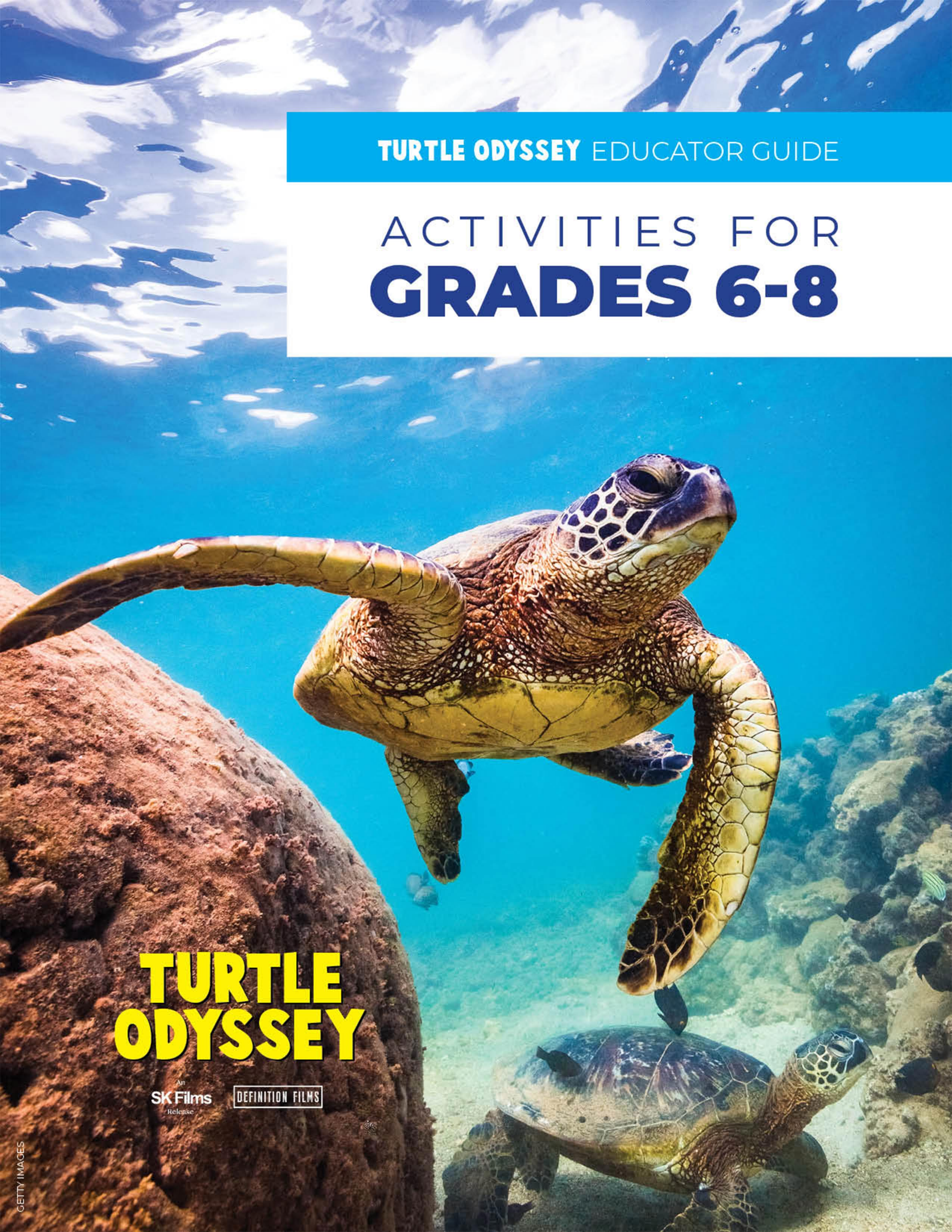
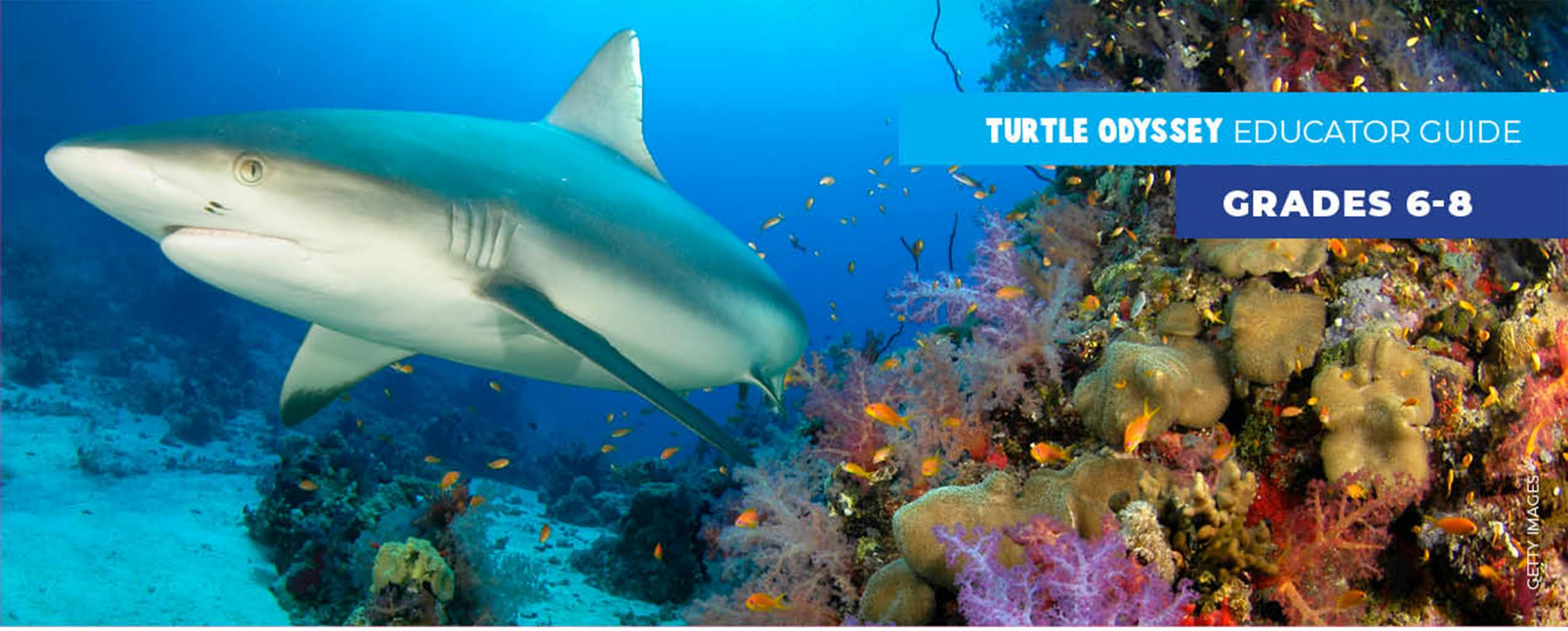
TURTLE ODYSSEY EDUCATOR GUIDE

ACTIVITIES FOR GRADES 6-8



GETTY IMAGES



ACTIVITY 6

Food Webs in a Coral Reef

Introduction

Turtle Odyssey introduces students to the bountiful diversity of organisms living in the ocean. It also offers an opportunity to consider how various organisms get the energy they need to live and the connections between the many animals in our oceans.

Summary

Students are often taught about terrestrial food webs, as they learn about ecosystems and the science ideas related to them. This activity gives them the opportunity to consider how energy and nutrients flow from one organism to another, and includes a simulation to help conceptualize how life is interconnected in a coral reef.

Materials and Preparation

- *Master 6.1, Information Card*
- *Master 6.2, Simulation Cards*, 1 set for a class of 30 students, cut apart
- *Master 6.3, Octopus Cards*, 1 set for a class of 30 students, cut apart
- Access to devices connected to the Internet or other resources to support students in researching organisms

NGSS Performance Expectations

MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MS-LS2-2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect population.

Procedure

1. Begin a brief discussion about food and energy by asking students, "Where do you get the energy you need to do all of the activities you do in a day?" They will likely say from food. Then ask, "Where do humans get our food?" There may be a range of answers, but some students will say that we get it from stores, restaurants, farms, or other locations.

2. Have students discuss the same two questions as they relate to Bunji and the other animals in the ocean.
   a. Where do animals in the ocean obtain the energy they need to do the activities they do, such as swimming?
   b. Where do animals in the ocean get their food?

   Although these questions may seem simple, they help to establish that animals eat to obtain energy and that animals must be able to find food in their surroundings. Do not spend too much time on these questions; however, note that they are important to ensure that students can make make sense of the information they are going to learn about food webs. They will need to understand that animals need energy and they eat food to obtain it.

3. Tell students that they are going to have an opportunity to become an expert on one of the organisms that appeared in *Turtle Odyssey.* As they do this, they will learn about how the organism gets its energy, and which animals obtain energy from it. Assign each pair of students one of the following organisms.
   - Algae
   - Zooplankton
   - Blue tang
   - Leafy sea dragon
   - Manta ray
   - Shark
   - Phytoplankton
   - Coral
   - Green sea turtle
   - Jellyfish
   - Cuttlefish
   - Parrotfish
4. Distribute 1 copy of *Master 6.1, Information Card*, to each pair of students. Have them read over the section headings to ensure they understand the task.
5. Allow students time to research the organism they are studying. You may choose to have them use a device connected to the Internet, or you may wish to provide printed resources or access to the school library during the class.
6. Once the pairs of students have had a chance to complete the information on *Master 6.1, Information Card*, tell them that you are going to work together as a class to create a food web that shows the connections between all of the organisms.
7. Ask for a volunteer pair of students to share the results of their research. They should show the organism, briefly describe it, and explain how it obtains its energy. Then have them attach the card in the space you are using to create the food web.
8. Next, ask which pairs were studying an organism that either gains energy from the living thing on the first posted card or that provides energy to that living thing. Choose a pair from these to share their information next.
9. The group should attach the card in an appropriate place near the first card. Draw or attach an arrow to show the relationship between the two. The arrow head should point toward the organism that receives the energy. For example, if the first two cards are the blue tang and algae, the arrow head should point toward the blue tang because it gains energy from the algae.
10. Discuss the direction of the arrow with students. Ensure that they understand that the arrow indicates the direction in which energy is flowing, not which organism eats the other. You may decide to spend more or less time on this step depending on whether your students have learned about food webs previously. Remind them that photosynthetic organisms like plants would have an arrow pointing from the sun to them because they gain energy from the sun.
11. Continue asking pairs of students to share the information they learned and connect their card to the food web. Remind them that they may need more than one arrow to indicate multiple connections.
12. Tell students that you want to focus in on one part of the food web for the next few minutes. Ask them to look at the food chain that includes jellyfish, green sea turtles, and sharks. Have them predict what might happen if there were suddenly no jellyfish in the ocean. Then tell them that you are going to simulate the connections between these animals. Note that sharks can eat jellyfish, but in this simulation, we will assume that they only eat turtles.
13. Assign a few students to be sharks, more to be green turtles, and the rest to be jellyfish by distributing cards from *Master 6.2, Simulation Cards*. In a class of 30 students, there should be 5 sharks, 10 green turtles, and 15 jellyfish. Tell the students to not show their card to anyone at this point. Run the simulation in the following way.
    a. Write down the number of each animal in a data table on the board.
    b. Have students display their card at the same time. This represents them looking for food. Sharks should try to find a green sea turtle and tag them. Green sea turtles should try to find a jellyfish and tag them. Each person should only tag one other person.
    c. Any green turtle that was tagged will now become a shark. Any jellyfish that was tagged will become a green turtle. (Note that these transfers of role represent well-fed organisms being able to reproduce.) Make sure students receive the appropriate card for their new role. If a student was not tagged, they remain in the role they were in. If a student did not find food (did not tag anyone), they must sit out one round.
    d. Collect and record data about the number of each animal represented at the end of the round. This will represent year 2.

e. Repeat the round with students displaying their cards and determining any new roles. As you enter the next year, any students who sat out a round can rejoin as jellyfish. Be sure to record the data for each round.

f. Continue for at least 8 rounds. If clear patterns have not emerged in the data, you may wish to continue for a few more rounds.

