YOUNG EXPLORER SERIES

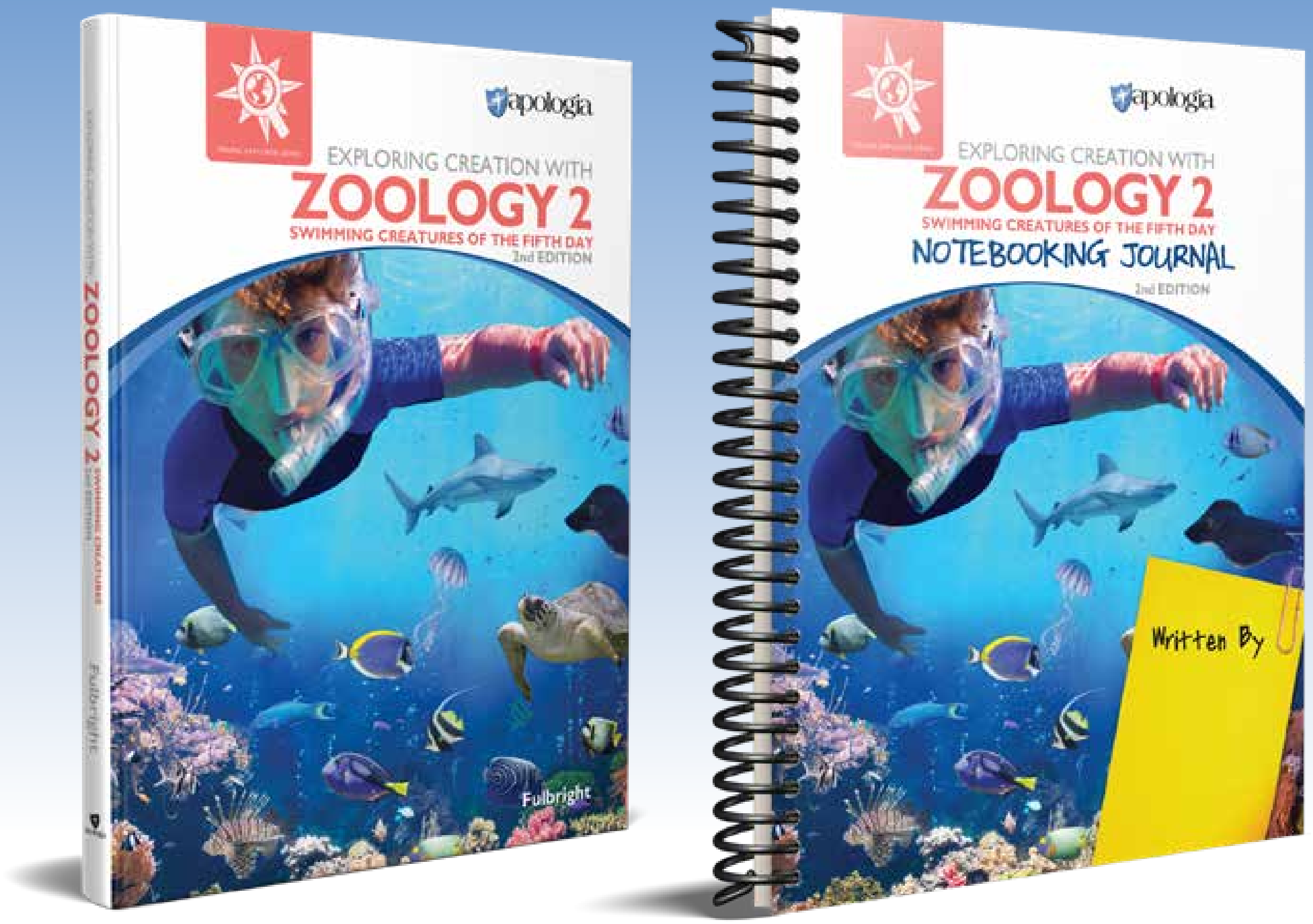
apologia

EXPLORING CREATION WITH ZOOLOGY 2

SWIMMING CREATURES OF THE FIFTH DAY

2nd EDITION

Fulbright



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LESSON 1

AMAZING AQUATIC ANIMALS

diving deeper

It's so exciting to learn about some of the amazing creatures God created. As we study Zoology and learn about the oceans and tides, the whales, dolphins, sharks, fish, and all the other wonderful animals, let us remember that it was God who designed everything. When we study science, we are studying what God did to make the world as it is. God is the Creator of all science. And He enjoys when we learn the scientific secrets He crafted in this fascinating world.

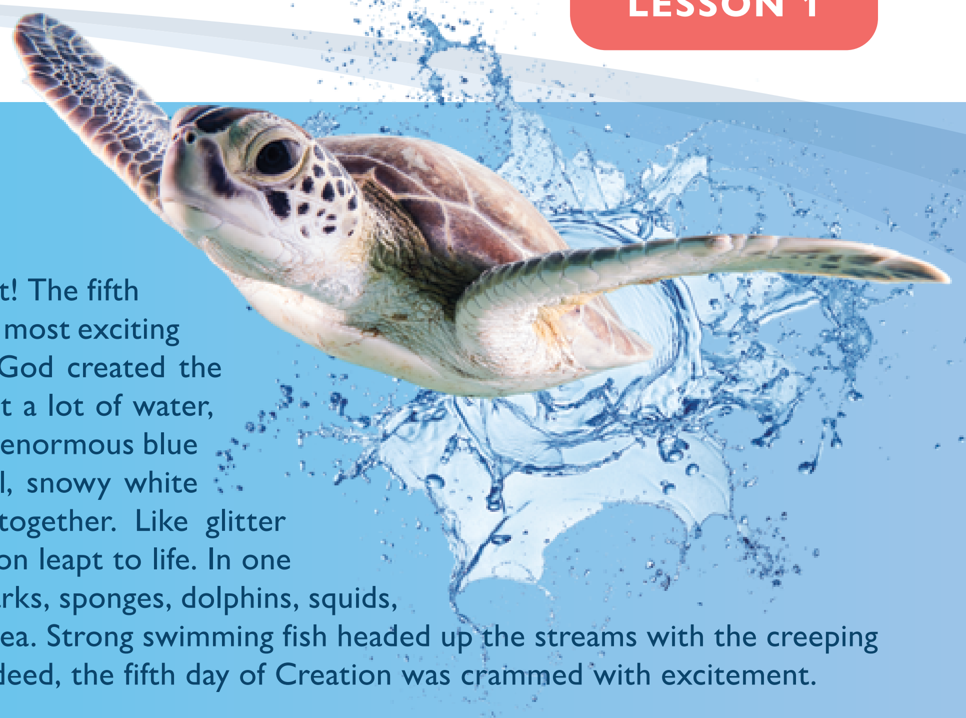
[He is] the maker of heaven and earth, the sea, and everything in them. He remains faithful forever.
Psalm 146:6

WELCOME

Welcome to the watery world of *Exploring Creation with Zoology 2: Swimming Creatures of the Fifth Day!* Zoology is an amazing field of science because it is the study of animals. And everyone, even the grumpiest person, likes animals. Because people are so fascinated by animals, we have studied them for thousands of years. So much is understood about animals that one single book could not cover every animal that existed on Earth. In fact, one book wouldn't be big enough to study just the animals that live on land. And new animals are discovered every year in the high mountains and low valleys on the Earth. But did you know that new animals are also discovered every year in the high mountains and low valleys in the ocean? Yes! The ocean does indeed have mountains and valleys. We'll learn all about the ocean and other bodies of water in this lesson.

Swimming animals are often called **aquatic animals** because *aqua* is a Latin word that means "water." Even though we know many facts about aquatic animals, there are still things about them that are mysterious. So much about them is still unknown to us because they are so hard to study. Their natural habitat spans the whole world, but we can't breathe naturally in their world! It's quite hard to follow, keep up with, stay near, film, photograph, and understand creatures that move about in such a vast environment. Over the years, however, scientists have been able to discover amazing things about the animals that live in the water. As you learn these facts, you will be filled with awe at the creativity of God and how many different kinds of marvelous creatures He made on the fifth day of Creation.

creation confirmation



Here's something I think about a lot! The fifth day of Creation must have been the most exciting event the angels witnessed when God created the world. One moment there was just a lot of water, and the next, God spoke. Instantly, enormous blue whales sprang into being. Beautiful, snowy white beluga whales swam and played together. Like glitter poured on water, billions of plankton leapt to life. In one moment, full-grown sea turtles, sharks, sponges, dolphins, squids, and octopuses joined them in the sea. Strong swimming fish headed up the streams with the creeping crayfish and the sluggardly snail. Indeed, the fifth day of Creation was crammed with excitement.

Have you ever wondered why God created so many different kinds of creatures that live in the water? Have you ever wondered why He created such wonderfully diverse creatures that do things we are just beginning to understand? I think God created all these glorious creatures because they delight Him; He enjoys them. He loves His creation and takes pleasure in the things He made. When people—who were created in the image of God—learn about these creatures, we can share in His joy and in the pleasure that God feels about the things He made.

Look at it this way: Have you ever done something that made you really proud? I have! And when I finished, I wanted to share it with the people I love. Like writing this book! I am so excited to share it with you. Did you feel that way when you accomplished something? You probably wanted others to share in the joy of your accomplishment. Well, that might be how God feels when we learn about His creation and all the wild and wonderful creatures He made. And do you know what else? It brings glory to God when we study His creation and give Him credit for what He has done. It's not enough just to study science; we need to also acknowledge the Creator of it all. Let's glorify God this year by delighting in our studies of the creatures of the sea and giving glory to God, who made them all.

Have you ever been to the beach? If you have, you know how wonderful it is to watch the waves crash onto the shore. Perhaps you've seen dolphins leaping through the surf, or maybe found a jellyfish washed up on the beach. Or perhaps you've been to a lake surrounded by green trees, where people boat or fish. Whether you've been to the lake or the beach, you probably felt pretty good when you were there. Scientists have discovered that being near lakes and beaches actually improves our health. We feel happier and calmer, breathe better, think better, and sleep better. And that's how God designed it. Did you know that the human body

