Lesson 1
Aquatic Animals

This interesting creature is a nudibranch. Like all swimming creatures, it was made by God on the fifth day of creation.

From the streams that begin in the mountains, through the lakes and rivers that lead to the oceans, and far down into the depths of the sea, the Lord God filled up the waters with creatures great and small. With a word, the enormous whales sprang into being. At His command, billions of plankton leapt to life. In one moment, full grown sea turtles, sharks, sponges, dolphins, squids, and octopuses joined them in the sea. Strongly swimming fish headed up the streams with the creeping crayfish and the sluggardly snail. Indeed, the fifth day of the earth's existence was crammed with excitement. We will explore the wonders of this day, focusing on creatures that swim in the water, whether they are in the pond down the street or in the ocean deep. So put on your scuba gear, and let's go.

The teeth in this shark's mouth tell you how dangerous it can be.

As you study these animals, you will be amazed by how different they are from one another. Some, like the nudibranch (noo' dih bronk) pictured above, are amazingly colorful. Others, like the anglerfish lurking in the abyss (uh bis'), look a little frightening and even bizarre. Some, like the arrow squid, are absurd and brilliant. They hunt in packs and can leap into the air in an amazing display. Still others, like the dolphin and the manta ray, are majestic, intelligent creatures. Finally, creatures like the sharp-toothed sharks are menacing and frightful as they stealthily stalk the sea.

We will study many, many swimming creatures in this book, along with the fascinating things they do. 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 which are mysterious. So much about them is still unknown to us because they are so hard to study, for their natural habitat spans the whole 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.

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 have, and I think I might understand the reason. I think God created all these glorious creatures because they delight Him; He enjoys them. He loves His creation, and though it is not the perfect place it was at first and continues to become even more corrupted, He still 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 the most – people who also love me. 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.

Aqua Mobility

You might think that every animal which lives in the water can swim, but that is not the case! Some aquatic animals can only scoot or creep around, and many aquatic creatures can only float, moving wherever the water takes them. We call animals that can swim **nekton** (nek' tun), which comes from the Greek word that means "swimming." They get from one place to another by propelling, gliding, or paddling through the water. They usually have fins or flippers. Whales, seals, fishes, sea snakes, turtles, octopuses, and squids are all **nektonic** (nek tahn' ik) animals.

This orange-lined triggerfish is a nektonic animal, because it can use its fins, tail, and body to swim in the water.

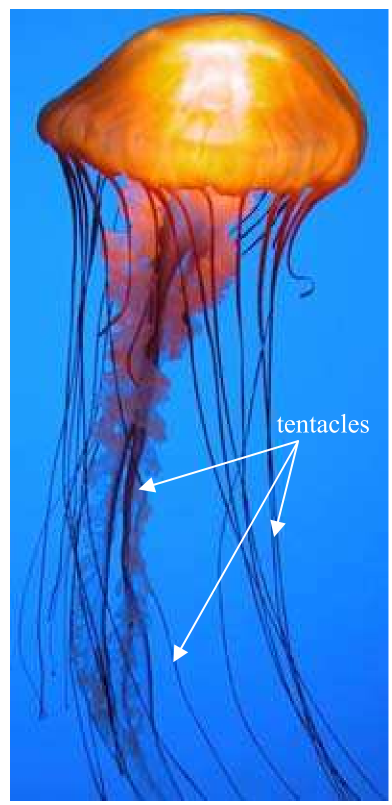
This sea star (often called a starfish) is a benthic creature because it scoots across the ocean floor.

Animals that don't swim but scurry, crawl, hop, scoot, burrow, or slither across the bottom of a body of water are called **benthos** (ben' thahs), or **benthic** (ben' thik) **animals**. Even animals like sponges that attach themselves to the ocean bottom and don't move around are a part of the benthos. This word comes from a Greek word that means "depths of the sea." Can you think of an animal that might be benthic? Crabs, lobsters, sea snails, clams, and sea stars are examples of benthic creatures.

How can you tell if an animal is benthic? Is it always benthic if it sits on the bottom of a lake or ocean? No. Some fish, like flounder and stingrays, rest on the floor of the ocean for a long period of time, but they can also swim from one place to another. Because they can swim, they are nektonic animals. Benthic animals *cannot* swim from one place to another. Lobsters and crabs, for example, must walk across the bottom of the ocean. Because they are unable to freely swim about the ocean, they are benthic animals.

Some benthic animals, like sponges, are also **sessile** (ses' uhl). Corals are sessile too. What do you think sessile means? It comes from the Latin word *sessilis*, which relates to sitting. Thus, sessile animals stick themselves to one place and just sit there. They don't move around. Sometimes, before they become sessile, these animals are **plankton** (plangk' tun).

