Unit 16: FOOD WEBS

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Coral Reef Ecology Curriculum

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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.

Author and Design/Layout: Amy Heemsoth, Director of Education
Editorial assistance provided by: Liz Rauer Thompson and Renée Carlton
Illustrations by: Amy Heemsoth
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Khaled bin Sultan Living Oceans Foundation
(443) 221.6844
education@lof.org

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KEYWORDS

- Apex Predator
- Atmosphere
- Autotroph
- Biogeochemical Cycle
- Biomass Pyramid
- Biosphere
- Carnivore
- Chemoautotroph
- Chemosynthesis
- Consumer
- Decomposer
- Detritivore
- Detritus
- Ecological Pyramid
- Energy
- Energy Pyramid
- First Law of Thermodynamics
- Food Chain
- Food Web
- Geosphere
- Herbivore
- Heterotroph
- Hydrosphere
- Law of Conservation of Mass
- Matter
- Nutrient
- Omnivore
- Photoautotroph
- Primary Consumer
- Primary Producer
- Producer
- Pyramid by Numbers
- Quaternary Consumer
- Secondary Consumer
- Sphere
- System
- Tertiary Consumer
- Top Predator
- Trophic Level
- Trophic Pyramid

FOOD WEBS

This unit explores the complex connections of the coral reef food web, and how energy is transferred and matter is recycled throughout this ecosystem.

STANDARDS

- CCSS: RST.9-10.1, 2, 4, 5, 7, 8, 10; RST.11-12.1, 2, 4, 10; SL.6.1-8.1; SL.6.5-8.5
- NGSS: MS-LS2-3, MS-LS2-4
- OLP: (grades 6-8) 5.A.1, 5.A.3, 5.A.4, 5.A.6, 5.A.16, 5.A.21, 6.A.5-6.A.7, 6.D

MULTIMEDIA RESOURCE

- *Coral Reefs: Unraveling the Web* YouTube video (*https://youtu.be/kuEe4376il8*)

LEARNING OBJECTIVES

- Differentiate between the four spheres on Earth – geosphere, hydrosphere, atmosphere, and biosphere.
- Understand that nutrients (matter) constantly cycle through all spheres through the biogeochemical cycle.
- Provide examples of biogeochemical cycles.
- Describe the Law of Conservation of Mass and how it relates to matter cycling.
- Describe the First Law of Thermodynamics and how it relates to energy.
- Distinguish between the terms autotroph (producer), heterotroph (consumer), and decomposer.
- Recognize the two subcategories of autotrophs – phototrophs and chemoautotrophs.
- Recognize the three categories of consumers and provide examples of each.
- Explain the difference between the terms decomposer and detritivore.
- Interpret a food chain.
- Define trophic level and differentiate between each of the different levels.
- Define top predator and apex predator.
- Create examples of food chains.
- Define food web and interpret a food web diagram.
- Explain how disturbances can affect the food web.
- Demonstrate understanding of an ecological/trophic pyramid.
- Recognize that there are various types of ecological/trophic pyramids that represent different types of information.
- Explain the “10% rule.”
- Explain how matter is recycled in a system.
- Provide an explanation of how energy is lost from trophic level to trophic level.

FOOD WEBS

UNIT PROCEDURE

1. Show *Coral Reefs: Unraveling the Web* YouTube video.
   a. Complete **Watch It! Unraveling the Web** student worksheet.
2. Teach *Unit 16: Food Webs - Background Information*.
   a. Complete **Lesson 1: Stringing it Together** student worksheet.
3. Teach students how to read and critique blogs.
   a. Complete **Read It! Sharks** student worksheet.
   b. Complete **Read It! Faces & Functions Algae** student worksheet.
4. Evaluate students using **Unit 16: Food Web Quiz** (found online at *www.lof.org/education/portal/quiz/food-web-assessment-1/*). NOTE: User must be logged in.

Name: ______________________________ Date: ______________

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WATCH IT! UNRAVELING THE WEB

INSTRUCTIONS: Watch *Coral Reefs: Unraveling the Web* YouTube video (*https://youtu.be/kuEe4376il8*) and answer the following questions.

1. What kinds of animals live in a coral reef ecosystem? Provide three examples.

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2. What is the role of a sea cucumber living in a coral reef?

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3. What is a food chain?

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4. What is a food web?

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5. What is the role of a parrotfish and sea urchins living in a coral reef?

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6. What happens when sea cucumbers and parrotfish populations decline?

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WATCH IT! UNRAVELING THE WEB

7. What does it mean to have a balanced food web?

8. Throughout the video there are examples of humans disrupting the coral reef food web. Provide three examples of how humans disrupt the coral reef food web either from the video and/or from independent research.

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WATCH IT! UNRAVELING THE WEB

VIDEO SCRIPT:

A coral reef, when healthy, it's one of nature's miracles.

An ecosystem that supports millions of different creatures.

From major predators like sharks to grazers like parrot fish, from sea urchins to octopus, to sea cucumbers.

This creature feeds on bacteria and other microorganisms that could become problems.

It breaks them down and then poops out clean sand, redistributing nutrients for other creatures.

Bacteria is at the bottom of a food chain, a diagram of "what eats what" in the reef.

But a coral reef is such a complex ecosystem, that it's better to think of it as a food web, a network of food chains that tells a story about the interdependence of all the animals and plants that live in the reef.

Take the parrotfish.

Named for its sharp, beak-like teeth, parrotfish feed on algae that grows on the reef.

Together with sea urchins, they act as lawnmowers, keeping the algae in check.

But in some places, like Jamaica, fishermen are now catching too many parrotfish.

The sea urchins nearby have also undergone a population crash.

The loss of these two grazers is reflected in Jamaican reefs. Many of them are now overgrown with algae.

So, the food web is all about balance.

If one link is threatened, or another one grows too dominant, it sends shock waves through the web.

Each link of the food web impacts every other part.

Follow the connecting lines and you'll see that animals can eat more than one animal and can be prey to many others.

They all need each other, even the large predators.

And many types of predators, like sharks, are now endangered by another predator far more dangerous – humans.

We disrupt the reef's food web in dozens of ways, large and small.

For example, too much fertilizer in farming or sewage in coastal areas, introduces too many nutrients into the sea.

This can trigger those booms and busts that upset the coral reef's food web.

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WATCH IT! UNRAVELING THE WEB

They threaten the reef's ability to support the millions of organisms that rely on it for food and shelter.

But a coral reef can recover.

It's up to us.

We are an important part of this food web.

We must change our actions and rethink what we do to help preserve reefs.

Only then can we restore their natural balance.

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WATCH IT! UNRAVELING THE WEB

INSTRUCTIONS: Watch *Coral Reefs: Unraveling the Web* YouTube video (*https://youtu.be/kuEe4376il8*) and answer the following questions.

1. What kinds of animals live in a coral reef ecosystem? Provide three examples.

   Answers may include snappers, butterflyfish, damselfish, clownfish, anemones, crabs, sea turtles, remoras, eels, corals, sharks, parrotfish, sea urchins, octopi, and sea cucumbers.

2. What is the role of a sea cucumber living in a coral reef?

   Sea cucumbers feed on bacteria and microorganisms living in sand, which can be harmful to a coral reef. The sea cucumber consumes the sand, eating bacteria and microorganisms; then it excretes clean sand, redistributing nutrients for other organisms to eat.

3. What is a food chain?

   A food chain is a linear diagram of what-eats-what, showing how energy is transferred from one organism to another.

4. What is a food web?

   A food web is a complex interdependent network of food chains.

5. What is the role of a parrotfish and sea urchins living in a coral reef?

   Their role is to consume algae that grows on coral reefs. They are called grazers.

6. What happens when sea cucumbers and parrotfish populations decline?

   There are not enough grazers (sea cucumber and parrotfish) to remove the algae and it begins to overgrow the coral reef.

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WATCH IT! UNRAVELING THE WEB

7. What does it mean to have a balanced food web?

When one or more plant and/or animal population(s) become too low and/or too high, this throws the entire food web out of balance. For example, if a coral reef predator, such as sharks, are almost completely removed from the ecosystem, then the population of the organisms that it consumes will go unchecked. These unchecked populations will increase, and they will consume more prey, because there are more of them. In turn, they will reduce their preys' populations. A food web consists of balanced production and consumption of all organisms. This does not mean that each population size is equal in size to all other populations though.

8. Throughout the video there are examples of humans disrupting the coral reef food web. Provide three examples of how humans disrupt the coral reef food web either from the video and/or from independent research.

Answers may include sewage and chemical runoff, sedimentation from removing trees and plants, oil spills, introduction of invasive species, marine debris, using harmful sunscreens; vessel groundings, anchor damage, physical contact with corals; destructive fishing practices and overfishing; and ocean acidification, sea level rise, and bleaching due to climate change.

