



Everblue Education

Learning from Lionfish

It's time for another return to the reef! This week, we'll be learning from lionfish. In this lesson, students will meld their math, geography, and biology skills together to learn about invasive lionfish in the Caribbean. Then, they'll spend some time thinking critically and using problem-solving to figure out how to manage these tropical reefs to keep them healthy. This week's lesson is based on the third and final paper by Dr. Jahson B. Alemu I in our Everblue At-Home Education reef series.

Everblue is a 501(c)(3) nonprofit dedicated to encouraging ocean-conscious living by increasing scientific literacy. Our online education resources connect current science to daily life, allowing you to learn about the ocean at your fingertips! Stay in touch by following @oceaneverblue on your preferred social media platform or by visiting our website at www.oceaneverblue.org.

To help us keep the ocean ever blue, please share this program with the teachers and parents you know. Partnering with marine scientists from around the world, we've created simple and engaging activities based on recently published papers! These activities connect you and your students to current research while fulfilling education standards for reading, math, science, and writing. Even though the activities are created for grade school, they're fun and informative for parents and siblings, as well! Everblue At-Home Education lessons were published once a week for eight weeks during the 2020 quarantine to provide resources for students and educators. Keep following Everblue for lessons posted monthly with each new Laboratory Collaboration!

Research Paper:

The status and management of the lionfish, *Pterois* sp. in Trinidad and Tobago.

Jahson B. Alemu I. 2016.

Grade Level:

Elementary School, Grades 1-3

Timing:

1 hour and 30 minutes

Materials:

- Writing utensils
- Coloring supplies (Crayons, colored pencils, or markers)
- Scissors

Common Core State Math Standards

Counting & cardinality
Operations & algebraic thinking

Next Generation Science Standards

Science & Engineering Practices:	Crosscutting Concepts:	Disciplinary Core Ideas:
Analyzing & interpreting data Using mathematics & computational thinking	Cause & effect Systems & system models	Biodiversity & humans Natural resources

Activity Overview

Title of Activity	Learning Cycle Stage	Time
Colorful Fishes	Invitation	10 minutes
Creating Reef Communities	Exploration	15 minutes
Mapping Reef Communities	Concept Invention	20 minutes
Assessing Reef Communities	Concept Invention, Application	20 minutes
Going Lionfish-ing	Application	20 minutes
Reflection	Reflection	5 minutes

Appendix Contents

Appendix I Instructor Support	Appendix II Attached Lesson Materials
Ocean Vocabulary Common Questions Lionfish Map Key	Dominoes Arithmetic Activity Sheet Lionfish Species Range Map



Activities

Colorful Fishes

In this activity, students will color their cut-out dominoes (*found in Appendix II on pages 10-12*) of lionfish, groupers, parrotfish, and damselfish. The last three fishes were introduced in Everblue's "Tropical Reef Communities" lesson. As your students are coloring their dominoes, have a discussion with them to encourage counting skill practice, and also share some fun facts about the different types of fish that will be in their reef communities as they color the different species.

Math discussion questions

- How many lionfish are on this domino?
- How many animals have you colored so far?
- Are there any sets of fish that have the same number as each other?

Lionfish Fun Facts

- Lionfish are **native** to the Indo-Pacific. This area makes up all the warm, tropical waters around India, China, Indonesia, the Philippines, southern Japan, and northern Australia.
- Lionfish are great **predators**! They use feathery fins to lure small fish towards their mouths and have venomous spines for protection.
- Even though lionfish are native to the Indo-Pacific, they have been invading the Caribbean since at least 1985, when they were first spotted in Florida. Since then, they've taken over the Caribbean. Recently, they've been spotted as far south as Brazil!

Grouper Fun Facts

- These groupers are usually one to two feet long, but can grow as long as four feet!
- Groupers eat other fish by opening their large mouths and swallowing their food whole.
- Groupers can change color based on their mood.

Parrotfish Fun Facts

- The parrotfish in our lesson can grow up to two feet long.
- Parrotfish have hard teeth that are all connected, or fused, to eat corals and seaweeds. This big tooth looks like a parrot's hard beak, which is where the fish get their name!
- These reef fish help keep the corals clean and healthy!

Damselfish Fun Facts

- The damselfish in our lesson are typically about four inches long.
- This type of reef fish eats the seaweed that grows on and around the corals.
- Damselfish often live in **schools** of twenty fish!

Creating Reef Communities

In this activity, students will create six reef communities by drawing dominoes from a shuffled pile. Students will practice their addition and then compare the number of invasive lionfish to the number of native reef fishes. *There is an arithmetic activity sheet in Appendix II on page 13; print one copy of this activity sheet for each of your students.*

1. Shuffle dominoes face down and make a pile
2. Draw 2 dominoes
3. On the activity sheet, write down the number of lionfish shown on each domino and find the sum of lionfish in this reef community.
4. On the same row on the activity sheet, write down the number of the other fish shown on each domino and find the sum of native reef fishes in this community.
5. Compare the total numbers of lionfish and reef fishes in this reef community. In the middle column labeled “Compare,” write the appropriate symbol (<, =, or >) between the lionfish and reef fishes. Is the total number of lionfish is less than, equal to, or greater than the number of reef fish?
6. Put these two dominoes aside.
7. Repeat steps 2-6 until all dominoes have been drawn and the activity sheet is completed.