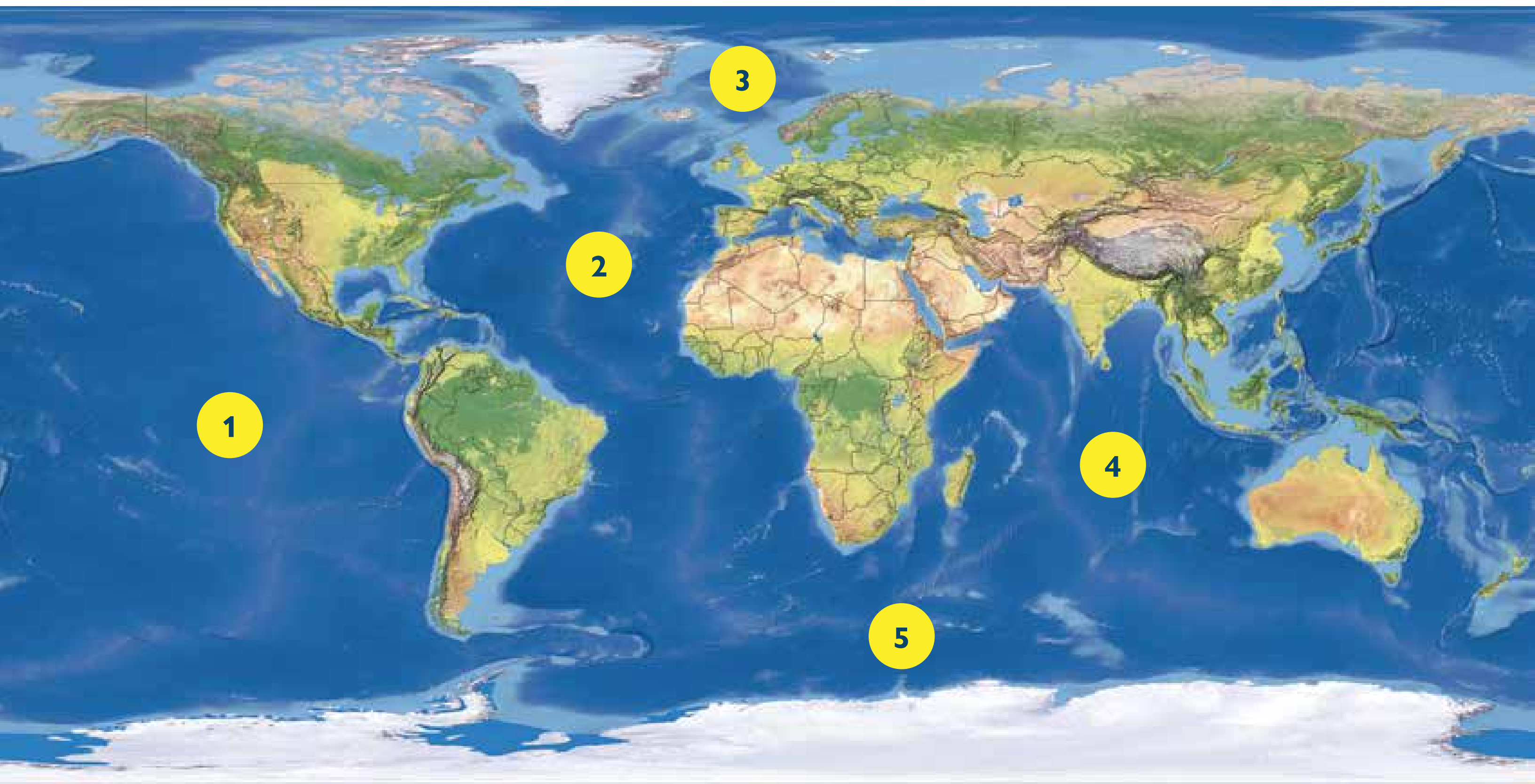
is at least 60% water? More than half of you is water! But what's even crazier is that more than half of the world is water too! An astounding 71% of the Earth is wet: oceans, seas, gulfs, lakes, rivers, and swamps. There's even water under the ground, most likely flowing right underneath the ground where you are sitting.

God must think water is a pretty important substance, and so do I! So before we dive in to swim with the sharks, let's find out about the bodies of water God created for all these amazing creatures to live in.

WATERY WORLD

Most of the water in the world, 97% of it—that's almost all of it—is found in the oceans. And most swimming creatures live in the oceans. So most of what we study in this book will be about animals that reside in the ocean.

There are 5 oceans on our planet, and they are all connected to one another. So it's more like one big ocean. The oceans are (labeled 1–5) called the Pacific Ocean, Atlantic Ocean, Arctic Ocean, Indian Ocean, and Southern Ocean. Look at the map below to see the locations of the 5 oceans of the world.



Activity 1.1
DRAW A MAP

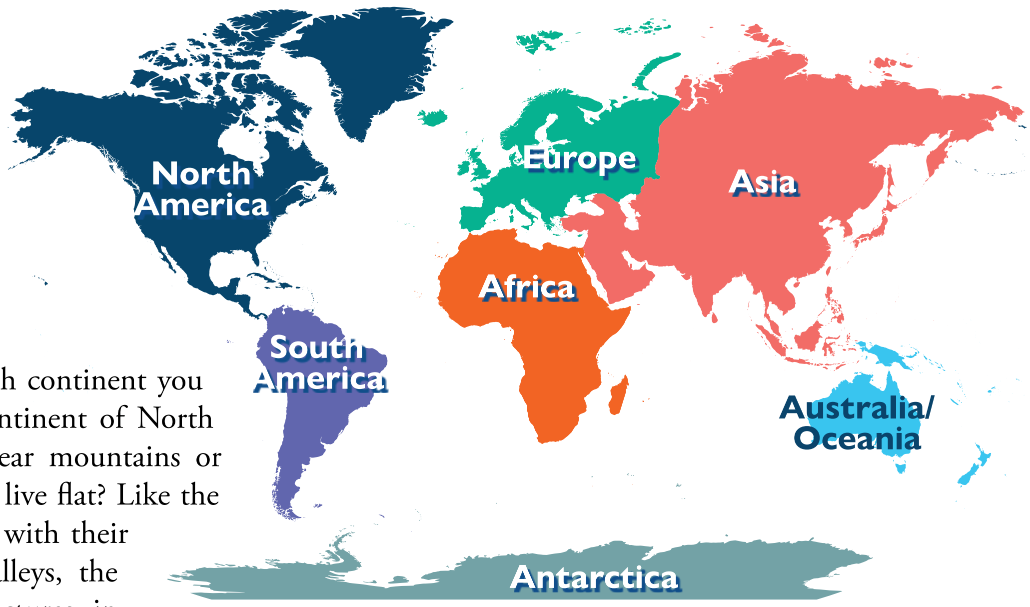
Draw a map of the world and write down the names of all the oceans. If you purchased the official *Exploring Creation with Zoology 2: Swimming Creatures of the Fifth Day Notebooking Journal,* the map is already drawn for you.

**Tell someone the most interesting thing you learned today.
Can you name the 5 oceans?**

OCEAN ANATOMY

Did you notice that the oceans are found surrounding the continents of the Earth? The continents are the large pieces of land. There are 7 continents on Earth.
They are:

Africa
Antarctica
Asia
Australia/Oceania
Europe
North America
South America

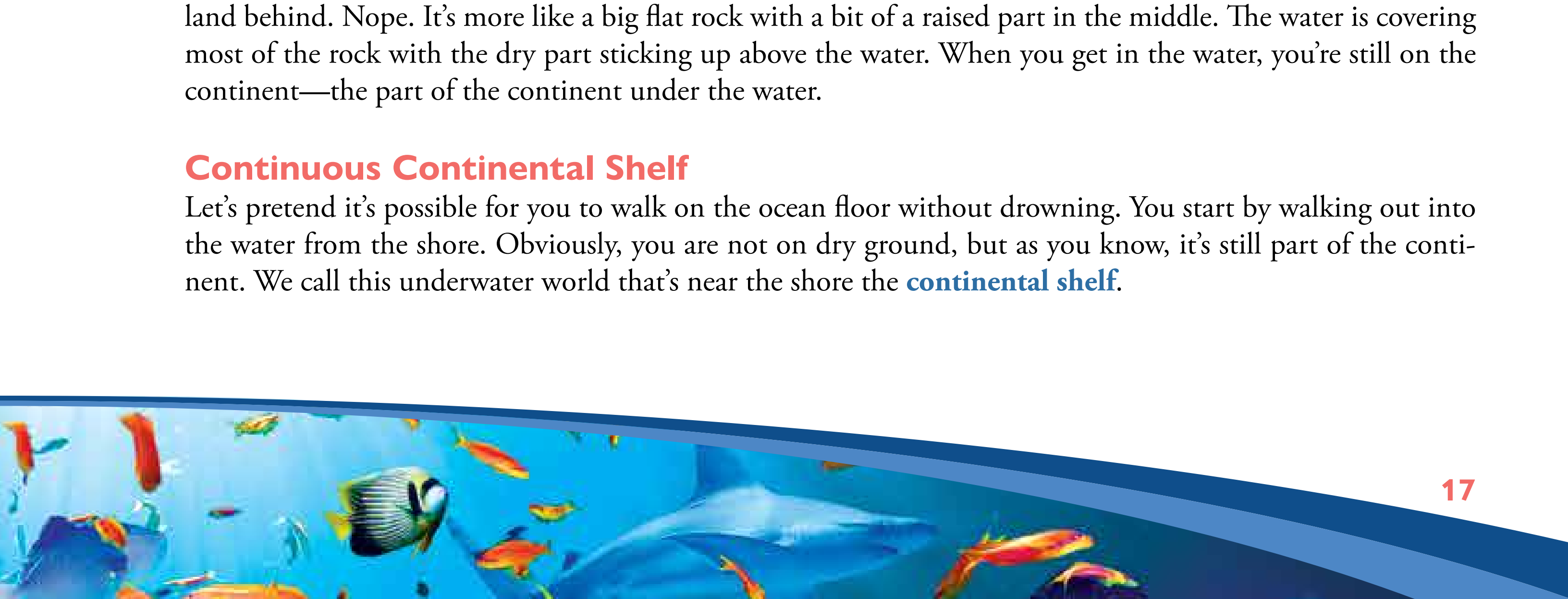


Do you know which continent you live on? I live on the continent of North America. Do you live near mountains or hills? Or is the place you live flat? Like the continents on the Earth, with their mountains, hills, and valleys, the ocean has different structures in different areas. Let's take a peek at the anatomy or different structures of the ocean.

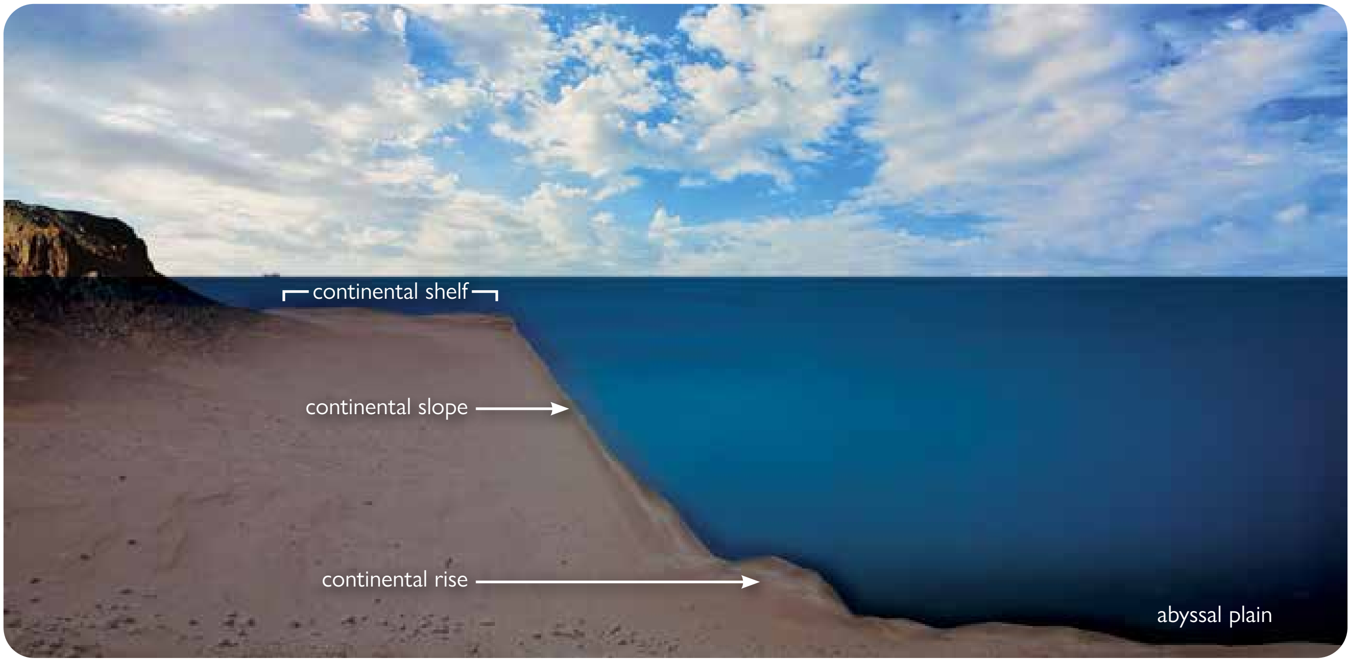
The first thing that you should know is that where the ocean begins, the continent does not end. It's not like the continent is a big round rock with water surrounding it and when you get into the ocean you've left the land behind. Nope. It's more like a big flat rock with a bit of a raised part in the middle. The water is covering most of the rock with the dry part sticking up above the water. When you get in the water, you're still on the continent—the part of the continent under the water.