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LESSON 1 Teacher's Notes

AUTHOR

- Amy Heemsoth, Khaled bin Sultan Living Oceans Foundation

LEARNING OBJECTIVES

- Define the terms matter and energy.
- Define and differentiate between the terms autotroph (producer), heterotroph (consumer), and decomposer.
- Recognize the two categories of autotrophs – photoautotrophs and chemoautotrophs.
- Differentiate between the three types of consumers – herbivore, omnivore, and carnivore.
- Differentiate between decomposer and detritivore.
- Define food chain.
- Illustrate how matter cycles and energy flows through an ecosystem.
- Interpret, construct, and draw a food chain.
- Classify organisms' type(s) of feeding strategies based on their diet.
- Define food web and interpret a food web diagram.
- Develop a model of a coral reef food web.
- Understand that food webs can become unstable when there are disruptions to biological or physical components of an ecosystem.
- Practice creating a food web that has encountered a disruption to identify how organisms' populations are affected.

KEYWORDS

- Autotroph
- Carnivore
- Chemoauto-troph
- Consumer
- Decomposer
- Detritivore
- Detritus
- Ecosystem
- Food Chain
- Food Web
- Herbivore
- Heterotroph
- Omnivore
- Photoauto-troph

MATERIALS

- *Coral Reefs: Unraveling the Web* YouTube video
- **Watch It! Unraveling the Web** student worksheet
- *Unit 16: Food Web Dynamics - Background Information*
- **Lesson 1: Stringing it Together** student worksheet
- **Appendix A: Coral Reef Organism Cards**
- **Appendix B: Matter & Energy Arrows**
- **Appendix C: Heat, Waste, Nutrients Arrows**
- **Appendix D: Feeding Strategy Cards**
- **Appendix E: Sun & Decomposer Cards**
- Poster paper
- Markers, colored pencils, and/or crayons (optional)
- Tape (optional)
- 1-2 Balls of yarn
- Hole puncher (optional)
- Alligator clips or lanyards (optional)

EXTENSIONS

- Teach students about trophic levels (see *Unit 16: Food Web Dynamics - Background Information*). After completing the *Procedure Section 2: Food Chains*, ask students to identify the trophic levels (primary producer, primary consumer, secondary consumer, and/or tertiary consumer) in each of the four food chains that they modeled. They can write the trophic level above each feeding strategy in the food chains.
- Students can research a coral reef ecosystem disturbance. They should specify how these disturbances can create instability in the food web (population declines or increases, people have less food, ecosystem collapse, etc.). Their answers should include information about how other populations could be affected by the disturbance.

STANDARDS

- **CCSS**: SL.6.1-8.1, SL.6.5-8.5
- **NGSS**: MS-LS2-3, MS-LS2-4
- **OLP**: 5.A.1, 5.A.3, 5.A.4, 5.A.6, 5.A.16, 5.A.21, 6.A.5-6.A.7, 6.D.1-6.D.21

ATTRIBUTIONS

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PROCEDURE

A. PREPARATION:

1. Prior to implementing the activity, print and then laminate **Appendices A-E**.
2. For *Part 4: Disruptions to the Food Web* activity, each student will need to fasten one food web organism to their clothing. This can be secured using alligator clips or lanyards. If these supplies are not available, print and laminate an extra set of cards. Punch holes in the top corners of each card. Cut a piece of yarn that is long enough to fit over the students' heads. Tie each end of the yarn to the holes in the corners of the card.

B. BACKGROUND INFORMATION:

1. Watch *Coral Reefs: Unraveling the Web* YouTube video (https://youtu.be/kuEe4376il8) and answer questions on **Watch It! Unraveling the Web** student worksheet.
2. Teach relevant information from *Unit 16: Food Web Dynamics - Background Information*.

C. FOOD CHAINS:

1. Divide students into groups. The activity will work best in groups of 3-4 students; however, it can also be conducted by individuals.
2. Throughout the activity, there are suggested prompts in blue boxes to engage students in learning. After each question (Q) are suggested answers (A). Begin the activity by asking:

Q: "Do you know of any of the organisms that live in or near a coral reef?"

A: *A variety of answers are acceptable including phytoplankton, zooplankton, sea turtles, jellyfish, octopus, clownfish, anemones, fish, sharks, sea cucumbers, sea urchins, corals, and sting rays.*

Q: "From prior units, do you recall any of the feeding relationships between any coral reef organisms?"

A: *Answers may include corals eat zooplankton.*

Q: "What is a food chain?"

A: *A food chain is a group of organisms that depicts the feeding connections in an ecological community. It is a linear sequence of what-eats-what in an ecosystem.*

Q: "What do the arrows represent in a food chain?"

A: *The arrows represent a transfer of matter and energy from one organism to another. The direction of the arrows does not represent the organism being eaten, but the organism doing the eating.*

3. Distribute **Lesson 1: Stringing it Together** student worksheet to each student and provide **Appendix A: Coral Reef Organism Cards** and **Appendix B: Matter & Energy Arrows** to each group.
4. Instruct students that they will construct a food chain using the cards and arrows provided. Explain that the cards represent some of the organisms that live in a coral reef ecosystem in Australia. The backs of the cards provide information about the diet and approximate size of each organism. Using this information, students should be able to construct multiple food chains. The food chain should contain at least two organisms; however, they should try to link as many organisms together as possible.
5. Next, review the different types of feeding strategies that organisms use. Provide each group with a set of **Appendix D: Feeding Strategy Cards**. Each group should review the diet listed on each organism card in their food chain. They should choose the corresponding feeding strategy card(s) and place it above each organism in their food chain. **NOTE**: Some organisms could have multiple feeding strategies. For example, mullet are herbivores and decomposers.
6. Each student should draw the food chain on their student worksheet. Instruct them to write the feeding strategy above each organism in their food chain.
7. Each group should create three additional food chains (repeat steps 4-6).
8. Once the students have modeled four food chains, ask each group to present one of theirs. If possible, ask students to draw them on a white board. After each group has presented, ask the class:

Q: "Do you notice anything about the food chains?" If students are not responding, prompt them further, "Are there any patterns that you notice?"

A: *Food chains usually begin with a producer (algae or phytoplankton).*

Q: "Why does the food chain begin with producers?"

A: *The primary source of energy in a coral reef ecosystem is the sun.*

Q: "Are there any other patterns that you notice?"

A: *Some organisms exist in multiple food chains, and food chains begin with small animals that are often consumed by larger ones.*

9. Review how matter cycles and energy flows through an ecosystem (see *Unit 16: Food Web Dynamics Background Information*).

Q: "What happens to matter when the last organism in your food chain dies?"
A: *An organism that dies is consumed by detritivores or broken down by decomposers.*

Q: "What is the difference between a detritivore and decomposer?"
A: *Detritivore directly consume the dead organism gaining matter, and the decomposers break down the matter into inorganic nutrients like carbon and nitrogen.*

Q: "Where do the inorganic nutrients go?"
A: *According to the Law of Conservation of Mass, matter cannot be created or destroyed; it can only be changed from one form into another. Through chemical reactions, atoms can be rearranged, but the total amount of each type of atom remains the same. Matter (atoms) cycle repeatedly between the living and nonliving parts of an ecosystem. Inorganic nutrients (nonliving) are returned to the ecosystem. The nutrients will be used by producers that continue cycling matter.*

Q: "Are there any other ways that matter flows through an ecosystem?"
A: *Organisms also secrete or excrete organic material. Examples of organic material include shedding body parts, molting, or waste (excretion).*

Q: "Do you think that decomposers play an important role in an ecosystem?"
A: *Decomposers are essential to cycling matter through an ecosystem. Without them, waste and dead organisms would accumulate. The waste and dead organisms wouldn't get broken down and cycled through the ecosystem; therefore, there wouldn't be enough matter to support it.*

Q: "Is all energy passed from organism to organism when feeding?"
A: *The First Law of Thermodynamics states that "energy cannot be created nor destroyed; it can be converted into different forms." Approximately 10% of energy is passed on to the next organism while the other 90% is lost as heat to the ecosystem. Heat is not returned to the sun.*

10. Provide groups with **Appendix C: Heat, Waste, Nutrient Arrows** and **Appendix E: Sun & Decomposer Cards**. Students should reconstruct one of their food chains that they made earlier and incorporate these cards into their model.
11. Choose one example to illustrate on the board and discuss.
12. Each student should draw this food chain on their student worksheet.