14. Have students examine the data to see what patterns they notice. They should see that when the numbers of some animals increased, the amount of food they had decreased. If the population of an animal became smaller, the population representing their food increased because fewer individuals were eaten.

15. Repeat the simulation, adding in some octopus cards from *Master 6.3, Octopus Cards*. Reduce the number of sharks, green sea turtles, and jellyfish by 2 each to add 6 students playing the role of octopus. Students playing the octopus role will tag students playing the role of jellyfish. The octopus competes with sea turtles for food. Although there are other relationships in this food chain, such as sea turtles and sharks eating octopuses, for this simulation, assume that the only relationship is with jellyfish.

16. Be sure to collect data for each round. With the addition of the octopus cards, students should see that the populations change in different ways from when they had only the simple 3-animal food chain. They should begin to realize that the interactions can lead to complex food webs and that predictions may not be as easily made when more organisms are part of the web.

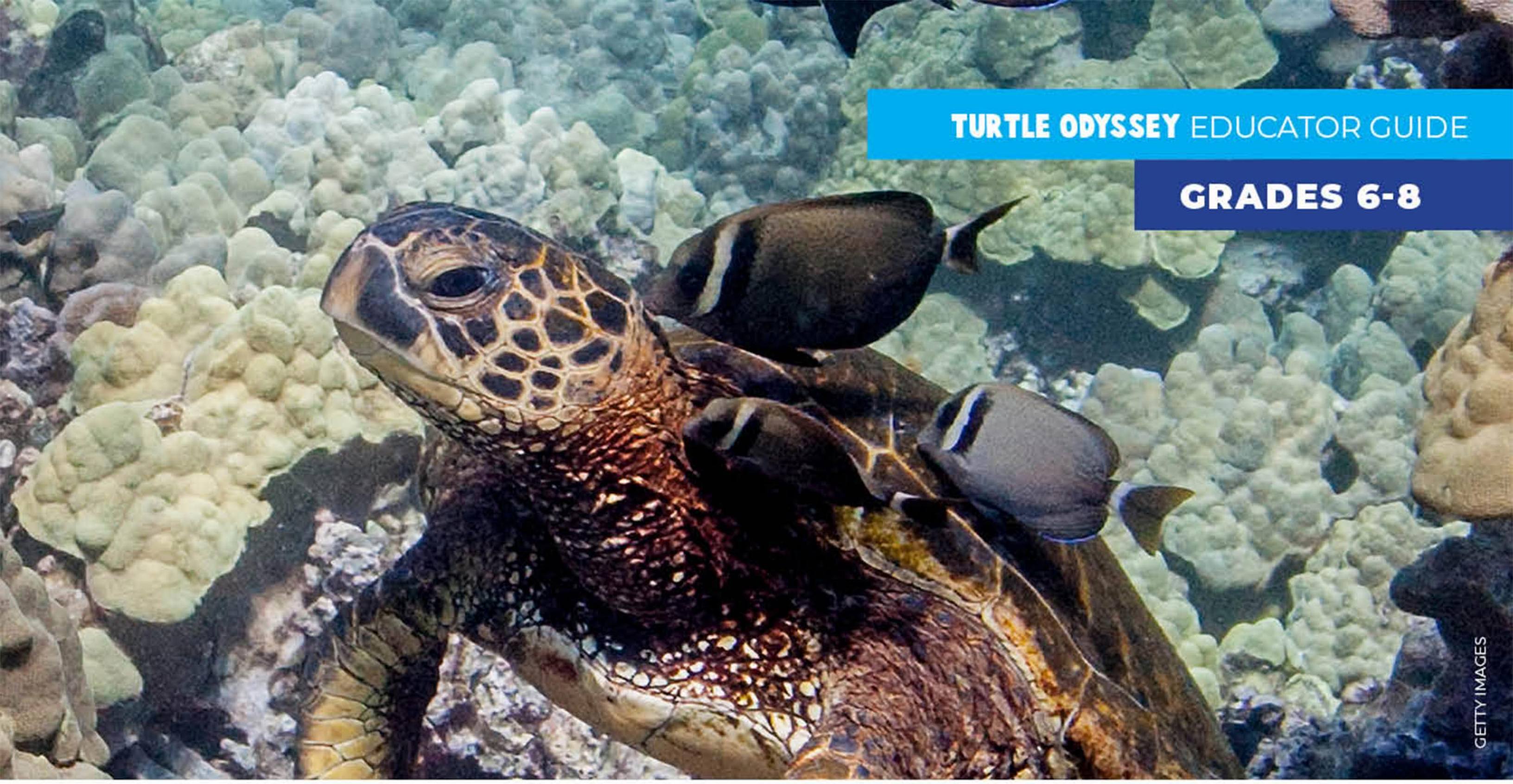
17. Have students return to the class food web. Challenge them to pick an organism and predict what would happen throughout the food web if that organism suddenly disappeared from the ocean. Then ask them to write an explanation to justify their ideas. To do this, students should complete the following steps.

    a. Make a claim. The claim should answer a question of, "What would happen if ___ [organism] disappeared from the ocean?"

    b. Include evidence. Students should list the evidence they have that supports their claim. This might include connections between organisms or data from the simulation.

    c. Add reasoning. Reasoning joins the science ideas to the evidence and helps show why the evidence supports the claim.

18. Lead a class discussion that allows students to share, discuss, and critique others' explanations. The discussion should help students understand that every organism plays a role in food webs. You may wish to further the discussion by sharing ideas about animal conservation or about keeping our oceans clean.



ACTIVITY 7

Relationships in the Ocean

Introduction

Turtle Odyssey includes a great array of relationships between organisms. As in any ecosystem, some relationships are predator-prey to move energy and matter through the system. You also have a chance to witness the cleaning stations of the ocean and the many organisms that live on Bunji, at least temporarily. Are these simply examples of only one animal benefitting from another, or is there more to these relationships?

Summary

In this activity, students will have a chance to explore the symbiotic relationships in the ocean. This will help them understand the complexity of the interconnectedness in an ecosystem.

Materials and Preparation

- *Master 7.1, Relationship Card Set*, 1 per group of 3 students, cut apart in advance
- *Master 7.2, Symbiotic Relationships*, 1 per group

NGSS Performance Expectations

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

Procedure

1. Ask students to think about how a sea turtle and a jellyfish are connected to one another. In other words, what is the relationship between a sea turtle and a jellyfish? Students are likely to know that sea turtles eat jellyfish.
2. Ask, "Do you think there are any other kinds of relationships between different species of animals besides one eating another?" Accept all answers at this point and use their ideas to understand where they are in their understanding about relationships in the natural world.
3. Distribute card sets from *Master 7.1, Relationship Card Set*, to groups of 3 students. Ask them to read through the different relationships in the natural world.
4. After students have had a chance to read the cards, ask if there were any that particularly interested them and allow time to share.
5. Have students try to categorize the cards. Do not give them specific instructions on how to do this, but tell them to see if they can find patterns among the relationships on the cards.
6. Ask students to describe how their groups sorted the cards. Again ask them to look for patterns in the way they categorized the relationships.

7. Tell students that each of the relationships on the cards represent symbiosis. Write the following definition on the board. "A symbiotic relationship is any long-term relationship between two or more species."

8. Have students pick the card that shows a relationship that was interesting to them. Ask them to consider how it represents symbiosis and discuss it with their groups.

9. Next, tell students that there are 3 types of symbiotic relationships that are represented by the cards. Provide each group with a copy of *Master 7.2, Symbiotic Relationships*. Ask them if they can assign a type of symbiotic relationship to their categories as they have them divided.
   - If so, the group should decide which definition fits each category of cards.
   - If not, tell them that they may resort their cards to assign each card to one of the relationships.

10. Direct students to do a gallery walk to look at the way at least 2 other groups sorted their cards. Allow time for students to ask questions of other groups related to the way they sorted their cards or clarify information about the relationships on the cards.

    For your information, the proper sorting of cards should be as follows.

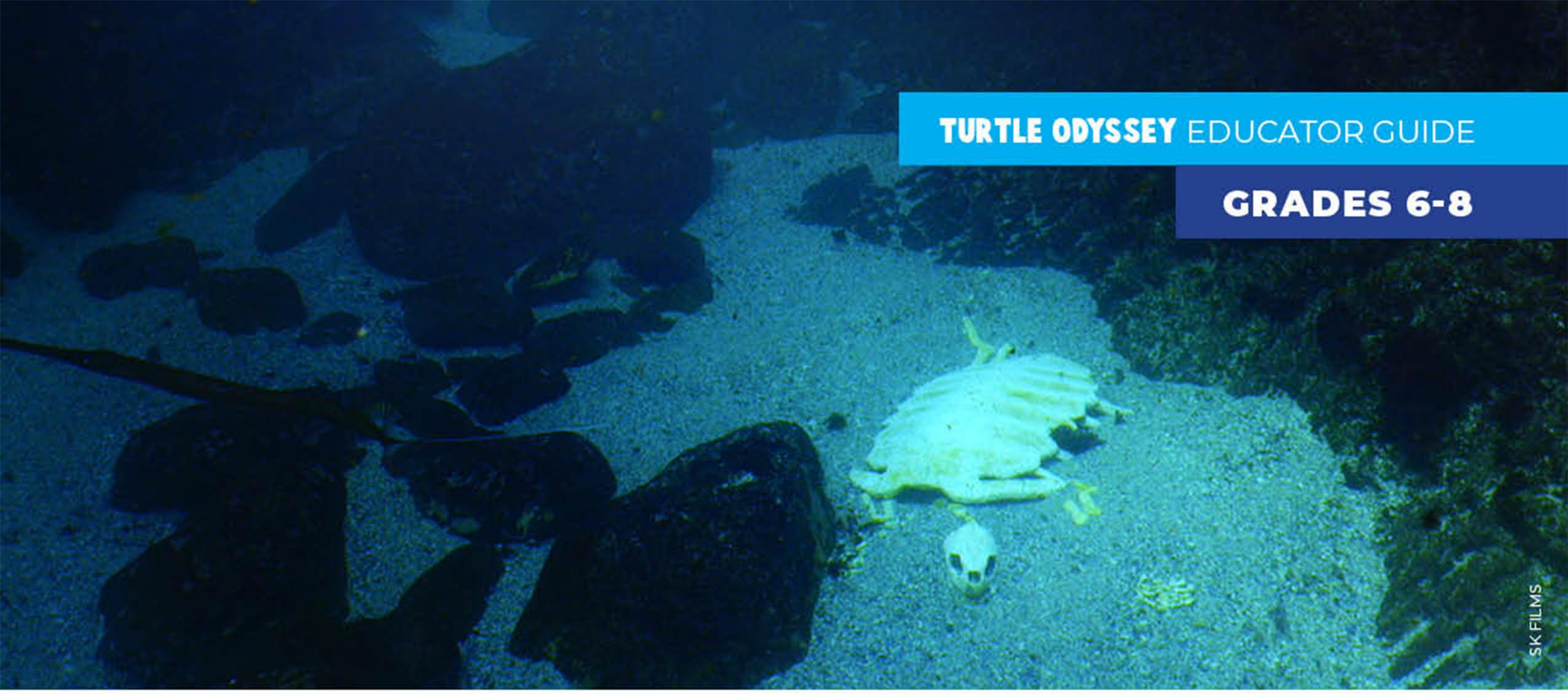
    Mutualism
    - Cleaner fish and sea turtle
    - Decorator crab and sponge
    - Sea turtle and sea grass bed
    - Coral polyps and zooxanthellae
    - Pollinator and plant
    - Ant and aphid
    - Clownfish and anemone

    Commensalism
    - Spider and Plant
    - Whale and Barnacle

    Parasitism
    - Human and tick
    - Fish and isopod
    - Ocean sunfish and sea lice

11. Ask students to develop an explanation to describe the type of relationships represented by
    a. a sea turtle covered in parasites, looking for an ocean cleaning station, and
    b. a sea turtle being cleaned in an ocean cleaning station.

