Lesson Plan: Spice of Life

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Target Grade: 2nd grade

Teacher Prep Time: 20 minutes

Lesson Time: 3 hours and 30 minutes (We recommend doing this lesson over 4 days, one part per day.)

- Part 1: Observations
    - 45 min – Video Observations
    - 15 min – Analysis and Explanations
- Part 2: Hungry Habitats - Normal Temperature
    - 10 min – Introduction
    - 25 min – Normal Temperature Habitats
    - 10 min – Food Web
- Part 3: Hungry Habitats - Higher Temperature
    - 10 min - Review
    - 25 min – Higher Temperature Habitats
    - 7 min – Food
    - 7 min – Animals
    - 11 min – Total Species
- Part 4: Explanation and Applications
    - 10 min - Review
    - 10 min – Explanation
    - 25 min – Applications

Where This Lesson Fits in:

Before students do this lesson, they should know what a habitat is and be able to name different habitats as well as the components of a habitat (plants, animals, etc.). Students should already be familiar with making bar graphs.

Lesson Overview:

In this lesson, students will make observations of coral reef habitats, one at normal temperature and one at higher temperature (which has caused the coral to die), to see the variety of life in two originally similar habitats. Next, they will enact a simulation of three distinct coral reef environments that have different food sources, which will allow them to construct a food web for three different animal species. They will then modify the simulation, which will allow them to observe the effects of increased temperatures on the habitats. This will allow students to generate the explanation that environments with diverse species are less affected by environmental changes and animals that eat a wider variety of foods have a higher likelihood of surviving environmental changes. They will apply this understanding to another habitat (rainforests).

Learning Objectives:

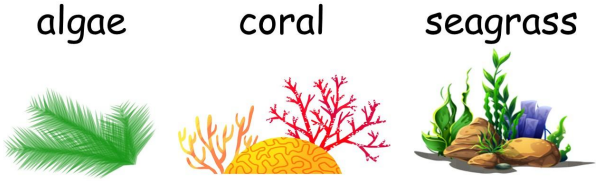
- Students will use observational data to generate the following explanations: 1) habitats with many different types of species are affected less by environmental changes and 2) animals that eat many different food sources are affected less by environmental changes.
- Students will know that if a habitat is not changing (the species found in the habitat are constant over a long time), it is stable. If an environmental change occurs, the habitat will likely become unstable and change. After the species that cannot live there anymore due to the environmental change move or die, the habitat can become stable again with less species.

NGSS:

- **Performance Expectation**
  - 4-LS2-1: Make observations of plants and animals to compare the diversity of life in different habitats.
- **Science and Engineering Practice**
  - #6 Constructing Explanations (for Science) and Designing Solutions (for Engineering)
    - Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.
      - Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
- **Disciplinary Core Idea**
  - LS4.D Biodiversity and Humans.
    - A range of different organisms live in different places.
- **Cross Cutting Concept**
  - #7 Stability and Change
    - Students observe that some things stay the same while other things change, and things may change slowly or rapidly.

Materials Needed:

- Student worksheets (1 per student + 1 class worksheet).
- Habitat A and B videos (3 minutes each).
- Animal and plant category pictures and category name cards.
- Animal cards (7 guard crabs, 7 sea snails, and 6 parrotfish for a class of 20). One per student that tells what animal they will be and what they eat.
- Food tokens: 125 small pictures of coral, 70 small pictures of seagrass, and 30 small pictures of algae (assuming a class of 20 students).



- Animal tokens: 8 tokens each of guard crabs, sea snails, and parrotfish.

- 1 set of Habitat Cards.
- 1 wet erase pen to write on the Habitat Cards.
- Document camera.

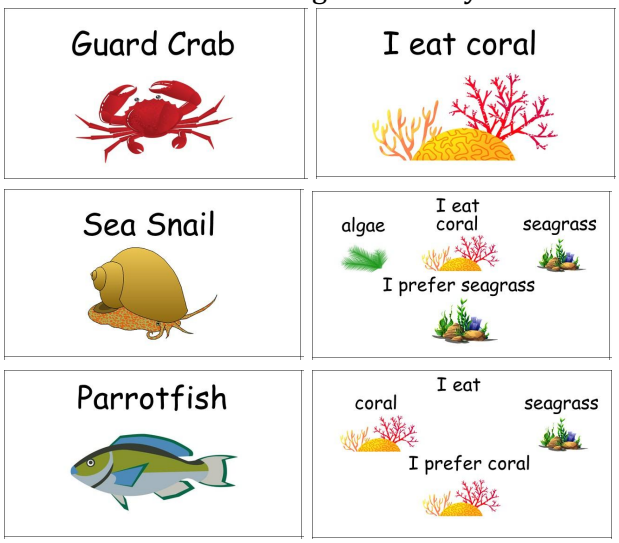
Teacher Prep:

Part 1:

- Make printouts of the worksheet for students.
- Print out animal category pictures and category name cards and laminate if desired.

Part 2:

- Prepare animal cards. Print them out on cardstock (and laminate if desired) and punch two holes in the top of each to attach a string. This will allow students to wear these around their neck during the activity.



- Print the food token on cardstock (laminate if desired). Use the table below to determine the number of food pieces that you need in each habitat. Have them in stacks, separated by food type for each habitat.

Foods for Normal Temperature Habitats

	Algae	**Coral**	**Seagrass**
Habitat 1	(# snails) x 2	(# crabs + # fish) x 2 - 2	(# snails x 2) - 2
Habitat 2	No algae	(# of students) x 2	(#snails x 2) - 4
Habitat 3	No algae	(# of students) x 2 + 6	No seagrass

- Print the Habitat cards on cardstock (laminate if desired).

Part 3:

- Use the table below to determine the number of food pieces that you need in each habitat. Have them in stacks, separated by food type for each habitat.
  Foods for High Temperature Habitats

	Algae	**Coral**	**Seagrass**
Habitat 1	(# snails) x 2	No coral	(# snails + ½ # fish) x 2
Habitat 2	No Algae	No coral	(# snails + # fish) x 2 - 2
Habitat 3	No Algae	No coral	No seagrass

Part 4:

- There is no prep for this part.

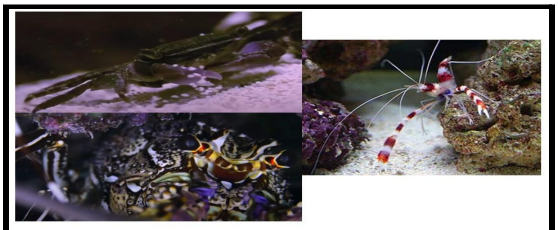
Lesson Sequence:

* For this activity we recommend that students work by themselves.