D. FOOD WEBS:

1. Review the definition of a food web. Students should understand that a food web is a series of interconnected food chains in an ecological community. As with food chains, arrows are used to show the transfer of matter and energy from one organism to another.
2. Explain that students will now create a model of a food web using all of the organism cards.
3. To conduct the activity, supply each group with a piece of poster paper and the organism cards.
4. Students will place the organism cards on the poster paper. Inform students that they will need to draw arrows from one organism to another. Again, reinforce that the arrows represent the flow of matter and energy, and the organism that consumes the other (not the organism being eaten). This is a complex

food web. It would be too confusing to include matter and energy arrows in their models; therefore, explain to students that they only need to use one arrow that represents matter and energy. Suggest that students first draw the arrows using a pencil. Later, students can trace the arrows with markers, colored pencils, or crayons (optional).

5. When each group has finished modeling, ask the class:

> **Q: "What is missing from your food web?"**
>
> **A:** *Food webs are extremely complex. There are many other species that live on a coral reef that are not included here. Although the food web includes organisms that are not listed as species (e.g., phytoplankton, zooplankton, and hard coral), food webs illustrate every species in an ecosystem. For example, there are thousands of phytoplankton species, and it would be extremely difficult to model this. The food web does not include decomposers such as bacteria or the source of the energy – the sun. Humans are also not included.* ***NOTE****: If they do not mention humans missing from the food web, make sure to introduce this idea in Part 4: Disruptions to the Food Web.*

6. Now provide students with the sun card from **Appendix E: Sun & Decomposer Cards**. Request that the groups insert the sun card in their food web.

> **Q: "What type of organisms receive energy from the sun?"**
>
> **A:** *Producers receive energy from the sun to create food.*

7. Instruct students to draw arrows to the organisms that receive the sun's energy (algae, phytoplankton). Reinforce that the arrow is the transfer of energy, but not matter. Producers use energy from the sun to produce their own food. They do not directly get food (matter) from the sun.
8. Provide students with the decomposer card.

> **Q: "What is a decomposer?"**
>
> **A:** *Decomposers are organisms that break down dead or decaying plants and animal parts, as well as waste.*
>
> **Q: "If you were to add the decomposers to your food web, from which organisms would they receive matter and energy?"**
>
> **A:** *All organisms in their food web will eventually die and pass on matter and energy to the decomposers.*
>
> **Q: "How would you show this in your food web?"**
>
> **A:** *There would be an arrow drawn from each organism in their food web to the decomposer card.*

9. Instruct students to transfer the model of their food web to their student worksheet.
10. Provide students with tape, so that they can tape down their organism cards and the sun to their poster paper. Display the food webs around the classroom (optional). **NOTE**: If the food webs are displayed, an additional set of cards will need to be printed for the *Part 4: Disruptions to the Food Web* activity.

E. DISRUPTIONS TO THE FOOD WEB:

1. If possible, have students stand in a circle about arm's length apart. **NOTE**: This activity is best conducted outside or in a gymnasium where there may be more space.
2. Hand out one organism card to each student. Instruct students to hang their card around their neck (see *A. Preparation* for more information), so that their hands are free.
3. Explain to students that they will be representing the organism listed on their card. Ask students to look around the circle and think about what might consume me and what might I consume.

> **Q: "Where should the coral reef food web begin?"**
>
> **A:** *Producers are the base of the food web.*

4. Hand the ball of yarn to a student representing a producer. Explain to students that in one hand they will hold the yarn and in the other they will throw the ball of yarn. Tell students that the yarn represents the matter and energy that is being passed from organism to organism. The student will pass the ball of yarn to an organism that requires its matter and energy. In other words, to the organism that eats it.
5. Try a practice round with students so that they understand the rules.
6. When the students get to the end of a food chain, ask:

> **Q: "Does anyone know what this represents?"**
>
> **A:** *It is a food chain.*

OPTIONAL: Ask students to identify the different trophic levels (primary producer, primary consumer, secondary consumer, etc.).

7. Tell the students that they are going to start over again, but that everyone who is holding a piece of yarn should remain holding it. Reinforce that the coral reef food web begins with producers by asking:

> **Q: "Where should the coral reef food web begin?"**
>
> **A:** *Producers are the base of the food web.*

8. Give the ball of yarn to a producer. Tell students to throw the ball of yarn to different organisms this time. Allow students to create another food chain. After each food chain is created, have the students throw the ball of yarn back to a producer, but make sure that each student with a piece(s) of yarn holds onto it. Continue making food chains until each student is holding a piece of yarn. **NOTE**: Some students will be a part of multiple food chains. Once completed, ask students:

> **Q: "Does anyone know what this represents?"**
>
> **A:** *It's a food web.*

9. Think about your feeding relationship – producer, consumer (herbivore, omnivore, carnivore), and decomposer.

Q: "Raise your hand if you are a producer."
A: *Algae and phytoplankton*

Q: "Raise your hand if you are an herbivore."
A: *Green sea turtle, mullet, sea urchin, and zooplankton*

Q: "Raise your hand if you are an omnivore."
A: *Clownfish, crustaceans, cushion star, giant clam, humpback whale, parrotfish, and sea cucumber*

Q: "Raise your hand if you are a carnivore."
A: *Anemone, butterflyfish, crown-of-thorns starfish, cuttlefish, Drupella snails, hard coral, octopus, reef shark, titan triggerfish, Triton's trumpet, and wedge-tailed shearwater*

Q: "Raise your hand if you are a decomposer."
A: *Crustaceans, mullet, and sea cucumber*

Q: "Who is holding the greatest number of strings? Why?"
A: *The producers are holding the greatest number of strings because they are at the base of the coral reef food web.* ***NOTE****: Energy from the last organism in the food chain does not provide energy to producers.*

Q: "Why are there some students holding more than one string?"
A: *In a food web, organisms can eat more than one organism and they can be prey to many others.*

10. Students should continue to hold the string(s) of the web. Ask:

Q: "What organism is not present in our food web, but can impact all organisms in it?"
A: *Humans (Homo sapiens) are not included in the food web.*

Q: "How can humans negatively disrupt a food web?
A: *Threats to coral reefs include, but are not limited to, coral bleaching, ocean acidification, destructive fishing methods, coral mining, boat anchor damage, unsustainable tourism, and sunscreen.*

11. Explain to students that their food web is stable; however, abiotic and biotic changes to this ecosystem can cause it to become unstable. Provide an example of the crown-of-thorns starfish (COTS). This creature is naturally present on Indo-Pacific coral reefs; however, their population sometimes explode when the right conditions are present. There are two reasons that scientists believe COTS populations become too large. 1) When nutrients from pollution are added to the ocean, these nutrients fuel an increase in phytoplankton and zooplankton populations. This is what the COTS larvae feed on. Under normal conditions, many of the COTS larvae will die from starvation, but with increased food supply, many more survive. 2) COTS' predators, the titan triggerfish and Triton's trumpet, are overfished. COTS populations go unchecked without these predators being present. The effects of the increase in the COTS population have devasting effects for corals too. COTS primarily feed on hard coral. When their populations explode, they can decimate a coral reef by eating most of the coral.
12. Using the COTS example, show how the food web is affected when there is a disturbance to a coral reef. Explain to students that there has been a COTS outbreak (too many COTS) because titan triggerfish and Triton's trumpet have been overfished. Ask the student with the COTS card to lightly tug on the string. Then ask students to raise their hand if they are directly connected to that organism (e.g., eaten or eats).

Q: "What happens if the COTS population explodes? What organism(s) are directly affected?"

A: *Coral is directly affected because COTS eat coral. The titan triggerfish and Triton's trumpet would also have an abundance of food to eat; however, in this scenario, their populations have decreased due to overfishing. Without these predators, COTS populations go unchecked. Students representing COTS, hard coral, titan triggerfish and Triton's trumpet should continue to keep their hands raised.*

Q: "What do you think happens to the coral population when a COTS outbreak occurs?"

A: *Too many COTS can reduce the number of coral on a reef.*

13. Now, have the student representing coral lightly pull on their string(s). Ask:

Q: "What organism(s) are directly affected by this?"

A: *The students representing "Drupella" snails, butterflyfish, parrotfish, and titan triggerfish should feel the tug because they all consume coral. Zooplankton should also feel the pull because they are consumed by coral. Students representing butterflyfish, COTS, "Drupella" snails, hard coral, parrotfish, titan triggerfish, Triton's trumpet, and zooplankton should continue to keep their hands raised. Students should recognize that if there are few to no corals, these organisms (except zooplankton) will have lost some portion of their diet (coral).*

14. Next, instruct students representing *Drupella* snails, butterflyfish, parrotfish, titan triggerfish, and zooplankton lightly pull on their string(s). Ask:

Q: "What organism(s) are directly affected by this?"