Continuous Continental Shelf

Let's pretend it's possible for you to walk on the ocean floor without drowning. You start by walking out into the water from the shore. Obviously, you are not on dry ground, but as you know, it's still part of the continent. We call this underwater world that's near the shore the **continental shelf**.



As you journey straight through the water, the continental shelf will begin to slope downward, getting deeper. Sometimes it's shallow for a great distance, coming up only to your knees when you are far from the beach. Sometimes it's only shallow for a few feet. Just like on the dry part of the continent, the continental shelf may have hills, caves, canyons, valleys, rocks, and reefs.



This drawing shows you how the land slopes away from a continent into an ocean. Please note that this drawing shows things much smoother than they really are.

As you walk farther and farther out on the continental shelf, you'll find the water getting deeper and deeper. The continental shelf is on average 200 feet deep. Although that is very deep, you are still on the shelf of the continent. You may be out deep-sea fishing, but you're usually not fishing above the deep sea. No, you're still fishing above the land that makes up the continent. As we walk out farther and leave the continent, that's when you get into the deep, dark ocean. But we aren't there yet.

Most animals live on or in the waters above the continental shelf. That's because most small fish depend on some ocean plants (called phytoplankton) for food. Plants don't grow well in the dark. They flourish closer to the ocean's surface, where the sunlight hits. So the little fish hang out near the sunlit water. Bigger fish depend on these little fish to survive. So they too, hang out near the sunlight to eat the little fish. And then even bigger fish eat those big fish and on and on it goes. So it turns out that most of the animals in the ocean live in the sunlit zone on the continental shelf and the waters above it. Therefore, most of the animals in the ocean live right off the coast where they aren't very far away from the beach. Though the ocean is immeasurably enormous, covering most of the Earth in water, most sea life lives right next to us—near the land, near the shore, and near the beach.

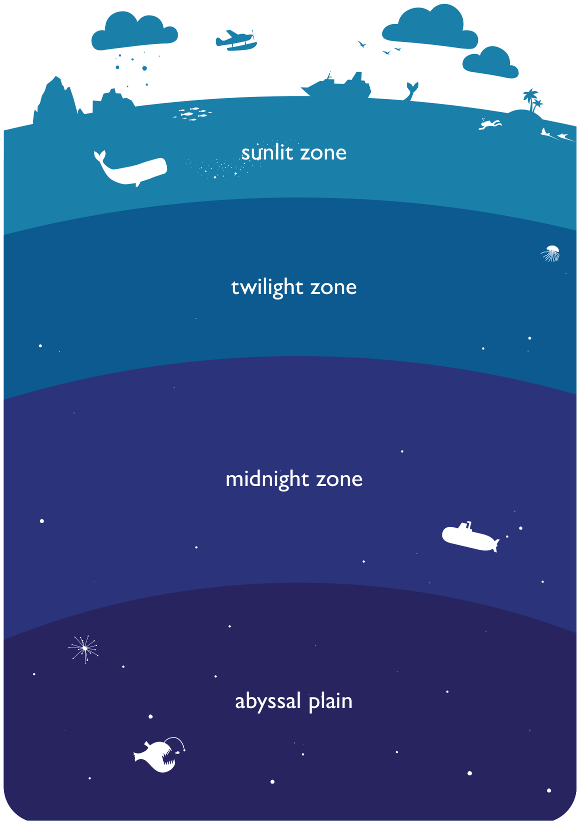
But let's continue our walking journey along the continental shelf. While you continue your hike over the continental shelf, you will find many different habitats such as kelp forests, coral reefs, and seagrass meadows. In the next lesson, we will swim through a discovery tour of many of the fascinating habitats and peek at some of the creatures we will find there.

Down the Continental Slope

Now we're about to reach a very different place. When you get to the end of the continental shelf, there is a drop-off into the deep ocean below. This drop-off is called the shelf break which then becomes the **continental slope**. The continental slope is like a giant cliff where the continent ends. And like a cliff, there are places where it goes straight down and other places where it slopes down a bit more gently. Sometimes the slope drop-off is not too far from the shore, such as in California; and sometimes the drop-off is far, far away from the shore, like in Siberia.

Zoned Out

When you leave the continental shelf and go deeper and deeper down the continental slope, you leave what is known as the **sunlit zone**, and enter the **twilight zone**. While the sunlit zone is well lit by the sun, the twilight zone is fairly dark, with very little sunlight coming through. Some animals can live in the twilight zone, but most prefer the sunlit waters above. Long before you reach the bottom of the ocean, however, you will hit the **midnight zone**. Why is it called the midnight zone? Because it is as dark as midnight, for no light from the sun ever reaches down this deep into the ocean.

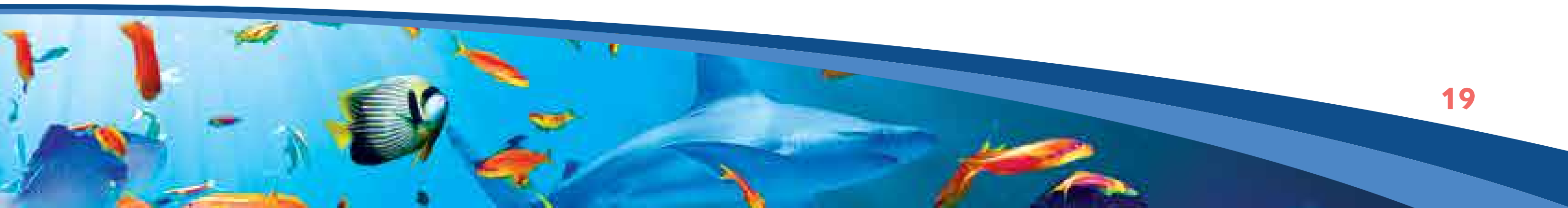


Down the Continental Rise

Generally, when you have a cliff, things can fall down that cliff. And when a lot of things fall down the cliff, they accumulate on the bottom of the cliff. That's exactly what happens on the ocean floor. Currents, underwater avalanches (in which tons of ground fall off a cliff) and gravity cause a bunch of sediment, rocks, and other debris to pile up at the very bottom of the continental slope. We call this area the continental rise because the pile of sediment makes a bump. This bump is the borderline between the continental shelf and the deep ocean floor.

Absolute Abyss

The continental rise ends when it reaches the deep, dark ocean floor, which is called the **abyssal plain**. It is pitch black down here. The sun's light is a distant memory. Unlike the continental shelf, which may have hills



and rocky areas with caves and caverns, the abyssal plain is mostly flat. If you walked for thousands of miles, you would eventually run into mountains, big and small, called seamounts, as well as volcanoes, valleys, and deep trenches that span untold distances. Most of the time, though, you would be traveling on flat land.

Crazy Creatures

The ocean floor in the deep, dark ocean is more immense than any land you have ever seen. It's bigger than any continent! It's so far down that only a few people in the world have ever gone down there. Food is so hard to find there that most creatures live off very little, and they usually only grow to be a few inches. Some, however, can be very large!

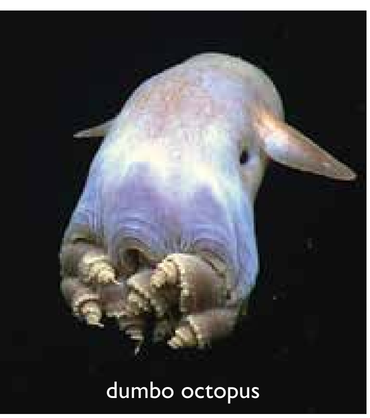
While most animals live on the continental shelf or the waters above it, God did create special creatures to inhabit the vast abyssal habitat. Many of these animals have the ability to make their own light. This is called **bioluminescence**. It is basically the same as the light that a firefly makes.

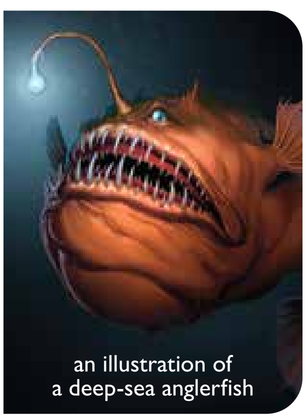

ribbon sawtail fish

Where's the Food?

Since the deep, dark ocean is much like a huge, empty wasteland, what do the creatures that live here eat? Most eat dead animals that have fallen from the open ocean, animal feces that drop to the bottom, and bits of mucus (slimy waste from other creatures) they find floating about. The animals that live here tend to have large mouths so that they can eat anything that happens to come their way.

Other animals that live here can attract things to eat. The deep-sea anglerfish, for example, has a built-in lure that it uses to attract other animals to it. The anglerfish lights its lure with bioluminescence, and then it wiggles the lure. When other creatures come to investigate this interesting source of light, the anglerfish eats them! It is not a very nice thing to do, but it allows the anglerfish to live in this deep, dark place. Do you know how this fish gets its name? Well, some people call fishermen "anglers." Since the deep-sea anglerfish catches fish with a lure just like fishermen do, it only makes sense to use the word *angler* in its name!


dumbo octopus


an illustration of a deep-sea anglerfish

In addition to finding deep-sea anglerfish, you can also find tiny white crabs, jellyfish, and gulper eels on the abyssal plain or in the deep water above it. Even though food is scarce for these animals, sometimes they happen upon a real feast! For example, if a big whale dies and sinks to the ocean floor, animals on the abyssal plain and in the waters right above it will often find the whale. This "whale fall," as scientists call it, gives these animals enough food so that they feast for many weeks!

Now, we don't know a lot about the creatures that live on the abyssal plain and in the deep waters right above it. That's because it's dangerous to go down there to study them. If animals like deep-sea anglerfish can

live down deep in the ocean, why can't we go down there to study them? We cannot go down there because of the **water pressure**. Do you know what water pressure is? Well, have you ever dived down to the bottom of a lake or pool? When you did that, did your ears pop? That was caused by the water pressing on you. Water is heavy, and when you pile a lot of water on top of your body, it begins to press on your body really hard. This is called water pressure. God designed the creatures that live in the deep ocean to handle this pressure. But if humans were to dive that deep, they would be crushed by all the water pressing down on them from above. Imagine lying on the ground and putting an enormous plastic bag on top of your body and filling it with water thousands of feet high. It would crush you just as if you dived down into the ocean and got underneath all that water.

Explain to someone the new things you discovered today.

Activity 1.2
WATER PRESSURE EXPERIMENT

Let's do an activity to see water pressure in action.

