Inspired by the amazing true story of Winter.

Dolphin Tale
A Study Guide
The movie, Dolphin Tale, tells not only an inspiring story but also provides an excellent opportunity for families to learn about some of the fascinating aspects of dolphins and the oceans in which they live. This Activity Book offers parents and students the tools to turn their movie experience into an enjoyable learning expedition, involving fun and interesting lessons, activities and experiments.

The Activity Book is divided into five major lessons, each covering a different aspect of dolphins and the ocean and how this information relates to the movie. All of the lessons contain instructions and activities for elementary to high school-aged students along with age appropriate explanations and vocabulary. Each academic level is represented by a symbol for easy identification.

The fish denotes activities and experiments geared toward elementary-aged students, the sea starfish for middle school-aged students, and the octopus for high school-aged students. The text is written in an engaging way so that parents can read aloud to younger students, and older students can easily read the material independently.

Students will be encouraged to keep a notebook in order to record their work. This will become a wonderful way to review the material before and after the movie experience. When combined with additional reading, these activities provide a unique unit study for summer enrichment or school-year science work.

The notebooks can consist of a three-ring binder with printed pages from the e-book, or students can construct lap books using colorful construction paper and photographs of their work. All of the lessons include vocabulary words in bold letters, so students may use them to record definitions or do copy work, if desired.

So dive in to this fun Activity Book, and get ready for a wonderful dolphin-filled experience!

NOTE:
The Answer Keys are located at the back of this Activity Book.

ABOUT THE AUTHOR

The Dolphin Tale curriculum was written by Apologia author Sherri Seligson. Sherri Seligson is a marine biologist and homeschooling mother who also authored “Exploring Creation with Marine Biology” high school text and curriculum.
LESSON ONE

SINK OR SWIM?

All creatures in the ocean have to keep themselves at a constant depth in the water. Some have body features to help them live on the surface of the water while others live much of their lives on the ocean floor. Those living up in the water column, the swimmers, have body features that help them stay at a certain depth without floating to the surface or sinking to the bottom. Because there are many strategies used to help ocean creatures stay afloat, let’s take a look at what things will sink or float in water.

Winter rests on a foam mat that floats on the water’s surface

WHAT YOU NEED:

A large clear plastic or glass flower vase
½ cup of honey or syrup
½ cup of cooking oil
Small items to test in the water - a piece of cork, a rock (not lava rock), a chunk of tomato or grape, and one teaspoon of solid shortening, butter or margarine
Printouts of Buoyancy Worksheet and Sea Creature pages
Colored pencils or crayons for elementary students
ACTIVITY: PART 1
Fill the vase with water about 2/3 full. Slowly pour the honey or syrup into the vase. Notice where it collects.
Now add the oil. Mark the location of each of the liquids on the vase diagram on the left of the Buoyancy Worksheet. Next to each liquid, write its name on the lines in the center of the diagram. Begin to slowly add the small items to the vase, noting the position of each one on the left side of the worksheet. Write the names of each item on the lines in the center of the diagram. If you’d like, take a photo of your experiment to add to your Winter Notebook.

DIVE DEEPER
You just created your own water column. A water column describes a pillar of water, beginning at its surface and extending to the bottom sediments of the ocean. Water columns are used or observed to better understand aquatic phenomena. In your lab, the water column you made helps you to see how objects float in comparison to each other. Scientists use water columns to better understand pressure, currents, varying salinities and temperatures, and isolated ecosystems of the ocean. In this activity, the water column helps us to see how liquid and solid materials sink or float in relation to each other.

Why did each of the items float at different levels? The important word here is density. Every object in the world (including air) is made up of tiny components called atoms and molecules. Density describes how close together an object's atoms and molecules are. The more tightly packed, the denser an object is. And, as a rule, denser objects sink below less dense objects.

There is one more idea that affects whether an item floats or sinks: its shape. The shape of an object helps determine how much water gets pushed away. When an object is placed on water, it pushes some of that water away. If the water that is pushed away is denser than the object that pushed it, the object will float. If the water pushed away is less dense than the object, the object will sink. Scientists call this phenomenon buoyancy, or the ability to float.

When you added honey to the vase of water, you should have seen that it sunk below the water. This is because honey is made of more tightly-packed atoms and molecules than water. The oil is made up of less dense material, so it floated above the water.

When you began adding the solid items to the vase, you should have noticed that the cork floated above the oil. What does that tell you about its density as compared to the oil? It is less dense. The solid butter floated at the bottom of the oil, but on top of the water, meaning it is denser than liquid oil, but less dense than water. Your tomato or grape should have floated on top of the water, but just under the oil. And, finally, the rock should have sunk to the bottom of the vase. It is the densest of all of the objects you tested.
ACTIVITY: PART 2

Now, cut out the images on the Sea Creatures page and place on the right side of the Buoyancy Worksheet at the locations described below. Beside each creature, write its name on the lines in the center of the worksheet.

- Place the Crab at the bottom of the water column.
- Place the Dolphin at the surface of the water column.
- Place the Plankton just below the dolphin.
- Place the Jellyfish just below the plankton.
- The Jack goes halfway down the water column.
- The Flounder should be placed just above the crab.
- The Butterflyfish goes halfway between the flounder and the jack.

Once the creatures are added to the Buoyancy Worksheet, younger students can color the liquids in the left column. Color the oil yellow, the water blue and the honey brown. They can also color the floating items.

DIVE DEEPER

A water column has different physical features at every depth. For example in most parts of the ocean, deep water is very cold and has little or no sunlight. Organisms living there also have to endure greater pressure. Creatures living at the ocean’s surface experience excessive sunlight, warmer temperatures, and effects of storms and waves. Because of this, sea creatures have to either remain at a specific place in the water column or have special body features to endure the changing temperature and pressure.