You will hear a lot about plankton in this book, so let's talk about them. Their name comes from the Greek word *planktos*, which means to wander or drift, and that's exactly what plankton do – they drift. There are two kinds of plankton: **phytoplankton** (fye' toh plangk' tun) and **zooplankton** (zoh' uh plangk' tun). Phytoplankton are a lot like plants, because they use the sun to make their own food. Zooplankton are more like animals. They need to eat to get food. In fact, zooplankton often eat phytoplankton! Although most zooplankton can swim a little, they are such weak swimmers that they cannot overcome the force of the currents. As a result, they drift to and fro at the whim of the waters.



Jellyfish like this one are zooplankton. They are such weak swimmers that they mostly drift with the currents.

While most plankton are very tiny, some are giant, like the lion's mane jellyfish, which rivals the blue whale as the longest creature on earth. The lion's mane jellyfish has tentacles that can grow to be over 100 feet long! Most plankton, however, are microscopic, which means they are so small you can't see them with your eyes. Instead, you need the help of a microscope to see them.

You might be surprised to learn that most aquatic creatures are actually plankton when they hatch. For example, lobsters lay eggs that hatch little larvae that can't swim. Instead, they drift with the currents and are therefore plankton. Eventually, they grow into adult lobsters, at which point they are benthic animals. Most fish are also plankton when they are first hatched from their eggs. They cannot swim until they get older, so when they are young, they are at the mercy of ocean currents that go around and around the earth, being carried this way and that way, wherever the currents may go.

It may seem like fun to ride the currents that circle the earth, but plankton have a truly difficult life. Without the ability to swim, they have very few ways to defend themselves from being eaten by other animals. And many animals, even giant ones like the 20-foot manta ray, the huge whale shark, and some great whales of the sea eat plankton. They must eat tons of plankton each day just to survive. Where do you think these giant animals search to find plankton to eat? Yes, they search for currents. We'll learn about these currents later in this lesson.


Although it is huge (notice how big it is compared to the diver), this whale shark eats mostly plankton. Its mouth is designed to capture them as they drift with the currents.

Though ever so small, even microscopic, zooplankton that live in the oceans are truly phenomenal creatures. Can you imagine if every night you had to climb 25 miles up a mountain in order to get a bite to eat? Then, just when the sun began to creep up over the horizon, you had to climb back down so you would not become a meal for another animal. That would be a lot of work, wouldn't it? Yet that's exactly what life is like for many zooplankton. You see, most predators hunt during the day. So, the zooplankton sink deep into the ocean, hundreds of feet down, during the day to hide. Of course, all the phytoplankton that the zooplankton eat are near the surface of the ocean. Remember, phytoplankton must have sunlight so that they can make their own food, so they are found near the surface. In order to eat, then, the zooplankton have to climb back up to the ocean's surface under the cover of darkness to reach their food. Some are able to flap their tiny little fins or pump their little bodies enough to rise to the surface. This is an incredibly long climb for them, but they do it every single night in hopes of remaining alive long enough to grow into a larger creature. Now please understand that even though they can swim well enough to climb up through the water, they are not strong enough swimmers to overcome the currents, so they are still plankton.

As spring brings warmer temperatures and longer days, plankton can multiply so quickly that the water becomes cloudy with them – that's called a plankton bloom. Plankton blooms are most common in the arctic regions and happen each spring. Whales, dolphins, and hundreds of other animals paddle their way across thousands of miles to arrive for the plankton bloom. Many thousands of creatures feed upon plankton, depending on these small creatures for their very lives. In fact, if God did not create plankton, many of the animals I will discuss in this book would become extinct.

You have learned about nekton, benthos, and plankton. Can you explain what you learned about them?

Filter Feeders

God created animals for many purposes, all magnificently displaying His glory. Yet some of these animals show us how practical and caring God is, such as the filter feeders He created. You will hear a lot about filter feeders in this book, because God made a lot of them. In every major animal group, there are usually one or two filter feeders. So what on earth are filter feeders? Filter feeders are animals that clean up the oceans and rivers of the world by eating the microscopic creatures and debris (duh bree') that float about in the water. Do you know what debris is? It is junk that has been discarded. Since they eat the debris, filter feeders are the "cleaning crew" of the water.

We call them filter feeders because the water goes into the animal and is filtered so that the debris and microscopic creatures can be consumed by the animal. After that happens, clean water is spewed out of the animal.