Part 1: Observations	
45 minutes	**Video Observations** ● Tell students, "You are going to be marine biologists, scientists who study life in the oceans, and study different types of coral reef habitats. To start studying, you are going to watch a video of two coral reefs and make observations of what plants and animals you see." ● Ask students, "What are observations?" Get them to understand that an observation is a description using their five senses. ● Play the Habitat A video (3 minutes). Have students shout out the types of animals and plants they see during the video and write them on the board. o ESR: Fish, eels, sharks, crabs, lobsters, shrimp, turtles, sea cucumbers, sea stars, anemone, coral, seagrass, sea sponges, and algae. ▪ If students do not state all of the animals and plants listed above, it is ok. ● Tape the names of the animal and plant categories to the board. ● Take out the animal and plant category cards. Show students one card at a time and then have them tell you what category name goes with the card. If there is more than one type of animal on one card (e.g., fish and eels), make sure students know which animal is which. Once they have made a correct match, tape the card and name together and tape that to the board. If students cannot figure out the match, skip the card and come back to it at the end. Below are the matches that should be made. Fish and Eels Sharks

Crabs, Lobsters, and Shrimp

Turtles

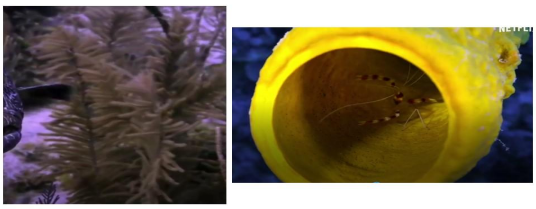


Sea Cucumbers and Sea Star

Anemones

Corals

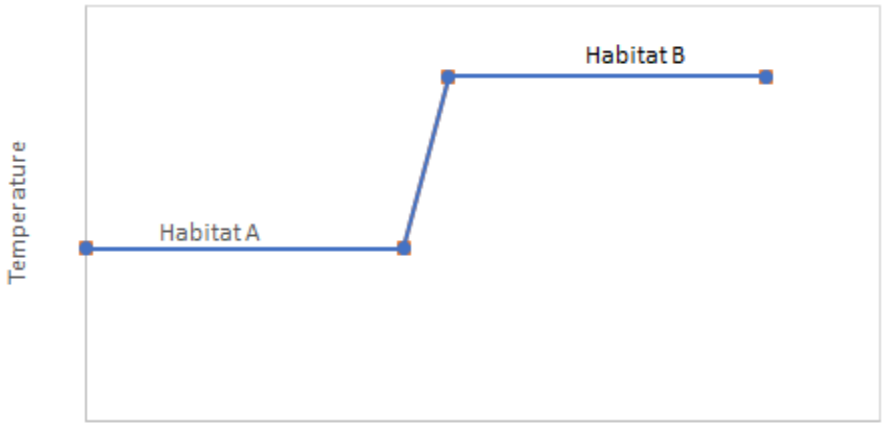
Seagrasses and Sea Sponges



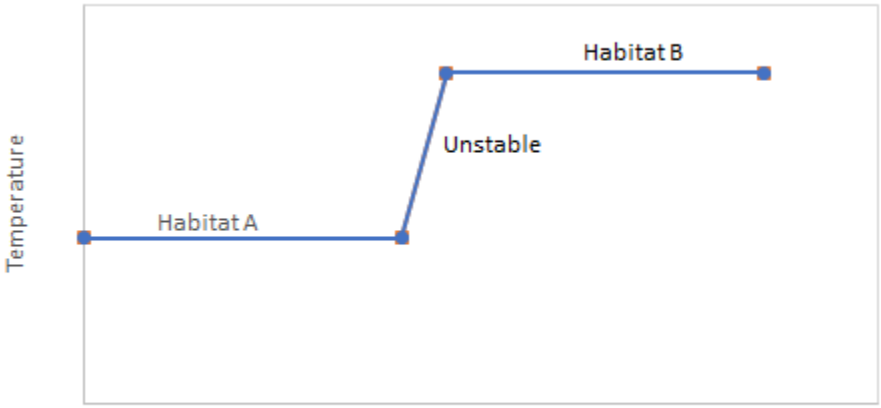
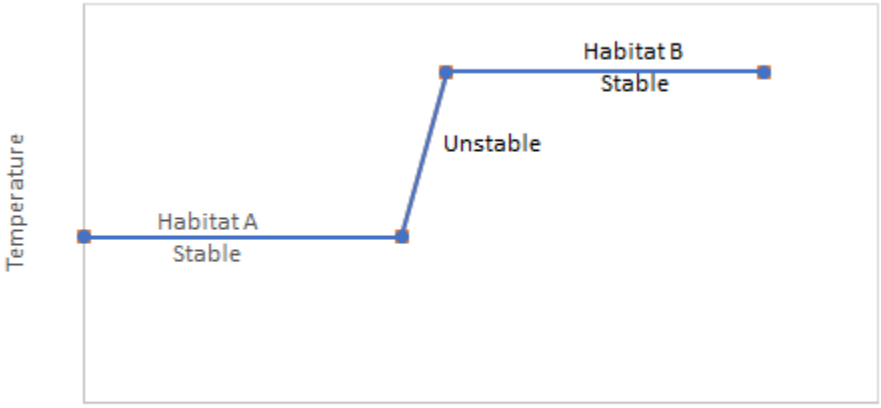
Algae

- Pass out worksheets to students.
- Keep one worksheet as a class worksheet. This will be placed under the document camera and will be written on so that students can follow along.
- Tell students, "Now that you know what some of the animals and plants look like for each category, you are going to watch the video again, but this time, you are going to put a tally mark on your worksheet every time you see an animal or a plant that fits into the category. If you write more than ten tally marks, you will just put a + to show that there are a lot of plants and animals in that category." Show students where they are going to write their tally marks and how to show when there are more than ten in a category.
- Play the Habitat A video again and mention that students should pay attention to what animals are eating during the video.
    - Walk around while the video is playing. If you notice that students are not marking tallies for some of the categories that should be marked, pause the video when you see an animal or plant from that category. Ask students what it is before telling them what category it belongs to.
    - When you see an animal that is eating something, pause the video and ask students, "What is that animal eating?"
        - eating algae (1:28-1:33)
        - eating coral (2:00-2:07)
        - eating seagrass (3:00-3:11)
- As a class, discuss which categories of animals and plants they saw and how many animals or plants were in each category. For each category, ask students to raise their hand if they saw a plant or animal that is in that category. If they did, put a check mark by the category on the class worksheet. Then, let a few students share out how many they saw and record the most common number on the class worksheet.
- Have students count the number of categories of animals and plants they saw in Habitat A. Then, fill in question 1 on the class worksheet while students record it on their worksheet.
- Discuss what they saw animals eating in the video. Fill in question 2 on the class worksheet while students record it on their worksheet.
- Ask students, "If you came back and observed Habitat A a year later, do you think you would see similar species? Why or why not?"
    - ESR: I think we will see similar species because the animals and plants have always lived there and won't tend to move.

- By the end of the discussion, make sure students understand that if nothing new were to happen to the habitat, we would expect those animals and plants to still be there after a year. Fill in question 3 on the class worksheet while students record it on their worksheet.
- Tell students, "Habitats that are not changing will have the same types of species in them for long periods of time. These are known as stable habitats." Write "Stable: Habitat is not changing" on the board. As a class, fill in questions 4 and 5 in the class worksheet while students record them on their worksheets.
- Ask students, "If stable habitats are those that are not changing, what might an unstable habitat be?"
    - ESR: A habitat that is changing.
- Write "Unstable: Habitat is changing" on the board.
- Draw the following graph on the board.