You will need:
- Large plastic 2-liter bottle
- Water
- Nail

You will do:
1. Using the nail on your bottle, make holes in a line from top to bottom about an inch apart.
2. Tape over the holes.
3. Fill bottle with water just above the top hole.
4. Ask yourself these questions: When you remove your tape, will the water flow out of the holes in the same way? Or will the pressure of the water flow vary?
5. Take the tape off and see if you can explain what is happening and why.

SEE THE SEA

In addition to oceans, there are smaller bodies of waters called **seas** all over the Earth. Just like all the oceans on the Earth, most seas are made up of salty water (especially if they are connected to oceans). Seas that are mostly surrounded by land but have one opening that leads to an ocean are called **marginal seas**.

There are some seas called **inland seas**. An inland sea is a body of water that is landlocked; that means it's got land all around it. The water in these seas comes from rivers and rain.

The Nile River flows north into the Red Sea.

Activity 1.3
FINDING THE SEAS

Look at the map of oceans and seas on this page and see if you can find these marginal seas:
Mediterranean Sea, Caribbean Sea, Sea of Japan, Yellow Sea.

See if you can find these inland seas:
Caspian Sea, Black Sea

RUSHING RIVERS

If you're traveling by foot across the world and want to find an ocean, just follow a river in the direction it is flowing and you'll eventually get to an ocean or a sea. Why is that? Because the world's rivers and streams eventually flow into these bigger bodies of water.

Streams and rivers are made up of water on the move, rushing toward the ocean. Some rivers are wide, like the Colorado River, which has many narrow places but is as wide as a lake in other areas. The beginning of a river is called its head, and the place where it empties into another body of water is called its mouth. The water in a river is usually fairly pure at its **head**. For example, many rivers begin in the mountains where melting ice is the river's source of water. As the water flows down the river, however, it picks up all sorts of things like soil, bits of rock, and so forth. If it is flowing by a polluted area, it could also pick up some pollution. These things get carried by the river to its **mouth**, where they are dumped into another body of water.

In North America, there are several major rivers that flow into either the Pacific Ocean, the Atlantic Ocean, the Arctic Ocean, the Bering Sea, or the Gulf of Mexico. The Mississippi River is the second longest river in North America and the fourth-longest river in the whole wide world. It starts in Minnesota and flows all the way down to the Gulf of Mexico.

Activity 1.4

FINDING THE RIVERS

Look at the map and see if you can find these rivers on the map and answer the questions. The answers are in the back of your book.

Mississippi River—In which state does it begin? In which state is its mouth? Into which body of water does it empty?

Snake River—In which state does it begin? In which state is its mouth? Into which body of water does it empty?

Rio Grande—In which state does it begin? In which state is its mouth? Into which body of water does it empty?

Chattahoochee River—In which state does it begin? In which state is its mouth? Into which body of water does it empty?

A Source of Course

Have you ever wondered where all this river water is coming from? Well, rain is a big factor for rivers, as is ice melting on the tops of mountains.

All these rivers are **freshwater** habitats, meaning they are not salty like the ocean. When these waters reach the ocean, however, they become more and more salty, or **brackish**, which is water that is partly freshwater and partly saltwater. Brackish water is usually found in the place where a river or stream meets with an ocean or sea, called an **estuary**. Where the estuary is closer to the river, the water is less salty, and it becomes saltier the closer it is to the ocean.

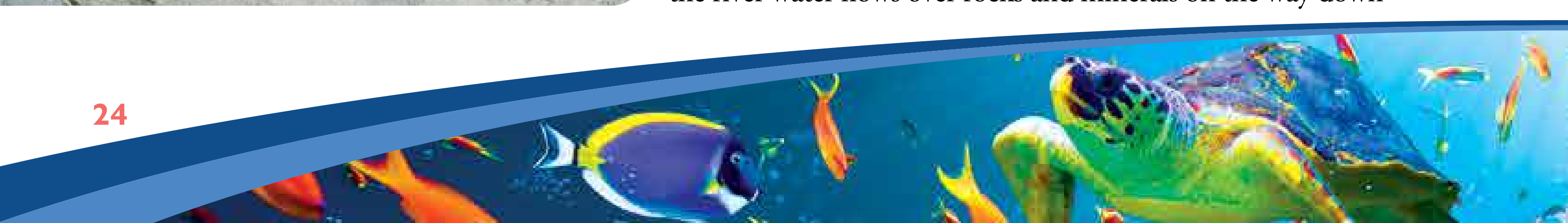
Estuaries are teeming with sea life! Lots of creatures live in estuaries because food is plentiful there. Although some animals can survive in both freshwater and saltwater, most prefer a specific amount of salt in the water in which they live. Because of this, most creatures stay in a specific part of an estuary, where the amount of salt in the water is just right for them.

Swimming Salmon

You will find all kinds of aquatic animals in these rivers. One of the more interesting creatures you'll find is a fish called salmon. Most salmon are **anadromous**. *Anadromous* is a Greek word that means "running upwards," and that's what they do. These interesting fish begin their lives in freshwater, later swim downstream to the ocean or sea where they spend most of their adult lives, and then end their lives by swimming back up to the very same place where they hatched so that they can lay eggs for the cycle to begin all over again. This entire journey can be over a thousand miles. And the swim back upstream is no easy task. They have to jump over newly built dams, waterfalls and rock-covered mountains flowing with fast rushing water. It's a hard journey, and the salmon have to be strong to make it. The salmon in the Northwest United States are a **keystone species**. That means that many, many other species of animal depend on them for their survival, like bears that eat them. That's another reason it's such a dangerous journey for them.

SALT SOLUTIONS

Why is the ocean salty? The first reason oceans are salty is believed to be from the rivers that flow into the ocean. You see, as the river water flows over rocks and minerals on the way down



to the ocean, these minerals dissolve into the flowing water. The water picks up some of the salty minerals and carries them down to the ocean. Another way salt gets into the Earth's oceans is through volcanoes. Volcanoes that erupt under the oceans release salt into the water. Even salt that comes from volcanoes far away from an ocean can eventually make it into ocean water through rivers and streams. In any case, the ocean is salty because salt is continually being added to it. Some parts of the Earth's oceans are saltier than others, depending on how much salt is poured into that region.

creation confirmation

Did you think that the oceans are getting saltier and saltier? Because rivers and volcanoes dump salt into the ocean continually, that would make sense. But God designed the Earth so that at the same time that salt is coming into the ocean, salt that is already in the ocean settles at the bottom. The salt level balances out. The animals that live in the oceans are precious to God. And God's perfect design takes care of all living creatures. Isn't that amazing?

Lively Lakes and Peaceful Ponds

Ponds and lakes are also freshwater habitats, but they don't have the rushing current that rivers have. Most lakes were formed by glaciers; however, some lakes are man-made. Usually this happens when people make lakes by finding a river and plugging it up with a dam. This causes the water to flood over a large amount of the land, making a lake. The water level can be controlled by the dam. This way, the river still flows, but now there is a nice, big lake where there wasn't one before. If a new dam is on a path salmon take home, they'll sometimes create a structure called a fish ladder that allows the salmon to swim up through the dam.

Explain out loud what you know about seas, rivers, and how the ocean becomes salty.

CURRENT EVENTS

Have you ever been to the grocery store and watched all the food you intend to buy move along the conveyor belt toward the checkout person? The conveyor belt moves the food from one place to the next. Well, guess what! The ocean also has a food delivery system much like that. Currents!

Currents are all about moving water from here to there. The current in a river, for example, moves water from the beginning of the river to its end. Do you remember what we call the beginning of the river? What about the end? You got it! The head and mouth! Although it is easy to think of a current in a river, currents also exist in the ocean. They carry cold water from the freezing areas near the polar regions (areas around the North Pole and South Pole), along with millions of zooplankton (small, almost microscopic animals) and other creatures, to warmer waters far away from the poles. They also carry those warmer waters to the polar regions, which helps to even out the temperatures of the ocean.

Many sea creatures follow ocean currents along their winding paths up or down across the ocean. These creatures instinctively know where the currents are, hitching rides on them. Other animals seek out the currents because they are places where food is found. Huge amounts of plankton from the arctic, for example, are caught up in currents and carried to other parts of the ocean. So ocean currents are like a giant food delivery system created by God to feed His animals!

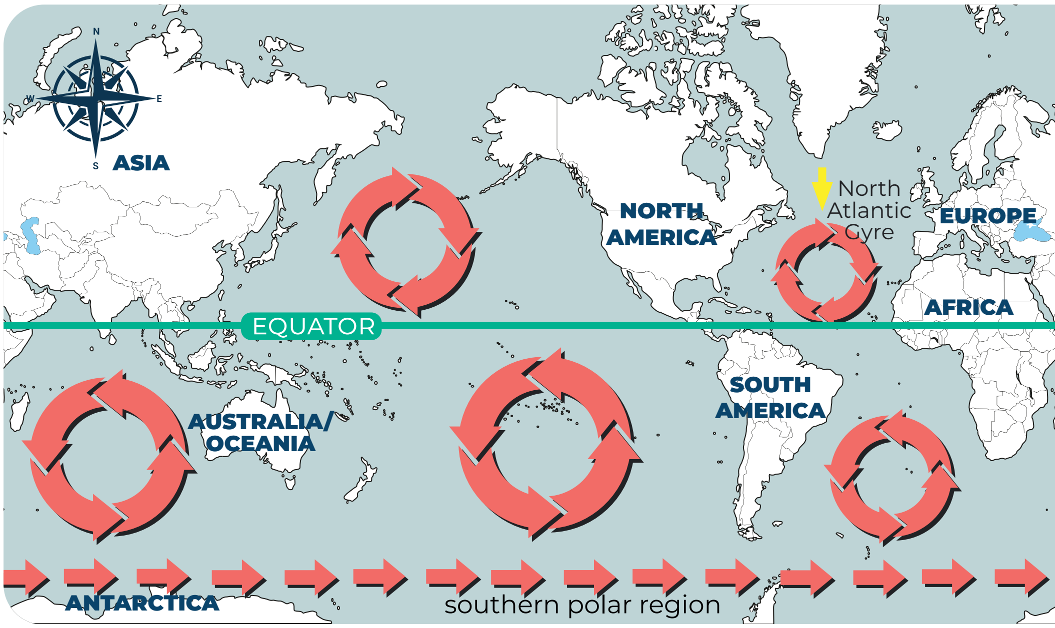
SURFING THE SURFACE

There are several kinds of currents in the ocean. One kind is called **surface currents**. Guess where you can find surface currents? On the top part of the water, the surface.

There is a surface current that pushes water straight along the equator, and another that pushes water straight along the southern polar region. The other surface currents, however, look like giant Ferris wheels that lie on their sides. These are currents that flow in a circle, around and around all day every day, called **gyres**.

All these surface currents are mainly formed by the **surface winds** that blow across the surface of the water. However, the currents are also affected by the Earth's rotation and the Earth's land. You see, the Earth spins 24 hours a day, 7 days a week. The spinning Earth affects the direction and the pattern of the surface currents.

What do you think would happen to these circular gyres if there were no continents blocking them from circling around where they currently are? That's an interesting thing to think about. However, we don't really know the answer for sure.



These are the major surface currents in the Earth's oceans. The arrows point the direction in which the currents flow.