Mapping Reef Communities

In this activity, there will be vocabulary words in **blue text**. These definitions and others can be found in Appendix I. Students will learn how to map lionfish ranges. *There is a blank map in Appendix II on page 14; print one copy of this map for each of your students. There is a map with a colored key in Appendix I on page 9 for you to help guide your students.*

If you want your students to explore an interactive map of where invasive lionfish have been found in the Caribbean, you can visit the USGS Nonindigenous Aquatic Species site <https://nas.er.usgs.gov/viewer/omap.aspx?SpeciesID=963>. Read the following to your students and guide them through coloring their map.

1. As we learned in our fun facts, lionfish actually have TWO big places they can be found in the world. Let’s label a map so we can start to figure out the lionfish species range.
 - a. *Help students fill in the 7 continents and 5 oceans on their world map. If they cannot yet write or spell, have them point and tell you where each one goes and write it in for them*
2. Now that we have our continents and oceans all labeled, do you remember the two oceans where lionfish are found in the world?
 - a. *Help students to the conclusion that lionfish are found both in the Indo-Pacific and in the Caribbean. The Indo-Pacific is in between Asia and Australia on their map; the Caribbean is in between North America and South America on the Atlantic side.*

3. That's right! Now, lionfish are **native** to the Indo-Pacific. Native means that it is natural and good to see them in this area! Can you think of examples of animals that are native to Antarctica? (*Think penguins, seals, orcas.*) What about animals that are native to Africa? (*Think elephants, giraffes, hippos.*)
4. Let's color in the native **species range** of the lionfish. The native species range is the area where an animal is normally found. Choose a color and fill in the ocean area on your map around Western Africa, India, Indonesia, northern Australia, China, and southern Japan.
 - a. *Use the key in Appendix I to help your student color the correct area. On the key, the native species range is shown in green and blue.*
5. While the lionfish are native to the Indo-Pacific, they are **invasive** in the Caribbean. Invasive means that they are not native to an area. This would be like if you found a penguin in the Arctic, where they do not normally live, instead of in Antarctica, their native habitat. Invasive species often cause harm to other creatures or people.
6. Let's color in the invasive species range of the lionfish. Choose a color that is different from your native color and fill in the ocean area on your map around Florida, the Caribbean, the coast of Central America, and the northern coast of South America.
 - a. *Use the key in Appendix I to help your student color the correct area. On the key, the native species range is shown in red.*
7. Now that we know where lionfish are native and where they are invasive, are you ready to survey some reef communities?

Assessing Reef Communities

In this activity, students will use their science skills to survey reef communities in the Caribbean using their arithmetic activity sheet from “Creating Reef Communities.” Students will also get to think critically, problem-solve, and practice coming up with ideas for effective management and conservation methods.

1. Let's pretend you are a scientist working in the Caribbean! You spend your days on a boat in the crystal clear waters of the Caribbean sea, counting lionfish and reef fishes to tell if the reef communities are healthy or unhealthy.
2. You've already taken a lot of your **data** for the day—data is what we call the numbers of fish you counted! Let's look again at the numbers we counted in the “Creating Reef Communities” activity.
3. As a scientist, you and your team are concerned about the growing numbers of lionfish on your reefs. This is because lionfish actually eat a lot of the smaller reef fishes, and they grow really fast, so it is easy for the lionfish to take over areas of the reef. We need to look at your six reefs and tell if they are healthy or unhealthy.

4. Knowing that lionfish are invasive to the Caribbean, and knowing that they can endanger reef fishes, do you think that a healthy reef would have more lionfish than reef fishes, equal amounts of lionfish and reef fishes, or less lionfish than reef fishes?
 - a. *Allow students to use the information they have to make guesses about reef health. If they are struggling, give them hints that point toward the conclusion that healthy reefs have less lionfish.*
5. That's right! Healthy reefs in the Caribbean will have less lionfish, or no lionfish at all! This means they have not been invaded yet, so the reef community is still made up of mostly or all native fishes.
6. Let's look at our fish count data! Using your comparison <, =, or > in the middle column, decide whether each reef community has more lionfish or more reef fishes.
7. Next, using what we know about lionfish and reef health, write "H" for Healthy or "U" for Unhealthy next to the six reef communities.
 - a. Which number reefs are healthy? Which number reefs are unhealthy?
8. What about the reefs where there are equal numbers of lionfish and reef fishes? Do you think these would be healthy, or unhealthy?
 - a. *Allow students to hypothesize based on what they know. If they are stuck, remind them that lionfish are voracious predators.*
9. Yes, because lionfish are such good predators, we wouldn't want to have a reef with equal numbers of lionfish and native fishes. This is because the predators could quickly overwhelm the native fishes!
10. Now, what do you think we should do about your unhealthy reefs? What are some ways you think we could help them?
 - a. *Allow students a few moments to brainstorm different reef management options. They should come up with ideas that involve moving or taking out the lionfish. If not, help guide them to this conclusion.*
11. You're right! One successful way that communities in the Caribbean have been managing the invasive lionfish is through fishing. Many places have even started fishing tournaments, so people can turn reef management and conservation into a sport! Do you want to go lionfish-ing? Then go ahead to the next activity!