- Explain to students that over time (on the x axis), the temperature of this coral reef increased and that we are going to watch a video to observe what it looks like now at the higher temperature.
- Tell students, " We will only watch the Habitat B video once and you will need to make tally marks for each animal and plant that you see in a category."
- Have the students watch the video. Make sure to point out to students that at the end of the video, they are showing the same location one year later.
- For each category, ask students to raise their hand if they saw a plant or animal that is in that category. If they did, put a check mark by the category on the class worksheet. Then, let a few students share out how many they saw and record the most common number on the class worksheet. This time they will not see plants and animals from all categories.
- Have students count the number of categories of plants and animals they saw in Habitat B. Then, fill in question 6 on the class worksheet while students record it on their worksheet.
- Ask students, "Did you notice anything different about the coral in Habitat B?"
    - ESR: It turned white.
- Explain to students that coral needs to be in water at a certain temperature. If the temperature of the water becomes too hot, it causes the coral to turn white and

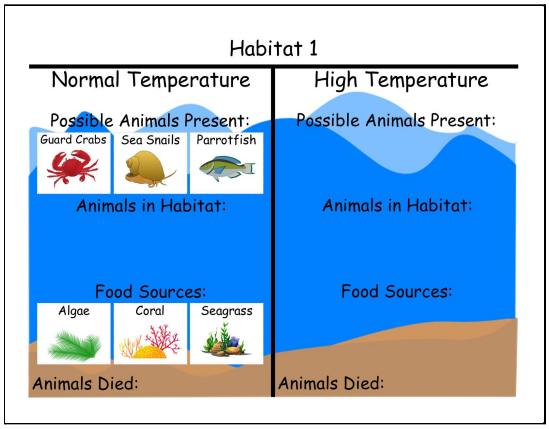
	die. Fill in question 7 on the class worksheet while students record it on their worksheet. ● Have students tell you how long the change in temperature took (the video told them it was one year). Then, have them tell you if they think the habitat was stable or unstable during the year when the temperature was changing. Make sure by the end of the conversation they understand that when the coral died, the number of animals and plants was changing, making the habitat unstable. Write unstable on the graph, as seen below:  ● Fill in questions 8 and 9 on the class worksheet while students record it on their worksheet. ● Ask students, "If you came back and observed Habitat B a year later, do you think you would see similar species? Why or why not?" o ESR: I think we will see similar species because these are the plants and animals that can live without coral. ● Tell students that if these plants and animals don't need coral to survive, they will live a long time, so there will not be any changes in types of species found in the habitat. Ask students, "If the number of species and the temperature are no longer changing, is our habitat now stable again or unstable?" o ESR: The habitat is now stable again since there are no changes occurring. ● Ask students, "Where on the graph should we write stable?" o ESR: By Habitat A and Habitat B. ● Label the graph as seen below: 

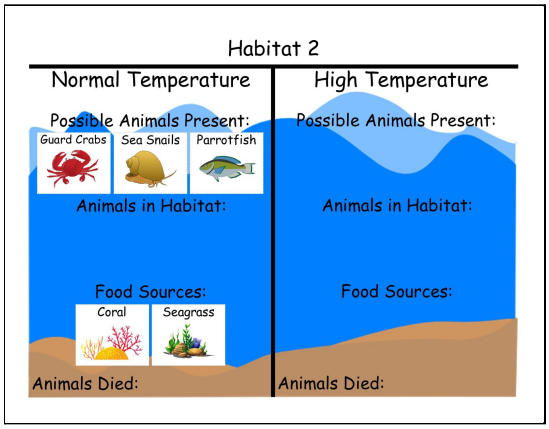
	● By the end of the discussion, make sure students understand that during a change the habitat is unstable, causing species to move or die. After the change, a stable habitat can be achieved again but in this case the habitat will no longer have any species that depended on the coral. Fill in question 11 on the class worksheet while students record it on their worksheet.
15 minutes	**Analysis and Explanations** ● Tell students, "To analyze the data that you just collected, you will make a bar graph." Read the instructions listed at the top of the page for the bar graph. Show students that the y-axis is labeled for the number of categories found in the habitat and the two habitats are listed on the x-axis. Tell students, "You have already recorded the number of categories in questions 1 and 6." Show them these questions and have them circle the numbers they will graph. Then, have them complete question 12 while you do it on the class worksheet. Once most students are done, put the class worksheet under the document camera for them to check their work. ● Ask students, "Which habitat had more categories of plants and animals?" o ESR: Habitat A. ● Ask students, "We figured out that Habitat A had more categories of plants and animals, but did it also have more plants and animals in general? For example, did Habitat A have more fish?" o ESR: Habitat A had more fish than Habitat B. ● Ask students, "Why do you think that Habitat A had more fish than Habitat B?" If students get stuck, tell them that there must be more fish because it's easier to survive in Habitat A. Ask them, "What things do fish need to survive?" Lead students to understand that fish need to eat food to survive and that they've seen that some fish eat coral, which is all dead in Habitat B, but is plentiful in Habitat A. ● Fill in question 13 on the class worksheet while students record it on their worksheet. ● Ask students, "Before the temperature changed, was the habitat stable or unstable?" Then, fill in the first blank in question 14. o ESR: Stable. ● Ask students, "When the temperature rose, did the habitat stay the same or was it changing?" Then, fill in the second blank in question 14. o ESR: It was changing. ● Ask students, "If it was changing, would this make it stable or unstable?" Then fill in the third blank in question 14. o ESR: Unstable. ● Ask students, "What do you think happened to many of the plants and animals during this time?" Then, fill in the fourth blank in question 14. o ESR: They moved or died. ● Ask students, "Eventually when the species that could not live there anymore died or moved, the ones that were left were those that did not need coral to survive. Those species then survived until the temperature eventually stopped changing. Was this habitat now stable or unstable?" If students get stuck, refer them to the definition and the graph on the board and ask, "Is there anything changing once

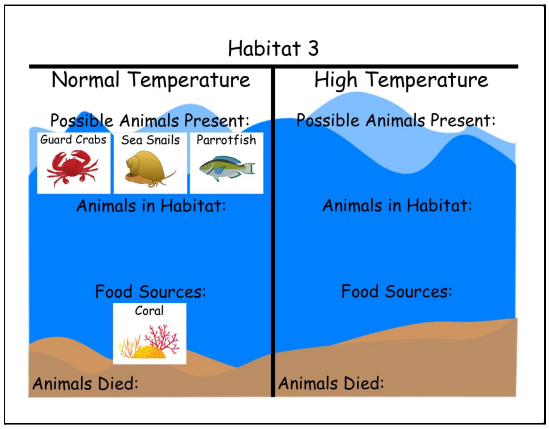
	the temperature and number of species become constant?" Then fill in the fifth blank in question 14. o ESR: It was stable. ● Ask students, "Even though it was stable, did it have the same number of species living in the area as it did before the temperature rose?" Then fill in the sixth blank in question 14. o ESR: No, less species now live in the area. ● Read the entire sentence to the students. ● Ask students, "If you were a fish, what habitat would you want to live in and why?" Have students turn to partners and talk for 1 minute about their answer. After, have students share their responses. Write one of them on the class worksheet for question 15, while students fill in this response or their own on their worksheet.
Part 2: Hungry Habitats – Normal Temperature	
3 minutes	**Review** ● Ask students, "What did we do the last time?" ○ ESR: We watched two videos of two different coral reefs and took count of how many animals and plants we saw. The two habitats were in the same place but they were filmed one year apart and Habitat B was at a higher temperature. ● Ask students, "Was Habitat A stable or unstable? How do you know?" ○ ESR: It was stable because nothing was changing in it and we expected to see the same plants and animals in one year. ● Start to recreate the drawing on the board done in Part 1 by drawing a flat line to demonstrate the temperature of Habitat A. Write "stable" underneath it. Tell students , "To get to a higher temperature in Habitat B, the temperature must have changed." Draw an increasing line on the drawing to show the temperature changing. Ask students, "When the temperature was changing, was the habitat stable or unstable? How do you know?" ○ ESR: It was unstable because there was something changing in the habitat (the temperature). ● Ask students, "Was Habitat B stable or unstable? How do you know?" ○ ESR: It was stable because there was nothing changing in it and we expected to see the same plants and animals in one year. ● Draw the line representing Habitat B's temperature and write "stable" underneath it. Remind students that when changes happen to a habitat, it becomes unstable. Eventually the habitat may become stable again, but it may have less animals and plants when it becomes stable again. Ask students, "Did our temperature change affect any animals or plants in Habitat B?" ○ ESR: The higher temperature caused the coral to die and there were less animals around compared to Habitat A.
12 minutes	**Introduction** ● Explain to students that they will be doing an activity to see how different types of animals are affected by the type of habitat they live in. They will be assigned to be a specific type of animal (guard crab, sea snail, or parrotfish) and will get to eat food in three different coral reefs. ● Pass out an animal card to each student and have them put it around their neck, with the picture of the animal facing outward.