A: *Many other students will raise their hands. Continue with this line of questioning until all students' hands are raised. Afterwards, they can put their hands down.*

Q: "When one organism is removed from the food web, what organisms are affected?"

A: *All organisms in the food web are affected in some way when a disturbance occurs in a food web. Some of these changes are small, but others can create instability in the food web. There are limited resources (nutrients and food) in a food web. When one population becomes too large or is greatly reduced, they can deplete resources that other organisms rely on for survival.*

15. When finished, collect the organism cards and yarn.
16. Instruct students to answer questions on **Lesson 1: Stringing it Together** student worksheet.

Name: ____________________________ Date: _____________

Khaled bin Sultan Living Oceans Foundation

LESSON 1 STRINGING IT TOGETHER

INSTRUCTIONS: Follow the instructions below.

1. Draw four different food chains below. Make sure to draw matter and energy arrows in the correct direction. Write the feeding strategy(s) for each organism in each food chain above the organism (producer, herbivore, carnivore, omnivore, or decomposer).

   a. Coral Reef Food Chain #1

   b. Coral Reef Food Chain #2

   c. Coral Reef Food Chain #3

   d. Coral Reef Food Chain #4

2. Choose one of the food chains that you created previously. Include the sun and decomposers and heat, waste, and nutrient arrows in your drawing. Make sure to include additional matter and energy arrows.

3. Answer the following questions.
   a. What is the main source of energy in the coral reef ecosystem? Explain.

   b. Which organisms are producers?

   c. Which organisms are herbivores?

   d. Which organisms are carnivores?

   e. Which organisms are omnivores?

   f. What is the difference between a decomposer and a detritivore?

   g. Which organisms are detritivores?

   h. Why are decomposers important in an ecosystem?

   i. Are there any organisms that have more than one feeding strategy (producer, consumer, decomposer)? If so, list the name of the organism and the different feeding strategies that they use.

   j. In your own words, describe how matter cycles through an ecosystem.

k. In your own words, describe how energy flows through an ecosystem.

l. Do food webs show detailed information about diets of each organism? What other types of information would you like to know about their diets that would be useful when trying to understand the feeding connections in an ecosystem? Explain.

m. What natural or human disturbances can cause the coral reef food web to become unstable? List three types of disturbances.

n. How do disturbances affect the food web? Provide one example of a disturbance.

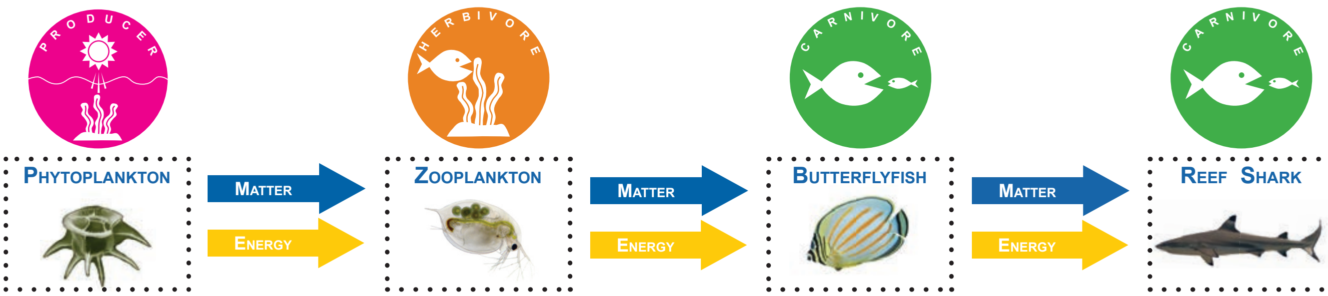
Khaled bin Sultan Living Oceans Foundation

LESSON 1 STRINGING IT TOGETHER

INSTRUCTIONS: Follow the instructions below.

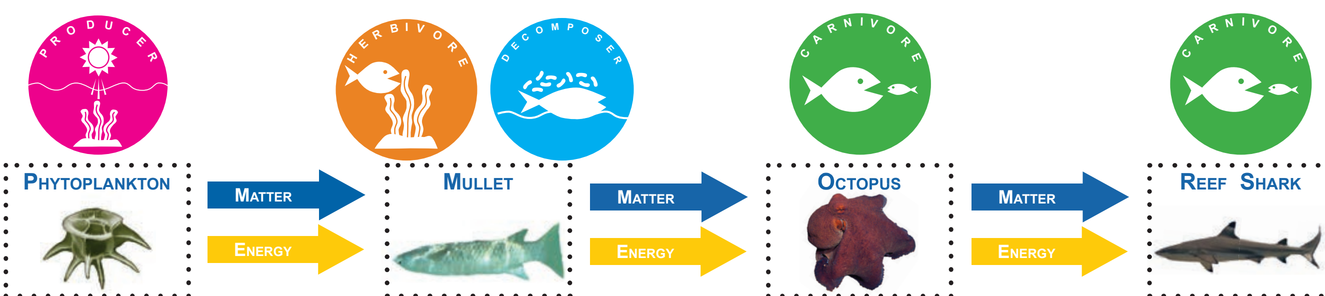
1. Draw four different food chains below. Make sure to draw matter and energy arrows in the correct direction. Write the feeding strategy(s) for each organism in each food chain above the organism (producer, herbivore, carnivore, omnivore, or decomposer).