All the bodies of water on the earth – ponds, rivers, oceans, seas, and lakes – contain so many microscopic creatures and debris that without the filter feeders, the waters would become contaminated. Filter feeders can take in the contaminated water and spurt out clean water in its place. Some filter feeders are tiny, like small clams that live near the shore. Others are enormous, like the giant barrel sponge that filters many gallons of water each day. One thing is for sure: Without filter feeders, the bodies of water on earth would be full of junk and germs!

This strawberry sponge is an example of a barrel sponge. It filters thousands of gallons of ocean water every day.

Animal Assortment

In this course, you will learn about a lot of animals, including **mammals**, **reptiles**, **amphibians**, **fishes**, and **invertebrates** (in vur' tuh brayts). Although you already learned some of these terms when you studied your first zoology course, I want to give you a brief overview right now to make sure you know what I am talking about.

Mammals are warm-blooded creatures that breathe air. Do you remember what "warm-blooded" means? It means their body temperature is always the same, no matter how cold it is outside. They also give birth to live young that drink milk from their mother's body. Mammals also have a backbone and hair. Some mammals, like whales, have hardly any hair, but they do have a few strands here and there. You will begin your study of aquatic mammals in Lesson 2, when you learn about the largest of creatures, the whales.

Reptiles are cold-blooded creatures that have scales, breathe air, lay eggs, and have a backbone. Do you remember what "cold-blooded" means? It means that their body temperature changes with their surroundings. Their bodies are warm when it is warm outside and cooler when it is cold outside. Amphibians are like reptiles, but they don't have scales. Fishes are cold-blooded, have a backbone, and have scales like reptiles, but they don't breathe air. They breathe under water using gills.

What do you think invertebrates are? Well, a **vertebrate** (vur' tuh brayt) has a backbone. When you add an "in" to the beginning, it means "without." So invertebrates are creatures that don't have a backbone. We'll learn about invertebrates in the last part of this book. You are likely to see many invertebrates when you visit the beach, including crabs, sand dollars, sea urchins, and sea snails.

Current Events

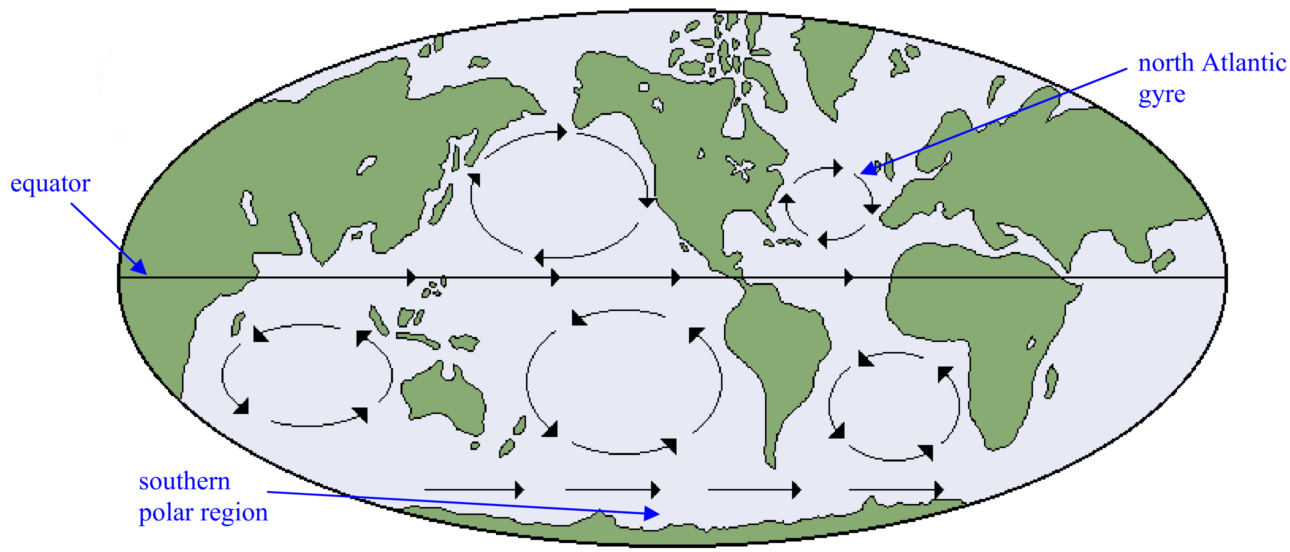
Before we study the various creatures that live in water, let's learn a bit about the ocean, where many of these creatures live. What helps whales migrate from the warm waters to the cold waters where the plankton blooms occur? How can fish that feed on plankton find enough to eat? The answers to these questions lie in a study of 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 (called the **head**) to its end (called the **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 and South Poles), along with millions of plankton, 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.

Sea turtles often use ocean currents so that they can travel over great distances. If you saw the movie *Finding Nemo*, you already know about animals hitching a ride on currents.