	● Tell students, “Look at the animal that you are. If you are a guard crab, raise your hand. Your animal signal will be to use your hands as pincers.” Demonstrate this and have the guard crabs show you their animal signal and then mark that they are a guard crab in question 16. ● Tell students, “If you are a sea snail, raise your hand. Your animal signal will be to put hands on your head and wave them like the sea snails’ tentacles.” Demonstrate this and have the sea snails show you their animal signal and then mark that they are a sea snail in question 16. ● Tell students, “If you are a parrotfish, raise your hand. Your animal signal will be to put your hands in your armpits and wave your elbows like fins.” Demonstrate this and have the parrotfish show you their animal signal and then mark that they are a parrotfish in question 16. ● Have students turn their animal card over. On the back side of the card it tells them what the animal can eat and, in some cases, the animal’s prefered food. Tell students, “Look at the food that you eat and circle it in question 17, but do not tell other students which type of food you eat because they are going to try to guess by what they see you eating.” ● Tell students, “Look at your card to see if there is a type of food that you prefer. If so, write this food type down for question 18. If you have a food type you prefer, you have to eat this before you eat other types of food.” o Guard crabs can only eat coral. o Sea snails can eat algae, coral, and seagrass, but prefer seagrass. o Parrotfish can eat coral and seagrass, but prefer coral. ● Tell students, “You are now going to visit the first coral reef. While there, you need to eat in order to survive. You have to eat twice to survive. If you eat once or not at all, you will starve and die. If you pick up more than two food tokens, you are making it so that other students are not able to participate and this is not fair to the other students in the class. Therefore, your food will be redistributed to students that were not able to eat and you will not be able to participate in the simulation any more.” Fill out question 19 in the class worksheet and have students fill it in on their worksheet. ● Explain to students that in order to eat, they will need to pick up small pictures of algae, coral, and seagrass. Show students what these pictures look like. Tell students, “As soon as I say go, you can walk around the room and look for the pictures of the food that you prefer to eat. If you cannot find that food, you can pick up any other food type that you eat.”
25 minutes	**Normal Temperature Habitats** ● Have the food for Habitat 1: Normal Temperature separated by food type at the front of the classroom. ● Put each of the food sources present in Habitat 1 under the document camera and have students tell you what it is and circle it in question 20 of the class worksheet while students circle it on their worksheets. ● Put the Habitat 1 Card under the document camera and under “Food Sources:” tape an extra food token of each food source found in that habitat: coral, seagrass, and algae. Tell students, “All animals could possibly be in this habitat. After the simulation we will learn about which one can survive in this habitat and for now

we will just tape on the animals that could possibly be present." Tape on each of the animal tokens under "Possible Animals Present:" guard crab, sea snail, and parrotfish.

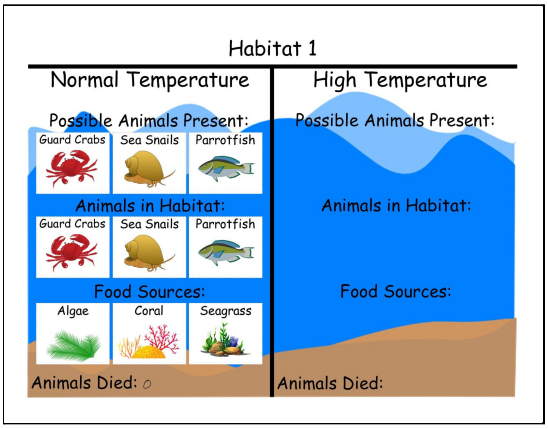
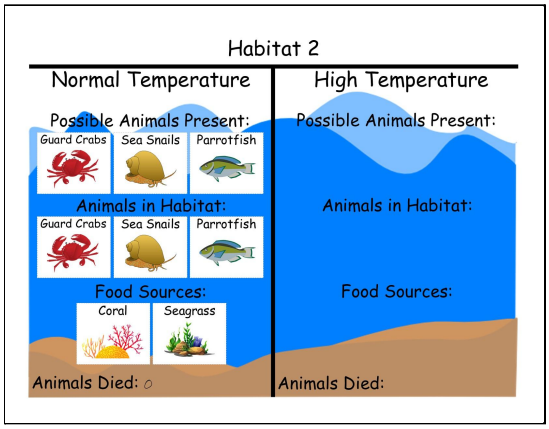
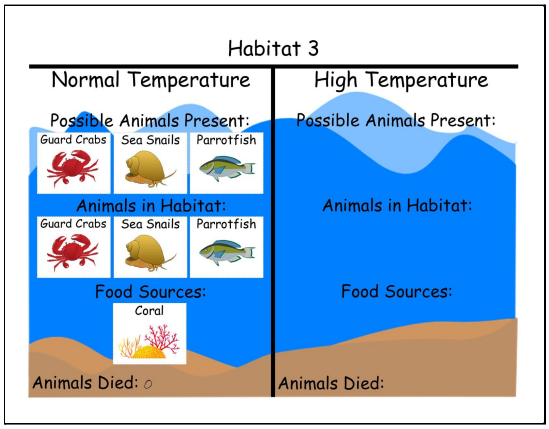


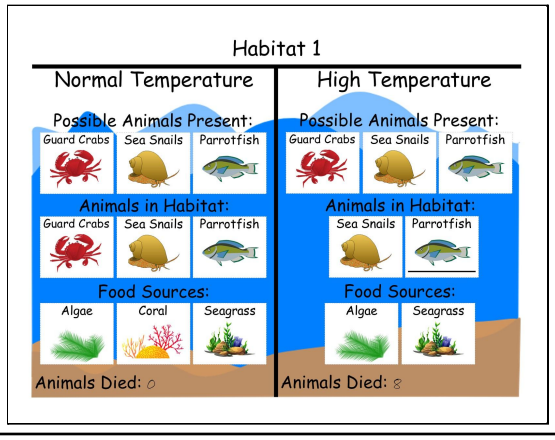
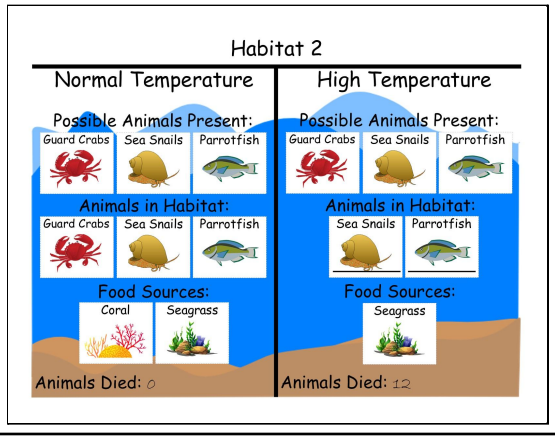