Going Lionfish-ing

In this activity, students will practice subtraction as they fish for lionfish to help their six reef communities from earlier in this lesson. Use the space at the bottom of the arithmetic activity sheet to write out the subtraction problems.

Note: If you have more than one student, you can turn this activity into a lionfish-ing tournament! Whichever student "catches" the most lionfish with their dominoes wins!

1. Shuffle all dominoes face down and make a pile.
2. Pick one of your unhealthy reefs to start fishing on! Which number reef will you fish on first?
3. Draw 1 domino from the pile.
4. Subtract the number of lionfish on this domino from your first unhealthy reef.
5. Is this reef community considered healthy now?
 - a. *To decide if it is healthy, help students compare the new numbers of lionfish and reef fishes. If the number of lionfish is still greater than or equal to the reef fishes, have the students fish again.*
 - b. If yes, add the number of reef fishes from the domino to the reef community and mark this community “H” for healthy.
 - c. If not, draw another domino to go lionfish-ing again!
6. Once your reef is healthy, move on to your next unhealthy reef. Repeat steps 3 - 5 until all of your reef communities are healthy!
7. Have a discussion with your students about what you could do with the lionfish that you caught. After all, even though they’re invasive, we don’t want to waste fish. Have students brainstorm ideas of what you could do with the lionfish.
 - a. *Some ideas:*
 - i. *Eat the fish! Lionfish are high in omega-3 fatty acids, making them very healthy fish to eat. And, since they are invasive, there is no worry for overfishing them, making them a very sustainable fish to harvest.*
 - ii. *Use the fish as bait. Lionfish spines are poisonous, so you want to be careful to remove those, but then they could be used as bait for local fishermen.*

Reflection

As you and your student are cleaning up, talk to your student about what you just did together. Here are some guiding questions to help shape your conversation.

- What was your favorite part of our activity today?
- What is something that you learned about lionfish?
- Did you notice any patterns during our activity today?
- What is something you wonder about reef communities?
- What surprised you the most during our activity today?



Appendix I - Instructor Support

Ocean Vocabulary

- Data - Pieces of information (like numbers, facts, and observations) that are written down for reference and analysis
- Ecosystem - A community of living organisms interacting with each other and the non-living environment.
- Invasive - An introduced species that spreads quickly in a new place, often harming the native community of organisms.
- Native - A species that originates in and occurs naturally in a specific place. Scientists also sometimes use words like “endemic” and “indigenous” to describe native species.
- Predator - An animal that eats other animals.
- School - A group of fish
- Species range - The geographic area where a particular species can be found during its lifetime.

Common Questions

Grammatical difference between “fishes” and “fish”

- *Fishes*: Used to describe multiple different species of fish.
 - For example, when referring to the groupers, parrotfish, and damselfish in our lesson, we say “the reef fishes.”
- *Fish*: Used to describe one species of fish.
 - For example, when referring to a large group of lionfish, we say “the invasive fish.”

