



Everblue Education

Sharks and Rays and Shark-like Rays, Oh My!

Sharks and rays and shark-like rays, oh my! Welcome to the wonderful world of cartilaginous fishes. This week, students will learn all about different kinds of sharks and their relatives! Students will use a key to correctly identify different species, and will learn about fishing pressure on sharks and how to protect them! This week's lesson is based on a paper that was just published this year called "The thin edge of the wedge: Extremely high extinction risk in wedgefishes and giant guitarfishes."

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 @oceanoeverblue 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 so we can spread ocean science far and wide. Partnering with marine scientists from around the world who study all parts of the ocean, 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! More activities will be available to download for FREE off of our website, with a new activity added every Friday until the end of quarantine.

Research Paper:

The thin edge of the wedge: Extremely high extinction risk in wedgefishes and giant guitarfishes. *Peter M. Kyne et al. 2020.*

Grade Level:

Elementary School, Grades 1-5

Timing:

1 hour

Materials

- Markers or colored pencils in at least four different colors
- One large bowl and three smaller bowls
- Two different kinds of small snack items

Next Generation Science Standards

Science & Engineering Practices:	Crosscutting Concepts:	Disciplinary Core Ideas:
Analyzing & interpreting data Developing & using models Designing solutions	Cause & effect Patterns	Biodiversity & humans Structure & function

Activity Overview

Title of Activity	Learning Cycle Stage	Time
Swim Like a Shark, Swim Like a Ray	Invitation, Exploration	5 mins
Shark, Skate, or Ray?	Concept Invention, Application	25 mins
Shark Protection Squad	Concept Invention, Application	25 mins
Reflection	Reflection	5 mins

Appendix Contents

Appendix I Instructor Support	Appendix II Attached Lesson Materials
Ocean Vocabulary Common Relevant Misconceptions	Shark, Ray, or Skate Activity Sheet



Activities

Swim Like a Shark, Swim Like a Ray

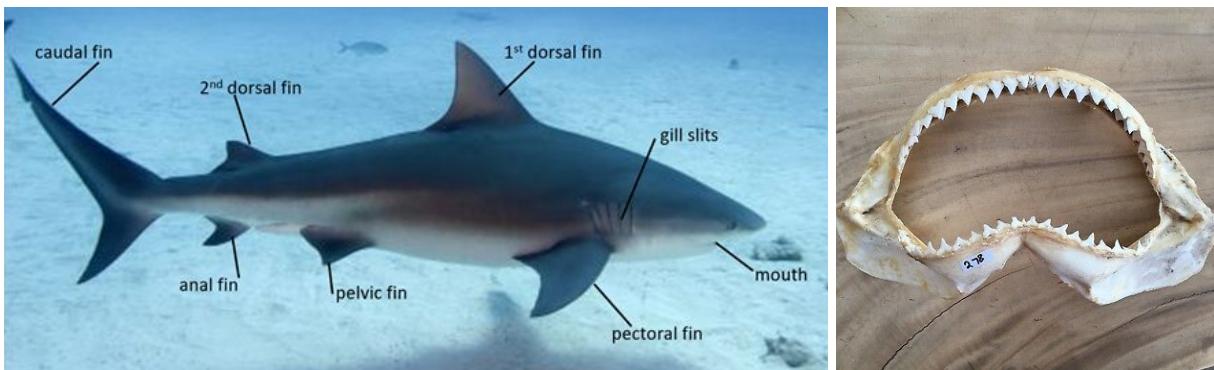
In this activity, students will move around, exploring some of the different ways that sharks, rays, and shark-like rays swim in the water. Read the following to your students, and feel free to try some of the movements as well.