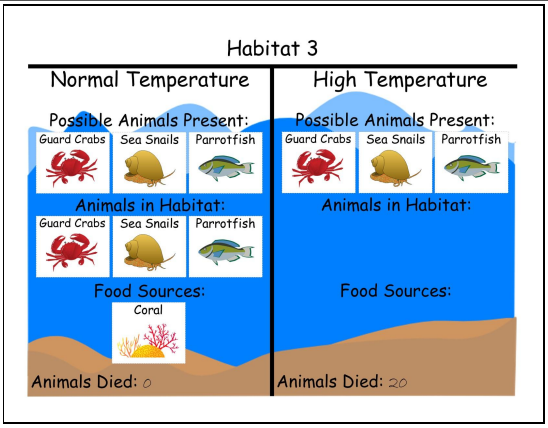


- As a class, count the numbers of each type of food that will be in the habitat and record them in the table for the starting amount for question 21.
- Tell students, "We will now learn about the animals in the area." Have each animal type separately stand up and do their animal signal as the class counts how many of each type of animal there are and record these numbers in the table for the starting amount for question 22.
- Mix and then spread the food cards around the room.
- Tell students, "You can now start to eat. Remember to eat the food source that you prefer first. Once you are done, come back to your desk and sit down."
    - Some students might not be able to find food to eat and if there is nothing left to eat you might have to tell them to just go back to their desk.
- Tell students, "You will now record in question 23 the number of times that you ate and if you are alive or dead. If you ate two times you will be alive and if you ate more or less than two times, you are dead." Then, have students fill out question 23.
- While students are filling out the question, collect the food pieces still on the floor and separate them by food type.
- As a class, count the number of each type of food that was left after the feeding and record them in the table for the finish amount for question 21.

	● Tell students, "We will now look at what happened to the animals." Have the students that are guard crabs come up the front of the classroom. Have students hand you their food tokens, one by one. If they have two food tokens, have them stand on one side of you. These will be the guard crabs that live. If they have one or more than two tokens, put them on the other side of you. These will be the guard crabs that died. Have the class count the number of guard crabs that are still living and record this as the Finish number of guard crabs in the table in question 22. o If a student has more than two food tokens, tell them that they will not get to participate in the simulation anymore and redistribute their food tokens to anyone that did not get to eat two times. ● Have the guard crabs sit back down. ● Place all of the food eaten by the guard crabs under the document camera and tell the class, "This is the food that was in the guard crabs' stomachs." Ask the rest of the students, "What do you observe that the guard crabs ate?" Record this for question 24 on the class worksheet while students record it in their notebook. o ESR: Coral ● Repeat the process for sea snails and parrotfish (question 25 and 26). ● Tell students, "We are now going to go to a different coral reef that has different sources of food." Repeat this process for Habitat 2, filling out page 6. ● Tell students, "We are now going to go to the third coral reef that again has different sources of food." Repeat this process for Habitat 3, filling out page 7.
10 minutes	**Food Web** ● Tell students, "Food webs are a way to represent what animals eat. Generally, the things lower on the food web get eaten by those higher up. Here we see that our food types are below our animals because they get eaten by our animals. We are going to try to fill in this food web and connect animals to their food based on what we saw animals eating in the coral reefs." Have students use their observations to tell you how to connect the boxes (question 41). Fill this in on the class worksheet, while students fill it in on their worksheet. ○ Make sure they make the connections on the food web based on the observations. If needed, the food web can be modified later if they observe an animal eating another type of food. ● As a class, answer question 42 which includes where a tiger shark would be in the food web. ● Ask students, "Do you think that because there is less food after you ate in each coral reef that means the food is gone forever?" ○ ESR: No, because the organisms reproduce over time. ● Ask students, "If some but not all of an animal type died, do you think that their population could increase again and that you would find this animal in this habitat a year from now?" ○ ESR: Yes, the animals can reproduce and increase their population again. We would find them in that habitat. ● Tell students, "We will now go through our habitat cards and tape on the animals that we would expect to find in that habitat." Bring out each card one by one and have students tell you the animals that they would expect to find in each habitat

	and tape them under "Animals in Habitats 1, 2, and3." In addition, record the animals that died in the habitat during the simulation. If there were animal species that had some animals die, underline that animal type.    • Ask students, "If we expect that the number of animals and food goes back up naturally, would we expect them to stay there over time? Does this make these habitats stable or unstable? ○ ESR: We would expect to see the same species of animals and food over time. This makes the habitats stable. • Explain that since the amount of food and animals can come back up naturally over time, that means that there won't be any changes in the species they could find in that habitat, making it stable. Fill in "stable" for question 43 on the class worksheet while students copy it on their worksheet. • Put each habitat card under the document camera one by one and have students circle the species that will be present in the coral reef after a year in question 44.
Part 3: Hungry Habitats – Higher Temperature	
10 minutes	**Review** • Have students tell you what they learned from the first two days of the activity. Make sure they realize that a habitat is stable when there are no changes occurring in it and that it is unstable when there are changes, but that eventually the habitat can become stable again. • Ask students, "What happened in the video when the temperature rose?" ○ ESR: The coral died and there were a lot less animals.

	• Tell students, "The habitats you have been studying had been stable for a long time, but recent increases in the temperature have caused changes in them." Ask students, "What do you think might happen to these habitats if the temperature increases?" Then, record this for question 45, on the class worksheet while students record it on their worksheet. ○ ESR: The coral will die. • Tell students, "We are going to repeat the simulation that we did last time, but in the reefs we explored, the temperature has risen, causing the coral in the area to die." • Tell students, "You will be the same type of animal that you were for the last session." Ask students to show you their animal signal when you call their animal type and pass them an animal card to put around their neck. Tell them, "Look at the back of your animal card to remember what you eat and if you have any food preferences." Remind students that they will start when you say to, that if they eat any number other than 2 times, they will die, and that if they eat more than 2 times, they won't be allowed to participate any more, because they will be ruining the activity for other students. Remind students that they need to eat their preferred food source before eating the other food sources that they can eat.
25 minutes	**Higher Temperature Habitats** • Repeat the same process as was done when the temperature was normal for Habitat 1 (page 9), Habitat 2 (page 10), and Habitat 3 (page 11) at high temperature. Make sure to fill out the Habitat Cards for each area. In addition, this time students will now need to calculate the total number of food sources (add the numbers of each food type together), the total number of animals (add the numbers of each animal type together), and the number of animals that died after the round (subtract the Finish number of animals from the Start amount). You do not need to document what the animals ate unless they eat something that was not recorded already in the food web. If this happens, have students go back and revise the food web in question 41. The filled out Habitat Cards should look like those below:  