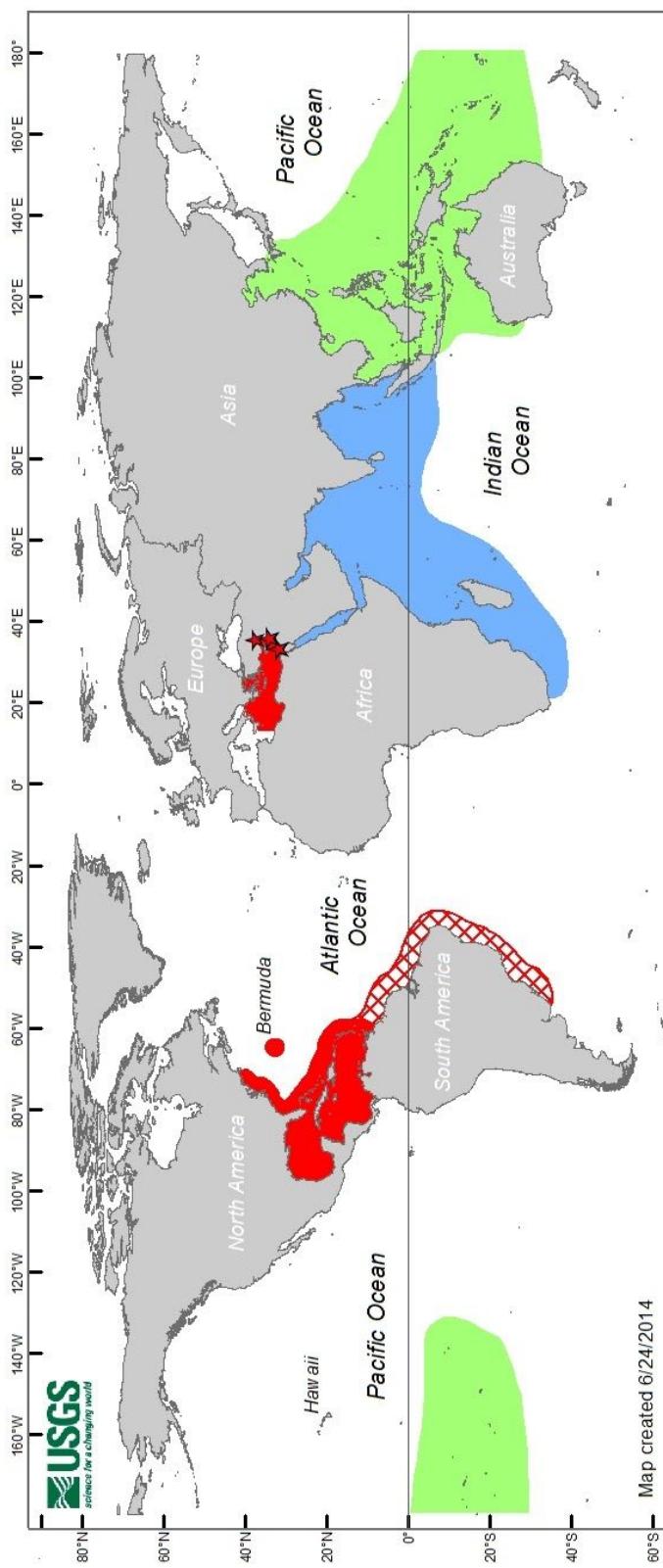
What makes a species “invasive”?

Invasive species are those that are introduced (perhaps accidentally) by people to new regions. These species often reproduce quickly and may tolerate lots of different environments. Additionally, the new communities may not have the predators or competitors that keep the invader’s numbers in check.

Why are invasive species a problem?

The invaders use up resources that native species need to survive. In the case of lionfish, they put unsustainable pressure on prey species, changing food web dynamics.