The gyres in the northern hemisphere run clockwise (the same direction a clock's hands turn), and the gyres in the southern hemisphere run counterclockwise (opposite of how a clock's hands turn). Notice the North Atlantic gyre pointed out in the drawing. It travels in a large circle from Florida up the East Coast of the US, crosses over to northern Europe, travels down to Spain and then goes across to Cuba and back up to Florida.

These circular currents are always moving, round and round they go day and night. What is super cool is that because of these currents, if you drop something that floats in the water off the coast of California, it will eventually make its way to Japan. And have I got a funny story for you.

Way back in the year 1990, a cargo ship heading from China to Seattle, Washington, was carrying huge containers of Nike® shoes, and the ship sank. But the shoes could float, and scientists predicted where they would wash up. And they were right! A year later, thousands upon thousands of Nike shoes washed up on the beaches of Oregon, then California, then Hawaii, then the Philippines, and finally Japan. They were tangled in seaweed and loaded with clinging barnacles and clams. But when cleaned off, they were perfect. Except the shoes never washed up in same-size pairs. Where might shoes wash up if they fell from a ship off the coast of West Africa? See how well you understand gyres!

DEEP OCEAN CURRENTS

Some currents are not caused by the wind; they're caused by water temperature or the amount of salt in the water. Did you know that the deeper you go into the ocean, the colder the water is? You see, cooler water is heavier than warmer water, and so it usually sinks below the lighter, warmer water. Every summer, ice from the cold polar regions melts and cold water begins to flow out into the oceans. Because this cold water is heavier than the warmer water at the surface, it sinks. It then moves slowly toward the equator, where it warms again and rises. This forms a large current flowing underneath the ocean.

A similar thing can happen when water evaporates from the surface of the ocean. When saltwater evaporates, it leaves the salt behind. The salt that's left behind makes the water on the surface of the ocean saltier, which also makes it heavier. This heavier water sinks to the bottom, forcing the lighter water to flow up to the top. Many times, it is both the temperature of the water *and* the amount of salt in it that causes the water to sink or rise, forming a deep ocean current. As a result, these currents are often called **thermohaline currents** because *thermo* means "heat" and *haline* refers to "salt."

Tell someone in your own words what you have learned so far about currents.

Activity 1.5

GYRE SIMULATION

You will need:

- 2 participants
- 2 hair dryers
- Cheerios® or glitter
- Long casserole dish

You will do:

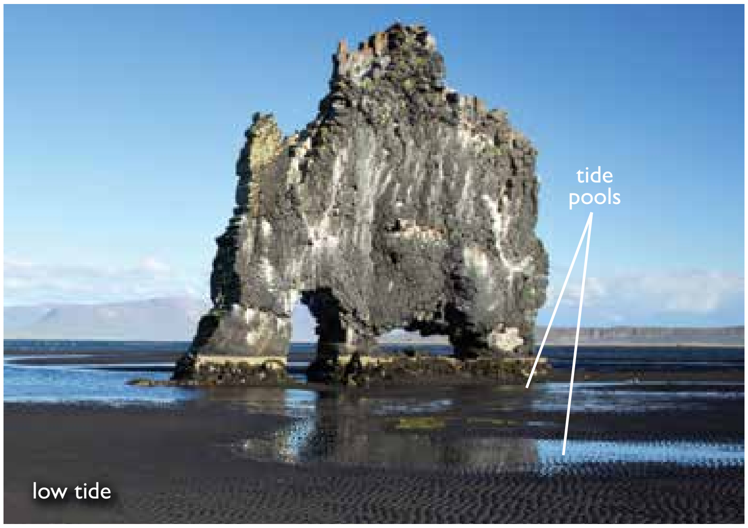
1. Fill the casserole dish with water and sprinkle Cheerios® on the surface of the water.
2. One person needs to hold a hair dryer on one end of the dish, and the other person needs to hold a hair dryer on the other end.
3. Turn the hair dryers on low and aim them just above the water. The other person's hair dryer should blow along one long side of the casserole dish, toward your end. Your hair dryer needs to blow along the other long side of the dish, toward the other person's end.

Eventually, you should see the Cheerios® start to flow in a circle. You have just created a miniature gyre! Just as your gyre was formed by winds from hair dryers blowing in opposite directions, ocean gyres are produced by winds on the Earth that blow in opposite directions.

LESSON 1

TIDES

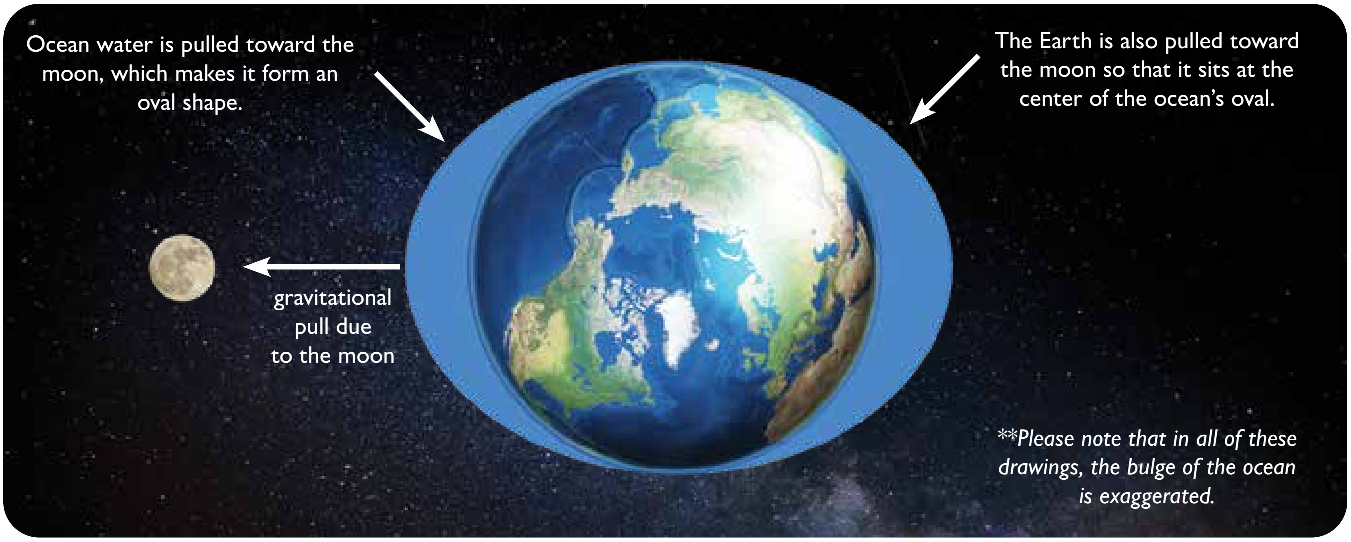
If you have ever spent time at the beach, you may have noticed that the place where you set your stuff down when you arrived isn't on dry ground later on in the day. Every day, all day long, the water is either moving closer to the shore or farther away from the shore—back and forth it goes. These are the ocean's tides. When the water comes way up onto the shore, we call it **high tide**. When it pulls way back exposing a lot of the beach, we call it **low tide**. Many creatures are dependent on the tides, especially animals that stay in tide pools.



Tide pools are created when the tide goes out but crevices in rocks or the sand form pools of water. Some sea creatures get trapped in tide pools, while others make their permanent homes there. Those that get trapped wait for the tide to come in so they can slip out of the tide pool and return to where they normally live. During low tide, many animals hunt for food in the shallow tide pools.

But why on earth does the ocean do this? Well, believe it or not, it's caused by an extraterrestrial force—a force that's out of this world. That's right! Tides are caused by the moon. It works like this: the moon pulls on the Earth and its oceans with a force called gravity. As the moon pulls on the Earth's oceans, the oceans bulge toward the moon.

When one side of the Earth's oceans are pulled toward the moon, the other side bulges in the opposite direction. This is because the gravitational force of the moon is not only acting on the oceans but also on the solid Earth. The Earth is not perfectly rigid, and as a result, it deforms slightly under the gravitational pull of the moon. It's like the Earth is being squeezed at the top and bottom and the oceans bulge out on both sides. It ends up that there are 2 bulges on either side of the Earth. And the Earth sits in the center of the bulge.



The moon takes more than 28 days to travel around the Earth, so within the space of a day, it really doesn't move very much. Because of this, the oval formed by the ocean stays pretty much the same all day long. But different parts of the Earth pass through the bulges. Twice a day, Florida will be right inside the bulges. Twice a day, Spain will pass through the bulges. China and Japan will pass through the bulges also. Every country on Earth will pass through the bulges twice a day. Why? Because the Earth is spinning around in place all day every day. The Earth spins completely around in a circle every 24 hours. This is why we have day and night. So think about what happens to a specific place (let's say an island) on the Earth as the Earth spins. In the diagram below, we are looking down on the North Pole of the Earth:

What happens to the island as the Earth spins? At first, it is sitting on one of the flat sides of the ocean's oval, where there is not much water. As a result, it experiences low tide. As the Earth spins, however, the island gets moved to the bulging side of the oval where there is a lot of water. So at this time, the island experiences high tide. As the Earth continues to spin, the island eventually gets to the other flat side of the oval, where it again experiences low tide. Eventually, the Earth's spinning takes it to the other bulge on the other side of the Earth—where it gets to experience another high tide on the same day. Over the course of the day, the island will experience a low tide, followed by a high tide, followed by another low tide, followed by another high tide. Every day, every continent experiences 2 high tides and 2 low tides. Every day, every continent experiences a First High Tide and a Second High Tide.

Everyone who does activities or who works on the ocean finds out when the high tide and low tide will happen. This is especially important for fishermen because during a high tide, fish are pushed toward the shore, and the fishermen know they will catch more fish.