    a. Coral Reef Food Chain #1

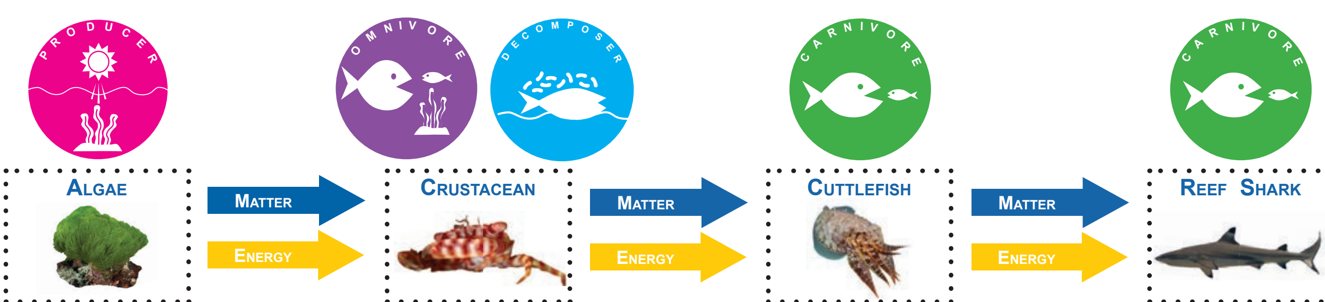


    b. Coral Reef Food Chain #2

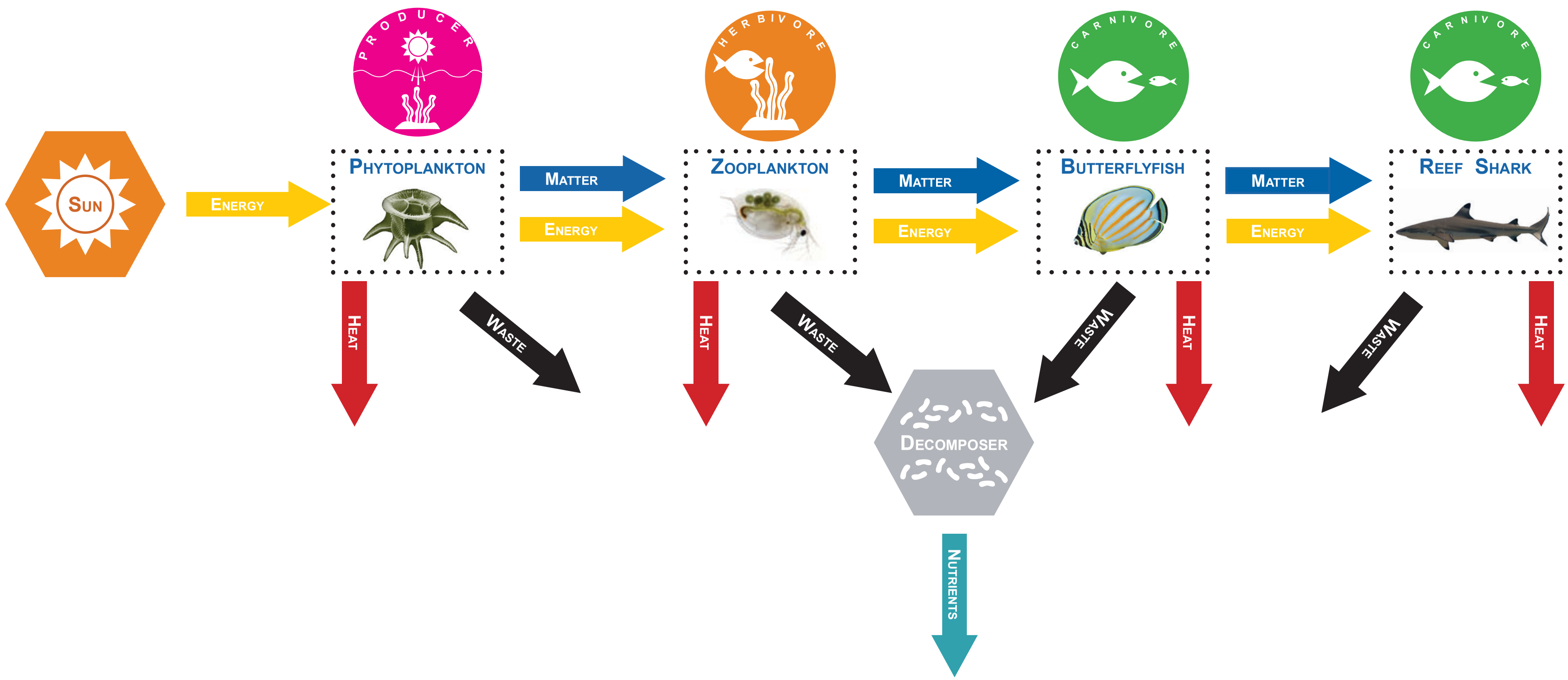
    c. Coral Reef Food Chain #3

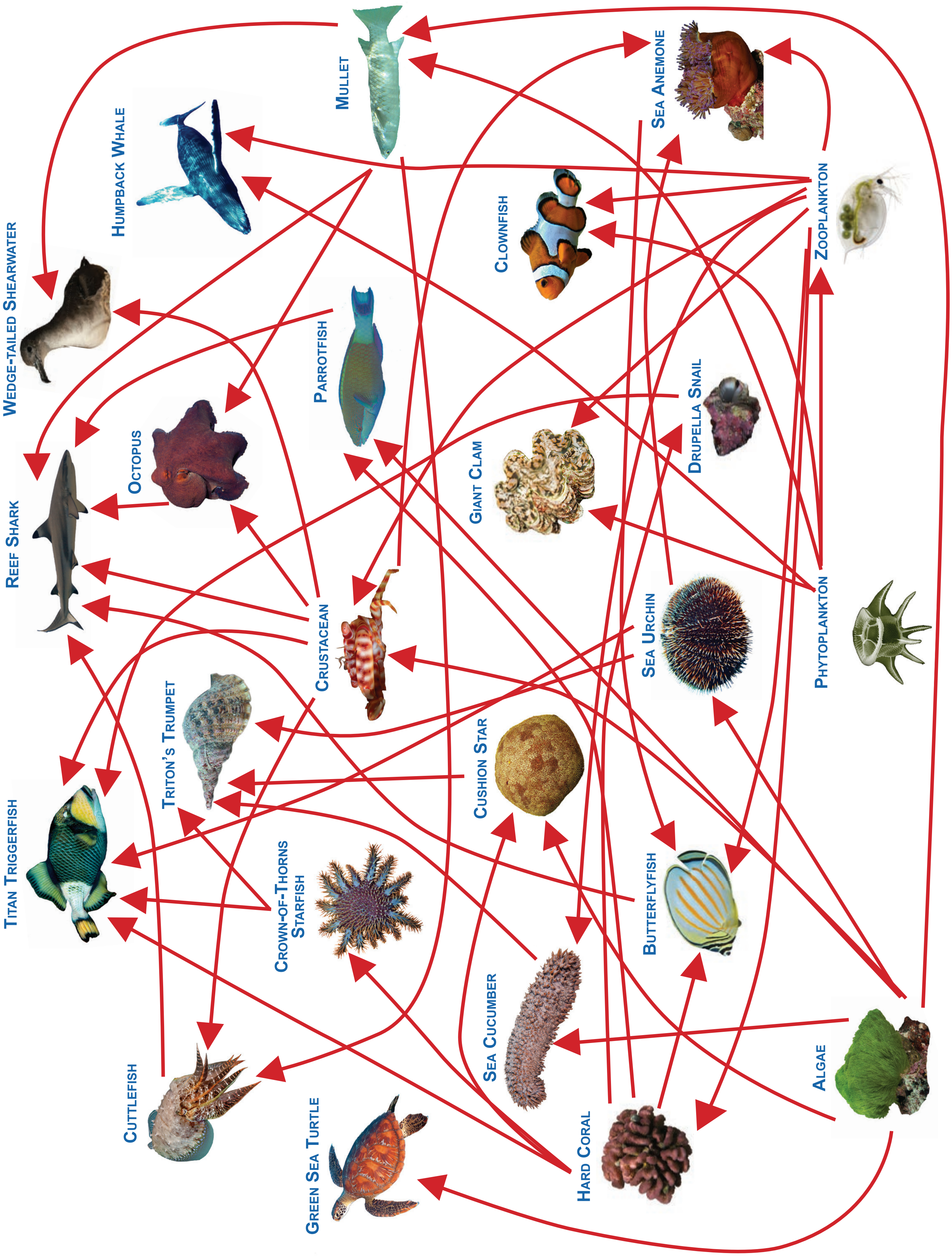


    d. Coral Reef Food Chain #4



2. Choose one of the food chains that you created previously. Include the sun and decomposers and heat, waste, and nutrient arrows in your drawing. Make sure to include additional matter and energy arrows.




Mullet
Humpback Whale
Wedge-tailed Shearwater
Sea Anemone
Clownfish
Zooplankton
Parrotfish
Octopus
Reef Shark
Drupella Snail
Giant Clam
Crustacean
Sea Urchin
Phytoplankton
Triton's Trumpet
Cushion Star
Titan Triggerfish
Crown-of-Thorns Starfish
Butterflyfish
Sea Cucumber
Algae
Cuttlefish
Green Sea Turtle
Hard Coral

3. Answer the following questions.
   a. What is the main source of energy in the coral reef ecosystem? Explain.
   The sun is the main source of energy. Phytoplankton and algae use energy from the sun to create food.

   b. Which organisms are producers?
   Algae and phytoplankton

   c. Which organisms are herbivores?
   Green sea turtle, mullet, sea urchin, and zooplankton

   d. Which organisms are carnivores?
   Anemone, butterflyfish, crown-of-thorns starfish, cuttlefish, *Drupella* snails, hard coral, octopus, reef shark, titan triggerfish, Triton's trumpet, and wedge-tailed shearwater.

   e. Which organisms are omnivores?
   Clownfish, crustaceans, cushion star, giant clam, humpback whale, parrotfish, and sea cucumber

   f. What is the difference between a decomposer and a detritivore?
   A detritivore directly consumes the dead organism gaining matter, but the decomposer breaks down the matter into inorganic nutrients.

   g. Which organisms are detritivores?
   Crustaceans, mullet, and sea cucumber

   h. Why are decomposers important in an ecosystem?
   Decomposers are essential to cycling matter through the living and nonliving parts of an ecosystem. Without them, waste and dead organisms would accumulate. There wouldn't be enough matter to support an ecosystem.

   i. Are there any organisms that have more than one feeding strategy (producer, consumer, decomposer)? If so, list the name of the organism and the different feeding strategies that they use.
   - **Crustaceans (decomposer and consumer)**
   - **Mullet (decomposer and consumer)**
   - **Sea Cucumber (decomposer and consumer)**

   j. In your own words, describe how matter cycles through an ecosystem.
   Matter in an ecosystem consists of the abiotic and biotic nutrients. Atoms, molecules, and ions are cycled repeatedly on Earth between the biotic and abiotic parts of an ecosystem. They recombine to create different forms of matter, and some even change states (solid, liquid, and gas), but according to the Law of Conservation of Mass, they are not created or destroyed. If someone were to count the number of atoms on Earth millions of years ago, they would be the same number as today. The difference would be that these atoms have recombined forming different forms of matter.

k. In your own words, describe how energy flows through an ecosystem.
Unlike matter, energy does not cycle repeatedly in an ecosystem. Energy flows one-way into and out of an ecosystem. Energy primarily enters an ecosystem as sunlight and is used by plants to produce glucose through the process of photosynthesis. Glucose can also be produced using the process of chemosynthesis. Some of that energy then flows to the organism and the rest is lost as heat to the ecosystem. The energy is not "created" by plants. It comes from the sun. The energy is also not "destroyed." It is stored and used by the plant. Organisms that cannot make their own glucose consume other organisms.

l. Do food webs show detailed information about diets of each organism? What other types of information would you like to know about their diets that would be useful when trying to understand the feeding connections in an ecosystem? Explain.
Food webs do not show all organisms' dietary information. They show what eats what, but they do not show the amount of each type of prey item that it consumes. It would be useful to know this information when determining how greatly a disturbance can harm the stability of the food web.