Clams, for example, live on the ocean floor where they can “vacuum” bits of food off the sand. They do not need to float in the water, so they have no swimming or floating features. Most jellyfish, on the other hand, need to stay afloat in the middle of the water column where they can capture their prey (fish). If they float too close to the surface, they are likely to get eaten by birds or other predators, and if they sink to the floor, they will not be able to get their food. Therefore, their bodies are very watery and have a similar density to water. They can therefore “hover” in the water column without sinking to the bottom or floating to the surface. This is called neutral buoyancy, and many other ocean creatures have features to help them maintain neutral buoyancy, so they can stay in one area of the water column.

Most fish have an organ in their bodies called a swim bladder which behaves like an internal balloon, filled with air. They are able to increase or decrease the amount of air in the swim bladder to help them to move up and down the water column. Plankton are tiny plants and animals that cannot swim against the ocean current. Many of them have droplets of oil in their bodies to help them stay up in the water column. Just like in the experiment, oil is less dense than water, so it floats above water. By keeping drops of oil in their bodies, plankton are better able to float.

Dolphins, like Winter, have strong muscles and a sleek design to enable them to easily move to almost any part of the water column they desire. When they float at the surface they fill their lungs with air, so their bodies have an overall density that is less than the water they displace. Their bodies also have lots of blubber, or fatty tissue, to help them stay afloat. In the lab, the solid butter behaved much the same way that blubber does, because it is less dense than water. Despite their many features to help them float, dolphins also have a collapsible rib cage which enables them to endure the pressures of deep water.

Older students can research a dolphin’s collapsible rib cage and how it keeps them from getting gases into their blood stream, sometimes called “the bends.”
### VOCABULARY - MATCHING

Match the vocabulary word with its definition:

<table>
<thead>
<tr>
<th><strong>BUOYANCY</strong></th>
<th>Small plants and animals that cannot swim against ocean currents</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DENSITY</strong></td>
<td>A sample of water in the ocean, beginning at the surface and extending to the bottom sediments</td>
</tr>
<tr>
<td><strong>NEUTRAL BUOYANCY</strong></td>
<td>Staying in one place in the water column, neither sinking nor floating</td>
</tr>
<tr>
<td><strong>SWIM BLADDER</strong></td>
<td>The ability to float or sink in a fluid because of relative density</td>
</tr>
<tr>
<td><strong>BLUBBER</strong></td>
<td>An internal, gas filled organ in fish which helps them to control their buoyancy</td>
</tr>
<tr>
<td><strong>PLANKTON</strong></td>
<td>A feature of plankton which helps them stay afloat in the water column</td>
</tr>
<tr>
<td><strong>OIL DROPLETS</strong></td>
<td>A layer of fat in dolphins which helps them to stay afloat in the water</td>
</tr>
<tr>
<td><strong>WATER COLUMN</strong></td>
<td>Refers to the closeness of an object's atoms and/or molecules</td>
</tr>
</tbody>
</table>
In order to get a better understanding of the location of ocean creatures in a water column, it would be fun to research the following creatures and decide where they should be placed in the ocean depths. In order to do this, you will need to look for clues, such as the type of food they eat and their habitat. If an organism lives on a coral reef, you can research how deep coral reefs can live to get an idea of the organism’s relative depth in the water column. If an organism needs to photosynthesize (make its energy from the sun) you can deduce that it must live near the ocean’s surface. Research the organisms in the list below and create a new water column in your notebook, placing them in their appropriate place. Also, as you place each organism in the column, write a short note explaining why you chose its placement (photosynthesis, habitat, prey, etc.)

GULPER EEL
PORTUGUESE MAN-O-WAR
KELP
HERMIT CRAB
BIG EYE TUNA
GOBLIN SHARK
SWORDFISH
WHAT DID YOU LEARN?

1. Name one ocean creature that spends its time at the bottom of the ocean. Why do you think it lives there?

2. Name one ocean creature that spends its time at the top of the ocean. Why do you think it lives there?

3. Why is it important for creatures in the ocean to have body parts which keep them from sinking in the water?

4. What do dolphins have in their bodies to help them stay afloat in the water?

5. What is the special word we use that means “the ability to float”?

1. What would happen if an organism designed to live on the deep ocean floor was brought to the surface of the ocean to live?

2. A small ball of steel will sink if it is dropped into water. Yet large ocean liners and aircraft carriers are made of millions of pounds of steel. Why don’t they sink? (Hint: check the information in Part 1)

3. Now that you have learned about buoyancy and density, do you think it would be important for the designers of Winter’s prosthetic tail to consider these concepts in its design? Why?

One of Winter’s most recent prosthetic designs
SEA CREATURES

Cut out these images for use in Part 2 of the activity. Elementary-aged students can color these before cutting them out.
LESSON TWO
A WHOLE OCEAN OF CREATURES.

The ocean is full of creatures that come in nearly every size, shape and color. They fill all the areas of the ocean and are perfectly designed to survive in some of the harshest conditions on earth! Near the ocean’s surface, they have to deal with constant sunlight while avoiding predators and keeping themselves afloat. At the deepest depths of the sea, ocean creatures experience extreme pressure, cold and complete darkness. Let’s explore some of these amazing organisms!

Winter shares the Clearwater aquarium with a host of sea creatures

We will take a look at three types of creatures in this activity: jellyfish, sharks and bioluminescent deep sea organisms. Though they all live in the ocean, that is where the similarities end. You will see that there truly are fascinating creatures in the world’s oceans!
EXPLORING JELLYFISH

Jellyfish are amazing creatures. They are animals with similar body structures to corals and sea anemones. Though they have no complex body organs, they are able to survive quite well in the ocean. Their mouth is located in the center of their tentacles, but it does not lead to a stomach. Instead it ends in a simple digestive sac with only one opening. Their watery body is not supported by a skeleton like humans, yet they maintain their shape using water pressure held between two thin layers of skin. If you have ever held a water balloon, you have felt the pressure of the water inside pushing against the balloon’s skin. That is similar to the way a jellyfish holds its shape.

Jellyfish are not able to swim against the currents of the ocean. Because of this, they are called planktonic creatures. They have muscle-like fibers in their two layers of skin, but they do not have true muscles. With these muscular fibers, they can pulse their bodies and move their long tentacles which helps them to stay afloat in the water.