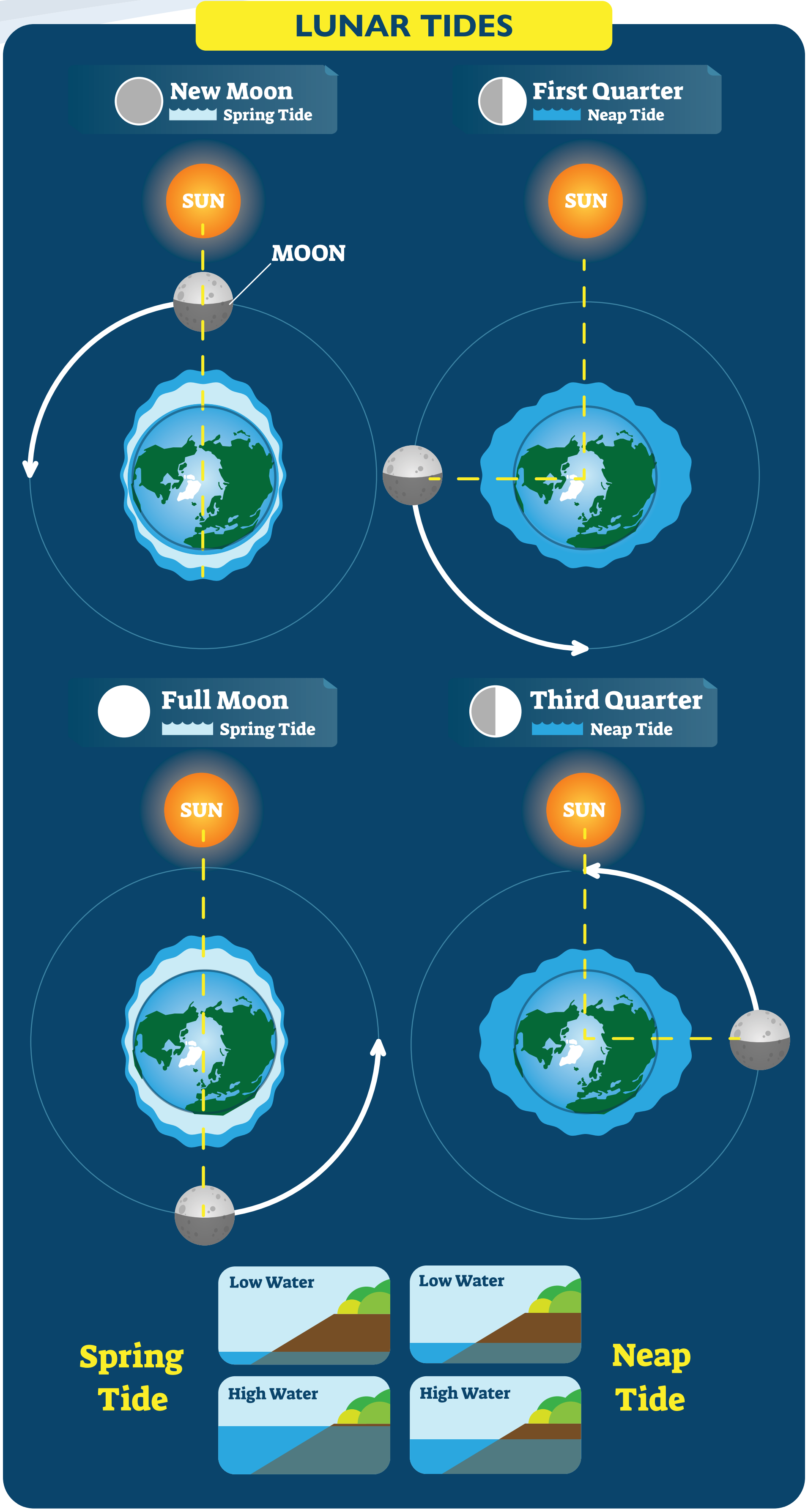
Full and New Moon

There's also another thing that affects the tides. A full moon and a new moon make the tides much higher and lower than normal. You know what a full moon is: when we can see the entire circle of the moon in the sky. We see the moon like this because it's on the opposite side of the Earth from the sun, lined up with the Earth and sun.

A new moon is when we can't see the moon in the sky because it's right between the Earth and the sun, also lined up with the Earth and sun.

Why would a full moon or a new moon have anything to do with tides? Well, when you have 2 things in space lined up, it creates an even greater gravitational pull because you have both the moon and the sun pulling on the Earth. If you have one person pulling a rope, and then add another person, that makes a greater force. This greater force makes the high tides higher and the low tides lower. We call these tides **spring tides**, even though they happen in all seasons not just spring. What is so interesting is that although the sun is much bigger than the moon, the moon actually has more gravitational pull on the oceans because it is so much closer to the Earth.

Something else really interesting happens after spring tides. The moon keeps moving around the Earth and 7 days after the spring tide, the moon is at a right angle to the sun, like in this picture. This causes **neap tides**. In a neap tide you've got the sun and moon pulling on the Earth in different directions, the pull balances out and when this happens, the tides don't bulge much. The water on the Earth is pretty much the same level all the way around, making less intense tides all the way around. Because the moon goes around the Earth once a month, and has a new moon and a full moon once a month, spring tides and neap tides happen twice a month.



Activity 1.6
NATURE JOURNALING

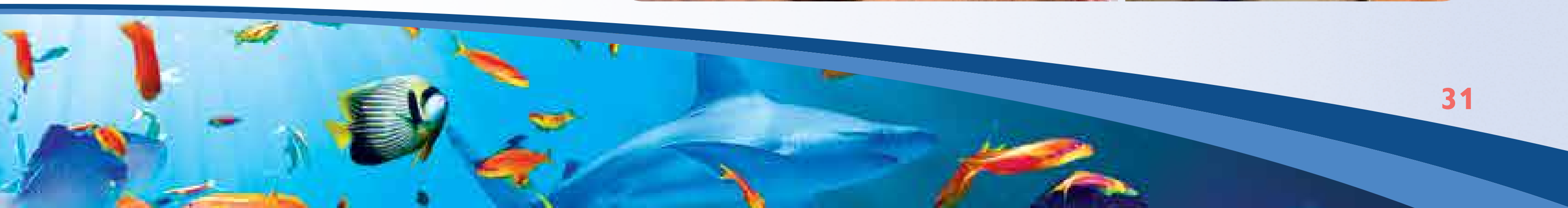
It is important that you review this material before you move on to the next lesson. You see, it isn't enough for students to just read and learn. You need to put information on paper by drawing pictures (illustrations) and writing (or dictating) what you have learned. This will help you to remember it longer, and it will provide evidence of what you learned. You will make illustrations, do fun assignments, record all that you learn, and even add pictures of other things you see and do. Your Zoology 2 Notebooking Journal will be a collection of your zoology studies. Inside it, you can record your time enjoying swimming creatures by creating a special section called a nature journal. You will write about the interesting things you observe while studying swimming creatures and draw them to the best of your ability.

When you look back over it in the years to come, you will be reminded of the many sea creatures and fascinating facts that you learned in this study of aquatic creatures. You can use a blank notebook or purchase the official *Exploring Creation with Zoology 2: Swimming Creatures of the Fifth Day Notebooking Journal* to do all your assignments. If you haven't already done so, record some of the fascinating facts from this lesson in the nature journal section of your Zoology 2 Notebooking Journal. You can choose anything you want to remember from the lesson. Just write it down in your own words. After that, make an illustration of the tides and write down why they happen.

Activity 1.7
DENSITY EXPERIMENT

We discussed currents caused by heavier water sinking below lighter water. The question I would like to ask is: Do you remember which is heavier, cold water or hot water? Let's do an experiment to find out.

You will need:
- 4 identical glass cups
- Piece of flat, hard plastic
- Red food coloring
- Blue food coloring
- Hot water
- Cold water
- Pan



You will do:

1. To avoid spilling accidents, conduct this experiment in the pan.
2. Fill 2 glasses, one with hot water and one with cold water.
3. Put red food coloring in the hot cup, and blue food coloring in the cold cup.
4. Stir it up.
5. Put the piece of plastic over the hot water cup, turn it upside down, and place it directly over the other cup.
6. Carefully pull the plastic out.
7. Note what happens.
8. You will do the same thing, repeating steps 1–4, and then put the plastic over the cold water cup, turn it upside down, and place it directly over the other cup.
9. What happens when you remove the plastic?

WHAT DO YOU REMEMBER?

Can you name the 5 oceans in the world? What are seas? What are estuaries? Beginning from the shore out to the deep, what are the zones of the ocean floor? What are the circular currents called? What are the currents caused by temperature and salt levels called? What causes the tides?

SUPPLY LIST

General art supplies such as clay, paper, paint, shells, feathers, and any other materials you choose will be used throughout the text for modeling sea creatures. We recommend you create a general art supply box that is readily available.

Lesson 1

- 2-liter plastic bottle
- Nail
- 2 hair dryers
- Cheerios® or glitter
- Long casserole dish
- 4 identical glass cups
- Piece of flat, hard plastic
- Red food coloring
- Blue food coloring
- Pan

Lesson 2

- 1-liter bottle
- Modeling clay
- Materials to add to the clay (chenille sticks, pieces of drinking straws, feathers, paper clips, beads, beans, rice)
- Timer
- Multiple pairs of shoes
- Clothing baskets
- Cardboard box of any size
- Blue paper
- Magazines or printed pictures

Lesson 3

- Timer
- Tea candle
- Lighter
- Cardboard tube such as a toilet paper tube
- Plastic wrap
- Rubber bands or tape
- Nail
- 2 empty tin cans such as soup cans
- 30 feet of 100% cotton yarn
- Hammer
- Sharpened pencil
- Plastic gloves
- Vaseline
- Bowl
- Kitchen tongs
- Comb
- Cup of Rice Krispies®
- Several corks or apple slices

Lesson 4

- 4 pieces of paper
- Scissors
- Tape
- 2 drinking straws
- 33 index cards
- Pictures of these 11 whales: right whale, gray whale, humpback whale, blue whale, pygmy right whale, dolphin, orca, porpoise, beluga whale, sperm whale, narwhal

Lesson 5

- Clay
- 2 toothpicks (optional)

Lesson 6

- Empty water bottle
- Balloon
- Pan
- Bowl
- Cardboard such as a cereal box
- Scissors
- Tape
- Pen
- Styrofoam® ball
- Toothpicks
- Paper
- Markers or paint
- Googly eyes
- Glue
- Fishing line or string (optional)
- Fork
- Clay
- Small whole fish from the market
- Thick paper such as watercolor paper
- Ink or paint
- Aquarium
- Filter
- Heater
- Thermometer
- Substrate
- Lighting
- Bubbler
- Fish
- Decorations
- Small net
- Fish food
- Water testing kit
- Dechlorinator
- Plants
- Other materials required (talk with your local aquarium experts)

Lesson 7

- Ruler
- Pictures of 24 sharks and 10 boney fish from course website or your Zoology 2 Notebooking Journal
- At least 35 magnets
- String
- Stick or rod
- Tape
- Clay
- Safety goggles
- Cup of 30% hydrogen peroxide solution
- Liquid dish soap
- Tablespoon of dry yeast
- Large jar such as a mason jar
- Smaller container such as a plastic bottle
- Funnel
- Stirring spoon
- Food coloring
- Bamboo skewer

Lesson 8

- Masking or duct tape
- Clay
- Vanilla extract
- Balloon
- Small funnel
- Box

Lesson 9

- 10-inch balloon
- Strips of scrap paper or newspaper
- 3 bowls
- Paintbrush
- Glue
- 4 cups of flour
- White, brown, green, and blue paint
- Black markers
- Thick seashell such as a clam
- Wet sand or soil
- Plaster of paris
- Small brushes such as toothbrushes
- Large foam board
- Static grass terrain powder
- Cardboard
- Popsicle sticks
- Miniature animals
- Mod podge or school glue
- Scissors
- Miniature trees (optional)
- Seashell
- O-shaped piece of cereal such as Cheerios®
- 2 glasses
- Container to hold water and dirt
- Broom
- Coffee stir or thin straw
- 4 plastic disposable containers
- Cup of sand
- Cup of clay
- Cup of potting soil
- Detailed seashell or small toy with ridges or other raised features
- Craft stick or plastic
- Permanent marker

Lesson 10

- 1 large oval paper plate
- Red tissue paper
- Glue
- Scissors
- Tape measure
- Tape
- Dry garbanzo bean
- A piece of paper
- Black permanent marker
- 2 rubber bands
- Clay
- Art paper
- Blue, green, orange, and white acrylic paint
- Crumpled paper
- Paper plates or paint palette
- Smock or old clothes to protect from paint
- Newspapers or drop cloth to protect workspace
- Sea monkey aquarium

Lesson 11

- Several foam dart guns such as NERF®
- Foam darts
- Balloon
- Newspaper
- Notebook paper
- Flour
- Bowl
- White paint
- Clay
- Seashells (optional)
- Several bottles of different sizes

Lesson 12

- Sheet of paper
- Pencil
- Scissors
- Tape
- 2 disposable plastic gloves
- Rubber band
- 1 cup Elmer's washable school glue
- Clay
- Chalk or a large number of sticks
- Measuring tape
- Balloon of any size (water balloon will be easiest)