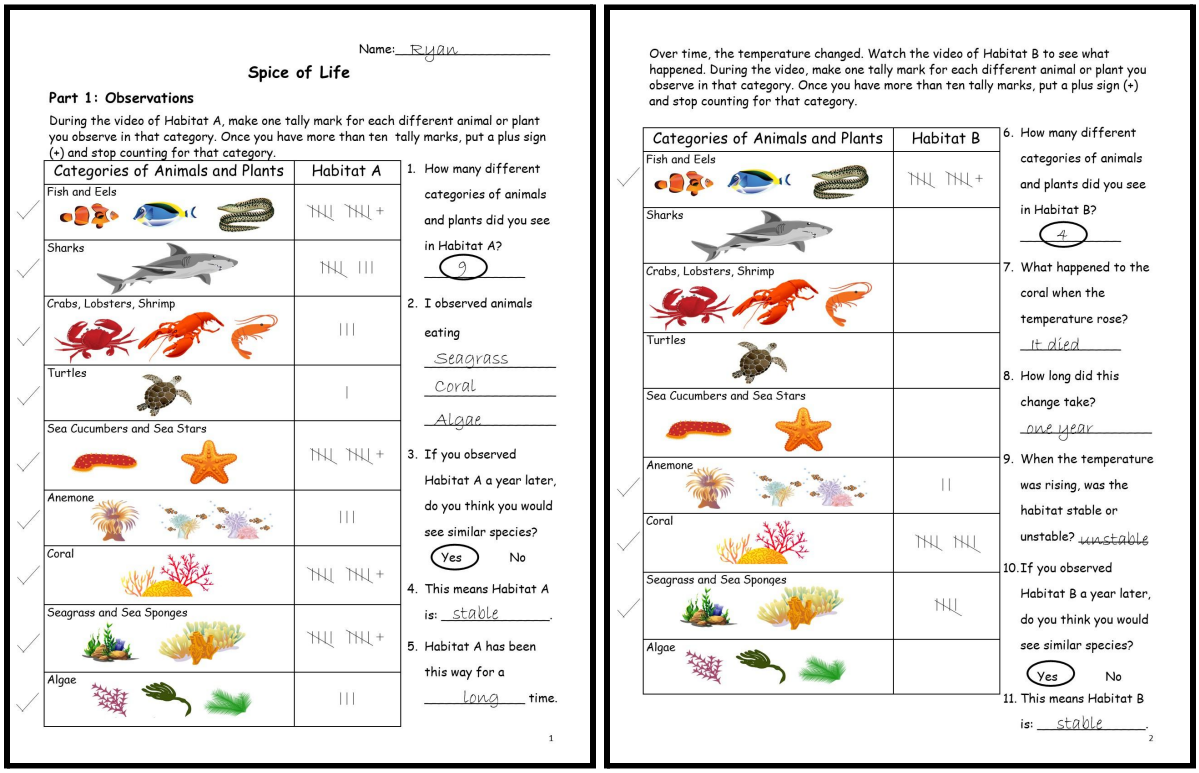
	
7 minutes	**Food** ● Tell students, "Now that we have run the activity at normal and higher temperatures, we need to figure out what caused the different habitats to be affected differently when the temperature changed." ● Tell students, "We are going to first look at how the sources of food differed in each habitat before the temperature changed." Bring out the Habitat Cards and have students circle which food sources were present in each habitat at normal temperature for question 61 while you do the same on the class worksheet. Ask students, "Which habitat had the least amount of food sources before the temperature change and how many did it have?" and, "Which habitat had the most amount of food sources before the temperature change and how many did it have?" o ESR: Habitat 3 had the least amount of food sources because it only had one food source (coral). Habitat 1 had the most amount of food sources because it had three food sources (algae, coral, and seagrass). ● Ask students, "Which food source was affected by the temperature increasing and how was it affected?" If they get stuck, remind them to think back to the second video they saw and their answer to question 7. o ESR: The coral is affected and it dies. ● Tell students, "If the coral dies, you will need to figure out how many food sources were still left for all of the animals to eat." Have students help you fill in the sentence frame for question 62 on the class worksheet while they copy it onto their worksheet.
7 minutes	**Animals** ● Tell students, "Now that you know how the food sources were affected by the temperature increase, you need to know what happened to those animals who eat that food." ● Fill out questions 63 and 64, focusing on Habitat 1. Use the Habitat 1 Card to help students fill in the information. Species that lost some, but not all, animals should be underlined. Repeat this process for Habitat 2, questions 65-66, using the Habitat 2 Card, and for Habitat 3, questions 67-68, using the Habitat 3 Card. ● Ask students, "Which habitat had the greatest number of animals die after the temperature changed?" o ESR: Habitat 3.

	● Explain that this means that Habitat 3 had the greatest change in the number of animals and then circle "Habitat 3" in question 69 on the class worksheet while students do the same on their worksheet.
8 minutes	**Total Species** ● Tell students, "When we think about changes in the habitats, we want to know how all species in the habitat were affected, which includes both the food and animals. If we count the total number of types of animals and types of food in a habitat, we will find the total number of species found in that habitat when it is stable. As a reminder, if a food type was present at the start of the simulation, it will rebound and be found in that area, and if not all of the animals of one type died, they will also reproduce and be found in the area." Take out the Habitat 1 Card and count the number of species present at both normal and high temperatures and record it in the table for question 70 on the class worksheet while students record it in their worksheets. ● Repeat the process for the other two habitats. ● Make sure students realize that the most species a stable habitat had was 6 (Habitat 1 at normal temperatures, where there was every food type and animal type) and the least species a stable habitat had was 0 (Habitat 3 at high temperatures, where there was no food and all of the animals died). ● Have students help you put the habitats in increasing order of number of species when the temperature was normal for question 71.
Part 4: Explanation and Applications	
10 minutes	**Review** ● Have students review what they learned the last time using the Habitat Cards. Make sure that they state the following: ○ Habitat 1 had the most amount of food sources and Habitat 3 had the least amount of food sources. ○ The temperature rise caused the coral to die off. ○ When the temperature rose, Habitat 1 lost the fewest animals and Habitat 3 lost the most. ○ Overall, Habitat 1 had the most amount(?) of species (animals and plants) and Habitat 3 had the least amount(?) of species. ● Ask students, "When are habitats stable and unstable?" ○ ESR: Habitats are stable when they are not changing and they are unstable when the species numbers are changing. ● Ask students, "When were our coral reef habitats stable and unstable?" ○ ESR: The habitat was unstable when the temperature rose and killed the coral but then it became stable again.
15 minutes	**Explanation** ● Ask students, "Why might the different habitats cause different numbers of animals to die?" After having a class discussion, have students help you fill in the sentence frame in question 72 of the class worksheet. Then, have them copy it onto their worksheet. ● Remind students that if we expect to find the same animals and food sources in a habitat even after a change to the habitat, that makes it stable. Ask students, "Which habitat was the most stable and why?"

