invasive lionfish. With few predators these invasives have disrupted the balance on coral reefs. Introduced species often have negative impacts on ecosystems altering their functions. For instance, invasives can out-compete native species causing extinction. Like lionfish, invasives often change the food web by destroying or replacing native organisms in it. Invasives can alter the biodiversity and/or the abundance of species in an ecosystem by replacing native species due to competition, disease, and predation. Invasives can also alter the conditions of an ecosystem. For example, European buckwood (*Rhamnus cathartica, L.*) is a shrub that is an invasive species in Midwestern United States. It is believed to alter the properties of soil, like pH and nutrient content.

8. Did you notice any human interactions? Explain your answer.
   Yes, I did notice some human interactions. When I was snorkeling, I noticed an anchor that was left behind. I also noticed that people were accidentally kicking the corals, which could cause harm to the corals.

   Depending on the ecosystem chosen, students will have a variety of answers. Answers can include pollution, habitat destruction, runoff, climate change, destructive fishing practices, overhunting, overfishing, deforestation, etc.

9. How do you think that human interactions affect ecosystems? Provide two examples to back up your claim.

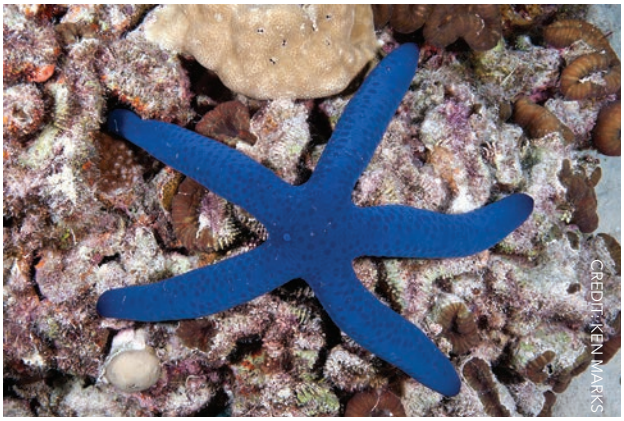
   Humans can cause negative impacts to ecosystems. These negative impacts can threaten the health of an ecosystem.

   1. **Destructive fishing such as anchoring on corals, dynamite and cyanide fishing, and fishing gear entanglement causes corals and other animals to die as well as animal's homes to be destroyed.**
   2. **Around the world, mangroves have been cut down to build houses, businesses, roads, etc. Coastal development causes habitat loss for mangroves and the organisms that rely on them for food and shelter.**

Here is an example of how students can submit their photos.

1. Giant clam

2. Blue seastar



6. Green sea turtle

7. Table *Acropora*

12. Pinkfish sea cucumber

14. Slipper coral

17. Diagonal-banded sweetlips

19. Staghorn coral