1. Have you ever seen a shark swim? They use their powerful tails to move through the water. Take a moment to swim like a shark around the room you are in. You can wiggle your hips and imagine that you have a long shark tail behind you.
 - a. Watch this video if you want an example of how sharks swim:
<https://www.youtube.com/watch?v=HqErSOEjHe4>
2. Have you ever seen a ray swim? These fishes swim by moving their large, wide fins similarly to how birds flap their wings. If you have watched *Finding Nemo*, Mr. Ray is a spotted eagle ray and swims like this! Take a moment to swim like a ray by slowly “flapping” your arms, imagining they are large fins.
 - a. Watch this video if you want an example of how rays swim:
<https://www.youtube.com/watch?v=wm3CukqD6vQ>
3. There are also some rays that have stronger tails and swim using their tail, similar to sharks, and rely on their fins to turn and balance! Take a moment to swim like a shark-like ray around the room you are in. Try combining different tail wiggles and fin movements as you turn to see which movements you like best.
 - a. Watch this video if you want an example of how shark-like rays swim:
https://www.youtube.com/watch?v=PV_geGaN-Tk

Shark, Skate, or Ray?

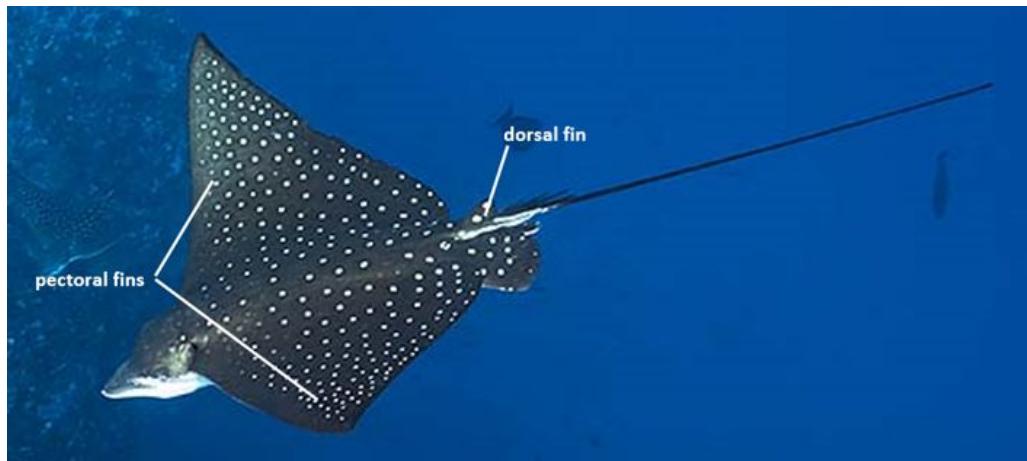
In this activity, the vocabulary words in **blue text** are defined in Appendix I. Students will use a tool called a **dichotomous key**, or an identification “ID guide,” to learn about the differences and similarities between sharks, skates, and rays. Use the ID guide in Appendix II to determine to which of these groups the animals pictured in this activity belong. Print one copy of this activity sheet for each of your students and use markers or colored pencils to trace your route to discovery! Assign a different color to each animal. As you go through the activity for each animal, pause at each decision point to read the corresponding paragraph to your students, have them examine the animal you’re focusing on, and decide which route to take. Notes to you, the instructor, are in *italicized text*.

Read the following to your students: Sharks and rays, along with another animal called a skate, are all named together in a group called the **cartilaginous fishes**. Wow, that's a big new word! Let's sound that out together; kar-til-AH-juh-nuhs. This means that these kinds of fish have skeletons made of cartilage instead of bones! We have some cartilage in our bodies too; feel the tip of your nose and your ears. Feel how they're stiff but still able to bend? That is because they are made of cartilage! Sharks, rays, and skates have many things in common, but they also have many differences that set them apart from each other. It can sometimes be hard to tell these different kinds of animals apart, so let's take a closer look at the things that make them different. To do this, we're going to use a tool called a **dichotomous key**, which you have printed out in front of you. This is another big new word, so let's sound it out together; die-KOT-oh-muhs key.