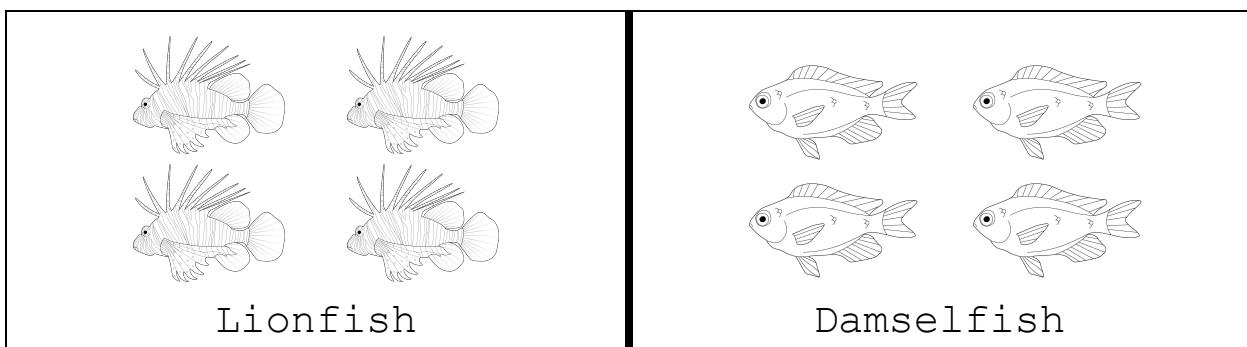
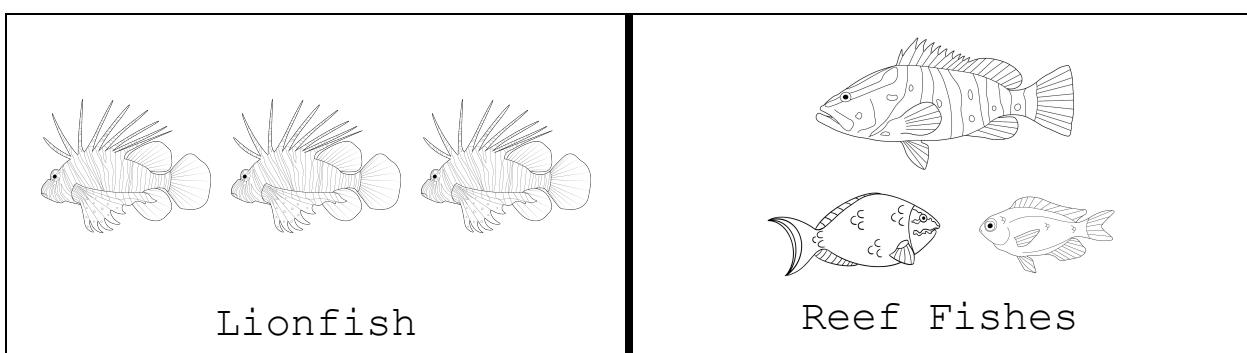
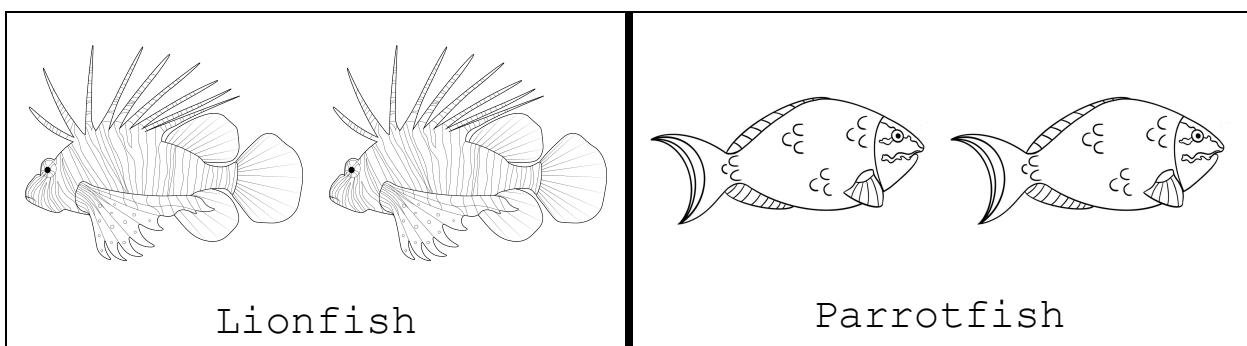
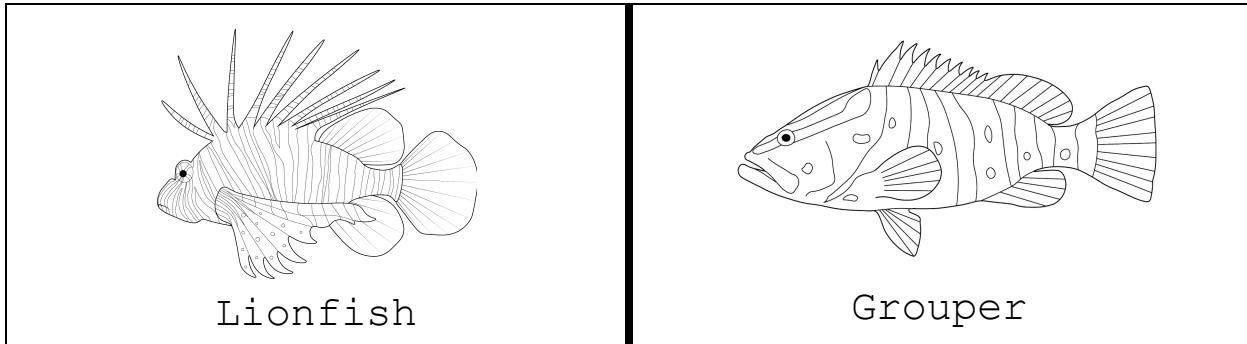
Lionfish Map Key