However, the tentacles of a jellyfish are more important for capturing prey. The long tentacles surrounding a jellyfish’s mouth have special cells with stinging structures called nematocysts. Once the prey is captured, it is pulled in to the digestive sac to be used for energy for the animal. Any wastes are released directly out of the cells in to the water.
MAKE YOUR OWN JELLYFISH

WHAT YOU NEED:

| An empty 2 liter soda bottle, cleaned |
| Thick and thin yarn (20 to 30 feet of each) |
| 1 sheet of white cardstock |
| Cellophane tape |
| Scissors |
| Ruler |
| Stapler |
| (Optional: fishing line for hanging) |

Hang your jellyfish and take a photo for your notebook!
A FEROCIOUS MONSTER?

If you think about it, jellyfish aren’t very intimidating creatures. After all, they don’t have sharp teeth (or any teeth, for that matter), their body is gelatinous and soft (making it easy for prey to fight back), and they cannot swim as fast as their prey (in fact, they can hardly swim at all). You probably cannot think of any sports team that has “jellyfish” as their mascot! That’s because they are not threatening organisms. At least, not at first glance…

If you take a closer look, though, you will notice that jellyfish have a way to capture their prey quickly and ferociously. The key feature they use for feeding and defense is a structure called a nematocyst. Nematocysts, located in the stinging cells of a jellyfish, are fascinating to study! Each nematocyst is basically a container full of venom with a skinpiercing harpoon inside. In most species of jellyfish, nematocysts are located on the tentacles (some species have them near their central mouths). When they are triggered by a stimulus, either mechanical (touch) or chemical, they unleash their deadly sting! In this activity, you will learn about the fascinating structure of a nematocyst and how it works.

A nematocyst is a bulb-shaped container, or capsule, that holds a coiled hollow thread attached to it. It is like a harpoon, waiting to be released. The hinged “lid” of the container is called an operculum. On the outside of the cell is a hair-like trigger called a cnidocil. When the trigger is activated, barbs help to pierce the skin and hold on so the venom can be injected. At this point, the hollow threads turn inside-out and extend into the victim to help the venom enter the body.

All of this happens in a couple of microseconds (that is a few millionths of a second!). The acceleration of the nematocyst discharge has been calculated to be over 40,000 times the acceleration of gravity!

So with millions of these powerhouses on the tentacles of a jellyfish, we can see that they are creatures to be respected. Indeed, they are more than fragile, gelatinous blobs!

Having read the information above, see if you can correctly identify the components of the nematocyst in the diagram on the next page. Use the bold vocabulary words in the text above.
NEMATOCYST DIAGRAM

Prey’s skin

Cell
Everyone seems to be fascinated with sharks. Perhaps it is their fierce, toothy smiles, their large, menacing size, or their less-than-polite table manners. But the more we study sharks, the more interesting we find them to be.

One of the first things people notice about these remarkable creatures is their teeth. Behind the functional rows of teeth are seven other rows which are developing in order to replace the working teeth as they are lost. All species of sharks continually shed their teeth and grow new ones. This is because they always need a sharp set of teeth to feed on their prey. They do not have flat-topped molars for chewing their food; rather, they bite into their prey, turn their head side to side to cut off a mouthful, and swallow the piece of food whole. This feeding strategy causes their teeth become dull quite quickly, so sharks have a conveyer belt design in their mouths. When a tooth is dull, it simply falls out and is replaced by a sharp, new one that comes up from behind. In this way, a shark will always have a completely sharp set of teeth. Studies on sharks have found that some species can lose and replace an entire set of teeth in 10 days! No need for a dentist here.

Not only do sharks have rows and rows of teeth in their mouths, they also have teeth all over their bodies! Their scales are a type of tooth called **denticles**. If you were to rub your hand over a shark’s skin, it would feel like sand paper. That is because of the tiny tooth-like denticles.

Another interesting feature of sharks is that they do not have a single bone in their body. Their entire support structure is made of **cartilage**. Cartilage is the same material found in the upper part of your ear. It is bendable but firm, so it allows sharks to maintain their large shapes yet be quite flexible in their swimming. This enables them to turn around rapidly while hunting for prey.

As sharks swim near the surface, their large **dorsal fin** often breaks through the water. This fin, located on the shark’s back, or dorsal side, helps the shark to maintain its balance in the water. Yet a sighting of a dorsal fin often causes confusion for people who cannot tell if the fin belongs to a shark or a dolphin. One easy way to tell the difference is to note the swimming pattern of the creature. You see, sharks are fish and dolphins are mammals. Fish swim in the water using a side to side motion, but marine mammals, like Winter, swim using an up-and-down motion. In this next section, we will take a closer look at sharks.
In the shark introduction, it was mentioned that research showed some species of sharks to lose an entire set of teeth in 10 days. How did the scientists know which teeth came from which sharks? Well, it turns out that every shark species has a differently shaped tooth. All of the teeth in the mouth of a single type of shark are the same shape. They vary only in size. So when a scientist finds a shark tooth, he is able to identify what kind of shark it belonged to just by looking at its shape.

In this activity, cut out each tooth below and tape or glue it to the Shark Tooth Identification page. Elementary students can write the name of the shark on the lines beside the tooth. Junior high school students should research to find one interesting fact about each shark and add it to the lines beside each tooth.
SHARK SENSE

Shark Sense: 

Sharks are known for their voracious appetites and less-than-mannerly feeding habits. But how do they find their food? Sharks have a poor sense of eyesight and a small brain as compared to their body size. So they have to depend on other senses to help them locate and capture prey. Their sense of smell is very good, enabling them to locate scents up to a third of a mile away.

On the shark’s snout is a pair of nostril-like nares. The organs inside identify the chemical odors released by other organisms. When a shark detects the right odor, it will turn toward the ocean current that is carrying that chemical. Its sense of smell is so sharp that it can identify which of its nares is getting the stronger scent and will navigate more accurately toward its potential prey.