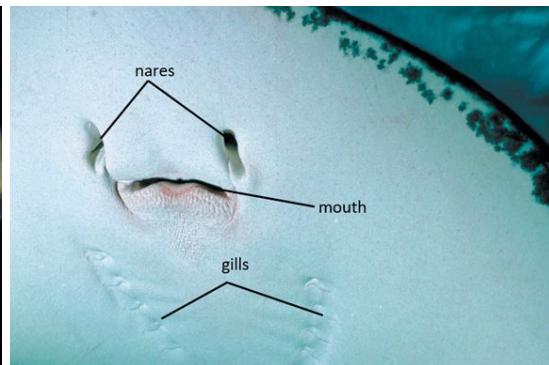


1. Let's start by looking at this first mystery animal, pictured above. You probably already know what this one is called, but we want to look at certain parts of it that make it different from others in its group.
 - a. First, we want to look at the whole shape of its body. Is it tube-like or flat?
Students should start at the top of the activity sheet from Appendix II and use their marker or colored pencil of choice to trace along the arrow labeled "Tube-like."
 - b. Next, we need to check to see if it has **dorsal fins**. These are the big triangle-shaped fins on the back of some fish. Does the animal in this picture have any dorsal fins? *Read the labels associated with both dorsal fins to students; they should use their writing utensil to trace the "yes" arrow.*
 - c. Now look at the picture of this animal's teeth. Are they big and sharp, or small and flat? Students should trace along the "sharp" arrow.
 - d. Finally, we need to find this animal's **gills**. Remember, all sharks, skates, and rays are types of fish, so they have to have gills to breathe! *Assist students in finding the gills if need be.* This animal has gills on the sides of its head behind its eyes.
 - e. Our dichotomous key tells us this is a shark! Do you agree? Sharks like this bull shark are some of the most famous animals in the ocean, so you've probably seen animals like this before.

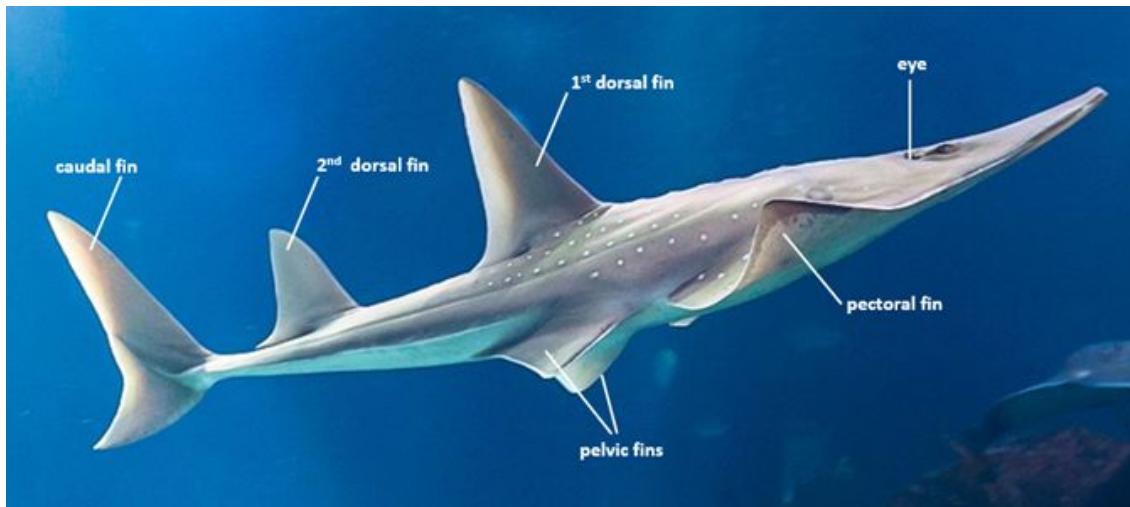
2. Our next mystery animal looks quite different from the bull shark. You may recognise this animal below from *Finding Nemo*.



- a. First, we want to look at the whole shape of its body. Is it tube-like or flat?
Students should trace along the arrow labeled "Flat."
- b. Now we need to check for a dorsal fin near the **tip** of the tail. Does this animal have one?
 - i. While this animal does have a very small dorsal fin, it is at the base of the tail, not near the tip. Students should trace the “no” arrow all the way to “Ray.”
- c. Our dichotomous key tells us this is a ray! Do you agree? Does this particular ray look familiar to you? If so, that’s because this is a spotted eagle ray, which we learned in the first activity is the same kind of ray as Mr. Ray!
- d. Rays have very different teeth from sharks; see for yourself! Rather than a shark’s sharp teeth for eating big fish, seals, or sea turtles, rays have flat teeth made for crushing. This is because they dig into the sand hunting for animals that live in hard shells, like clams. Because they hunt and feed this way, their mouths are on the bottom of their bodies, as are their gills! Looking at the bottom of a ray often looks like looking at a smiling face! What you’re actually seeing where the “eyes” appear to be are two small holes called nares, which are their version of nostrils.