	○ ESR: Habitat, 1 because it had the least number of animals die off. ● Ask students, "Which habitat was the least stable and why?" ○ ESR: Habitat 3 because it had the most animals die off. ● As a class, discuss and fill in question 73. Make sure that students understand that the more species present in a habitat, the more stable the habitat will be.
25 minutes	**Applications** ● Ask students, "Was there any particular animal that was affected the most by the change in temperature and what evidence do you have for that?" Lead students to realize that the guard crabs all died off when the temperature increased. ● Have each animal type tell you the number of food types that it could eat (guard crabs: 1, sea snails: 3, parrotfish: 2) and record this over the species name for question 74. ● Ask students, "Why were the guard crabs affected the most?" ○ ESR: They only ate one food type, which died off when the temperature increased. ● Ask students, "What was the next most affected species and why?" ○ ESR: Parrotfish, because they only eat two things. ● Go back to the data for the three habitats at high temperature and show students that more parrotfish died than sea snails. ● Make sure students understand that species that eat more than one type of food are more likely to survive, even if one food type dies off, because they can eat other food sources. ● As a class, fill in the evidence for question 74 and questions 75 and 76 in the class worksheet while students fill it in on their worksheet. ● Explain to students that there are other animals that depend on the guard crabs, sea snails, and parrotfish as a food source. Ask students, "Do you know an animal that eats some of these animals?" ○ ESR: Tiger shark. ● Guide students through answering question 77. First, point out the food web in question 41 and that the tiger shark only eats guard crabs and parrotfish. Then have them think about the higher temperature changes in the habitat and how that would impact the tiger shark. ● Tell students, "We now know that a habitat is stable if there are many different species in it. But there are many more types of habitats than just a coral reef. "Ask students, "Can anyone give me examples of other habitats that are not in the ocean?" ○ ESR: Desert, forest, tundra, rainforest. ● Tell students, "We are going to draw what you think a stable and unstable rainforest might look like." Ask students, "What would a stable rainforest look like?" ○ ESR: It would have a lot of different types of food sources and animals. It would also have lots of each type of food source. ● Ask students, "What are some animals that live in a rainforest?" When students give their answers, ask them, "What would we need to include in our picture for them to eat?"

	o ESR: Frog: it would eat flies and other bugs. Bird: it would eat fruit and insects. ● Tell students, "You will now do your drawing showing a stable and unstable rainforest. When you do your drawings you will also record the number of animal and food species in your picture along with if there are multiples of each food type." Have students complete their drawing for questions 78 and 79. ● As students are finishing, have them partner with another student to share what makes their rainforests stable and unstable. ● Once students have finished their drawing, have a few of them share their drawing under the document camera and have them explain why they are stable or unstable. ● Tell students, "You have taught me a lot about habitats. I now know that the more species in a habitat, the more stable a habitat is and the less it will be affected by environmental changes, like when the temperature increases. I also learned that the more things an animal eats, the more stable that species is and that fewer of these animals will die off if the environment changes. Also, if there is a change to that habitat that makes it unstable, the habitat can become stable again, sometimes with fewer species."

Example Student Work



Name: Ryan

Spice of Life

Part 1: Observations

During the video of Habitat A, make one tally mark for each different animal or plant you observe in that category. Once you have more than ten tally marks, put a plus sign (+) and stop counting for that category.

Categories of Animals and Plants	Habitat A
Fish and Eels	𝍸 𝍸 +
Sharks	𝍸 III
Crabs, Lobsters, Shrimp	III
Turtles	I
Sea Cucumbers and Sea Stars	𝍸 𝍸 +
Anemone	III
Coral	𝍸 𝍸 +
Seagrass and Sea Sponges	𝍸 𝍸 +
Algae	III

1. How many different categories of animals and plants did you see in Habitat A? (9)
2. I observed animals eating Seagrass, Coral, Algae
3. If you observed Habitat A a year later, do you think you would see similar species? (Yes) No
4. This means Habitat A is: stable.
5. Habitat A has been this way for a long time.

1

Over time, the temperature changed. Watch the video of Habitat B to see what happened. During the video, make one tally mark for each different animal or plant you observe in that category. Once you have more than ten tally marks, put a plus sign (+) and stop counting for that category.

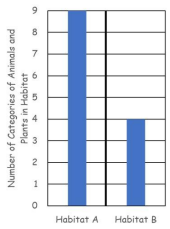
Categories of Animals and Plants	Habitat B
Fish and Eels	𝍸 𝍸 +
Sharks	
Crabs, Lobsters, Shrimp	
Turtles	
Sea Cucumbers and Sea Stars	
Anemone	II
Coral	𝍸 𝍸
Seagrass and Sea Sponges	𝍸
Algae	

6. How many different categories of animals and plants did you see in Habitat B? (4)
7. What happened to the coral when the temperature rose? It died
8. How long did this change take? one year
9. When the temperature was rising, was the habitat stable or unstable? unstable
10. If you observed Habitat B a year later, do you think you would see similar species? (Yes) No
11. This means Habitat B is: stable.

2

Analysis

12. Fill in one box for each category of animal and plant that you recorded in each habitat (look at questions 1 and 6 for help).



13. More fish live in Habitat A than in Habitat B. This might be because there is more food to eat in Habitat A.

Explanations

14. Before the temperature change, the habitat was stable. The temperature rise caused the habitat to change, making it unstable. During this time many plants and animals moved or died. Eventually the habitat became stable again, but fewer species lived there.

15. If I were a fish I would want to live in Habitat A because there are a lot of other fish and there is more food in Habitat A than in Habitat B.

Part 2: Hungry Habitats — Normal Temperatures

16. Circle the animal you are: Guard Crab (Sea Snail) Parrotfish

17. Circle the foods you eat: (algae) (coral) (seagrass)

18. Do you have a preference for any food and, if so, what? Seagrass

If you have a preference for a food, you have to eat that food first if you can.

19. I have to eat 2 times to survive. If I eat less than that, I will die. If I eat more than that, I will not be allowed to participate in the simulation any more.

Habitat 1: Normal Temperature

20. Circle the foods that are found in Habitat 1: (algae) (coral) (seagrass)

21. Fill out the table with the amount of food at the start and finish.

	Algae	Coral	Seagrass
Start	14	24	12
Finish	0	10	0

22. Fill out the table with the number of animals at the start and finish.

	Guard Crab	Sea Snail	Parrotfish
Start	6	8	6
Finish	4	8	6

23. I ate 2 times, so I am (alive) dead.

24. I observed the guard crabs eating: algae (coral) seagrass

25. I observed the sea snails eating: (algae) coral (seagrass)

26. I observed the parrotfish eating: algae (coral) (seagrass)

Habitat 2: Normal Temperature

27. Circle the foods that are found in Habitat 2: algae (coral) (seagrass)

28. Fill out the table with the amount of food at the start and finish.

	Algae	Coral	Seagrass
Start	0	40	10
Finish	0	8	0

29. Fill out the table with the number of animals at the start and finish.

	Guard Crab	Sea Snail	Parrotfish
Start	6	8	6
Finish	6	8	6

30. I ate 2 times, so I am (alive) dead.

31. I observed the guard crabs eating: algae (coral) seagrass

32. I observed the sea snails eating: algae (coral) (seagrass)

33. I observed the parrotfish eating: algae (coral) seagrass

Habitat 3: Normal Temperature

34.Circle the foods that are found in Habitat 3: algae (coral) seagrass

35.Fill out the table with the amount of food at the start and finish.

	Algae	Coral	Seagrass
Start	0	46	0
Finish	0	6	0

36.Fill out the table with the number of animals at the start and finish.

	Guard Crab	Sea Snail	Parrotfish
Start	6	8	6
Finish	6	8	6

37.I ate 2 times, so I am (alive) dead.