But perhaps the most amazing sense that sharks possess is their ability to detect electric fields. Scattered along their snouts are small pores containing cells called Ampullae of Lorenzini. These cells are able to identify minute electric fields up to 1,000 miles away! How is the ability to detect electric fields helpful in finding prey? Well, when a fish swims, its brain sends electric signals along its nerves toward its muscles to prompt them to contract or relax. When electric signals travel along a pathway, they create an electro-magnetic field. Thus, when a fish swims, it is creating a magnetic field.

Many people know that sharks are drawn to blood and splashing in the water. Now you can understand why this is. You know that sharks have an amazing sense of smell and can identify blood chemicals in the water from miles away. They can also identify magnetic fields from long distances. These are the two indicators of an injured fish. When a fish is injured, it often is bleeding and swimming erratically. The irregular swimming creates a massive electric field. Sharks are drawn to the blood and splashing because those are clues that there is an easy meal nearby! Thus, most sharks are not voracious, evil predators but scavengers that feed on the injured and weaker organisms in the sea. Let’s explore the magnetic fields created by electricity in the activity below.

WHAT YOU NEED:

- A 1.5 volt battery (You can use any size, such as AA, C or D – but do not use a 9 volt battery!)
- A nail made of steel or iron
- A few loose staples and a metal paper clip
- Aluminum foil

Scatter the staples and the metal paper clip on a table. Holding the nail in your hand, touch its tip to the staples and the paper clip and then pull it away. Did the staples or paper clip stick to the nail? Would you say the nail is magnetic?

Now cut a strip of foil about triple the length of the nail and roll it up so it is like a long wire. Coil this “aluminum wire” around the nail so that each end sticks out about 3 inches. Using your thumb and forefinger, hold one end of the wire to the top of the battery and the other end to the bottom. You may feel the foil get warm because electricity is flowing through it. If it is too warm to hold, you can use a glove or fold a kitchen hot pad over the ends of the battery. While the electricity is flowing through the aluminum, try to touch the tip of the nail to the paper clip or staples. Write what happens in your notebook.
EXPLORING BIOLUMINESCENCE

Creatures that live in the deepest parts of the ocean have to endure conditions that humans would consider very harsh. With all of that water above them, the pressure is extremely strong. The temperature is very cold, and there is little light for organisms to see. But some creatures have an interesting ability to make their own light and carry it around in their bodies! This ability is called bioluminescence, and creatures will make light for many reasons. Because of the minimal light and the difficulty to see, some use bioluminescence to communicate with each other. Others produce light to locate food or attract prey. Still others use their light to frighten or confuse predators.

The light-producing organs are called photophores. Chemicals inside the photophores blend together to produce light. The amazing property of this process is that the light produced is cool. When you get near a light bulb that has been lit for a while, you can feel the heat it produces as well as light. In fact, most light-producing items that you are familiar with will also create heat when they glow. But if organisms created light like the table lamp in your home, the heat would damage their body parts. So the interesting design of photophores enables them to make the light they need without the damaging heat!

Though there are very few types of creatures that bioluminesce on land, it is much more common in the deep ocean. Glowing creatures, such as squid, snails, worms, jellyfish and a whole host of fish produce light in various ways. Some create a soft glow, many have physical “flashlights,” and others produce glowing ink. There are various deep sea organisms whose light-producing organs are arranged in beautiful patterns along their bodies and can flash like the fanciest fireworks show.

A glowing comb jelly
MAKE A DEEP SEA CREATURE

One of the most bizarre looking fish in the deep sea is the deep sea anglerfish. There are over 200 different species of anglerfish in the ocean! They get their name from a spine located on their back that has a photophore on its end. When the right chemicals combine in the photophore, the glowing bulb on the end of a spine is much like a fishing lure. The anglerfish will wave its “fishing rod” to attract its prey. When the prey moves close, the anglerfish uses its large mouth and sharp teeth to rapidly grasp and inhale its food.

In this activity, we will make our own anglerfish.

WHAT YOU NEED:

An empty egg carton
1 pipe cleaner, cut to 4 inches in length
Scissors
White cardboard
White glue or cellophane tape
Markers
One pony bead (even better, a glow-in-the-dark pony bead)
2 or 3 small craft feathers

Cut out two cups from the carton so that they are still attached to each other. Make a small slit between the cups so they can bend towards each other but are still attached (see photo below). Cut out teeth from the cardboard and glue or tape them to the inside edges of each cup along all the sides except for where the cups attach. Allow to dry.

Use the markers to draw eyes, side fins and even scales on the outside of the cups. Have a parent carefully poke a hole in the base of the cup that has the eyes on it.

Take the pipe cleaner and roll one end into a small ball. Thread the other end through the hole in the cup. Thread the pony bead about 1 centimeter onto the end of the pipe cleaner and bend the end of the pipe cleaner so the bead stays in place. Shape the pipe cleaner so that it curves toward the front of the fish.

Bend the cups together to create the fish's head and body. If desired, glue or tape feathers to make a tail.

Cut a small slit between cups  Deep sea anglerfish
BIOLUMINESCENT CHEMICALS

Deep sea creatures use the light they produce the same way people use flashlights to see or emergency lights for warning. But they produce light very differently. As you already read, it needs to be produced in a way that will not create heat which can damage the organism’s tissues.

To bioluminesce, organisms combine two substances to make light. Depending on the creature, different chemicals are used. But scientists use a general term for each type of chemical. Two proteins, luciferin and luciferase combine to cause a light-producing chemical reaction to take place. Lots of different substances can act like luciferins and luciferases, depending on the deep sea species.

This effect is very similar to what occurs in glow-in-the-dark light sticks. To activate them, you have to bend the stick, causing a small glass vial inside to break. Inside that vial is a chemical which will then mix with the chemical outside the vial, giving off a soft glow.

By doing this activity, you can further explore the basics of bioluminescence.