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. Ocean currents, then, are like a giant food delivery system created by God to feed His animals!

Surface Currents

Currents that form on the surface of the ocean are not surprisingly called **surface currents**. These currents are mainly formed by the winds. Interestingly enough, when you look at the surface currents in the world's oceans, you see that they form circular patterns called **gyres** (jires). To see what I mean, look at the drawing below:



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

Notice there is a current that pushes water straight along the equator, and another that pushes water straight along the southern polar region. The other currents, however, look like giant Ferris wheels that lie on their sides. These are the gyres. 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 U.S., crosses over to northern Europe, travels down to Spain and then goes across to Cuba and back up to Florida. To understand how winds are the major cause of these currents, do the following activity:

Try This!

You will need another person, two hair dryers or personal-sized electric fans, some Cheerios or glitter, and a long casserole dish. Fill the casserole dish with water and sprinkle the Cheerios on the surface of the water. The other person needs to hold a hair dryer on one end of the dish, and you need to hold the hair dryer on the other end. Now 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, towards your end. Your hair dryer needs to blow along the other long side of the dish, towards 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.

Here's an interesting story that illustrates how gyres work. One day, in the Pacific Ocean off the coast of California, a ship that was carrying Nike shoes sank. Thousands of Nike shoes were dumped into the ocean. Scientists predicted that because the shoes would be caught in the currents near where the ship sank, these shoes would wash up on beaches that lie along the clockwise gyre in the northern Pacific Ocean. Guess what? They did! They showed up on the beaches of California, then Hawaii, then the Philippines, and then Japan. Can you follow that pattern on the map on the previous page?

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 it is heavier than the warmer water at the surface, it sinks. It then moves slowly towards 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 salt water 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** (thur moh hay' line) **currents**, because thermo means "heat" and haline refers to "salt."

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

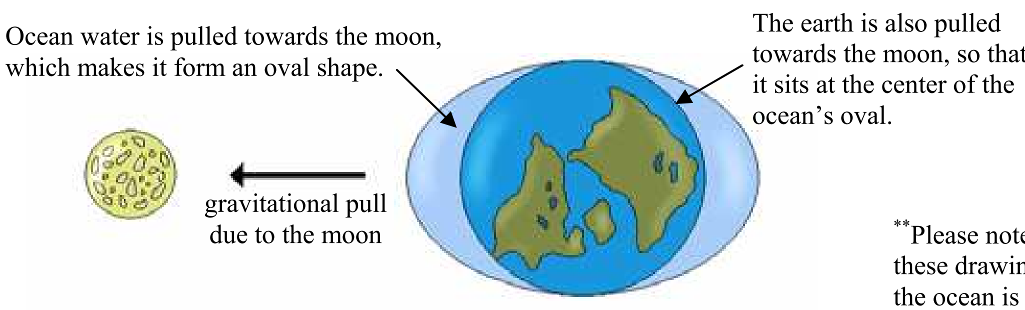
Tides

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 upon the tides, especially animals that stay in tide pools.

These photos show the same beach at high tide (left) and low tide (right). Notice the tide pools that are formed at low tide.

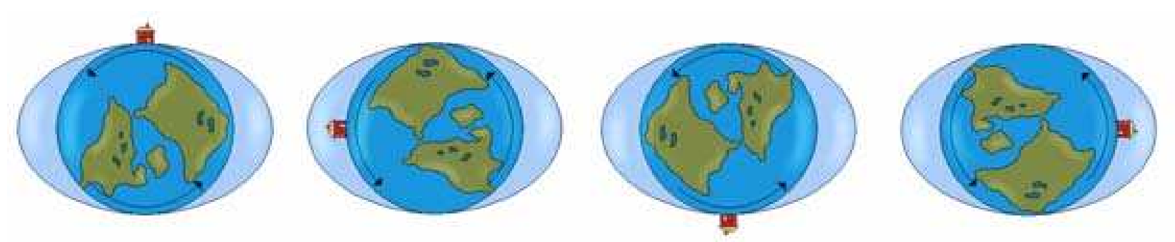
Tide pools are created when the tide goes out but crevices in rocks or the sand form pools of water. Some sea creatures get trapped in tide pools, while others make their permanent homes there. Those that get trapped wait for the tide to come in so they can slip out of the tide pool and return to where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

What causes these tides? Well, do you realize they are caused by an extraterrestrial (ek' struh tuh res' tree uhl) force – a force outside of this world? That's right! They 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** towards the moon, making an oval shape. At the same time, the earth is also pulled towards the moon, which makes the earth sit at the center of the oval.