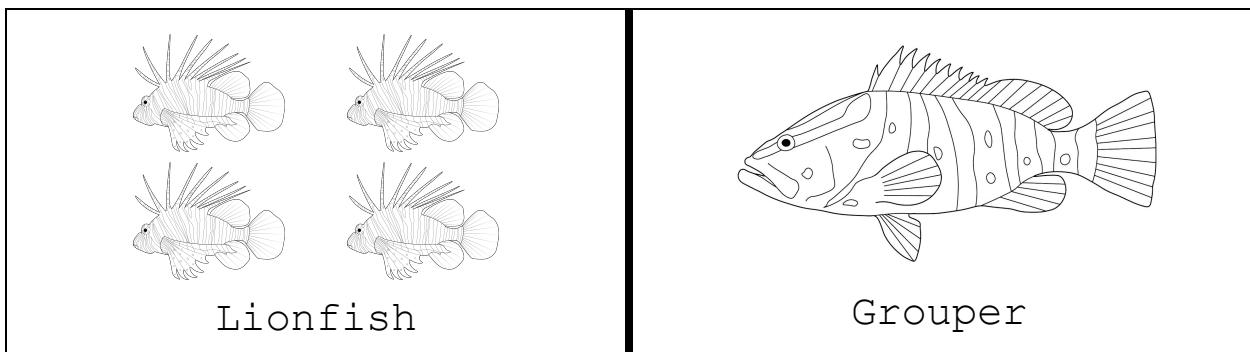
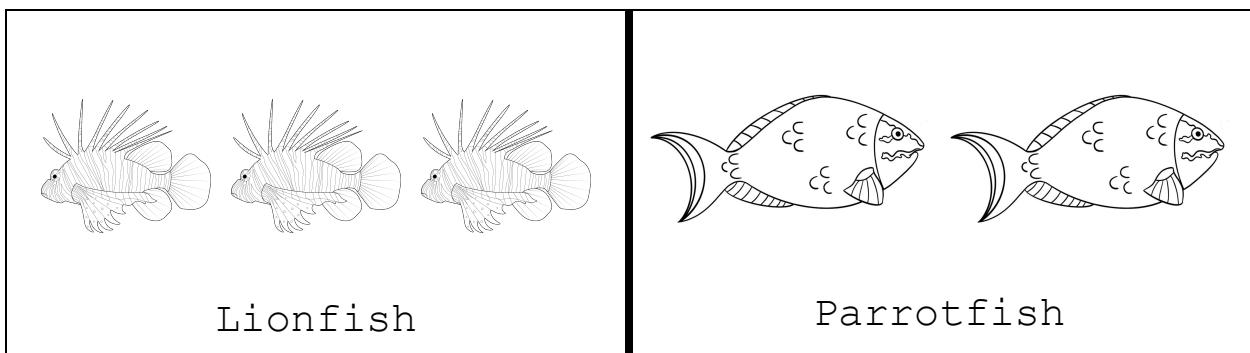
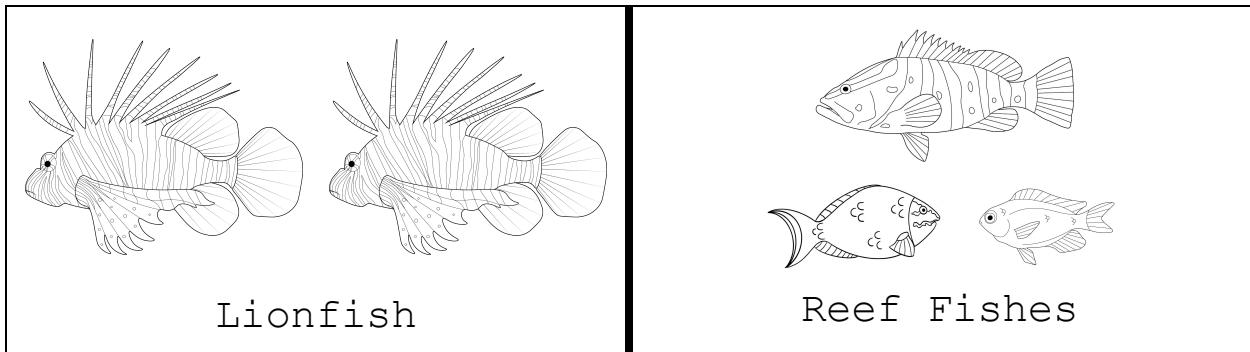
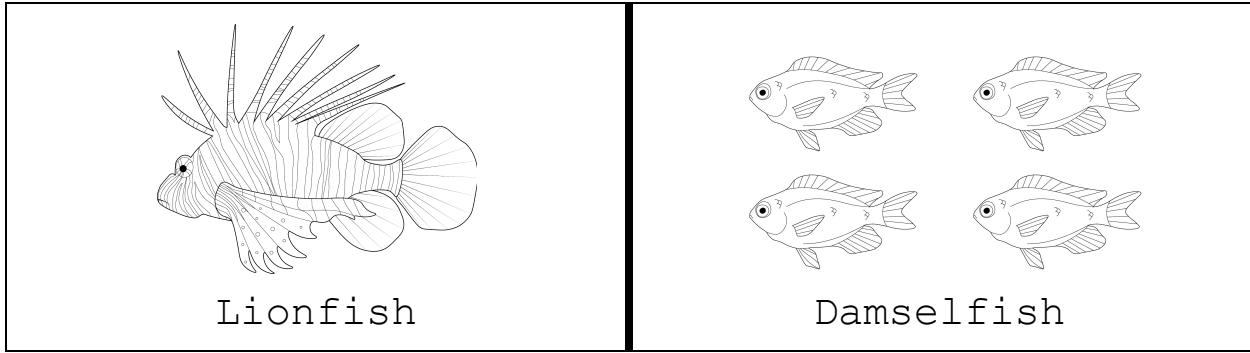
Map from USGS, 2014, adapted from Schultz (1986) and Randall (2005).