WHAT YOU NEED:

- Glow-in-the-dark light stick
- Two small, clear juice glasses
- Cold water
- Hot water

Holding the light stick in your hand, notice the color of the liquid inside and write the color in your notebook. Depending on where you purchased it, the color may be yellow, green, pink or even blue. That is from dyes added to the chemicals inside. Now gently tip the stick from side to side. Can you see the glass vial floating inside? Move to a dark room and carefully bend the light stick so the glass vial breaks. Do not shake the stick. Note what you see and remember to record that in your notebook.

Now vigorously shake the light stick. Can you see that the light glowed brighter? Notice if the light stick feels warm or cool.

Come out of the dark room and fill a juice glass with cold water. Place the light stick in the glass and allow it to sit for five minutes. Note what happens to the glow as compared to before you put it in the glass.

Add hot water to the second juice glass and place the light stick in it. Let it sit for five minutes and note how it glows. Write what you saw in your notebook.

DIVE DEEPER
What happened to the light stick when you broke the vial inside? You should have seen it begin to glow a little. Then, when you shook the light stick, it glowed brighter. This is because the chemical in the vial was able to completely mix with the chemical outside of the vial. And though the chemicals mixed and produced light, you should have noticed that the stick did not feel warm.

That is what happens in a bioluminescent organism when luciferin and luciferase combine. They produce a chemical reaction that releases light without releasing much heat.

When you placed the light stick in the cold water, you should have seen that it did not glow as brightly. Yet when you placed it in the hot water, it glowed brilliantly. Heat actually speeds up chemical reactions, so by warming up the stick, you were causing the chemicals to react together at a faster rate, producing more light.

If you think about, organisms in the dark ocean do not need to produce a lot of light because they are in a dark environment. Therefore this cool, slow, low-light reaction is perfect for deep sea creatures.
In the movie, *Dolphin Tale*, the main focus of the story is the amazing situation of a young dolphin named Winter. She has an injury that causes her to lose her tail fins, or flukes. The marine biologists that work with her have to know a lot about dolphins to make sure they can properly care for Winter while she is healing. In this lesson, we will take a closer look at some of the fascinating features of dolphins.

*Winter comes to the surface to breathe*
Dolphins are members of a group of animals called **mammals**. This means that they are warm-blooded animals with a backbone, give birth to live young (most of them), nourish their young with milk, and have hair or fur on their skin.

There are over 40 different types of dolphins. Most live in oceans, but some actually live in freshwater rivers. One of the most common types of dolphin is the Atlantic bottlenosed dolphin, like Winter. They can grow to be 2.8 meters or 9 feet in length. The largest dolphin is the **orca**, more commonly called the killer whale. They can grow to 6.1 meters or 20 feet in length!

Dolphins are fast swimmers, swimming up to 20 miles per hour, depending on the situation. They usually search for their food near the water’s surface, but can dive very deep if necessary. Some have been recorded to dive as deep as 850 feet below the surface. They cannot stay at that depth for long, though, because they have to return to the surface to breathe. Dolphins will usually come to the surface every five to fifteen minutes to exhale and take another breath.

Dolphins are social creatures, living in groups, called **pods**, and working together for activities such as getting food or raising their young **calves**. To work together, they have to be able to communicate, and they effectively do this with signature **whistles** and body movements. In fact, dolphins have distinct “voices” that seem to be recognizable by other dolphins.

In the wild, dolphins live to be about 40 years of age, though most live about 20 years.

When dolphins eat, they don’t chew their food. They have to swallow it whole. That is because dolphins’ teeth are designed for grasping, not chewing. When you chew your food, you take a bite, then move the food to the back of your mouth to grind it into smaller pieces with your flat-topped molars. Dolphins do not have molars; their teeth are all the same cone-like shape. They swallow fish whole and head first so that the scales and fins of the fish do not catch the throat.

Dolphins only grow one set of teeth in their lifetime. Interestingly, we can tell a dolphin’s age by counting the **growth rings** lying within its tooth.

*In the film, Sawyer tries to feed Winter a bottle of food*

Each ring represents a year of life. But because dolphins have one set of permanent teeth, pulling out a tooth to determine their age is not a good idea, since they cannot grow a new one.

Calves drink their mother’s milk up to 6 months of age. When Winter was brought to the aquarium, she still had to be fed from a bottle until she was old enough to eat whole fish.
MAKE A MINIBOOK

WHAT YOU NEED

A copy of the minibook pages at the end of this lesson
Crayons or colored pencils
Scissors
Stapler

Print out the minibook pages at the end of the lesson using one piece of paper, printed on both sides. You want to print it out so that Page 2 is directly behind Page 3.

Using the information written above, fill out the blank spaces on the minibook pages. Color the pictures and then cut the pages in groups of two so that pages 7 and 8 are attached, pages 5 and 10 are attached, pages 1 and 14 are attached, and pages 3 and 12 are attached. Line up the pages so the page numbers are in the correct order. Then staple your book on the center fold, pages 7 and 8.

ECHO...ECHO...ECHO – ECHOLOCATION!

One of the most interesting things about dolphins is their ability to echolocate. This means that they send out sound waves and can hear the returning echoes. But this is a much more involved process than how people hear echoes. Dolphins can tell an object's location, its size, and even from what material it is made. All from an echo.

It turns out all dolphins and toothed whales use echolocation to “see” around them. This sense is even more important than vision. And if you think about it, it makes a lot of sense. The deeper they dive in the water, the less light there is. In fact, just a few hundred feet below the surface all light levels disappear. But that doesn’t stop dolphins from seeing what is around them.

Dolphins produce high pitched clicks. When these clicks hit an object, they bounce back to the dolphin. The sound of the returning echo along with the length of time it took for the echo to come back gives the dolphin clues as to the distance and the composition of the object in front of it. Some sound actually can penetrate an object and reflect off the structures inside. For example, if the object is a shark, some of the sound will bounce off the shark’s outside skin, some will reflect off the shark’s skeleton and internal organs, and even some off of the skin on the other side. This means that just one click gives dolphins information about the size and structure of the shark. They may even be able to tell if it is injured!