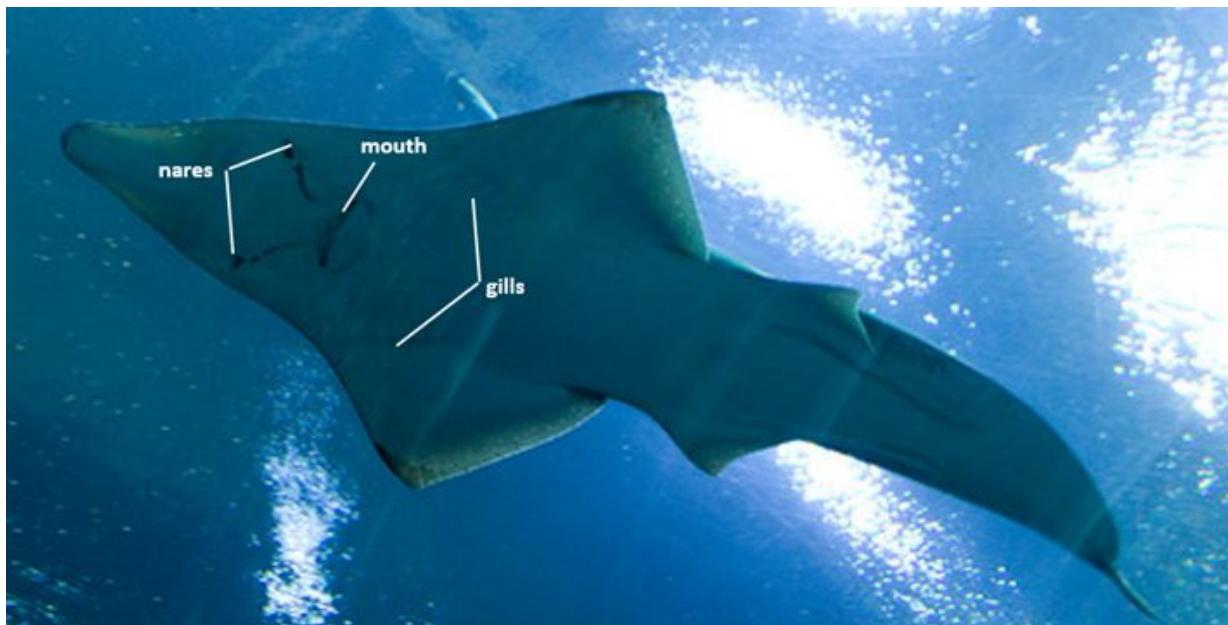
3. Our third animal is much trickier than the first two, so get ready!



- a. As we're familiar with by now, we first need to look at the whole shape of its body. Is it tube-like or flat? *Students may be thrown by this one, as this animal looks like a shark with a flat head. Encourage them to explain why they think it is flat or tube-like, but ultimately guide them to the "tube-like" arrow.* Although part of this animal is somewhat flat, the overall shape is long.
- b. Next, let's check for dorsal fins. Does this animal have any? *Read the labels associated with both dorsal fins to students; they should use their writing utensil to trace the "yes" arrow.*
- c. Time to check it's teeth! Does this animal have big sharp teeth like a shark or flatter teeth like ray? *Students should trace the "flat" arrow.*



- d. Finally, we need to find this animal's **gills**. Remember, all sharks, skates, and rays are types of fish, so they have to have gills to breathe! *Assist students in finding the gills if need be.* This animal has gills on its underside just like a ray.
- i. *You and your students may have noticed that there is a route from this point back to "sharks." That is because not all sharks have sharp teeth! The nurse shark has flat crushing teeth like a ray, but still has gills on the sides of its head.*



- e. Our dichotomous key tells us this is a shark-like ray! Do you agree? This is a strange animal indeed! The giant guitarfish pictured above looks like the perfect combination of a shark and a ray. That's why it is called a shark-like-ray; it looks like a shark in many ways, but it is more closely related to rays.