    If your students have had experience with claim, evidence, and reasoning, you may wish to have them structure their explanations in that way. If not, ask them to write a paragraph that tells which kind of relationship(s) are represented, gives examples of the organisms involved, and provides a description of how each organism is benefitted, harmed, or is unaffected.



ACTIVITY 8

Ancient Turtles

Introduction

In *Turtle Odyssey*, Bunji swims by an old turtle skeleton and you hear that turtles have remained largely unchanged for 100 million years. How do scientists know this? Why would sea turtles have kept their characteristics over that period of time?

Summary

In this activity, students will have a chance to consider the evidence scientists use to claim that turtles have remained unchanged for so many years. They will also describe ideas for why turtles have stayed the same.

Materials and Preparation

- Display copy of *Master 8.1, Bunji and the Turtle Skeleton*
- Display copy of *Master 8.2, Fossils*
- 1 copy of *Master 8.2, Fossils*, per student
- Different-colored pens or pencils

NGSS Performance Expectations

MS-LS2-4. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

Procedure

1. Display a copy of *Master 8.1, Bunji and the Turtle Skeleton*. Tell students that they saw this image in the movie as Bunji swam into a cave. Ask, "What features of this skeleton are like those of a turtle?" Give students time to share.

2. Tell students that scientists can learn a lot about plants and animals that lived in the past through fossils. Ask if they have heard of fossils and what they know about them.

3. Once students have shared their ideas, post a simple definition of a fossil, "Fossils are the remains or the impression of an organism that lived long ago."

4. Share with students that they are going to have a chance to look at some fossils and determine if any of them are evidence of turtles living long ago. Distribute and project *Master 8.2, Fossils*.

5. Ask students to write a claim to answer the question, "Which of the fossils, if any, are from a turtle that lived long ago?" Tell them that they will have a chance to revise their answer at a later time, but to write their first impression.

6. Underneath the claim, students should draw a 2-column table. The left side should be labeled, "Evidence" and the right side should be labeled, "Reasoning."

7. Have students work with their groups to write evidence for their answer in the left column of the table. They should list at least 3 to 5 pieces of evidence about the fossil they chose. Use your discretion about how many pieces of evidence are reasonably for your class. You may wish to suggest that the evidence be written in the form of I see statements. For example, "I see that fossil X has 4 legs."

8. Once students have the statements written about the fossil they chose, they should add at least 1 piece of evidence about each of the remaining fossils describing why they think it is something other than a turtle. An example might be, "I see that fossil Y does not have a tail."

9. Ask students to write their reasons or justification for their evidence in the right column. For each piece of evidence, they should list their reasoning on the same line in the right column so that evidence statements and reasoning statements are paired. An example of might be, "Turtles have four limbs that they use for walking, swimming, or digging, depending on the type of turtle. Fossil Z has four limbs, so that supports that it might be a turtle." They should write reasoning for the statements about the fossil they chose and about the statements that describe why other fossils are not turtles.

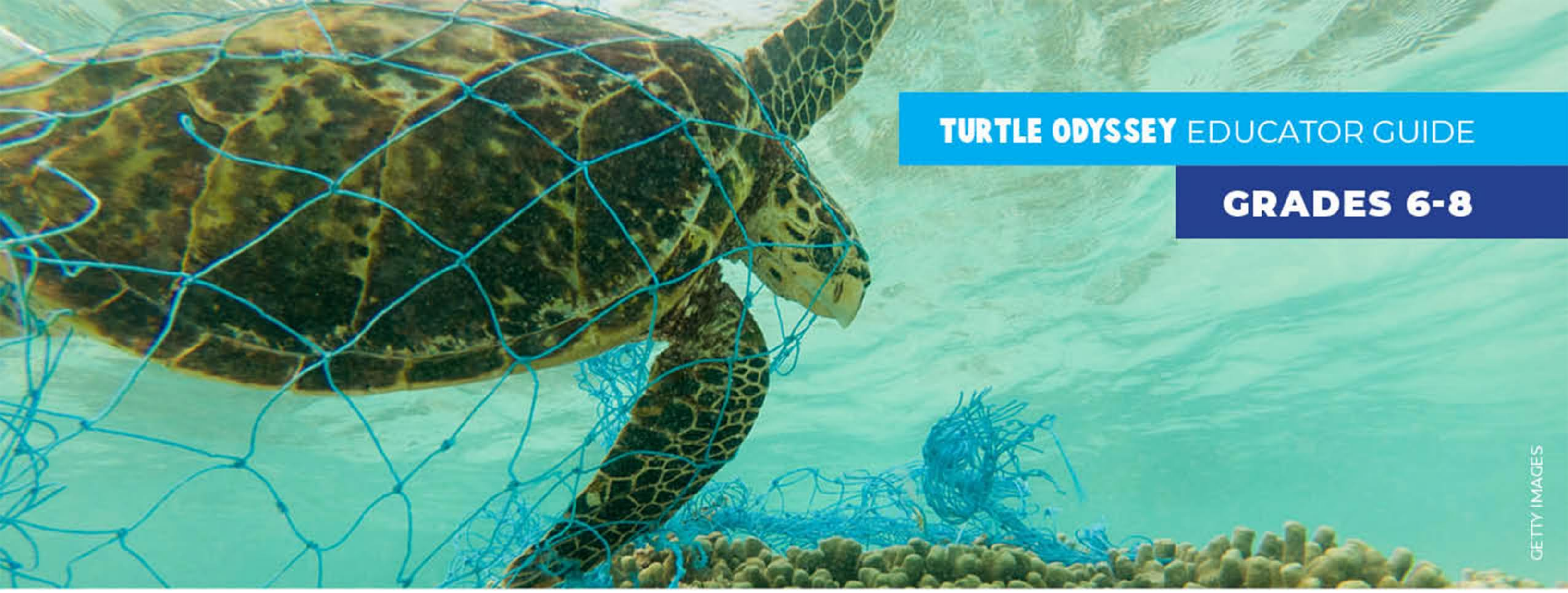
10. Have students read through each piece of evidence with its paired reasoning statement. Ask them to determine the 4 pieces of evidence and reasoning that make the strongest argument for the fossil they chose and draw a star next to those statements.

11. Ask students to write an explanation for which fossil represents a turtle that lived long ago. To do this, they should write their claim, followed by 4 sentences that join their best evidence and reasoning statements together.

12. Have students pair with a partner and read their explanations to one another. Then ask them to share constructive feedback about their partner's explanation. You may need to give examples of constructive feedback to help students know what is expected.

13. Provide students with different-colored pens or pencils. Then tell them to revise their explanations based on the feedback they received. They should use a different color so that they can track their learning.

14. Lead a class discussion about what features helped them recognize Fossil B as a turtle. Ask why they think that turtles have not changed much over time. Ask them to relate their ideas to the places turtles live, the activities they carry out, or the functions of different parts of their bodies.



ACTIVITY 9

Animal Restoration Plans

Introduction

According to the IMAX® film *Turtle Odyssey*, humans are the greatest threat to Bunji. Often, green sea turtles are impacted by humans' poor management and actions. Consider the ways in which we must monitor species in order to prevent unnecessary harm through human intervention. Green sea turtles are hurt by boats and plastic pollution. What are some ways that this can be managed?

Summary

In this activity, students have an opportunity to study some example animal restoration plans. They then work in small groups to write a basic restoration plan for an animal.

Materials and Preparation

- Device with Internet access
- Poster board and markers, or presentation software, depending on desired presentation format
- Chart to show the key components of an animal restoration plan (see list in step 11)

NGSS Performance Expectations

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Procedure

1. Introduce students to the idea of human management of animals using a description from part of the movie *Turtle Odyssey*.

   Dr. Ian Bell is a part of the Threatened Species Unit, working to tag and track green sea turtles. The data collected is a combination of the efforts of government agencies and citizen scientists. Research has indicated that there are only half of the number of sea turtles in the ocean now compared with 100 years ago.

2. Ask students to share their ideas about why tagging and tracking green sea turtles might help them. Do not correct them at this point, but gather as many ideas as possible.

3. Share another section from the movie.

   The film highlights the success story of the humpback whale. They were once critically endangered due to hunting, however in recent years they have made a full recovery off the East Coast of Australia.

4. Ask students to share any ideas they have about how the humpback whales might have made such a recovery, and what changes humans might have had to make. Again, do not correct them at this point, but do limit them to reasonable answers.

5. Tell students that scientists are working to help other populations of threatened animals recover. One example is the alligator snapping turtle. Show the video found at this website to introduce them to these turtles: **www.prweb.com/releases/2017/05/prweb14358550**. Have students discuss the video and what they noticed.

6. Have students work in groups of 4 to get additional information about the research on alligator snapping turtles. Have the groups divide themselves so that two members read each of the following articles. As they read, they

should look for information that will help them answer the questions in step 8. Share these questions with them by writing them on the board or projecting them.

a. **www.prweb.com/releases/2017/05/prweb14358550**

b. **www.tnaqua.org/newsroom/entry/scouring-the-swamp-aquarium-scientist-radio-tagging-ancient-looking-alligat**

7. Ask students who read the same article in a group to discuss their ideas. Then have the pairs share what they read with the other half of the group.

8. Lead a class discussion on the following questions.

   a. What are Dr. Ennen's research goals?

   b. What has been a historic threat to the alligator snapping turtle?

   c. In what ways is the alligator snapping turtle different than the green sea turtle from the film?

   d. The scientists are using radio tags to locate the turtles that have been caught. They use passive integrated transponder (PIT) tags, which can be coded with information and then read withing having to sacrifice the animal that has been tagged with it. Why do they want to know where the turtles are going? Is this similar to or different from the tagging of green sea turtles in the film?

9. Share the following with students.

   Dr. Ennen says, "By extending our research of these long-lived animals, we'll be able to develop a more complete picture of their numbers and individual health. That way, we'll be better prepared to write a recovery plan if we determine these turtles should be listed as endangered." Remember this as we move into our next activities.