Lesson 13

- White coffee filters, 11 per jellyfish you prefer to make
- Food coloring
- Paintbrush
- 3" or 4" ball or Christmas ornament
- Bamboo skewer
- Glue stick
- Cup
- 2 ft. yarn
- Bowl
- Scissors
- Plate
- Round crackers
- Jam
- Knife
- Banana
- Straw
- Toothpick
- Pull 'N' Peel Twizzlers®
- Oyster crackers
- Sanding sugar
- Glass baking dish
- Frozen fruit pop (for best results, use one made from real fruit)

Lesson 14

- Clay (optional)
- Feathers (real or artificial, optional)
- 5 six-inch segments of cotton string
- Container of salt
- Food coloring (any color)
- Wide mouth glass jar or glass measuring cup
- Pot for boiling water
- Wooden spoon for stirring
- Markers
- Blank file folder
- Set of index cards
- Dice
- Small plastic animals (optional)
- Jell-O® Mix
- 1-liter plastic soda bottle
- Various candies or fruit
- Whipped cream
- Scissors
- Egg crate lid
- Butter knife
- Platter

YOUNG EXPLORER SERIES

apologia

EXPLORING CREATION WITH

ZOOLOGY 2
SWIMMING CREATURES
NOTEBOOKING JOURNAL

2nd EDITION

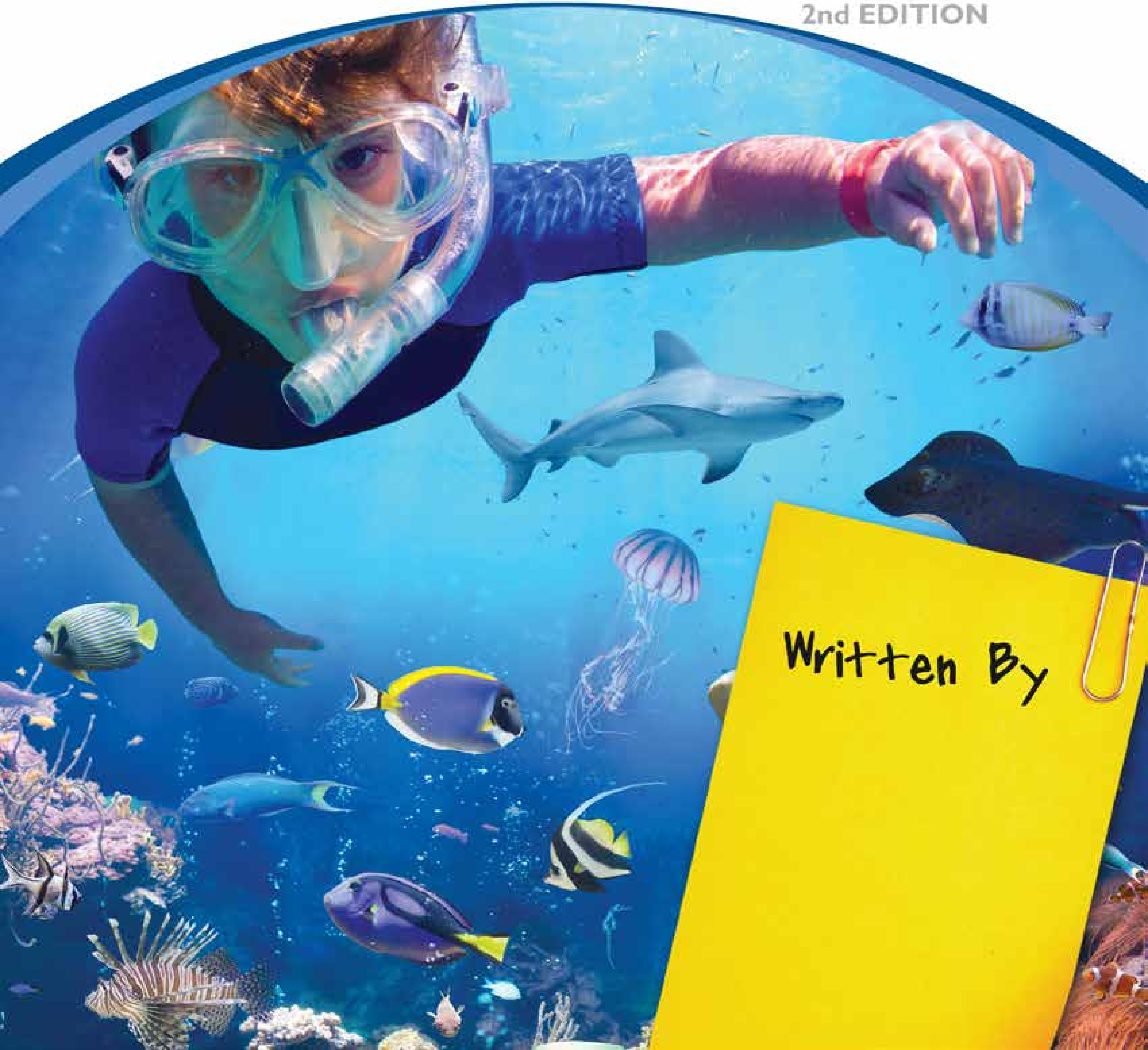


TABLE OF CONTENTS

EXPLORING CREATION WITH

ZOOLOGY 2

SWIMMING CREATURES OF THE FIFTH DAY

2nd Edition

Two Days a Week Suggested Schedule

Please feel free to adjust this schedule to fit your family's needs.

BEFORE YOU BEGIN

❒ Textbook Introduction p. 10–12

❒ Notebooking Journal (NJ) Parent Guide p. xvii–xviii

- Coloring pages, Fascinating Facts, Creativity Pages, and some others are not included in the daily lessons. They are to be used as the parent/student decide.
- Please create the Creation Confirmation Bookmark with your child p. xix-xxii
- Please review the Nature Journal pages found after Lesson 14 in this Notebooking Journal and make plans to include them throughout your year of studying Zoology 2.

WEEK 1

❒ **LESSON 1 – AMAZING AQUATIC ANIMALS**

Textbook p. 13–17

Activity 1.1

NJ p. 26

❒ **LESSON 1 – AMAZING AQUATIC ANIMALS**

Textbook p. 17–21

Activity 1.2

NJ p. 26

LESSON 1

AMAZING AQUATIC ANIMALS

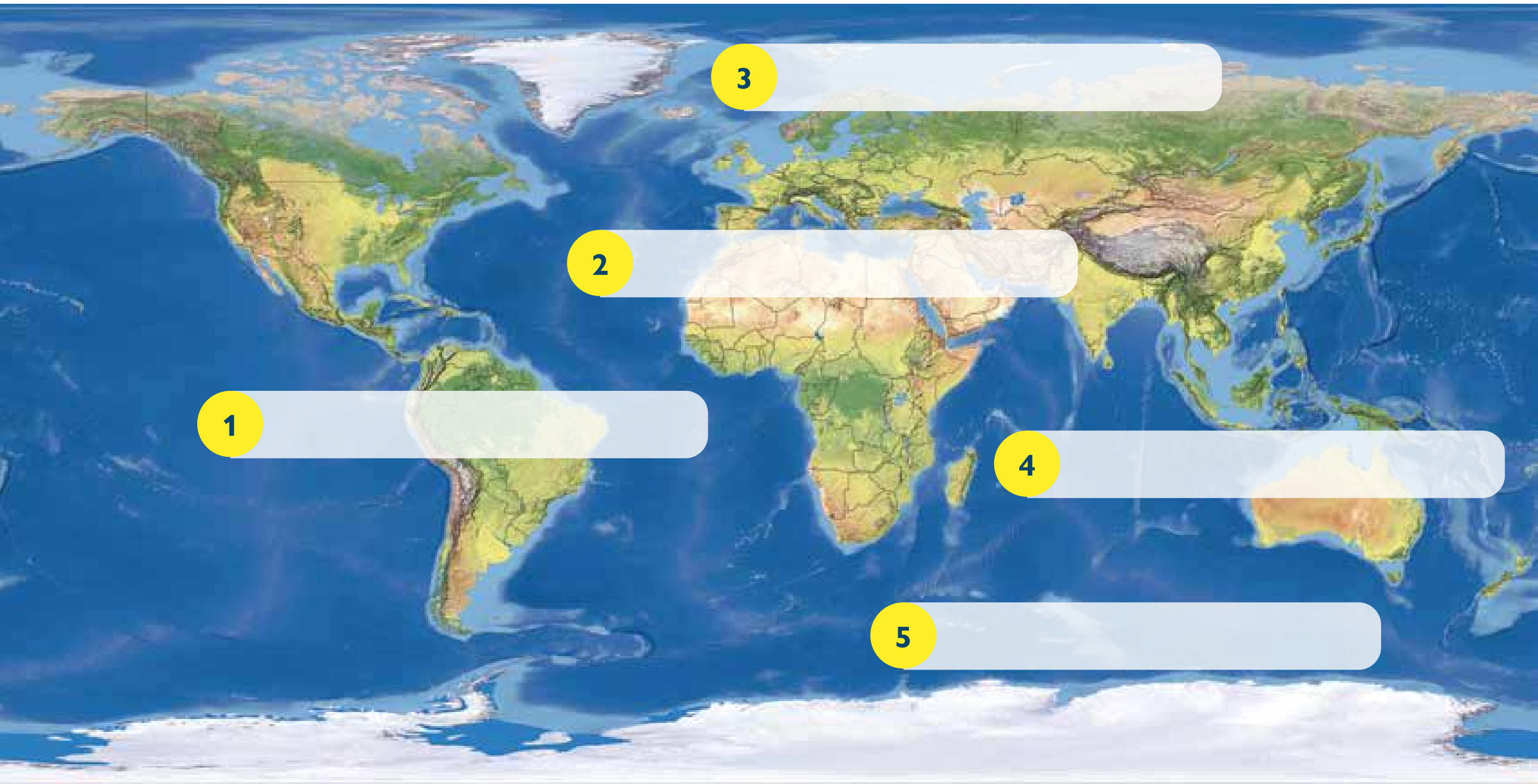
ZOOLOGY 2

FASCINATING FACTS AND PERSONAL REFLECTIONS

Activity 1.1

DRAW A MAP

Label the names of the oceans.



Activity 1.2

WATER PRESSURE EXPERIMENT

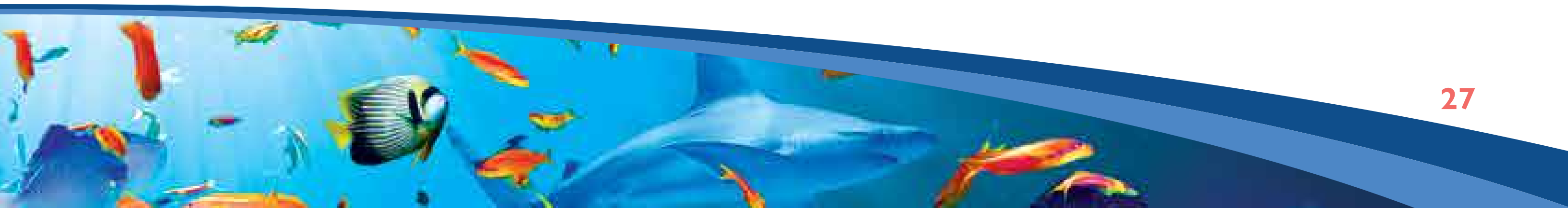
what I did

what I learned

Activity 1.3
FINDING THE SEAS

Look at the map of oceans and seas on this page and circle these marginal seas: Mediterranean Sea, Caribbean Sea, Sea of Japan, Yellow Sea.