4. You may have noticed that there is one more animal at the bottom of our dichotomous key that we haven't learned about yet; skates! As you can see below, these animals are very similar to rays in many ways. They have flat, kite-shaped bodies, flat teeth for crushing, mouths and gills on their undersides, and tiny dorsal fins. Unlike rays, the dorsal fin of skates is near the tip of their tail, not the base. Look closely and you can spot them on the clear nosed skate pictured below! Skates also tend to be smaller than rays. Additionally, many rays have a barb on their tails that they use to help protect themselves from animals trying to eat them. Skates do not have a barb.



[Shark Protection Squad](#)

In this activity, you'll become a part of the Shark Protection Squad! Our scientific paper for this week measured the health of populations of wedgefish and guitarfish. The scientists found that these shark-like rays are at risk from being **overfished!** Let's learn about how we can try and manage fishing well so that they don't get overfished.

Set up

1. Find two different snacks such as crackers, pretzels, or nuts. For this activity, we'll use Goldfish crackers and almonds as an example.
2. Make a large pile of one snack and call it "fishes." Make a small pile of the other snack and call it "shark-like rays." For our example, the crackers will be the fishes and the almonds will be the shark-like rays.

3. Get a large bowl to be your “ocean.” Then, get three smaller bowls to be your “boats.” Your hand will be your “net.”
4. Fill a large bowl with your two piles and mix it around to simulate an ocean community of fishes and shark-like rays. Now, we’ll explore three different types of fishing! Remember, when we’re fishing, we’re targeting the fishes, not the shark-like rays.

Part I - Three types of fishing

5. First, take your hand and scoop out two big handfuls of snacks, making sure that your hand scrapes the bottom of the large bowl. Place your handfuls in another smaller bowl.
 - a. What did you notice about this type of “fishing?” How many fishes did you get, and how many shark-like rays?
 - b. Set your small bowl to the side for the end of the activity.
6. Next, let’s try another type of fishing. For this type, you’ll be using your hand “net” to scoop up handfuls, but you’ll only skim the surface of the snacks and only take out one handful. Try out this type of fishing and place your handful in another small bowl.
 - a. What did you notice about this type of “fishing?” How many fishes did you get, and how many shark-like rays?
 - b. Set this small bowl next to the first and save for the end of the activity.
7. For the last type of fishing, you’ll be using your fingers to individually pick out the fish that you are targeting! So for our example, we’ll only be picking out the crackers and leaving the almonds in the bowl. Drop all of the fishes you pick up into another small bowl. You have 30 seconds to fish. Start the timer and go!
 - a. What did you notice about this type of “fishing?”
 - b. Set this bowl next to the first two.

Part II - Examining fishing practices

8. Look at all of your fishing “catches” in your three boats. In the first boat, when our hand scraped the bottom of the bowl when we fished, we used a type of fishing called **bottom-trawling**. In the second boat, where we scooped fish from the surface, we used a type of fishing called **trawling**. In the third boat, where we picked fish out of the bowl one by one, we used a type of fishing called **hook and line fishing**. Let’s compare the three types of fishing!
 - a. Which boat had the biggest **catch**?
 - b. Which boat had the smallest amount of shark-like rays?
 - c. Which boat had the most fishes?

9. The boat with the largest amount of shark-like rays should be the bottom-trawler. Bottom-trawl nets are dropped to the bottom of the ocean, where they scrape the seabed and bring up whatever gets caught in the net. Can you think of the pros and cons of this way of fishing?
- a. *Allow students a few moments to think about pros and cons. If they are stumped, help them along the way to the following list. Pros: it is efficient, and can pull up a lot of fish all at once. Cons: it wrecks the seabed and any algae, corals, or other animals growing on the bottom. It also has a large bycatch.*
10. **Bycatch** is the amount of animals caught in your nets that are not supposed to be there! In our activity, which animals are the bycatch?
- a. *Students should answer that the shark-like rays (the almonds in our example) are the bycatch.*
11. One of the easiest ways to protect sharks, rays, and their relatives is by reducing bycatch, so only the targeted fish are caught, and not anything extra. Let's examine the two other types of fishing to see how they compare with bycatch!
12. The boats with the most fish should be the bottom-trawler and the trawler. This is because trawling nets can pull up large volumes of fishes. However, while the bottom-trawlers scrape the seafloor, the trawlers only drag a net through the open water. Can you think of the pros and cons (pros = good things and cons = bad things) of this way of fishing?
- a. *Allow students a few moments to think about pros and cons. If they are stumped, help them along the way to the following list. Pros: it is efficient, and can pull up a lot of fishes all at once. Cons: It can have some bycatch.*