10. If you would like students to learn more about global recovery efforts before moving to the next activity in the lesson, divide the following reading up so that each student reads about one animal then shares the information they read.

    www.theguardian.com/environment/2018/jun/03/rewilding-conservation-bison-wolves-beaver-giant-tortoise-tigers

11. Display the chart showing the components of successful restoration plans. In particular, ask students to discuss why each of the components is important to make sure that a plan is successful.

    - An understanding of the species history, physical characteristics, behavior and social organization, population characteristics, habitat conditions, and distribution
    - A goal for the recovery plan
    - Requirements for recovery
    - Desired areas for recovery (habitat, range, etc.)
    - Implementation
    - Monitoring

12. Have students work in small groups to create a simple animal restoration plan for one of the following animals.

    - Green sea turtle
    - Leatherback sea turtle
    - Black rhino
    - Amur tiger
    - Asian elephant
    - Blue whale
    - Bluefin tuna

    Allow time for groups to research the animal then have them choose 1 threat to the animal. They should use that as the basis for their plan. Continue to display the chart of the components of a successful restoration plan as they work. Ask that they label and address each component.

13. Have groups outline their species recovery plan in class. Consider including some or all of the following discussion questions.

    - Why did you choose the species you did?
    - In what ways is your specific species threatened or endangered?
    - What were some of the difficulties you encountered when developing your species restoration plan?
    - In what ways is your species specifically impacted, whether positively or negatively, by human influence? Is this something to consider when developing a species restoration plan?

14. Lead a discussion about the ways in which different groups' plans were similar and different. Wrap up by pinpointing ways in which students could contribute to the restoration of various species. These efforts can be as simple as planning a beach clean-up or as wide as writing their local representatives to highlight the ways in which they value protecting species.

Extension: If students would like to learn more about endangered species in the area where they live, share the U.S. Fish and Wildlife Service Endangered Species page. **www.fws.gov/endangered/map/index.html**

ACTIVITY 10

Changes in the Ocean

Introduction

In the film *Turtle Odyssey*, the narrator states: "Strangely, for such an ancient creature, the biggest threat to her survival is a relative newcomer—humans." What impact are humans having on the ocean? As the world has become more industrialized, humans have developed technologies that release more carbon dioxide into the atmosphere. Much of the information about carbon dioxide and other greenhouse gases relates to the impact on global temperature and atmosphere. However, the ocean is also absorbing more carbon dioxide and it is taking a major toll on the life within.

Summary

Students will watch a demonstration that represents the impact of ocean acidification on the organisms that live there. They will then have a chance to use news articles to learn more about the impacts of climate and ocean changes on reef habitats around the world.

Materials and Preparation

- 2 identical clear jars or beakers, one labeled "250 years ago" and one labeled "today"
- Salt water, made with 3.5 g salt in 100 mL water
- Acidic salt water, made with 3.5 g salt in 1 mL vinegar and 99 mL water
- 3 short pieces of chalk (use chalkboard chalk; sidewalk/molded chalk will not work)
- 3 shells or chicken bones
- Devices for students to access the Internet, or printed copies of news articles

NGSS Performance Expectations

MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment. (Extension)

Procedure

1. Conduct the following demonstration for students.
   a. Place 50 mL of the salt water in the beaker labeled "250 years ago" and 50 mL the acidic salt water in the beaker labeled "today." Do not share the ingredients with students, but tell them that these represent the ocean 250 years ago (before industrialization began) and the ocean today.
   b. Add a piece of chalk to each beaker and leave one next to the beakers as a negative control. Have students observe the changes that occur over the next few minutes. Ask them to write down their observations.
2. Lead a discussion about what might be different between the ocean 250 years ago and today. At this point, simply have students share their ideas, but do not correct them.
3. Tell students that chalk is made of the chemical calcium carbonate. Shells are also made of calcium carbonate. Bones contain some calcium phosphate, which also dissolves in acidic conditions. Corals in the ocean are small creatures called polyps that secrete a skeleton made up of calcium carbonate, also called limestone. This skeleton attaches the polyps to rocks or to other polyps. Ask students, "If this beaker represents the ocean today, what would you predict is happening to some of the life in the ocean?"

4. Let students know that you are going to set up the demonstration again, but this time include shells or bones instead of chalk. Leave the beakers for a week and have students make observations each day. Tell them that after a week they will have a chance to feel the bones/shells.

5. Share with students that ocean water today is more acidic than it was 250 years ago. Humans have developed technologies that have increased the amount of carbon dioxide in the air. Some of this carbon dioxide has been absorbed by the oceans and has lowered the pH of the ocean so it is now more acidic than it used to be. In the demonstration, the water was even more acidic so they could see rapid results. Then ask, "Do you think even slight changes in the pH of the ocean can affect the organisms that live there?" Allow students time to share their ideas.

6. Tell students that they will each have an opportunity to learn about one threat to reefs. Have them join with others to form a group of 4. Then have each student pick an article to read. They should pay attention to the location of the reef and the threat(s) involved.

   www.eurekalert.org/pub_releases/2018-04/uoe-dgb042718

   news.nationalgeographic.com/2016/05/160502-reef-florida-acidification-fish-miami

   www.miamiherald.com/news/local/environment/article210295394.html

   www.npr.org/sections/thetwo-way/2018/05/02/607765760/hawaii-approves-bill-banning-sunscreen-believed-to-kill-coral-reefs

   www.washingtonpost.com/lifestyle/kidspost/hawaiis-coral-reefs-and-fish-face-serious-threats/2017/11/03/ccbd6282-c0d2-11e7-959c-fe2b598d8c00

7. Allow students to join with an expert group of 3 to 4 students who read the same article to discuss the following questions. Remind students that they are the experts for their home group, so they should take notes as they talk so they will be able to share.
   - How are reef ecosystems influenced by the threat you studied? By humans?
   - Were any communities working to protect these ecosystems? How?

8. Have students return to their home groups and allow them time to discuss the threat that they studied.
   - Do all reef ecosystems seem to have similar threats? Explain your answer.
   - What do you think the effect of multiple threats might be on a reef ecosystem?

   Students should understand that it is still very important to wear sunscreen when swimming and that they can make choices about the type of sunscreen. Also, make sure they understand that when there are a number of different threats that can impact reef ecosystems, it can make it very difficult for reefs to be healthy and thrive. They are also less resilient to climate change when they are impacted by several threats.

9. After a week, remove the shells/bones from the solutions, dry them off, and allow students to observe and touch them. Then lead a class discussion about the following questions. You may want to point out that both calcium carbonate and calcium phospate dissolve in acidic conditions to help students support their ideas.
   a. What did you notice about the specimens in the acidified solution? Did they hold up as well as those in the salt water? Why or why not?
   b. How does this relate to the living things in our ocean? How might acidified ecosystems impact them?
   c. Consider the food web. If coral and other shelled creatures are at risk due to climate change, how might this influence the fish that consume these species? What about the larger fish and humans that consume seafood?
   d. What are some ways that we can reduce the impact of greenhouse gases on a global scale? What about here in our school? What about at your home?
   e. Choose at least one action you are willing to take in the next week to reduce the impact of greenhouse gases.

Extension: Allow students an opportunity to carry out the design process to come up with a new solution related to greenhouse gases, climate change, or ocean acidification. To do this, they should:

- Define the problem.
- Collect information.
- Analyze ideas.
- Develop a solution and/or build a model.
- Present the idea to others and receive feedback.
- Revise the solution.

ACTIVITY 11

Why Would a Turtle Eat Plastic?

Introduction

In *Turtle Odyssey*, Bunji encounters a plastic bag. Viewers learn that one of the major and growing problems facing our ocean is plastic pollution. This is another way that humans represent a threat to the organisms that live in the ocean. The magnificent journey of a sea turtle could come to an end with a simple plastic sack—an item that is commonly used, but not for very long.

Summary

In this activity, students will have a chance to consider what materials make up items they use commonly. They will compare how materials break down using different solutions and in a model landfill. They will focus on plastics and learn how microplastics are causing concern among scientists. Students will consider ways that people can reduce their use of plastic items, particularly single-use plastics.

Materials and Preparation

- Small pieces of newspaper, 1 per group
- Plastic straws cut into 1" pieces, 1 per group
- Spoons, 1 per group
- Cups of solutions and mixtures, 1 per group. These could include water, soapy water, vinegar, salt water, water with baking soda, and others that students might think would break down plastic.
- Plastic shoebox filled with dirt
- Materials to bury in a model landfill. These could include food items, paper, plastic items, cardboard, and others. Use small pieces of each item that you bury.
- Water
- Materials to create a bulletin board or display (optional)

NGSS Performance Expectations

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.

Procedure

1. Ask students to work individually to make a list of items they use in a day. Tell them to think about waking up, getting ready for school, going through the day, eating meals, and getting ready for bed. Give examples such as a toothbrush, a hairbrush, a metal spoon, a drinking glass, a plastic straw, a notebook, and a pen.

2. Once students have had time to compile a list of at least 20 items, have them join with their group. The group should discuss their lists. Then, ask them to begin to make a group list that is categorized based on the main material that makes up each item. For example, a toothbrush might be listed as plastic, while a fork might be listed as metal.

3. After categorizing all of the items, ask students to calculate the percentage of items that are made of each material. For example, to calculate the percentage of plastic items, they should count the number of plastic items, divide by the total number of items on the group list, and multiply by 100.
4. Have each group make a pie chart to show the materials and percentages. Depending on your students' familiarity with pie charts, you can have them create the graph by hand or on a computer using spreadsheet software. Ask each group to share and tell students to look for patterns as they hear about the charts other groups made.
5. Tell students that you are going to focus on the plastics section. It is likely to be a large percentage of the materials they use in a day. Ask them to look back at any item they listed as plastic and determine how long or how many times they use the item. For example, a plastic straw is used one time.
6. Lead a class discussion about what groups discover. Although there are some plastic items, such as reusable water bottles, that can be used for years, many plastics that people use in everyday life are used only one time.
7. Ask students for their ideas on what happens to those single-use plastics once they have been thrown away. Accept all ideas at this point.
8. Tell students that they are going to have a chance to learn a little more about how quickly some materials break down. To do this, complete steps a through c.
   a. Provide students with a spoon, a small piece of newspaper, and a small piece of a plastic straw.
   b. Allow them to choose a cup of one of the prepared solutions/mixtures.
   c. Tell students to place both items in the solution and stir for 3 minutes. They may use their spoons to press on the items or rotate the items, but they may not touch the paper or straw with their hands.
9. At the end of the 3 minutes, ask students what they observed. Regardless of the solution, the paper should have broken down more than the plastic. After different groups share their results, ask students to make a general rule about whether it is easier to break down plastic or paper. They should say that it is easier for paper to break down.
10. Tell students that much of the waste in the United States goes to landfills. Rather than having a solution and something to stir materials, this waste sits in the ground as it decomposes. Share that you are going to set up a model landfill to see what happens to materials there.
11. Add dirt to the plastic box. Then add several materials to it, based on what students choose. Be sure to include some food material, some paper material, and some plastic material. Ask students to draw a diagram of where each material is in the box while you bury it under dirt.
12. Care for your model landfill over the next 2 weeks by placing it in a warm, sunny spot. Add some water to it every 2-3 days to represent rain.
13. At the end of 2 weeks, have students dig up each material and determine which materials break down more easily in a landfill. You may want to provide gloves as the food materials may be very broken down or moldy. Ask students to record their observations of what happened.
14. Lead a class discussion about what happened to each material, focusing on the idea that the plastics have not broken down much.
15. Read the following paragraphs to students. As you read, pause after each sentence or two and ask students to paraphrase what you read. This literacy strategy will ensure that they are making sense of the scientific ideas.