**Please note that in all of these drawings, the bulge of the ocean is exaggerated.

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 over the course of a day. The earth, on the other hand, spins completely around in one day. So think about what happens to a specific place (let's say a house) 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 house 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 house gets moved to the bulging side of the oval where there is a *lot* of water. At this time, then, the house experiences high tide. As the earth continues to spin, the house eventually gets to the other flat side of the oval, where it again experiences low tide. Eventually, however, the earth's spinning takes it to the other bulge on the oval where it once again experiences high tide. Over the course of the day, then, the house (really any place near the ocean) will experience a low tide, followed by a high tide, followed by another low tide, followed by another high tide.

Interestingly, the tides are not always the same. During a new moon or a full moon, the high tide is higher than usual and the low tide is lower than usual. We call these **spring tides**, even though they happen in all seasons, not just in the spring. Spring tides are caused by the sun working with the moon to pull on the oceans of the world. You see, the sun pulls on the earth and its oceans with its gravity as well. However, because the sun is so far from the earth, its effect on the oceans is small. Even so, when the sun's gravity adds to the moon's gravity, the high tides are noticeably higher and the low tides are noticeably lower. In the same way, depending on where the moon is compared to the sun, the sun's gravity can work *against* the moon's gravity, making the high tides lower and the low tides higher. When this happens, we say that the earth is experiencing **neap** (neep) **tides**.

What can you tell me about currents and tides?

Planet Water

If you look down at the earth from space, you can see that the earth should have been named "ocean" instead of "earth," for the whole earth is mostly ocean! From up in space, it looks like a giant blue marble with white splotches. Why does it look blue? Because it has more water than land! Of all the animal habitats, the biggest and most abundant is the aquatic habitat.


This is the earth as seen from space. Although you see some land (the brown areas), you see mostly ocean (the blue areas) and clouds (the white areas.)

Most of the waters of the world can be found in the oceans. Can you tell me how many oceans our world has? It has four: **Pacific**, **Atlantic**, **Indian** and **Arctic**. Do you think you can find these oceans on a globe? Try that now. For another fun activity, look at how your globe is divided into a top half (Northern Hemisphere) and a bottom half (Southern Hemisphere). Which hemisphere is covered with the most ocean? Which is covered with the most land?

Connected to these oceans are several **seas**. Seas are smaller than oceans, but are made up of salt water because they are connected to oceans. Although seas are mostly surrounded by land, they are usually joined to an ocean on at least one side. Can you find a sea on your globe? Look for a sea called the Mediterranean (med' ih tuh ray' nee un) Sea. It's just below Europe and above Africa. Can you find any others? The earth has lots of seas.

If you want to find an ocean, just follow a river in the direction of its flow, and you'll eventually get there, because the world's rivers and streams eventually flow into the seas or oceans. Where does the water that makes these rivers, lakes, and streams come from? Well, rain is a big factor; however, ice melting on the tops of mountains, or underground springs that pour forth water each day also create rivers. All these rivers are **fresh water** habitats, meaning they are not salty like the ocean. When these waters reach the ocean, however, they become salty, or **brackish**. The place where a river meets with an ocean or sea is called an **estuary** (es' choo air' ee). Where the estuary is closer to the river, the water is less salty, and it becomes saltier the closer it is to the ocean. Lots of creatures live in estuaries because food is plentiful there. Although some animals can survive in both fresh and salt water, most like a specific amount of salt in the water in which they live. As a result, most creatures stay in a specific part of an estuary, where the amount of salt in the water is just right for them.

Fresh Water Facts

Have you ever wondered what the differences are among ponds, lakes, swamps, streams, and rivers? Streams and rivers are made up of fresh water on the move – water continually flows through them. 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. Eventually, they will make it to a sea or one of the oceans.

Can you see which direction the water is flowing in this river?

Ponds and lakes are also fresh water habitats, but they don't have the rushing current that rivers have. As a result, lakes are often dark and murky with the growth of plankton. Many lakes are man-made, which means that people actually made it. Usually, 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 river still flows through holes in the dam, but only a little water is let out each day. This way, the river still flows, but now there is a nice, big lake where there wasn't one before. If the dam breaks, any town that popped up on the other side of the dam could be flooded and destroyed.