Appendix II - Attached Lesson Materials

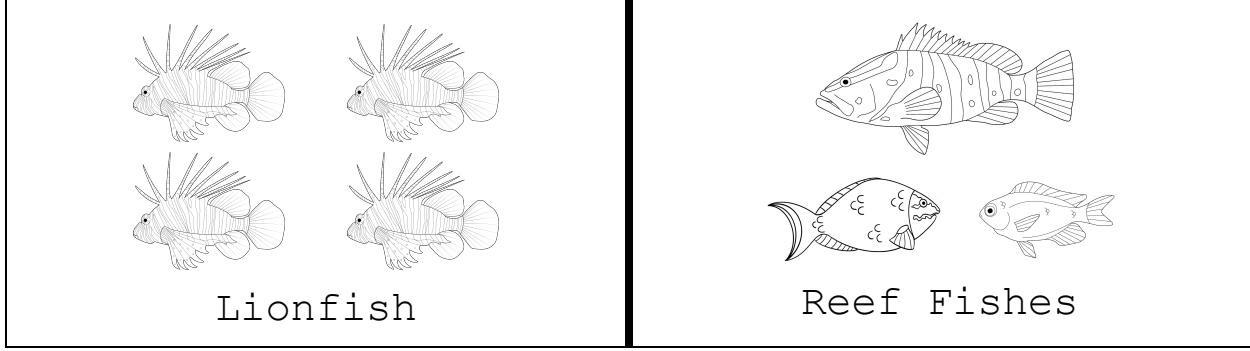
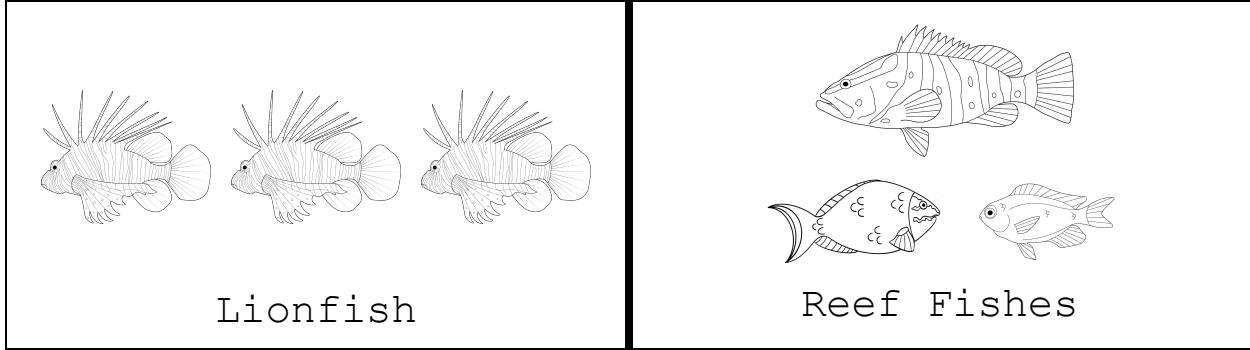
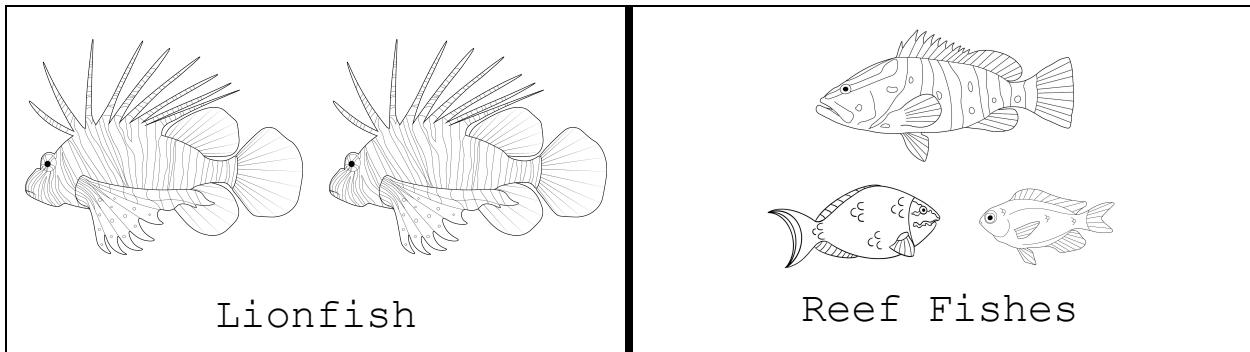
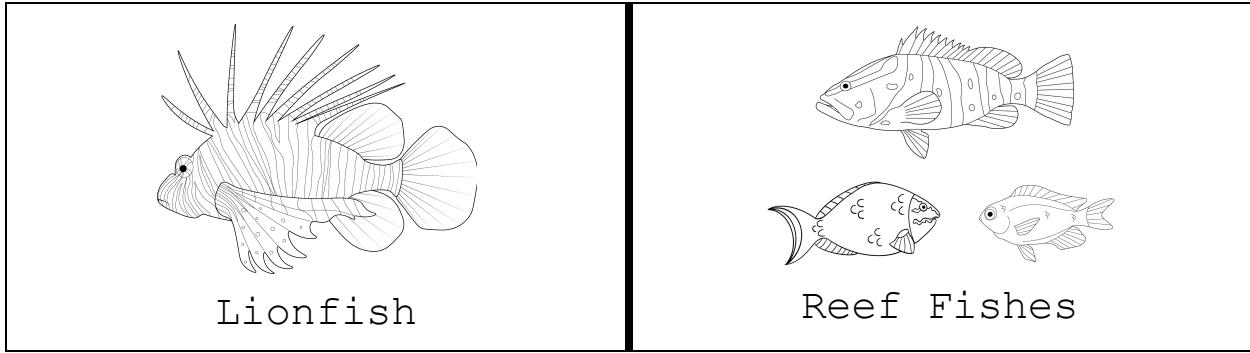
Dominoes - 1/3