Find and circle these inland seas: Caspian Sea, Black Sea



Activity 1.4

FINDING THE RIVERS

Circle the rivers on the map and answer the questions.

MISSISSIPPI RIVER

In which state does it begin? In which state is its mouth? Into which body of water does it empty?

SNAKE RIVER

In which state does it begin? In which state is its mouth? Into which body of water does it empty?

RIO GRANDE

In which state does it begin? In which state is its mouth? Into which body of water does it empty?

CHATTAHOOCHEE RIVER

In which state does it begin? In which state is its mouth? Into which body of water does it empty?

Activity 1.5
GYRE SIMULATION

what I did

___

___

___

what I learned

___

___

___

___

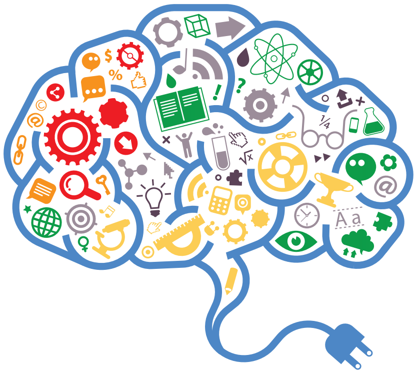
Activity 1.6
NATURE JOURNALING

This Notebooking Journal has a special section in the back for you to record your time enjoying learning about swimming creatures. Please use those pages throughout this year to record your experiences and thoughts.

Activity 1.7
DENSITY EXPERIMENT

what I did

what I learned



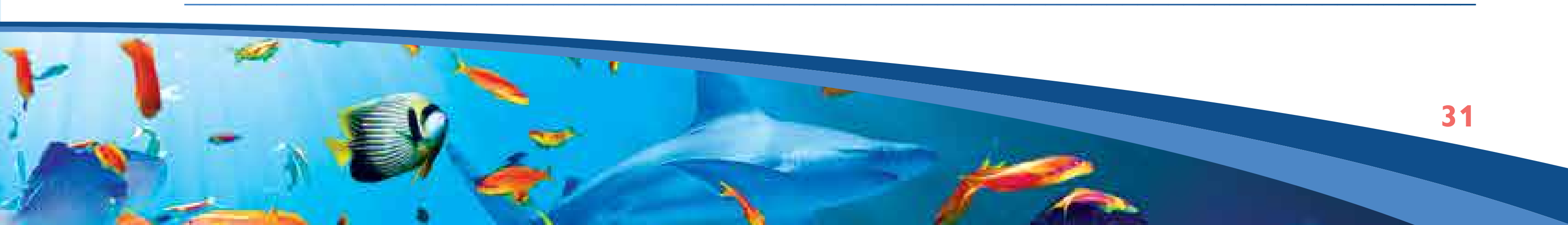
WHAT DO YOU REMEMBER?

Name the 5 oceans in the world.

What are seas?

What are estuaries?

Beginning from the shore out to the deep, what are the zones of the ocean floor?



What are the circular currents called?

What are the currents caused by temperature and salt levels called?

What causes the tides?

oceans MINIBOOK

INSTRUCTIONS:

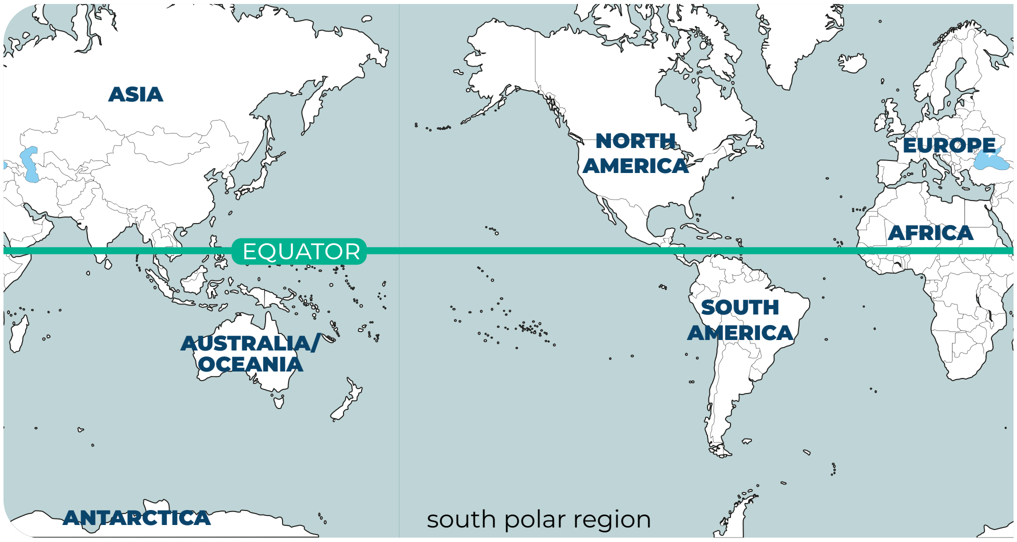
1. Cut along the dashed lines.
2. Fold along the yellow fold lines.
3. Stack the pages by placing the Oceans cover face down with the Tides tab in the upper right position.
4. Place the Zones page on top, right side up.
5. Staple the pages together on the fold.
6. Attach the back cover to the minibook page.

Label the moon, high tide, and low tide.
Write a few words about tides.

TIDES

SURFACE CURRENTS

Draw the currents as shown on page 26 of your textbook. Write a few words about currents.



OCEAN ZONES

OCEAN ZONES

Label the ocean zones and write a few words in the lines.

SURFACE CURRENTS

oceans MINIBOOK

Attach your oceans minibook below.

Attach your minibook here.

Vocabulary

WORD BANK AND PUZZLE CLUES

ABYSSAL PLAIN
ANADROMOUS
AQUATIC ANIMALS
BIOLUMINESCENCE
BRACKISH
CONTINENTAL SHELF
CONTINENTAL SLOPE
ESTUARY
FRESH
GYRE
HIGH TIDE
LOW TIDE
MARGINAL SEAS
MIDNIGHT
NEAP
POOLS
SUNLIT
SPRING
SURFACE
THERMOHALINE
TWILIGHT ZONE
WATER

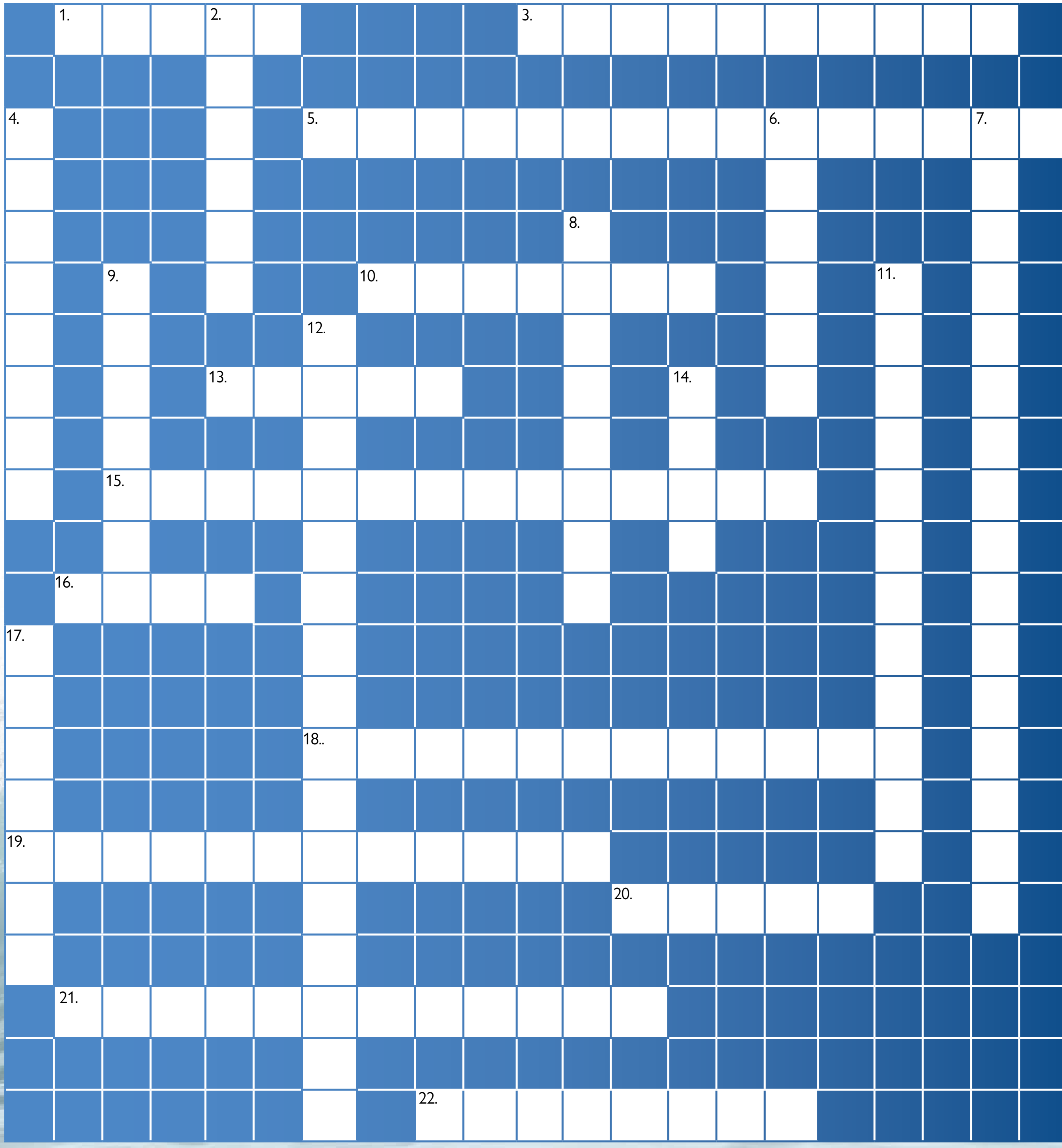
ACROSS

1. ___________water habitats—bodies of water that are found inland with little to no salt content
3. Fish that migrate upriver from the sea to lay their eggs
5. The ability of an animal to make its own light
10. When the water retreats far from the shore
13. Tide________ — pools of water that form during low tide where many animals are found
15. Swimming animals
16. Current that flows in a circle
18. The fairly dark second zone of the ocean under the sunlit zone
19. The ocean floor
20. ___________ pressure—the force that water exerts on objects
21. ___________ currents—deep ocean currents
22. ___________ water—water that is partly fresh and partly salty

DOWN

2. ___________ tides—tides that are higher and lower than average because the sun and moon are pulling in the same direction
4. ___________ zone—the very dark part of the ocean where no light penetrates
6. ___________ zone—first ocean zone closest to the surface
7. The part of our continent that is underwater where most animals live
8. When the water rises and flows onto the shore
9. The place where rivers and streams join with the ocean containing brackish water
11. Seas that are mostly surrounded by water but have an opening that leads to an ocean
12. The drop-off where the continent ends and the deep ocean begins
14. ___________ tides—tides that aren't very high or low because the sun and moon are pulling with equal exertion
17. ___________ winds—air that blows over the ocean forming gyres

Vocabulary
CROSSWORD



There are no spaces between words.

CREATIVITY PAGE

Make a scrapbook page of your journey learning about aquatic animals.