Salt Solutions

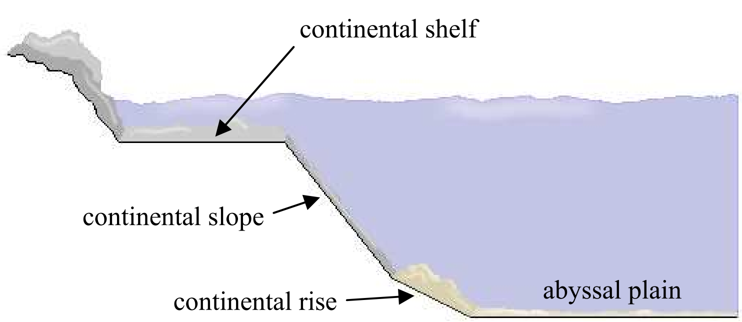
You probably know that the water in the earth's oceans is salty, but did you know that most of the salt in ocean water is exactly the same stuff you sprinkle on your food? In fact, some brands of table salt come straight from the ocean. "But how does the salt get into the earth's oceans?" you might ask. One way salt gets into the oceans is by rivers that flow over rocks containing salt. As the river water flows over those rocks, it picks up some of the salt, and since the river water eventually ends up in one of the oceans, the salt ends up there as well. 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. 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 based on how much salt is poured into that region.

Can you explain what you have learned so far about the oceans and waterways of the world?

Creation Confirmation

Did you know that the oceans are getting saltier and saltier? This is because rivers and volcanoes dump salt into the ocean continually, but it is very hard for salt to leave the oceans. Because of this, the amount of salt in the ocean keeps rising. This actually tells us that the earth is not billions of years old, as some would have you believe. If the earth were really billions of years old, the amount of salt in the oceans would have been building up for billions of years, making them *much, much* saltier than they really are. In fact, the amount of salt in the oceans indicates that the earth's oceans (and the earth itself) are very young.

Continental Shelf



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.

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 it's still part of the continent (kon' tuh nent). It's called the **continental** (kon' tuh nent uhl) **shelf**. It is the part of the continent that is under water. It slopes gradually downward, and the water gets deeper and deeper. Sometimes it's shallow for miles and miles, and sometimes it's only shallow for a few feet. 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 **continental slope**. The continental slope is like a giant cliff. And like a cliff, there are places where it goes straight down and other places where it slopes down a bit more gently. One part near the very end of the drop-off has a much more gentle slope. This is called the **continental rise**. The continental rise ends when it reaches the deep, dark ocean floor, which is called the **abyssal** (uh bis' uhl) **plain**.

As you walk farther and farther out on the continental shelf, you'll find the water getting deeper and deeper. However, the continental shelf is usually not more than 600 feet deep. Although 600-feet deep water is pretty deep, you are still on the continental shelf. You may be out deep-sea fishing, but you're not fishing above the deep sea. No, you're still fishing above the land that makes up the continent. Sometimes the continental 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.

Along the continental shelf, you will find many different habitats such as mangrove forests, kelp forests, coral reefs, and sea grass meadows, and closer to the shore, rocky shores with animal-rich tide pools. For further study, you can research each of these different habitats and learn where they occur and what kinds of animals you'll find in each habitat.

The Abyss

If you were to leave the continental shelf and dive deeper and deeper down the continental slope, you would 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. A few 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 – even darker than – midnight, for no light from the sun ever reaches down this deep into the ocean.

When you leave the continental slope, you reach the continental rise. When that ends, you find yourself in 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 pretty flat. If you walked for thousands of miles, you would eventually run into huge mountains (the tallest mountains on the earth are at the bottom of the oceans), volcanoes, valleys, and deep trenches that span untold distances. Most of the time, though, you would be traveling on flat land.

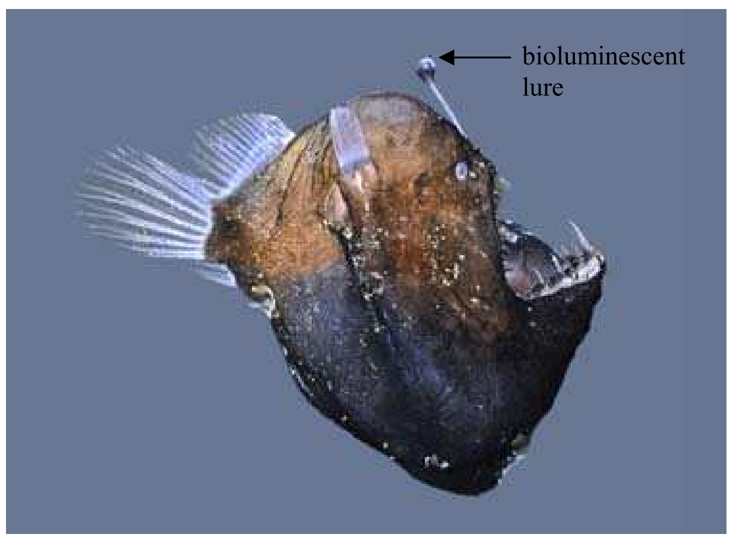
Most animals live on or in the waters above the continental shelf. Very few live down here in the deep ocean. Can you guess why? Think about what phytoplankton need to survive. That's right! They need the sun, because they make their own food using sunlight. What feeds on phytoplankton? Many creatures do, including zooplankton. Also, other creatures feed on the creatures that feed on phytoplankton. So the animals tend to stay where the food is. In the end, 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. 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, near the beach. God sure was nice to put most of the oceans' animals right near the shore so that we could discover and enjoy them!