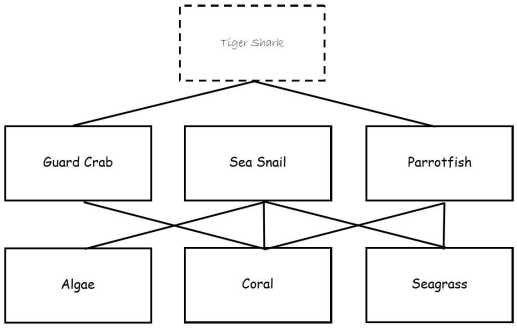
38.I observed the guard crabs eating: algae (coral) seagrass

39.I observed the sea snails eating: algae (coral) seagrass

40.I observed the parrotfish eating: algae (coral) seagrass

41.Based on what you have learned about Habitats 1, 2, and 3, fill out the food web below by drawing lines connecting the animals to what they eat.

Food Web



42.In coral reefs, tiger sharks eat guard crabs and parrotfish. Draw a box where tiger sharks should be in the food web and connect it to what it eats.

43.While the animals in some of the habitats seemed to eat up a food source, these food sources would be expected to grow back over time (as long as they were there to start with). Having the same species of plants and animals in an area for a long time would make the habitat stable.

44.Which species do you think would be found in each habitat after one year?

Habitat 1: (algae) (coral) (seagrass) (guard crabs) (sea snails) (parrotfish)

Habitat 2: algae (coral) (seagrass) (guard crabs) (sea snails) (parrotfish)

Habitat 3: algae (coral) seagrass (guard crabs) (sea snails) (parrotfish)

Part 3: Hungry Habitats — High Temperatures

While the habitats had been stable for a long time, increasing temperatures caused a change in them.

45.Thinking back to the video, how do you think the increasing water temperature would affect the habitat? The coral will die.

Habitat 1: High Temperature

46.Circle the foods that are now found in Habitat 1: (algae) coral (seagrass)

47.Fill out the table with the amount of food at the start and finish.

	Algae	Coral	Seagrass	Total Food Sources
Start	14	0	20	34
Finish	10	0	0	10

48.Fill out the table with the number of animals at the start and finish.

	Guard Crabs	Sea Snails	Parrotfish	Total Animals
Start	6	8	6	20
Finish	0	8	4	12

49.I ate 2 times, so I am (alive) dead.

50.Number of animals that died: 8

Habitat 2: High Temperature

51.Circle the foods that are now found in Habitat 2: algae coral (seagrass)

52.Fill out the table with the amount food at the start and finish.

	Algae	Coral	Seagrass	Total Food Sources
Start	0	0	24	24
Finish	0	0	0	10

53.Fill out the table with the number of animals at the start and finish.

	Guard Crabs	Sea Snails	Parrotfish	Total Animals
Start	6	8	6	20
Finish	0	6	2	8

54.I ate 2 times, so I am (alive) dead.

55.Number of animals that died: 12

Habitat 3: High Temperature

56.Circle the foods that are now found in Habitat 3: algae coral seagrass

57.Fill out the table with the amount of food at the start and finish.

	Algae	Coral	Seagrass	Total Food Sources
Start	0	0	0	0
Finish	0	0	0	0

58.Fill out the table with the number of animals at the start and finish.

	Guard Crabs	Sea Snails	Parrotfish	Total Animals
Start	6	8	6	20
Finish	0	0	0	0

59.I ate 0 times, so I am alive (dead.)

60.Number of animals that died: 20

Food

61.What was different between the food sources in the habitats before the temperature change?

Habitat 1 had (algae) (coral) (seagrass)
Habitat 2 had algae (coral) (seagrass)
Habitat 3 had algae (coral) seagrass

62.The food source that was affected by the temperature change was coral. This left Habitat 1 with 2 food sources, Habitat 2 with 1 food source, and Habitat 3 with 0 food sources.

Animals

63.In Habitat 1, circle what animals were present before and after the temperature change. If a species had some animals die, but not all of them, underline it.

Before: (guard crab) (sea snail) (parrotfish)
After: guard crab (sea snail) (parrotfish)

64.The temperature change caused Habitat 1 to lose 1 species of animal and 8 total animals.

65.In Habitat 2, circle what animals were present before and after the temperature change. If a species had some animals die, but not all of them, underline it.

Before: (guard crab) (sea snail) (parrotfish)
After: guard crab (sea snail) (parrotfish)

66.The temperature change caused Habitat 2 to lose 1 species of animal and 12 total animals.

67.In Habitat 3, circle what animals were present before and after the temperature change. If a species had some animals die, but not all of them, underline it.

Before: (guard crab) (sea snail) (parrotfish)
After: guard crab sea snail parrotfish

68.The temperature change caused Habitat 3 to lose 3 species of animal and 20 total animals.

69.Which habitat had the largest change in the number of animals present after the temperature increased? Habitat 1 Habitat 2 (Habitat 3)

Total Species

70.How many species (food and animals) are present when the habitat is stable for both normal and high temperatures?

	Normal Temperature	High Temperature
Habitat 1	6	4
Habitat 2	5	3
Habitat 3	4	0

71.List the habitats in increasing order of the number of species they had when the temperature was normal. 3 (lowest) 2 1 (highest)

Part 4: Explanations and Applications

Explanations

72.Why might the differences in the habitats cause different amounts of animals to die after the temperature changed?

Habitat 1 had the **fewest** animals die off because it had the most food sources. Habitat 3 had the **most** animals die off because it had no food.

73.Habitats are most stable when they have many different species.

Applications

Use your food web on page 8 to answer these questions.

74.Circle the animal that was affected the most by the increase in temperature.

Ate 1: (guard crab) Ate 3: sea snail Ate 2: parrotfish

Evidence: This animal was affected the most because it only ate one type of food and that all died.

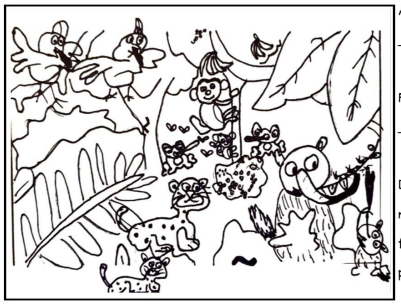
75.Animals are more likely to survive changes in the environment when they eat many different things.

76.The species that was most stable was sea snails.

77.What would happen to tiger sharks if the temperature of the seawater increased?

When the seawater gets warmer, coral dies, which means that all (none/some/all) of the guard crabs die and some (none/some/all) of the parrotfish die. This causes some (none/some/all) tiger sharks to die because there are no more guard crabs and fewer parrotfish to eat.

78.Draw what you think a stable rainforest might look like.



Animal Species

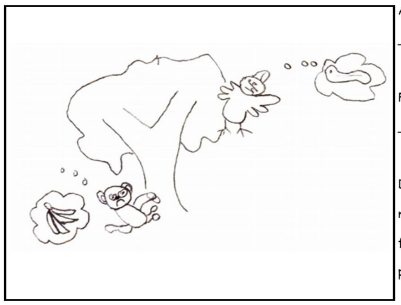
5

Food Species

6

Do you have multiple of each food species in your picture? (Yes) No

79.Draw what an unstable rainforest might look like.



Animal Species

2

Food Species

1

Do you have multiple of each food species in your picture? Yes (No)

15