Food webs also do not illustrate decomposers. This information is important to understand because it helps to understand how nutrients cycle through the ecosystem.

m. What natural or human disturbances can cause the coral reef food web to become unstable? List three types of disturbances.
Potential answers include overfishing, coral bleaching, ocean acidification, destructive fishing methods, coral mining, boat anchor damage, unsustainable tourism, pollution, sunscreens, hurricanes/cyclones/typhoons, introduction of invasive species

n. How do disturbances affect the food web? Provide one example of a disturbance.
Large disturbances can create instability in the food web. When one population becomes too large or is greatly reduced, they can deplete resources that other organisms rely on for survival. Examples provided will vary.

Cushion Star

Reef Shark

Butterflyfish

Octopus

Butterflyfish

Common Name: Ornate Butterflyfish
Scientific Name: *Chaetodon ornatissimus*
Size: to 18 cm. (7 in.)
Diet:

- Anemone
- Hard Coral
- Zooplankton

Cushion Star

Common Name: Cushion Star
Scientific Name: *Culcita novaeguineae*
Size: to 25 cm. (10 in.)
Diet:

- Algae
- Hard Coral

Octopus

Common Name: Day Octopus
Scientific Name: *Octopus cyanea*
Size: to 80 cm. (2.5 ft.)
Diet:

- Crustaceans
- Mullet

Reef Shark

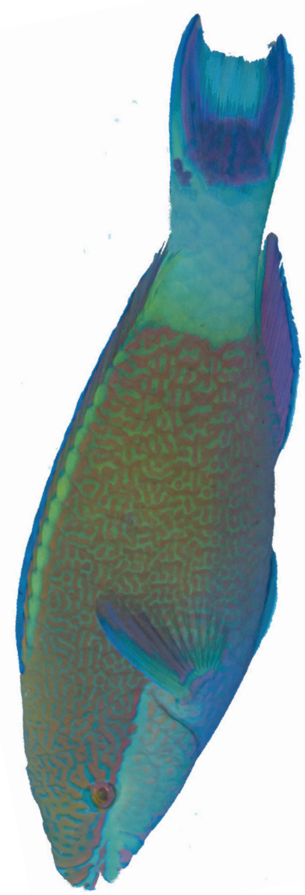
Common Name: Blacktip Reef Shark
Scientific Name: *Carcharhinus melanopterus*
Size: to 180 cm. (7.75 ft.)
Diet:

- Butterflyfish
- Crustaceans
- Cuttlefish
- Mullet
- Octopus
- Parrotfish

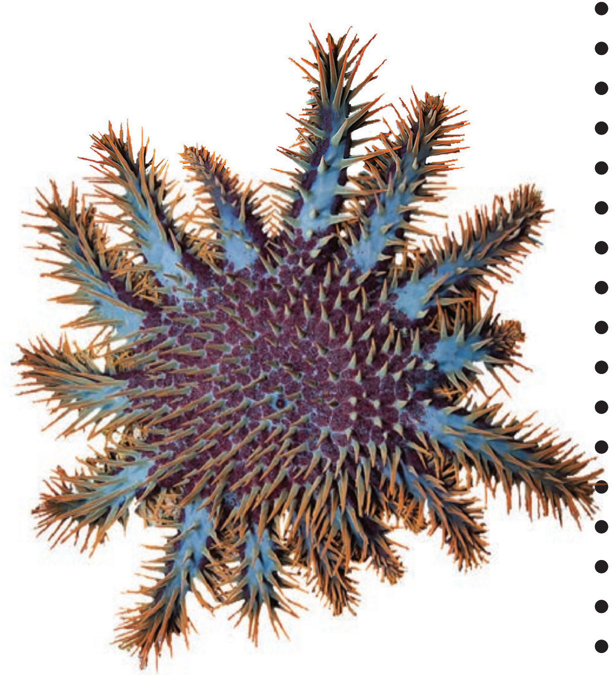
Sea Cucumber

Triton's Trumpet

Parrotfish



Crown-of-Thorns Starfish



Parrotfish

Common Name: Bridled Parrotfish

Scientific Name: *Scarus frenatus*

Size: to 47 cm. (18.75 in.)

Diet:

- Algae
- Hard Coral

Sea Cucumber

Common Name: Pineapple Sea Cucumber

Scientific Name: *Bohadschia graeffei*

Size: to 30 cm. (12 in.)

Diet:

- Algae
- Detritus
- Zooplankton

Crown-of-Thorns Starfish

Common Name: Crown-of-Thorns Starfish (COTS)

Scientific Name: *Acanthaster planci*

Size: to 40 cm. (16 in.)

Diet:

- Hard Coral

Triton's Trumpet

Common Name: Triton's Trumpet

Scientific Name: *Charonia tritonis*

Size: to 50.8 cm. (20 in.)

Diet:

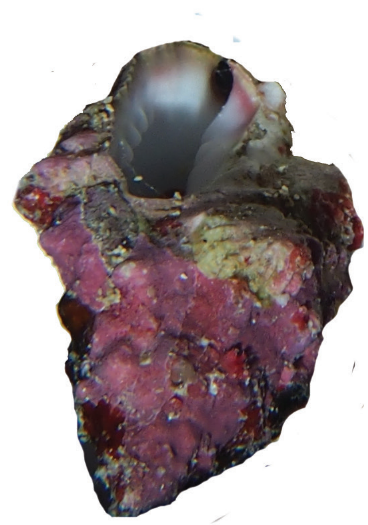
- Crown-of-Thorns Starfish
- Cushion Star
- Sea Cucumber
- Sea Urchin

Titan Triggerfish

Humpback Whale

Giant Clam

Drupella Snails



Giant Clam

Common Name: Giant Clam
Scientific Name: *Tridacna gigas*
Size: to 1.5 m. (4.92 ft.)
Diet:

- Phytoplankton
- Zooplankton

Titan Triggerfish

Common Name: Titan Triggerfish
Scientific Name: *Balistoides viridescens*
Size: to 75 cm. (2.5 ft.)
Diet:

- Crustaceans
- *Drupella* Snails
- Hard Coral
- Crown-of-Thorns Starfish
- Sea Urchin

Drupella Snails

Common Name: *Drupella* Snails
Scientific Name: *Chaetodon kleinii*
Size: to 4 cm. (1.25 in.)
Diet:

- Hard Coral

Humpback Whale

Common Name: Humpback Whale
Scientific Name: *Megaptera novaeangliae*
Size: to 16 m. (52.5 ft.)
Diet:

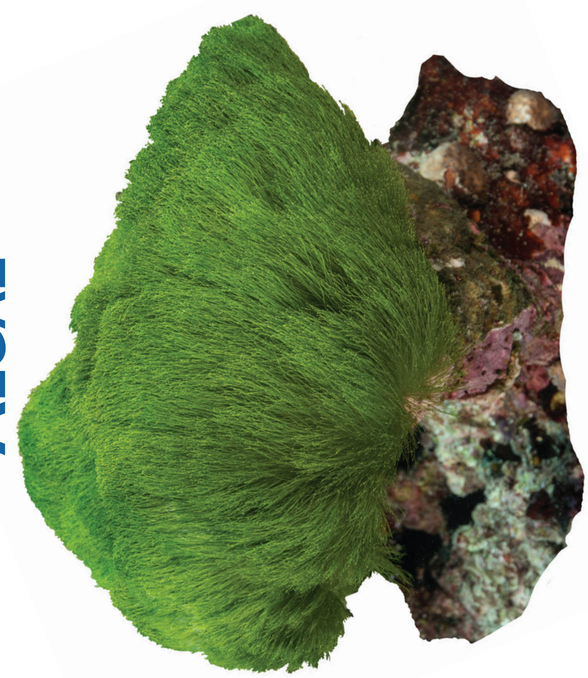
- Phytoplankton
- Zooplankton

HARD CORAL

CLOWNFISH

CUTTLEFISH

ALGAE



Cuttlefish

Common Name: Cuttlefish (unidentified)
Scientific Name: *Sepia spp.*
Size: to 25 cm. (10 in.)
Diet:

- Crustaceans
- Mullet

Hard Coral

Common Name: Cauliflower Coral
Scientific Name: *Pocillopora spp.*
Size: NA
Diet:

- Zooplankton

Algae

Common Name: Green Algae (unidentified)
Size: Dependent on species
Diet:

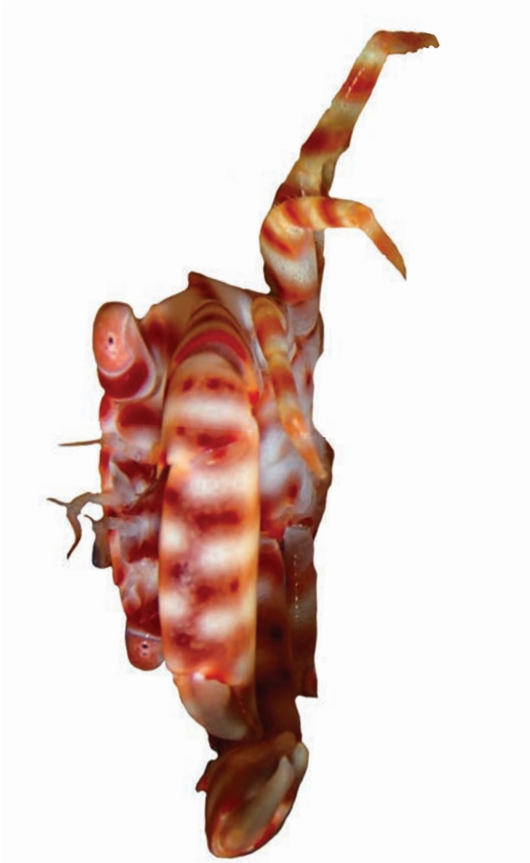
- Sunlight (photosynthesis)

Clownfish

Common Name: Orange Clownfish
Scientific Name: *Amphiprion percula*
Size: to 11 cm. (4.3 in.)
Diet:

- Phytoplankton
- Zooplankton

Crustaceans



Anemone

Green Sea Turtle

Sea Urchin

Green Sea Turtle

Common Name: Green Sea Turtle
Scientific Name: *Chelonia mydas*
Size: to 1.2 m. (4 ft.)
Diet:
- Algae

Crustaceans

Includes: Crabs (in photo), shrimp, lobsters
Size: to 75 cm. (2.5 ft.)
Diet:
- Algae
- Detritus
- Zooplankton

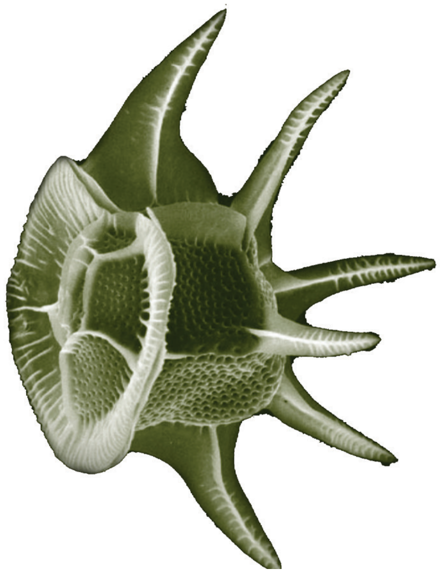
Sea Urchin

Common Name: Sea Urchin (unidentified)
Class: Echinoidea
Size: to 10 cm. (4 in.)
Diet:
- Algae

Anemone

Common Name: Magnificent Anemone
Scientific Name: *Heteractis magnifica*
Size: to 1m. (3.3 ft.) diameter
Diet:
- Crustaceans
- Sea Urchins
- Zooplankton

Phytoplankton



Mullet

Wedge-tailed Shearwater

Zooplankton

Wedge-tailed Shearwater

Common Name: Wedge-tailed Shearwater
Scientific Name: *Ardenna pacifica*
Size: to 46 cm. (18.1 in.)
Diet:

- Crustaceans
- Mullet

Phytoplankton

Common Name: Dinoflagellate
Scientific Name: *Ceratocorys horrida*
Size: 60 microns (in micrograph image)
Diet:

- Sunlight (photosynthesis)

Zooplankton

Common Name: Zooplankton
Size: 1.5-5.0 mm (.059-.2 in.)
Diet:

- Phytoplankton

Mullet

Common Name: Squaretail Mullet
Scientific Name: *Ellochelon vaigiensis*
Size: to 63 cm. (24.8 in.)
Diet:

- Algae
- Detritus
- Phytoplankton


Energy
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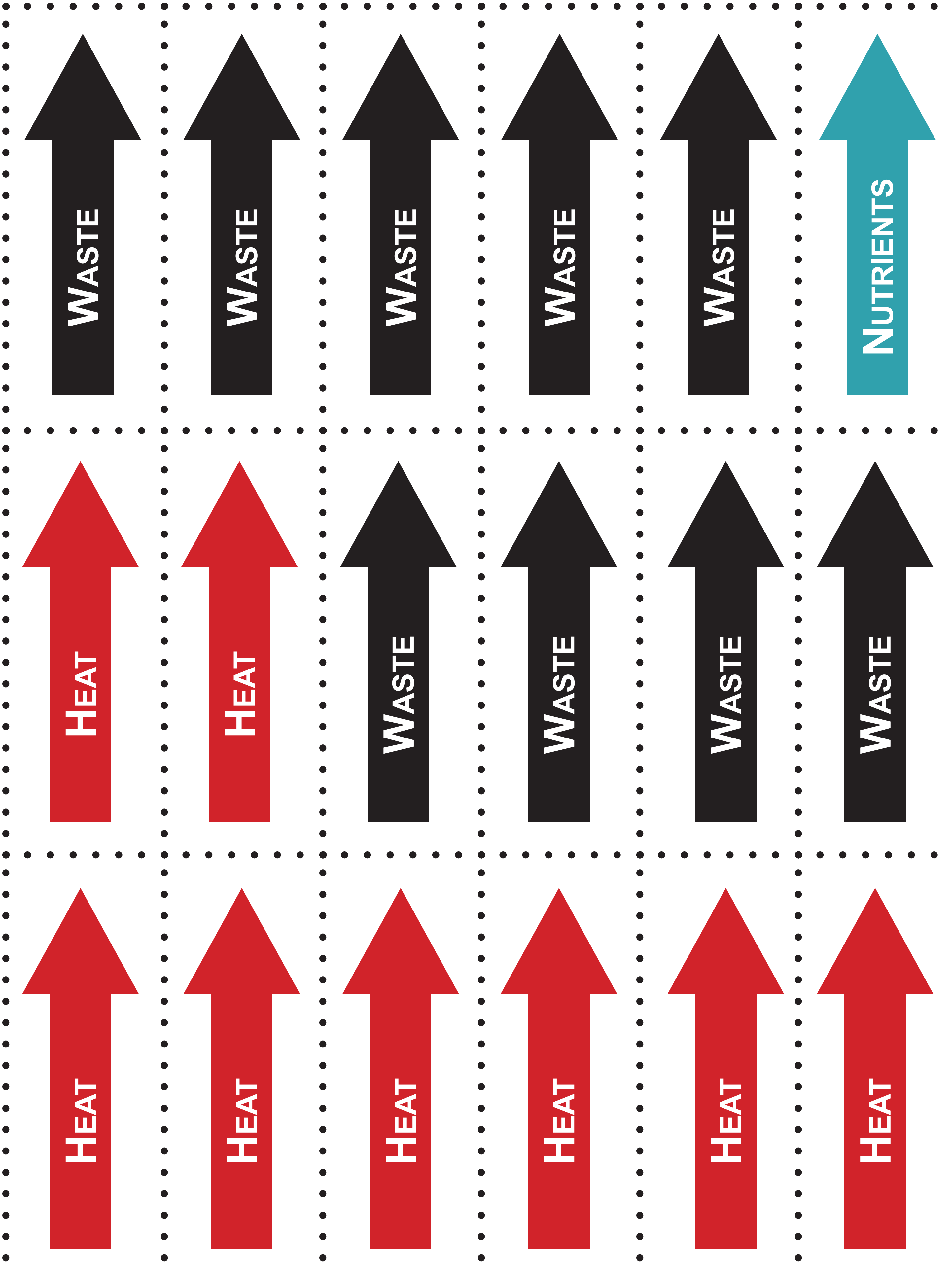
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DECOMPOSER
DECOMPOSER
DECOMPOSER
DECOMPOSER
OMNIVORE
OMNIVORE
OMNIVORE
OMNIVORE
CARNIVORE
CARNIVORE
CARNIVORE
CARNIVORE
HERBIVORE
HERBIVORE
HERBIVORE
HERBIVORE
PRODUCER
PRODUCER
PRODUCER
PRODUCER


Sun


Decomposer

Khaled bin Sultan Living Oceans Foundation

READ IT! Teacher's Notes

Author

- Amy Heemsoth, 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
- *Sharks* blog (*https://bit.ly/sharksGBR*)
- **Read It! Sharks** 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.9-10.1, 2, 4, 5, 7, 8, 10; RST.11-12.1, 4, 10
- **NGSS Practices**: 6, 7, 8

Procedure

1. Have students read *Sharks* blog (*https://bit.ly/sharksGBR*).
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! Sharks** 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.