Abyssal Animals

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 no one has ever been to the bottom. Food is so hard to find there that most creatures live off very little, and few grow longer than several inches. 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** (by oh loo mih ness' ens). It is basically the same as the light that a firefly makes.

Since the deep, dark ocean is much like a huge, empty wasteland, what do the creatures that live there 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, it only makes sense to use the word "angler" in its name!



This deep sea anglerfish uses its bioluminescent "lure" to attract other animals so that it can eat them.

Besides 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 on 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 we can't 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 dove down into the ocean and got underneath all that water.

Did you know that inside your body you have pockets of air? These pockets of air represent another problem when you try to dive into deep water. Think about your lungs, for example. Your lungs are like big air balloons inside your body. When you dive down, the water pressure is increased, and those "balloons" get scrunched smaller and smaller. When you come up closer to the surface, there is less water pressure, so your lungs grow larger and larger until they are back to the normal size they are meant to be when you reach the surface. Isn't that interesting? You can simulate this with a balloon.

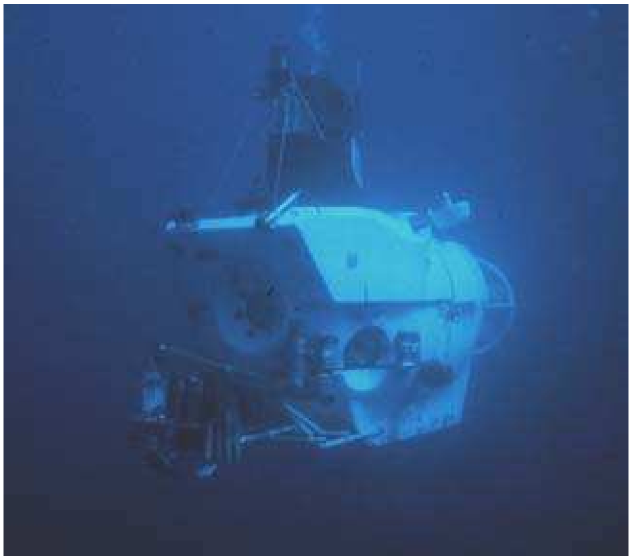
Try This!

For this activity, you will need a small balloon and a clear plastic 2-liter bottle (like a plastic soda pop bottle) with a lid. Hold the balloon in the bottle upside down so that the top of the balloon is in the bottle and the opening of the balloon is sticking out the opening of the bottle. Now blow up the balloon as much as you can. You won't be able to blow it up very big, because it will squeeze against the walls of the bottle. That's fine. Just do the best you can. Then, tie off the balloon to trap the air inside it. When the balloon is tied off, push it down into the bottle so that you now have a partially inflated balloon inside the bottle. Next, put the lid on the bottle tightly, so there is an airtight seal. Now lay the bottle on its side on the floor, keeping the balloon on one end of the bottle. While you are looking at the balloon, have a parent or older sibling step on the bottle (not where the balloon is) with all of his weight. The bottle should crumple where his foot is. What happens to the balloon? While you are still watching the balloon, have him lift his foot off the bottle. What happens?

When the person stepped on the bottle, he increased the air pressure in the bottle. What happened to the balloon as a result? It got smaller, didn't it? Stepping on the bottle simulates what happens to your lungs when you dive down into the depths of the ocean. As you dive deeper, the pressure on your body increases, and just like the balloon, your lungs get smaller. When he lifted his foot off the bottle, the pressure was relieved, and the balloon went back to its normal size. This is what happens to your lungs as you come back up to the surface. Now you can see one reason divers use oxygen tanks! Not only do those tanks provide the oxygen that the divers need to breathe, but they also increase the pressure in a diver's lungs so his lungs don't collapse when he goes deeper into the ocean.

The Bottom Line

So, if scientists can't get down into the deep ocean, how do they know what is down there? Well, scientists have designed scuba diving suits that are pressurized, allowing scuba divers to get over 1,200 feet deep, but that's not anywhere near the abyssal plain. To see down that far, God has enabled man to design large machines, sort of like space ships that go under water instead of into space. These "underwater space ships" are called **submersibles** (sub mur' suh bulz). Some submersibles carry people, and some are unmanned, meaning that they go down without a person inside. Unmanned submersibles are less expensive to build and are able to take pictures of what is down under the ocean and bring back samples of what is found down there. However, scientists like the manned submersibles better, because they want to actually go and see for themselves!