Part III - Creating Solutions

13. Can you think of any ways we might fix the trawling nets so they don't have as much bycatch?
- a. *Allow students a few moments to brainstorm. They should soon arrive at the conclusion that you can make small escape routes in the nets for species that aren't targeted for fishing. If they don't arrive at this conclusion themselves, give them some hints to help.*
14. Yes, one way to make sure we don't accidentally catch other animals like sharks and rays is to create little escape routes! Scientists like to call these TEDs, which stands for Turtle Exclusion Devices. This is a fancy way of saying that the escape routes in the nets help keep sea turtles and other animals out!

15. Now, let's move on to our last boat. The boat with the smallest amount of shark-like rays is the boat that used hook and line fishing! Can you think of the pros and cons of this way of fishing?
- a. *Allow students a few moments to think about pros and cons. If they are stumped, help them along the way to the following list. Pros: It has no bycatch. Cons: it is not as efficient as trawling, and can only pull up one fish at a time.*
16. Can you think of any ways to make hook and line fishing more efficient?
- a. *Allow students a few moments to brainstorm. They should soon arrive at the conclusion that you could drop multiple lines in the water at once to catch more fish. If they don't arrive at this conclusion themselves, give them some hints to help.*
17. Yes, one way to make hook and line fishing more efficient is to fish with more lines in the water! When you drop many lines in the water while boating, it's called **trolling**.
18. So, after learning about all of these types of fishing, what do you think is the best way to fish so we can protect the shark-like rays as much as possible?
- a. *Allow students time to discuss and brainstorm. There are multiple ways that we could protect the shark-like rays: you could have the fishermen put TEDs in their nets, or you could have fishermen only use hook and line fishing!*

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 sharks and rays?
- Did you notice any patterns during our activity today?
- What is something you wonder about protecting shark-like rays?
- What surprised you the most during our activity today?



Appendix I - Instructor Support

Ocean Vocabulary

- **Bycatch** - the unwanted fish and other marine creatures caught during commercial fishing for a different species.
- **Cartilaginous fishes** - a group of fish that have skeletons made of cartilage - the flexible material our ears and noses are made of. This group of fishes include the sharks, rays, and skates explored in this lesson, as well as another group of fish called chimaeras.
- **Catch** - The amount of fish caught at one time
- **Dichotomous key** - This tool uses a series of prompts with two options to choose from. ‘Dichotomous’ means ‘divided into two parts’. By making these decisions, you can use this tool to identify a type of animal, like we did in this lesson, identify an unknown plant, or even decide what to eat for dinner!
- **Dorsal fin** - an unpaired fin on the back of a fish or whale. ‘Dorsal’ refers to the back, or the part nearest the spine (on a shark, you might see this as the ‘top’).
- **Gills** - These are the slits on the side of sharks (or underside of rays and skates) that are used for underwater breathing. As water passes through, the animal extracts oxygen from the water.
- **Overfish** - The unsustainable removal of fish. Overfishing occurs when too many fish are caught too quickly to replenish naturally.

Common Relevant Misconceptions

What is the difference between trawling and trolling?

Trawling and trolling are both methods used in commercial fishing, and sound very similar when said out loud! *Trawling* involves pulling a net behind a boat. *Trolling* is similar but uses baited fishing lines instead of nets.

Grammatical difference between “fish” and “fishes”

- **Fish:** Used to describe one species of fish.
 - For example, when referring to a specific type of fish that a fisherperson is trying to catch, we say “the fish they caught.” *Note: ‘fish’ could be singular or plural.*
- **Fishes:** Used to describe multiple different species of fish.
 - For example, when referring to the different sharks, rays, shark-like rays, and skates in our lesson, we say “the cartilaginous fishes.”

Appendix II - Attached Lesson Materials

Shark, Ray, or Skate Activity Sheet

Shark, Ray, or Skate?