    When food or paper decomposes, chemical reactions take place to break the materials down to very small particles, called molecules. These particles are even smaller than what can be seen by typical microscopes. For example, organisms in soil can break down food or paper using chemical reactions, and then recycle the molecules into the food chain. These organisms cannot usually break down plastic because plastic is chemically different.

    Instead, plastic is generally shredded and broken into smaller and smaller pieces of plastic. When plastic is 5 mm or less it is classified as a microplastic. Scientists have found microplastics in soil, water, and air. Some microplastics in water are the result of larger pieces of plastic making their way down streams and rivers to the ocean and being broken apart. Other microplastics in water are the result of plastics broken down on land then washed into waterways. There are also microplastics released from clothing made of synthetic materials during washing. These are known as microfibers.

Just as sea turtles may see a plastic sack in the ocean, many animals are attracted to pieces of plastic near the surface of the water and eat them. Some animals are filter feeders that ingest plastic as part of their feeding behavior. Even though we cannot necessarily see the plastics, they are still there. Sometimes these plastics block the guts of the animals and kill them. Scientists also think that sometimes the plastics pass through animals, but that chemicals leach out of the plastic into their bodies. There is still a lot of research that scientists need to do to completely understand the complexity of microplastics and their effect on ecosystems.

16. Lead a class discussion with the following questions.
    a. What surprised you from the information I read?
    b. How does this information relate to what we did with the model landfill activity?
    c. What do you think happens if bigger animals, including humans, eat seafood that has been exposed to microplastics?
    d. The interior of a car is made mostly of plastic, from the dashboard to the door handles. The bumpers are also plastic. How does the plastic in a car differ from the plastic used to make up a straw?
17. Tell students to look back at the list of items they use in a day. Ask them to come up with ways that a person might reduce the amount of plastic he or she uses, particularly related to those that are only used once.
18. Consider creating a bulletin board or other display for your classroom or school to share ideas about reducing plastic use.

ACTIVITY 12

Fishing for Solutions

Introduction

Fishing methods can represent a threat to sea turtles. Although commercial fishermen want to catch as many fish as possible, some of their methods also catch sea turtles and other marine life. Developing a solution to this problem represents an engineering solution that can help Bunji, the turtle in the movie *Turtle Odyssey*, and other turtles like her stay out of harm's way.

Summary

Students will have an opportunity to simulate fishing practices to consider the points of view of various stakeholders.

Materials and Preparation

- 1 copy of *Master 12.1, The Stakeholders*, per group, cut apart into the roles
- Gumdrops, approximately 50 per group in multiple colors
- Spatula or large spoon for each group
- Toothpick for each group

NGSS Performance Expectations

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Procedure

1. Have students join together in groups of 4. Distribute 1 copy of *Master 12.1, The Stakeholders*, to each group. Ask students to choose one of the roles to play.
2. Have students read the information about their role and ask any questions they might have.
3. Ask students to spread the gumdrops out on the table. They should make sure that the gumdrops are well separated from one another. Ask them to choose a color to represent shrimp.

ACTIVITY 12 *continued*

4. Describe the first simulation. Tell students that one method of commercial fishing is trawling. In this type of fishing, fishermen drag a net behind one or more boats to catch fish. Students should use the spatula to try to mimic trawling. Tell them to imagine that they are a boat and the spatula is the trawl net. Then give them 10 seconds to catch as many fish as they can.

5. Lead a discussion about the following questions.
   a. How did you use the spatula to mimic trawling?
   b. How many shrimp did you catch in 10 seconds? (chosen color of gumdrop)
   c. How many other fish or turtles did you catch? (all other colors of gumdrops)

6. Students should see that they were able to catch a lot of shrimp in a short period of time, but that they also caught many other animals. Tell students that in the ocean, about 40 percent of what trawling catches is other animals, and those animals are often simply thrown away. In addition, trawling can injure animals and damage the sea floor.

7. Ask students to play their role and discuss their ideas about this method of fishing.

8. Now have students simulate fishing with a line and hook. To do this, one student should use a toothpick. Tell the students that they can only take one gumdrop at a time and they must pull it off and put it in a pile before trying to get another gumdrop. Allow 10 seconds for the students to simulate this form of fishing.

9. Repeat the discussion from step 5. Students were probably not able to catch too many shrimp but also did not catch other types of marine animals.

10. Ask students to again play their role and discuss this method of fishing.

11. Give students time to talk in their group and ask them to come up with a summary of the problem represented by the simulation and stakeholder roles. They should say that trawling catches all kinds of fish, some of which are thrown away or injured, while hook and line fishing can often be harder for commercial fishermen to make a living.

12. Display a picture of a turtle excluder device, such as the one shown here: **www.worldwildlife.org/magazine/issues/summer-2016/articles/how-a-simple-technology-is-saving-turtles**.

    Tell students that these devices are basically a filter for a trawl net so that large animals, such as sea turtles, run into the bars and are able to escape through the net while small animals, such as shrimp, pass through the bars into the bottom part of the net.

13. Have students take on their role one more time. They should decide on at least one statement of support that a stakeholder in their role would have for a turtle excluder device and one question that a person in that role might be concerned about before supporting this technology.

MASTER 6.1 • Information Card

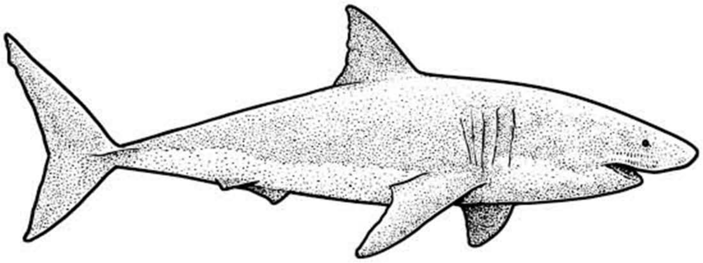
Write your answers in large print that can be read from several feet away.

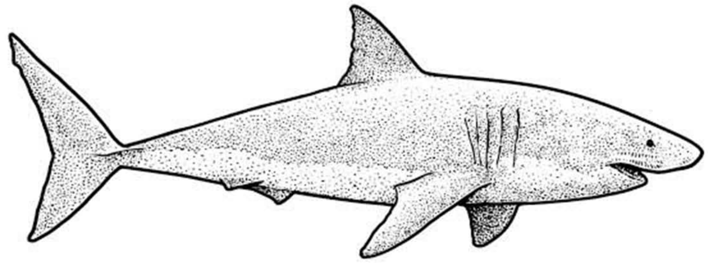
Name of the organism you are studying:

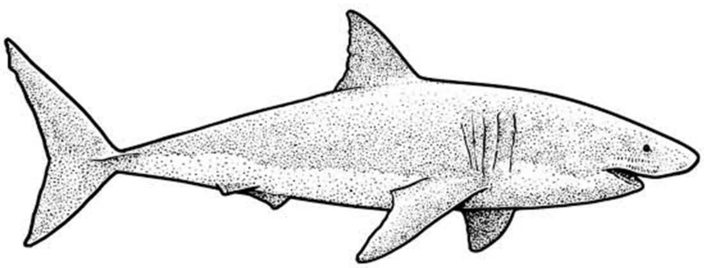
Draw or paste a picture of the organism in this space.

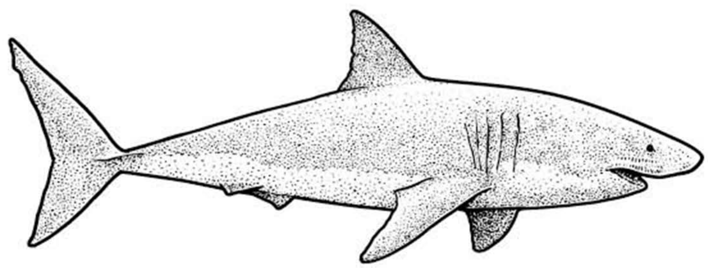
Where does this animal get its energy?

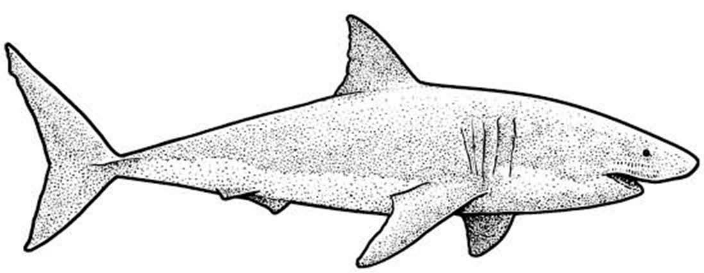
Are there other organisms that use this animal to get energy?