Even more amazing, dolphins send out a rapid series of clicks at a time, sometimes hundreds or thousands in one second. The information from the echoes of these clicks tells the dolphin all about what is around it. And remember, since dolphins usually travel in groups, or pods, they have to figure out which returning echoes are their own. Indeed, they hear so well that they can identify their own echoes among the thousands from other dolphins. They can also weed out all of the other sounds traveling through the water. Let’s explore more about dolphin echolocation in the activities below.
WHAT’S THAT SOUND?

WHAT YOU NEED:

A wood cutting board (or plank of wood)
A plastic cutting board
A metal sauce pan
A large metal spoon
A bandana or piece of cloth for a blindfold
Someone to help you

ACTIVITY

Hold the spoon and wood cutting board in each hand. Gently hit the spoon against the wood cutting board. Now in the same way, hit the spoon against the plastic cutting board and then the metal sauce pan. Pay attention to the sound each one makes. Now put on the blindfold and ask a helper to hit the spoon against one of the three items. See if you can tell which one was chosen. Write what you learned in your notebook.

Now move to an open area where there is no furniture to get in the way. Put the blindfold back on and ask your helper to begin hitting the saucepan with the spoon in a rhythmic beat. Ask your helper to begin to slowly move around while hitting the saucepan. See if you can follow the sound. Write a sentence or two in your notebook describing how it felt to follow the sound without being able to see.

DIVE DEEPER

In the activity, you had the opportunity to feel what it is like to use your ears to “see” what is around you. In the movie, this is what Winter did in when she was moved to the aquarium after she was injured. The echoes she received helped her to figure out what things were around her. With the blindfold on, you were able to tell the material of an object by its sound. Hopefully, you could tell the difference between the sounds of wood, plastic and metal. Dolphins use the echoes that come from an object to help identify what it is. They can hear the difference between a hard coral reef, a school of fish, or other dolphins in the area.

In the second part of the activity, you hopefully were able to follow a sound using just your ears. Did you find it easy? Were you tempted to take off your blindfold to take a peek? Even though dolphins can see under water, they cannot see very well because light does not penetrate the water very far. So they use echolocation to tell where their prey is and “follow the sounds” so they can catch a meal!
WHAT’S THAT SHAPE?

WHAT YOU NEED

- A wood cutting board (or rectangular piece of plywood)
- Newspaper
- Scissors
- Large metal spoon
- Cellophane tape
- Someone to help you

Stack six layers of newspaper. Cut out a 4-inch by 4-inch square. If needed, use a few small pieces of tape just to hold the layers together. Now cut out a triangle and diamond so they are about 4 inches in height (see photo below). Tape edges if needed.

Line the shapes vertically on the board. Have your helper tap the back of the spoon against the wood a few times. Note the sound it makes. Now have your helper tap the newspaper shapes with the back of the spoon. Notice how the sound is different.

While you face away from the board, ask your helper to choose one shape and begin tapping the back of the spoon over the shape, moving in a left-to-right direction. Then move about ¾-inch down and tap along the board from right to left. The helper should follow the tapping pattern in the image below, making sure they use the same number of hits each horizontal pass.

Once they have moved all the way over the length of the shape, see if you can guess which shape was chosen based on the sounds you heard. Now have the helper choose a different shape and tap the pattern over it. See if you can guess which shape was chosen.
DIVE DEEPER

You just echolocated like a dolphin! When a dolphin sends out sounds toward an object, it aims the out-going clicks in a path similar to what you did, scanning all the parts of the object. By listening to the incoming echoes, dolphins (and you) are then able to tell the shape of the object. That is because the echoes sound differently when they bounce off different material (like wood and newspaper). Of course, dolphins like Winter are able to rapidly send out their own sounds. They can also hear echoes from distances much farther than humans can. Additionally, can you imagine trying to identify a shape while 10 other students are doing the same activity in the room with you, plus having the radio and television playing at the same time? That is more like the situation dolphins experience!

In your notebook, write a summary of this activity. For further study, research the organs that a dolphin requires to echolocate. Make a sketch of them and label the parts.

IT’S COLD DOWN HERE

Dolphins are in a class of animals called mammals. One characteristic of mammals is that they are warm-blooded. This does not mean that their blood is always warmer than cold-blooded animals. In fact, on really hot days, some cold-blooded animals, such as snakes and lizards, will have warmer blood than mammals. The term “warm-blooded” means that animals are able to maintain a constant internal body temperature. Scientists call them homeothermic. A dolphin’s internal body temperature is kept at a constant 98 degrees Fahrenheit. It means that when the surrounding water is colder than 98 degrees (and it almost always is), dolphins have to generate more heat to keep their body at that temperature.

One of the benefits of being homeothermic is that dolphins can be very active in cool water while cold-blooded fish cannot. This is because of their muscles. Muscle activity depends on chemical reactions in the body, and chemical reactions run much slower when it is cold. When it is hot, they run more quickly, so warm-blooded creatures can move quickly whether the water is warm or cold. Fish tend to slow down in colder water, so many cannot survive well in cooler oceans. Therefore, being homeothermic allows marine mammals to live in more areas of the ocean.

To help keep warm, dolphins have a thick layer of fat called blubber located just under their skin. It helps to hold heat inside their bodies. Yet unlike land mammals, dolphins are really never in an environment where they have to cool themselves down. So they do not have any sweat glands.

Humans, like dolphins, are also homeothermic, maintaining a constant body temperature of 98.6 degrees Fahrenheit. When humans swim in water, much of their internal heat leaves the body. Because they do not have blubber to help them stay warm, people wear wetsuits to help hold in the heat. You may notice in the movie that Sawyer wore a wetsuit when he swam with Winter. This was so he could stay warmer for a longer time.

A wetsuit is made of a spongy material called neoprene that has very tiny pockets of air in a layer of soft rubber. It is actually similar material to the mousepad you use at a computer. When a person wearing a wetsuit gets in the water, a thin layer of water seeps in between the skin and the suit. This water gets warmed by the person’s body heat and helps them to stay warm.