Dominoes - 2/3



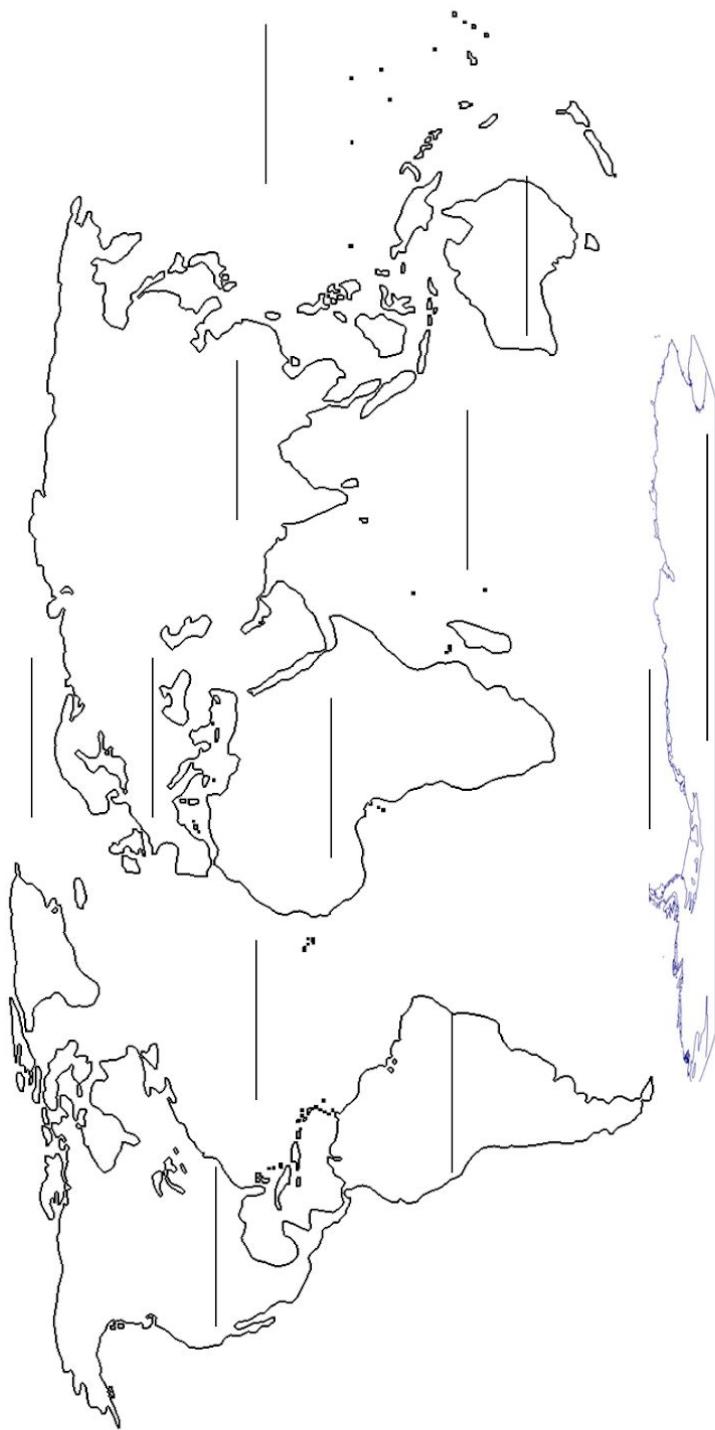
Dominoes - 3/3



Arithmetic Activity Sheet

Reef Community	Number of Lionfish	Compare < = >	Number of Reef Fishes	Healthy or Unhealthy?
<i>example</i>	$2 + 4 = 6$	>	$3 + 1 = 4$	<i>U</i>
1	+ =		+ =	
2	+ =		+ =	
3	+ =		+ =	
4	+ =		+ =	
5	+ =		+ =	
6	+ =		+ =	

Lionfish Species Range Map



Continents: Africa, Antarctica, Asia, Australia, Europe, North America, South America

Oceans: Pacific, Atlantic, Indian, Arctic, Southern Ocean

Map adapted from TES for Schools, tes.com