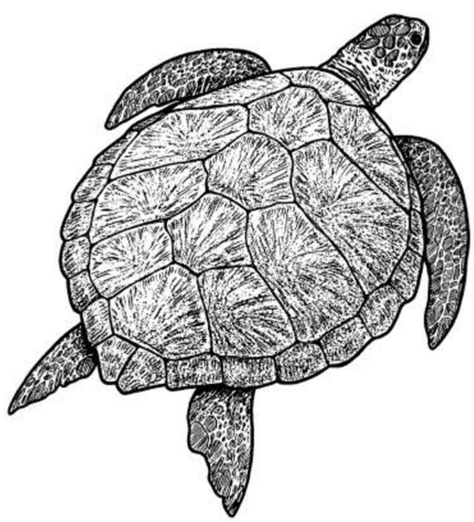




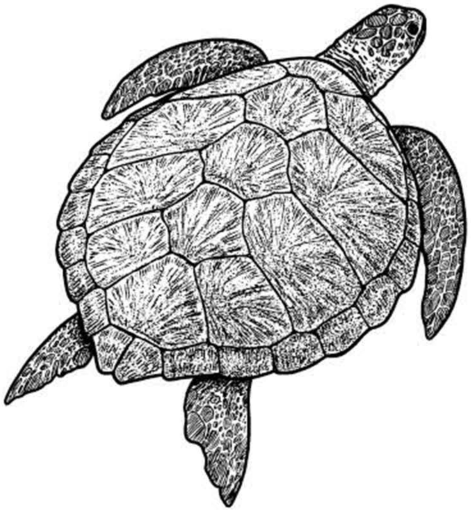


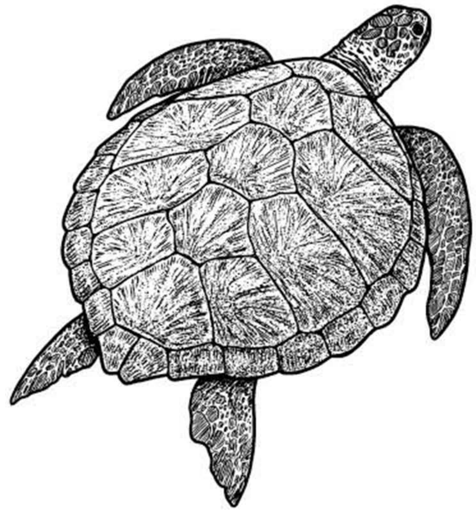


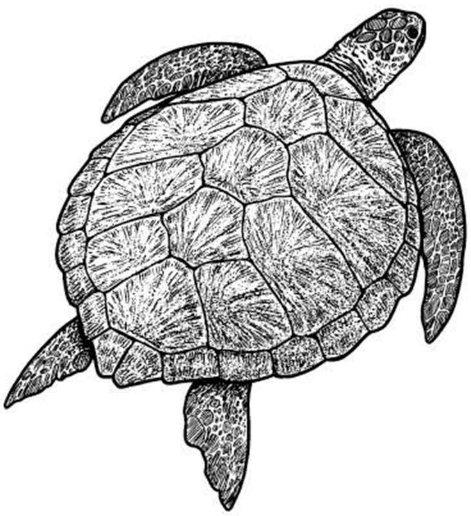


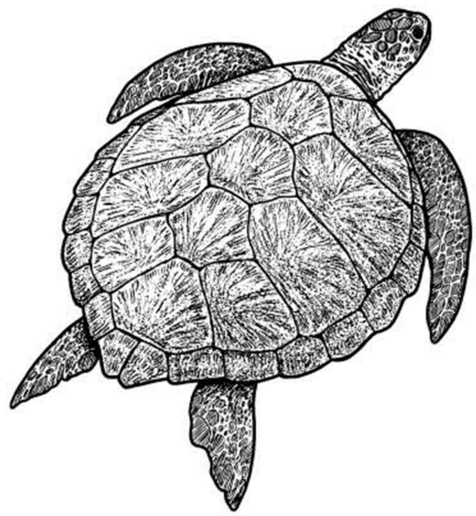


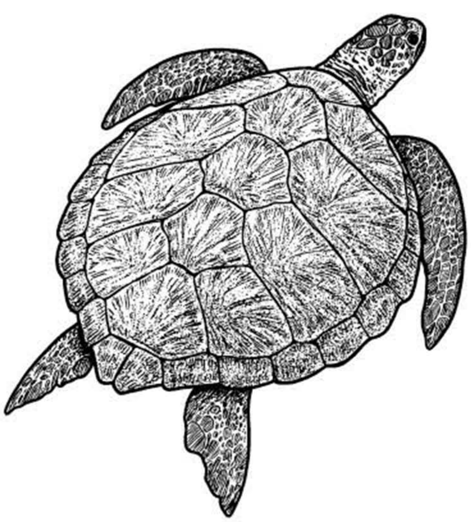
MASTER 6.2 • Simulation Cards, 2 of 5

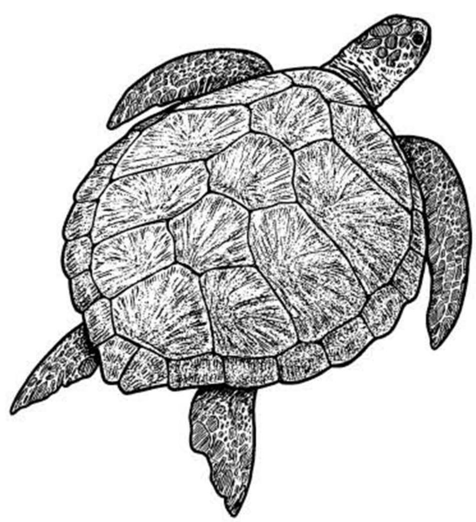


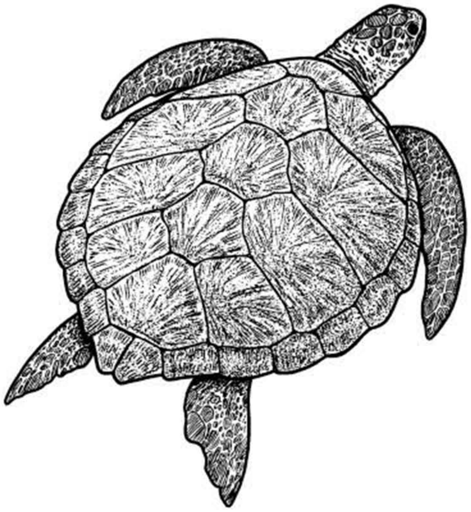


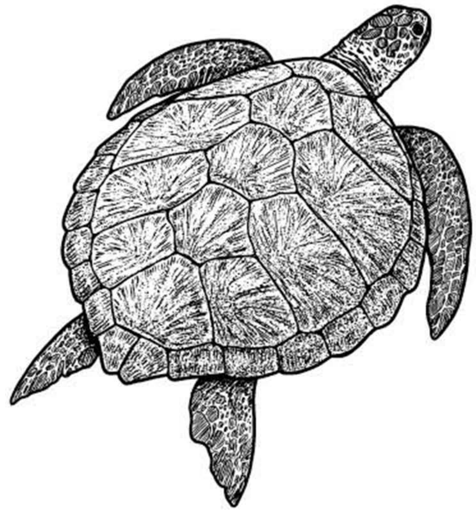


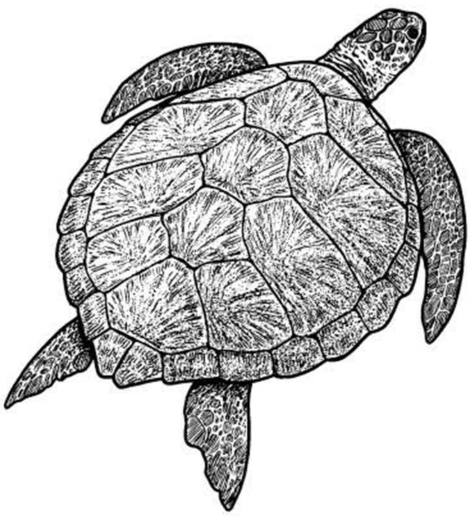


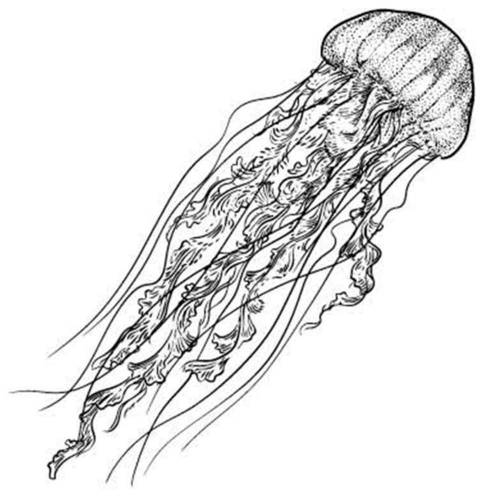


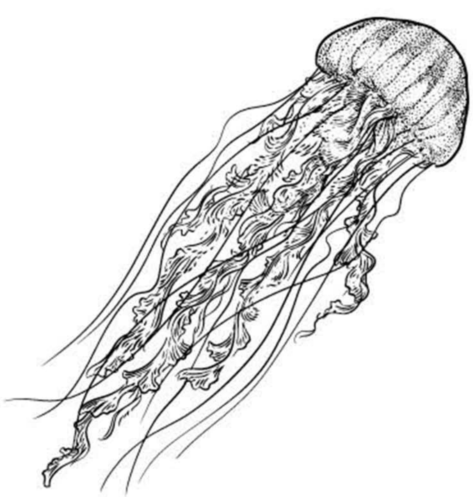


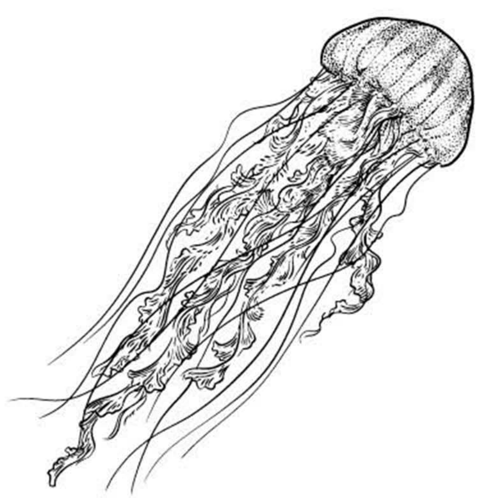


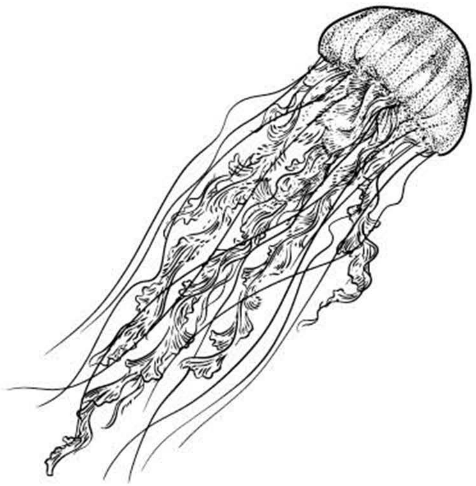


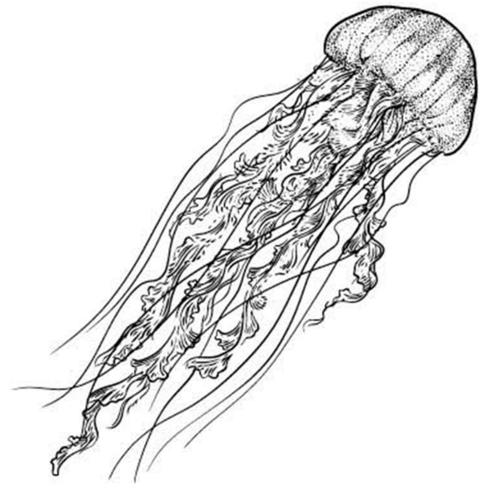


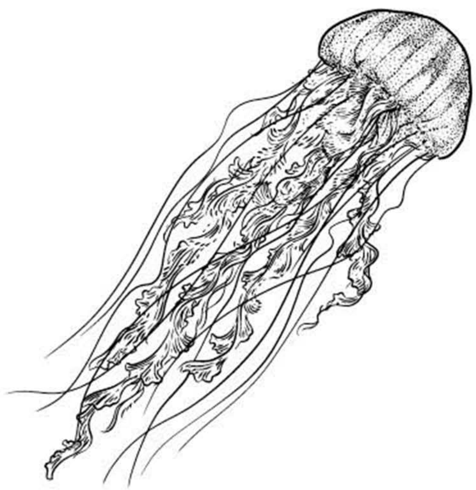


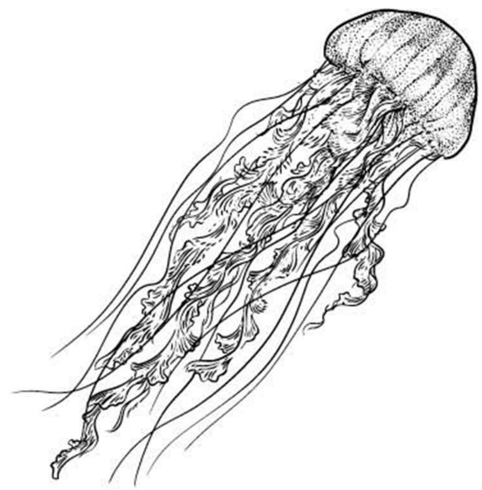