Try the activity below to feel how a wetsuit helps a diver in the ocean.
A MINI WETSUIT

WHAT YOU NEED

Two old mouse pads (the kind that are made of the spongy neoprene material, sandwiched between fabric)
Duct tape
A large bowl
Cold water
Ice
Stopwatch (and a helper) or clock with a second hand

Take the two mouse pads and hold them together, matching up the sides. Using the duct tape, seal three of the sides together. You want the seal to be a good one, so you may want to use extra tape and wrap it all the way around the pads a few times. You have now created a mousepad "mitten."

Fill the bowl with cold water and ice. You want more water than ice so you can put both hands in the bowl.

Now put one of your hands in the mousepad mitten. At the same time, plunge both of your hands (the one without the mitten and the one with the mitten) into the water. Try not to allow water to seep over the top of the mitten. Have a helper start the stopwatch or keep an eye on the second hand of the clock. See how long you can keep your hands in the water. Note the time you kept each hand in the water and write it in your notebook. Figure out how much longer you kept the mitten hand in the water and write it in the notebook, too. You can also, take a photo of this activity for your notebook.

DIVE DEEPER

You should have noticed that your hand with the neoprene mitten was able to endure the cold water much longer than the hand without. That is because the neoprene acted as an insulator. An insulator is a material that does not easily let heat pass through it. So the neoprene did not allow the heat from your hand to move into the water.

Dolphins do not have to wear a wetsuit because their blubber behaves as an insulator.
“IT’S COLD” VOCABULARY

COPYWORK:
Write out the vocabulary words from this section into your notebook. Use your best handwriting.

<table>
<thead>
<tr>
<th>INSULATOR</th>
<th>WETSUIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEOPRENE</td>
<td>HOMEOTHERMIC</td>
</tr>
<tr>
<td>WARMBLOODED</td>
<td>BLUBBER</td>
</tr>
</tbody>
</table>

WORD SCRAMBLE:
Unscramble the vocabulary words from this section below. See if you can write the definitions once you unscramble them.

<p>| AMLOEDDOBRW |
| JETMHOERHMCO |
| LBUREBB |
| EIWTTUS |
| EEPROMNER |
| RUNSILOAT |</p>
<table>
<thead>
<tr>
<th>A group of dolphins is called a</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>This book is completed by</td>
<td>15</td>
</tr>
<tr>
<td>Dolphins do not chew their food. They swallow it whole.</td>
<td>5</td>
</tr>
<tr>
<td>All About Winter</td>
<td></td>
</tr>
<tr>
<td>Dolphins send out to communicate with each other.</td>
<td>4</td>
</tr>
<tr>
<td>There are about different types of dolphin.</td>
<td>13</td>
</tr>
<tr>
<td>We can tell a dolphin's age by counting the of its tooth.</td>
<td>11</td>
</tr>
<tr>
<td>As a young dolphin, Winter became caught in a crab trap and injured her tail. The fins of a dolphin's tail are called</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
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</tr>
<tr>
<td>14</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

When Winter was first brought to the aquarium, she was given food from a bottle.
LESSON FOUR

DOLPHINS AND PEOPLE

When Winter was found in the ocean, she had to be taken to an aquarium so she could get care. But how do you keep an ocean animal in captivity? You first have to make sure you have a large enough space for the dolphin to swim, and it has to be deep enough for the dolphin to dive. Even the water has to have special chemicals so it will not harm the dolphin’s skin.

In the wild, dolphins spend much of their time looking for food. Because they do not have to hunt in captivity, they need to redirect that energy to another activity. Training is one of the best ways to keep them busy and continually learning.

One of the benefits of training dolphins is the opportunity we have to learn from them. The more we interact with them, the more we know about their needs in the wild and how we can preserve it. And sometimes, as in the case of Winter’s tail, people benefit from what we learn about dolphins.

In this lesson, we will take a closer look at how people interact with dolphins.

Winter is being well cared-for in a special aquarium
The first thing that dolphins need in captivity is a tank for swimming. Usually tanks are circular, shaped like a figure-eight, or have rounded edges so the dolphins can swim longer distances without having to stop and turn.

Another important feature of dolphin tanks is the water. Because dolphins are marine animals, they survive best in salt water. The amount of salts in the water is its salinity. Dolphin pools are often filled with sea water pumped from the ocean or fresh water that has been mixed with the correct amounts of salts and other minerals. Of course, the water has to be kept clean, so just like a backyard swimming pool, dolphin pools have water treatment plants to filter and clean the water.

Naturally, dolphins in captivity have to be fed. And their diet consists mainly of fish. As a rule, dolphins receive freshly frozen fish that, once thawed, are enriched with vitamin supplements. This is so they receive all of the nutrients they would be getting in the wild. And they eat a lot. Depending on the types of fish, they can eat up to 20 pounds of food each day!
Color the picture of the dolphin in the aquarium.
When dolphins are kept in an aquarium environment, marine biologists have to be careful to make that environment as similar to the conditions in the ocean as possible. This is because dolphins were designed to live in the ocean. Though some species of dolphin can actually live in fresh water, most dolphins need salt water to best survive. One of the reasons for this is buoyancy. When water has salts and other chemicals dissolved in it, objects can float more easily. Explore this by doing the following activity.

WHAT YOU NEED:

- Two clear drinking glasses
- Warm water
- A measuring cup
- A tablespoon
- A spoon
- Salt
- Two grapes

Carefully measure one cup of very warm water into each of the two drinking cups. Into one of the cups add two tablespoons of salt. Stir until you can get as much of the salt to dissolve as possible. (There may be some salt that does not dissolve, but that is fine; just try to get as much dissolved as you can.) Add one grape to each of the glasses. What happens?

DIVE DEEPER

When you added the grapes, you should have seen that the grape in the fresh water glass sunk to the bottom. The grape in the salt water glass should have floated. This is because salt water has materials dissolved in it which help “hold up” objects.