This submersible, called "Alvin," carries three scientists and has been to depths of more than 6,700 feet.

Now that you have learned a lot about the places where the aquatic animals live, the rest of this book will focus on the animals that dwell in these places. Before you go on, however, it's time to spend some time reviewing what you have learned and experimenting so that you can learn a bit more.

What Do You Remember?

What are nektonic creatures? What are benthic creatures? What are plankton? Where can zooplankton be found at night? Why are plankton important to all sea life? What are filter feeders? Can you name the four oceans in the world? What are seas? What are estuaries? Beginning from the shore out to the deep, what are the four zones of the ocean floor? From the surface of the ocean to the deep, what are the three zones in which aquatic creatures live? What are the circular currents called? What are the currents caused by temperature and salt levels called? What causes the tides?

By the Beach

If you can go to a beach, the best place to look for sea life is in tide pools. Tide pools are filled with all manner of sea life. They are best found on rocky shores, but even a sandy shore can have tide pools. You can often find sea life hidden under rocks and in crevices in the tide pools. Look carefully, and you might discover a wonderful world of aquatic animals!

This tide pool was formed when the tide went out. It is a great place to look for aquatic life.

Fresh Water Finds

If you can go to a lake, look for signs of animal life in the water. Do you see unusual clumps of mud possibly made by an aquatic creature? Do you see the telltale marks of a slithery water snail? If you look carefully, you are sure to see signs of life. You might even see aquatic creatures for yourself.

Your Notebook

It is important that you review this material before you move on to the next lesson. You see, as a student, it isn't enough 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. The main way you will review material in this course is to make a notebook of your zoology studies. You will make illustrations, do fun assignments, record all that you learn, keep scientific speculation sheets from experiments, and even add pictures of other things you see and do. Your notebook will be a collection of your zoology studies. 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.

Start your notebook by writing down what you have learned in this lesson. You just answered a bunch of questions in the "What Do You Remember?" section on page 16. Use that as a guide for what to write in your notebook. In addition, make drawings like the ones on pages 9 and 12 so that you can explain what causes the tides and what the regions of the ocean floor are called.

Ocean Box

You are going to create a box to display your own models of the animals you learn about in this book. Today, you will build this box, called your **ocean box**. You can choose any size box - a small shoebox or a large shipping box. You need to line it with blue paper, just like the boy is doing in the picture on the right. That way, it looks like the ocean.

In each lesson you will learn about some aquatic animals, and you will then make a model of those animals and add them to your box. You can use clay, or you can cut out pictures from magazines or print pictures from the Internet. At the end of the course, you will have a box filled with sea life like the one shown on the left. Most of the animals in this ocean box were created from clay and either glued to the box, stuck to the box with tape, or hung from the top. As you put your ocean box together, do a good job so that you can be proud of your accomplishment when you are done with this course!

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:

- A Scientific Speculation Sheet (found on page iv)
- A large clear bowl or container (It could even be the bottom half of a plastic soda bottle.)
- A paper or Styrofoam® cup
- A nail or pen to puncture a hole in the cup
- Blue and yellow food coloring
- A spoon with which to stir
- Hot water and ice cold water

1. On your Scientific Speculation Sheet, record your hypothesis about which will be heavier: hot water or cold water.
2. Fill a large glass bowl with hot water. You can warm the water in the microwave if you wish. **Make sure it is not too hot!**
3. Place a drop or two of blue food coloring in the water and stir.
4. Pour ice cold water into the cup and add several drops of yellow food coloring. Stir so that the ice water is yellow.
5. Holding the cup over the sink, puncture a hole in the bottom of the cup with a nail or pen.
6. Hold your finger over the hole and slowly place the cup in the hot, blue water.
7. Pull your finger off the hole in the bottom. What happens? Why do you suppose the cold water pours into the bowl? Does it appear to be mixing well? Which way is it moving as it pours into the bowl?
8. Now let's change the experiment. Empty the bowl and this time fill it with ice cold water, adding a few ice cubes to keep it cold.
9. Add a drop or two of blue food coloring and stir.
10. Place your finger over the hole and fill the cup with hot (**not *too* hot!**) water, and add yellow food coloring to the hot water. Stir to make sure the food coloring mixes with the water.
11. Place the cup in the bowl of blue ice water and take your finger off the hole. What happens? How is this different from what you saw in step 7? Why is this happening?
12. Based on this experiment, which is heavier: hot water or cold water?
13. Fill out the rest of the Scientific Speculation Sheet and place it in your notebook.