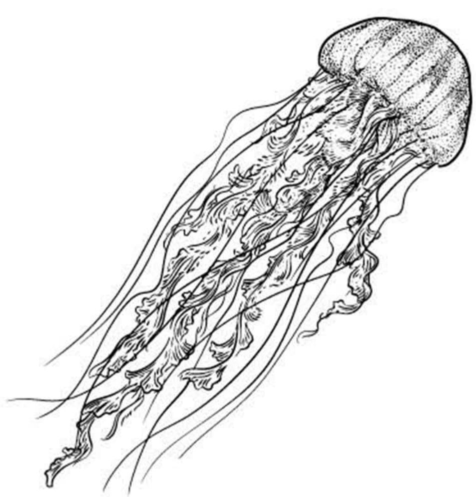


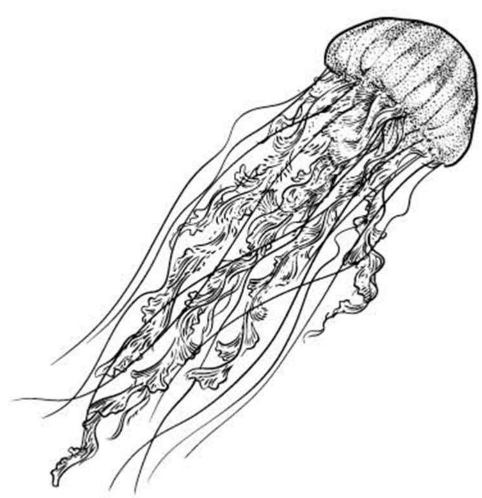


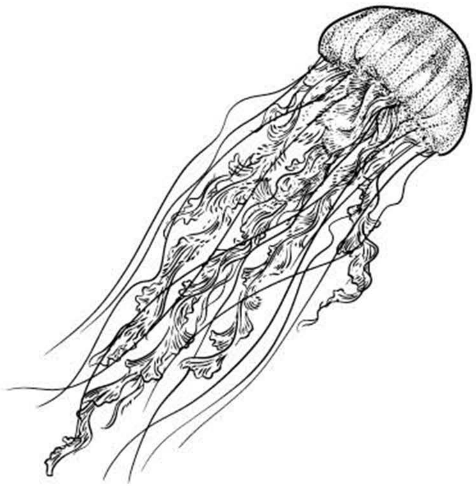


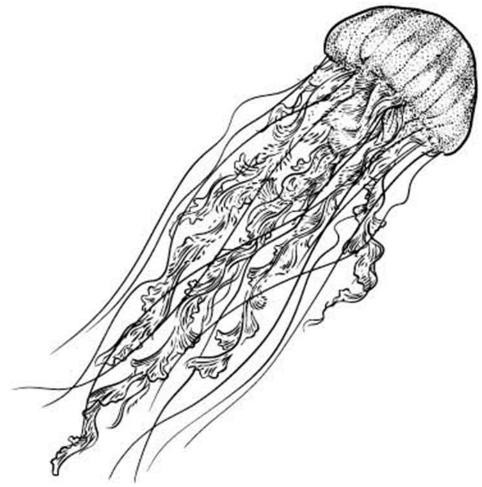


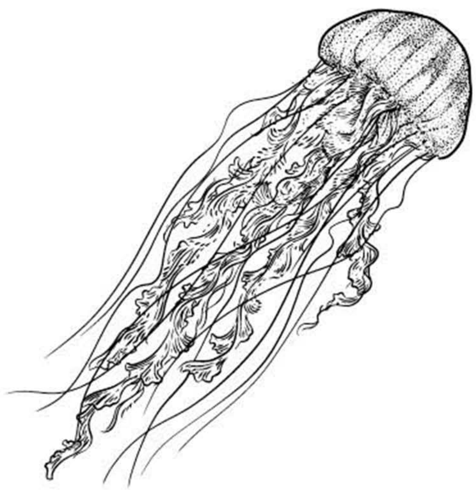


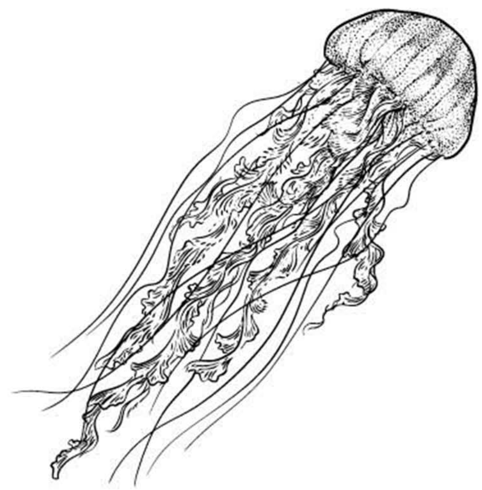


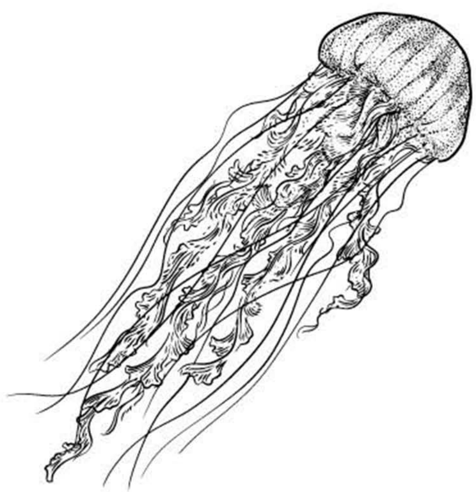


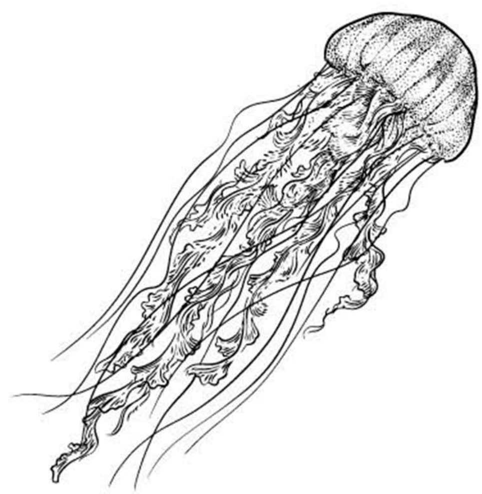




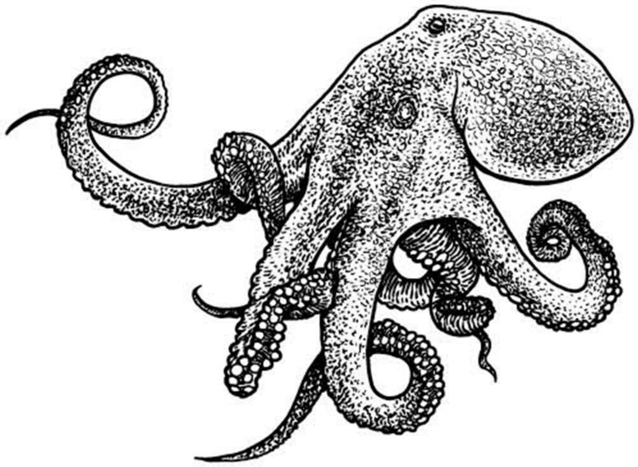


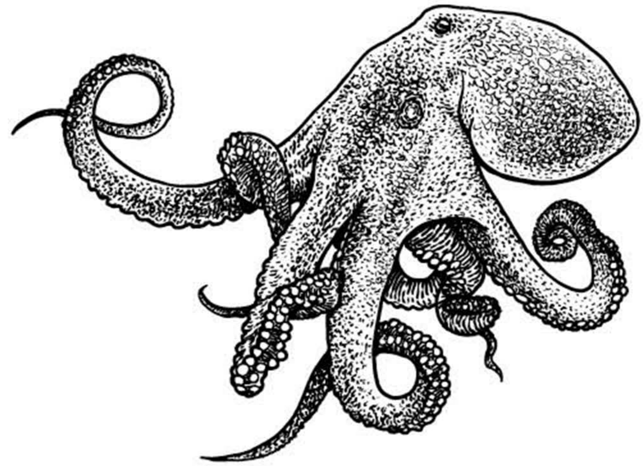


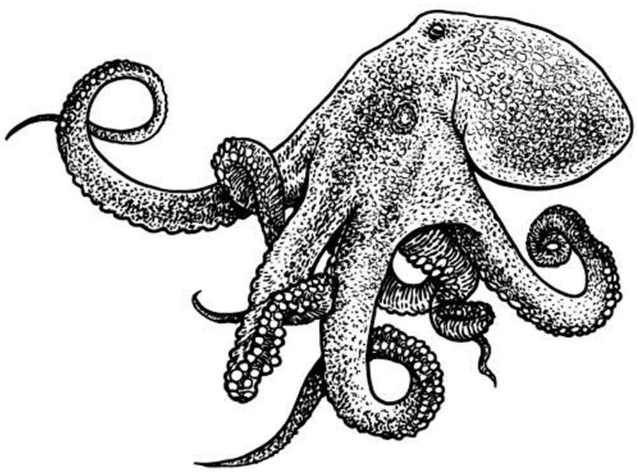


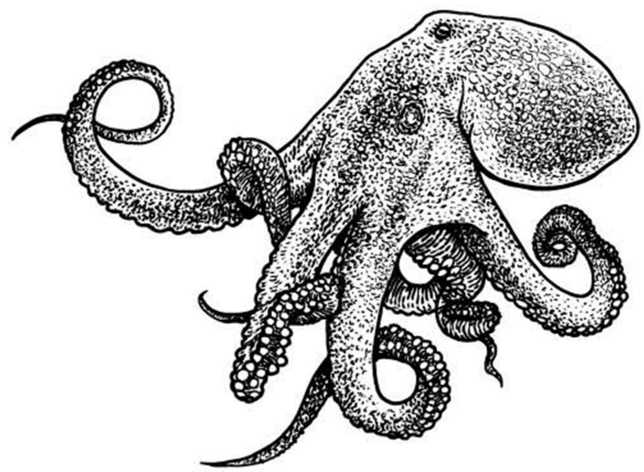


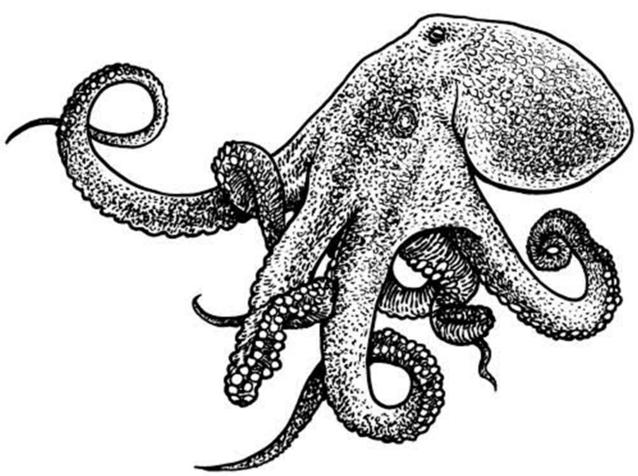
MASTER 6.3 • Octopus Cards

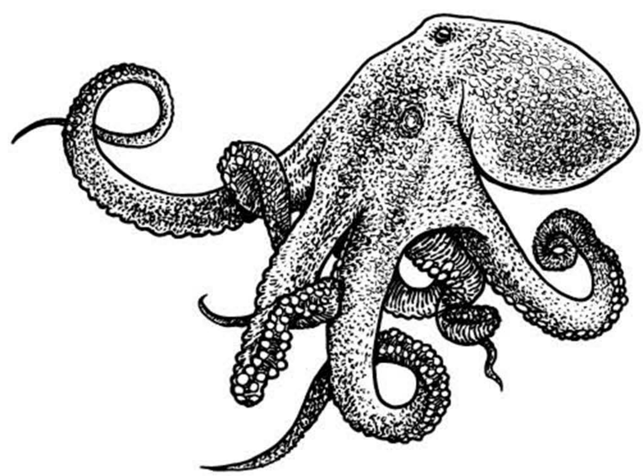












MASTER 7.1 • Relationship cards set

Sort the relationship cards into the appropriate category on Master 7.2.