Name: ______________________ Date: __________

Khaled bin Sultan Living Oceans Foundation

READ IT! SHARKS

INSTRUCTIONS:

1. Read *Shark*, a blog from our Great Barrier Reef, Australia mission (*https://bit.ly/sharksGBR*).
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. How does the first paragraph tie into the rest of the blog (what is its purpose)?

2. What is a shark's trophic level? What is their role on the coral reef?

3. Compare and contrast the shark populations from the previous study to what the scientists are finding on this Great Barrier Reef research mission. Cite specific textual evidence to support this.

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

5. *Top-order predator*, *abundance*, and *fishing regulations* are specific vocabulary for the topic of this blog. Define them below.

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

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

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

9. Describe three things that you learned while reading this blog entry.

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. How does the first paragraph tie into the rest of the blog (what is its purpose)?
   This paragraph provides background information about the importance and role of sharks in the coral reef ecosystem. It also describes the types of sharks, how to identify them, and the coral reef zone that they inhabit on the Australian Great Barrier Reef. This information helps connect the reader to the information in the rest of the blog.

2. What is a shark's trophic level? What is their role on the coral reef?
   Sharks are apex predators, or as mentioned in the blog, top-order predators. They are in low abundance on most reefs because they are a top predator; however, their presence often indicates that the coral reef ecosystem is healthy.

3. Compare and contrast the shark populations from the previous study to what the scientists are finding on this Great Barrier Reef research mission. Cite specific textual evidence to support this.
   Ten years prior, research revealed that fishing had caused shark abundance to decline on the Great Barrier Reef. As a result, fishing regulations were put into place. Ten years later, Dr. Will Robbins observed that the fishing regulations seemed to be having a positive effect because there were more sharks present. Students should have specific quotes to back up this claim, which may vary but might include the following:
   - **"Estimates of reef shark abundance conducted 10 years ago found significant declines in reef shark abundance in areas open to fishing, and in entry-but-no-take zones on the Great Barrier Reef."**
   - **"This research resulted in changes to fishing legislation in 2004, giving reef sharks a greater level of protection."**
   - **"Excitingly, our abundance surveys indicate that the modified fishing regulations are having a positive effect on shark numbers. For example, grey reef shark numbers are much higher than 10 years ago, and encouragingly the biggest increases have been found in management zones previously found to be markedly depleted of sharks."**

4. Did the author fully support his claim? Explain why you think this.
   Answers may vary. Students should explain their reasoning. Suggested answer: Although the author provides evidence that shark abundance seems to be greater than ten years prior, he makes it known that these are only initial observations. Dr. Robbins expresses how these initial observations are encouraging, but that further research is needed to determine if shark abundance has increased. Then the author continues to explain how scientists use a stereo video system to determine the exact size of the shark and make sure that the sharks are not being counted more than once in their abundance results. These results will provide scientists with the ability to later calculate the size structure of each shark population.

5. *Top-order predator*, *abundance*, and *fishing regulations* are specific vocabulary for the topic of this blog. Define them below.
    - **Top-order predator: This is another term for apex predator, which means an organism that resides at the top of the food chain and have few to no predators. They help regulate the food chain.**
    - **Abundance: The number of individuals per species in a given area.**
    - **Fishing regulations: Rules and laws that reduce the threat of destructive and unsustainable fishing practices to aid in rebuilding overfished aquatic and marine ecosystems.**

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

    ***Top-order predators*, such as sharks, typically have a lower *abundance* than their prey because of they are at the top of the food chain; however, when there are few *fishing regulations* in place, their *abundance* can decline to unstable levels.**

7. 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.

8. Do you notice any bias in this writing? If so, what?
   Answers may vary but may note that it seems very factual.

9. Describe three things that you learned while reading this blog entry.
   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.

Khaled bin Sultan Living Oceans Foundation

Read It! Teacher's Notes

Author

- Amy Heemsoth, 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
- *The Faces and Functions of Algae on the Reef* blog (https://bit.ly/functionsalgae)
- **Read It! Faces & Functions Algae** 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.9-10.1, 2, 4, 5, 7, 8, 10; RST.11-12.1, 2, 4, 10
- NGSS Practices: 6, 7, 8

Procedure

1. Have students read *The Faces and Functions of Algae on the Reef* blog (https://bit.ly/functionsalgae).
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! Faces & Functions Algae** 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.

Name: ______________________________ Date: ___________

Khaled bin Sultan Living Oceans Foundation

READ IT!

Faces & Functions Algae

INSTRUCTIONS:

1. Read *The Faces and Functions of Algae on the Reef*, a blog from our Palau mission (https://bit.ly/functionsalgae).
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. What is algae's trophic level? How are algae beneficial to the coral reef food web? Cite specific textual evidence to support this.

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

4. Algae, *competition*, and *eutrophication* 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. Read *Alices' Fishes*, a blog from our Columbia mission (https://www.lof.org/alices-fishes/). Compare and contrast the information about the role of algae on coral reefs (found in this blog) to that from *Alice's Fishes.* Be sure to cite the other sources of information in your answer.

9. Describe three things that you learned while reading this blog (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?
Although algae may often be associated with environmental decline, it provides many benefits to the coral reef ecosystem under normal conditions.

2. What is algae's trophic level? How are algae beneficial to the coral reef food web? Cite specific textual evidence to support this.
Algae are primary producers because they photosynthesize to create their own food. Even though algae can have negative impacts on the coral reef food web, in normal conditions, they are beneficial in many ways. They provide food and habitat for organisms. Different genera have different roles, such as producing sand, providing substrate, and cementing the reef. Students should have specific quotes to back up this claim, which may vary but might include the following:
   - **"They provide important habitat for many small creatures and act as the base of the food chain that fuels the community of coral reef critters."**
   - **"…has branches that contain calcium carbonate—these calcified segments become sand on the reef…"**
   - **"…referred to as the "cement of the reef" because it grows over loose bits of reef and essentially glues them together."**
   - **"Turf is an important food source for herbivorous fishes and sea urchins…"**

3. Did the author fully support her claim? Explain why you think this.
Answers may vary. Students should explain their reasoning. Suggested answer: The author expresses minimal opinions in the blog. She primarily provides factual evidence. In addition to presenting the reasons that algae are beneficial to this ecosystem, she also provides evidence for how algae can become a problem when pollution and overfishing fuel the excess growth of these producers.

4. *Algae*, *competition*, and *eutrophication* are specific vocabulary for the topic of this blog. Define them below.
   - **Algae: (plural for alga) A group of aquatic photosynthetic organisms that are often referred to as "seaweeds."**
   - **Competition: An interaction between organisms of the same or different species that are vying for the same resources.**
   - **Eutrophication: An excess of nutrients in an aquatic ecosystem that stimulates rapid growth of organisms such as algae, phytoplankton, and cyanobacteria, which can lead to adverse effects. Often eutrophication is due to pollution such as dumping sewage, fertilizer, and wastewater into an aquatic ecosystem.**

5. Write a sentence of your own creation that connects the three words from #4, above.
   ***Algae* are in constant *competition* for space and sunlight with corals, but when *eutrophication* occurs, this fuels the rapid growth of algae which can then outgrow corals.**

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 should note that there is factual evidence presented. Responses may also include that the author provides evidence explaining multiple points of view – how algae can be both detrimental and beneficial to coral reefs.

8. Read *Alices' Fishes*, a blog from our Columbia mission (https://www.lof.org/alices-fishes/). Compare and contrast the information about the role of algae on coral reefs (found in this blog) to that from *Alice's Fishes.* Be sure to cite the other sources of information in your answer.
Answers may vary. Students should the similarities and differences between blogs.

Similarities	Differences
• **Herbivores are important in helping regulate algae.** • **Algae can overgrow coral when too many herbivores are removed due to overfishing.** • **Pollution fuels the growth of algae.**	• **The author of *Alice's Fishes* points out that algae can also overgrow corals when they are sick or diseased.** • **Although it is expected that there is a balance between algae, corals, and herbivores in a coral reef ecosystem, perhaps that is not always the case. In *Alice's Fishes*, the author reveals that there are many herbivores, but also plentiful algae. They suspect that perhaps on this reef, there were never large corals that dominated the reef, but perhaps they were always algae-dominated. This blog suggests that not all reefs are alike and that sometimes other environmental factors shape the dynamics of the reef.**

9. Describe three things that you learned while reading this blog (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.

Khaled bin Sultan
Living Oceans
Foundation

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.