Decorator crab and sponge

The crabs cut pieces of sponges to attach to itself, providing camouflage. The sponges move with them so they have access to new food and a secure place to live.

Human and tick

Ticks attach to humans and other warm-blooded animals and consume their blood. In addition to taking blood from their hosts, they can sometimes carry diseases that affect the host.

Coral polyps and zooxanthellae

Zooxanthellae (algae) provide food for the polyps from sunlight; calcium carbonate secreted by polyps provides protection for the zooxanthellae (algae).

Sea turtles and seagrass beds

Seagrass beds are food for turtles; turtles assist with cleanup and new growth for the seagrass bed

Fish and isopods

Isopods crawl into fish gills and attach to the fish's tongue, eventually severing and replacing the tongue. These isopods may then consume the fish's food, depriving the host of its food source.

Ants and aphids

Ants protect the aphids and aphids provide sugar-rich honeydew as food for ants.

Pollinators and plants

Pollinators get food from the plants, while spreading around the pollen inadvertently collected in order to help fertilize other plants.

Anemone and clownfish

Clownfish has a shelter/home and helps protect the anemone from possible predators by scaring them off.

Spiders and plants

Spiders get a place to live; plants are not affected.

Cleaner fish and sea turtle

Cleaner wrasse remove any parasites by eating them; this provides food for them and parasite removal for sea turtles.

Whale and barnacle

Barnacles are able to get a ride through nutrient rich waters and have access to food they might not have had otherwise; whales are unaffected.

Ocean sunfish and sea lice (copepods)

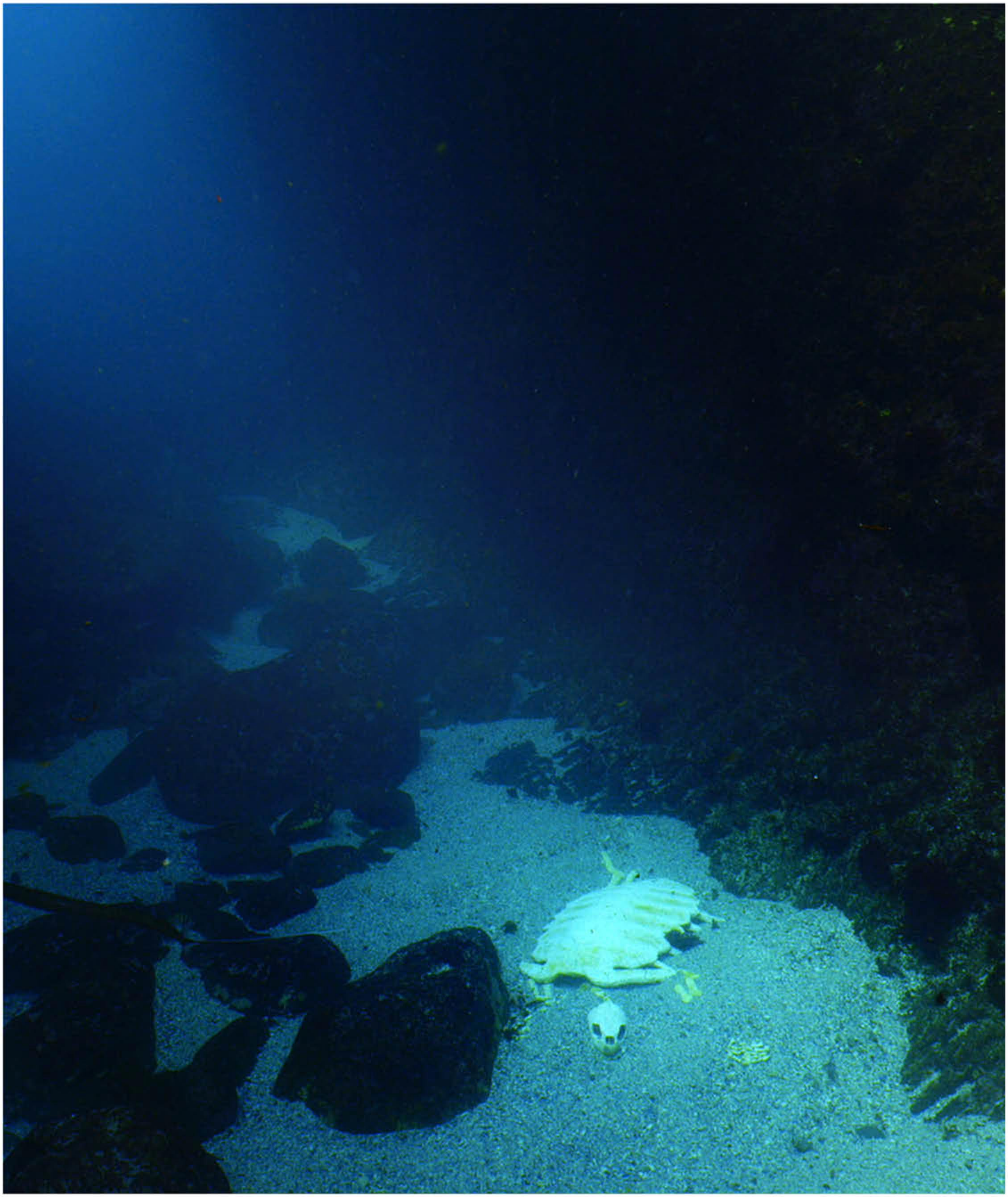
When it is time to lay their eggs, copepods feed on the tissues of the sunfish

MASTER 7.2 • Symbiotic Relationships

Sort the relationship cards into the appropriate category.

Mutualism	Commensalism	Parasitism
is a relationship that benefits both organisms involved. This type of relationship is good for both organisms.	is a relationship that benefits one organism and does not affect the other. This type of relationship is good for one organism and neutral for the other.	is a relationship that benefits one organism and harms the other one. This type of relationship is good for one organism and bad for the other.

MASTER 8.1 • Bunji and the Turtle Skeleton



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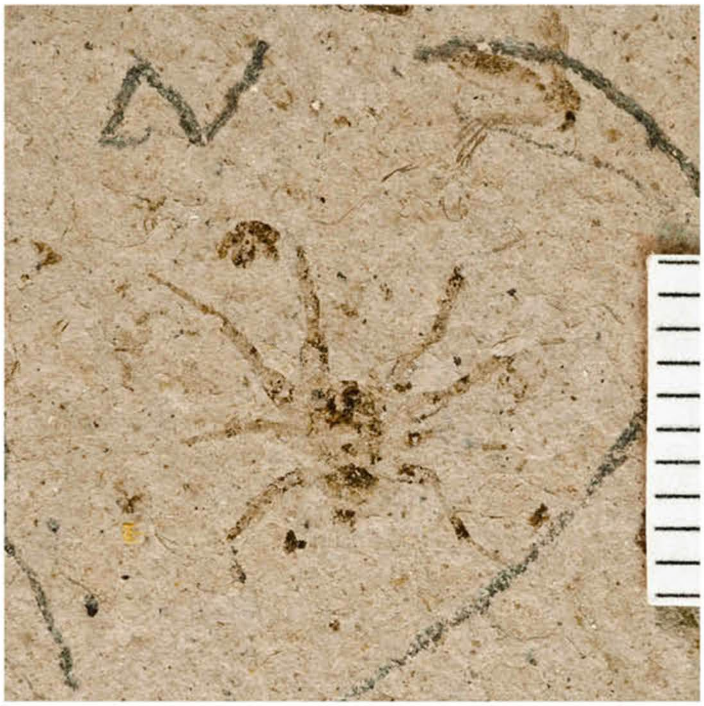
MASTER 8.2 • Fossils



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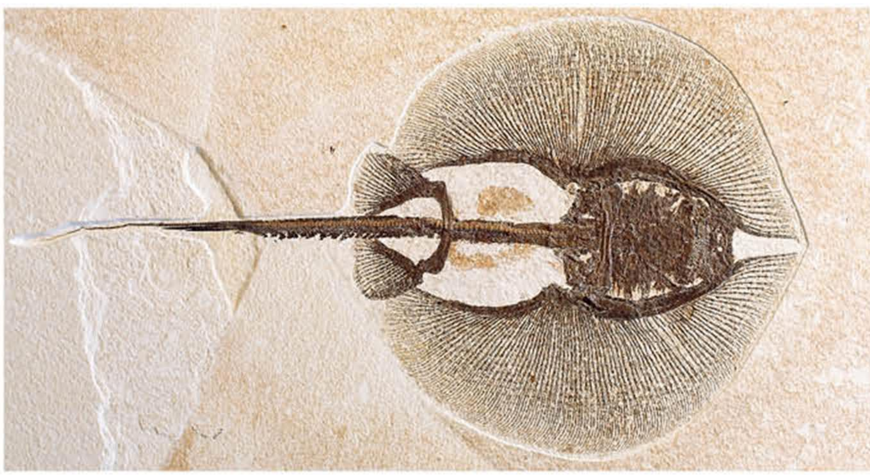

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MASTER 12.1 • The Stakeholders

Stakeholder 1 is a commercial fisherman. He gets paid based on the pounds of shrimp he is able to catch and bring in to the market. It is to his benefit to catch as many shrimp as possible, even if it means catching other fish as well. He says, "I understand the concerns about the fish that we dispose of, but I need to feed my family and make a decent living. Leaving shrimp in the area does not help me do that."

Stakeholder 2 is an environmental educator. He is concerned with commercial fishing not only because it can injure or kill sea turtles, but also because it leads to overfishing. "If we trawl for fish regularly, we will lose many of the species of fish from the Earth," he says. He supports strict limits on the amount of fish that can be caught and does not eat any form of seafood.

Stakeholder 3 is the mayor of a coastal town. She has been a popular mayor and wants to continue in office. She knows that many of the residents of the town depend on fishing for their income. She says, "We are a popular tourist town very well known for our fresh seafood. If we cannot meet the demand of the restaurants, we will not only have residents out of jobs, but we will also lose an important source of money coming into the town from tourists."

Stakeholder 4 is a conservation scientist who does research on sea turtles. She tells anyone who will listen about her concerns with trawling and commercial fishing. She believes that there is no reason fishing should injure or kill other animals, particularly sea turtles. She says, "I am always looking for ways to help sea turtles. I have lived in this town my whole life, other than during school, so I support the community. There has to be a better way than trawling."

Additional Resources

Sea Turtle Conservancy
conserveturtles.org

NOAA Fisheries
nmfs.noaa.gov/pr/species/turtles

United States Fish and Wildlife Services
fws.gov/northflorida/SeaTurtles/seaturtle-info.htm

Defenders of Wildlife
defenders.org/sea-turtles/basic-facts

World Wildlife Foundation
worldwildlife.org/species/sea-turtle

Recovery Plan for Marine Turtles in Australia
environment.gov.au/marine/publications/recovery-plan-marine-turtles-australia-2017

Environmental Warming and Feminization of One of the Largest Sea Turtle Populations in the World, co-authored by Dr. Ian Bell, scientific advisor for *Turtle Odyssey*
sciencedirect.com/science/article/pii/S0960982217315397

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