When ocean dolphins swim in fresh water, they have to work harder to stay afloat, since their bodies are suited to salt water and are used to the extra buoyancy it provides. This is why it is helpful for aquaria to keep their tanks filled with salt water.
DOLPHIN TRAINING

When Winter was taken to the Clearwater Aquarium, she first began interacting with people. These interactions were needed to help her heal. But almost immediately, trainers began to work with her. Training is an important tool in the husbandry of dolphins. Animal husbandry has to do with the care of animals in captivity.

By training and working with Winter, trainers are able to daily evaluate how she is doing. They can notice any behavioral changes and get a better idea of how she is feeling. Additionally, it is helpful to train dolphins so they can cooperate with veterinarians during medical tests. They can be trained to hold themselves still at the surface during the examinations. Winter was trained to present her peduncle, or the lower part of her body, so that she could be fitted with a prosthetic tail fluke.

Training also keeps dolphins occupied and engaged in what is around them. They need to be entertained and mentally stimulated to remain healthy. Training channels their energy by helping them focus on activities each day. They have an amazing eagerness and ability to learn new things and solve problems.

A trainer works with a dolphin to cause it to perform a desired movement, or behavior. A dolphin behavior is how the animal acts under specific conditions. Dolphin training involves using positive reinforcement. This means that if the dolphin performs a desired behavior correctly, it is reinforced, or rewarded.

Often the reward is a fish or a toy. But the reward has to be given right at the moment the dolphin is doing what you are looking for. That would not be possible if you want to deliver the reward while the dolphin is under water doing a spin. Instead, most trainers use token reward called a bridge. Many trainers use a whistle as a bridge. While training the dolphin, the bridge, or whistle, is blown at the same time a dolphin gets a fish. This way, the dolphin associates the whistle with the fish – something good. Eventually the whistle can be used as a reward, because the dolphin knows a reward is coming when it hears the whistle blows.

Dolphins love to play and constantly want to explore. So most dolphin aquaria have lots of pool toys around.

DOLPHIN “TRAIL”

In the maze on the next page, help Winter find her way around the pool toys to find the fish.
BE A “DOLPHIN” TRAINER

One of the challenges of training a dolphin is to get the dolphin to do a specific movement you would like. For example, if a dolphin presents its tail when a trainer prompts it, that was the result of hours and hours of training. Sticking their tails out of the water is a natural behavior, but how does the dolphin know that is what the trainer wants?

There are many ways to teach a dolphin a new behavior. One way is by **scanning**. Trainers watch the dolphin closely and reward it when it does something close to what they are looking for. By blowing the whistle, the dolphin will likely do the same movement again.

Another training method is called **shaping**. This means taking a certain movement and working towards a desired behavior in small steps. A good example of this is to first train a dolphin to follow a target, such as a ball on the end of a stick. The target can then be used as a guide for the dolphin to follow.

**WHAT YOU NEED:**

- A whistle
- Someone to help you

It is very frustrating sometimes for a dolphin to understand what a trainer wants it to do. After all they cannot communicate with each other. To get an idea of how a trainer works, have a helper volunteer to be your “dolphin,” and try to train your helper to do a behavior.

Choose one of the following behaviors (jump, sit or spin) without your helper knowing. Now, with the whistle in your mouth, stand near your helper and tell him or her to just start moving around. They will not know what you are looking for, so they will just need to start moving. When you see them begin to make a movement that is close to your chosen behavior, blow the whistle. Try not to talk at all (though you might be tempted). Your helper should then try to do something similar to what they did when you blew the whistle and, hopefully, will eventually do the chosen behavior correctly.

**DIVE DEEPER**

In the above activity, you can begin to understand the challenges of training a dolphin. You used the whistle as a reward and had to use scanning until your “dolphin” did a similar movement to the desired behavior. You then used shaping to get your dolphin to finally make the correct changes to complete the behavior. Go ahead and give them a fish!
A MAN-MADE TAIL

When Winter was found, she had terrible injuries to her tail flukes. They eventually fell off, leaving her without a means of swimming. But, amazingly, she figured out a way to swim by moving her peduncle from side-to-side, like a fish. This is not a natural movement for dolphins. Their backbones and muscle structure are designed to move from back-to-front. Though she could swim side-to-side, she began to develop problems with her back. By using a prosthesis, a device that substitutes for her missing tail, she eventually was trained to swim properly.
MAKE A DOLPHIN “TAIL”

WHAT YOU NEED:

<table>
<thead>
<tr>
<th>The images below</th>
<th>About 12” of string</th>
</tr>
</thead>
<tbody>
<tr>
<td>White cardstock</td>
<td>Stapler</td>
</tr>
<tr>
<td>Scissors</td>
<td>Hole punch</td>
</tr>
<tr>
<td>Metal paper fasteners (the kind that have two prongs that split apart)</td>
<td></td>
</tr>
</tbody>
</table>

Print out the following page onto the cardstock. Cut out the pieces. Use the hole punch to punch out a hole where the dots are. Cut along the slit on the tail piece and at the end of the peduncle. Assemble the pieces together using paper fasteners, attaching #1 to #2, #2 to #3, and so on. Finally, slide the tail piece onto the end of the peduncle. Staple a string to the top of the tail at the “x.” You just created a model of a dolphin’s tail.

Now, holding the string, blow on the tail to see how it catches the wind. This is why a dolphin needs its tail flukes to swim. They provide resistance in the water so the dolphin can propel itself forward. Take the tail flukes off of your model and blow like before. Can you see how important the tail flukes are?
Find the vocabulary words from this lesson in the word find below.

SALINITY
WATER TREATMENT
HUSBANDRY
PEDUNCLE
BEHAVIOR

BRIDGE
SCANNING
SHAPING
PROSTHESIS
The field of biomedical engineering uses engineering technology to help solve medical problems. Biomedical engineers try to understand living systems and develop new devices or techniques to help improve the health of medical patients. One area of this field involves the development of artificial prostheses. People have greatly benefited from the use of prosthetic devices to replace lost limbs.

One of the challenges with Winter’s prosthetic tail was the need to help it adhere to her skin without irritating it. A dolphin’s skin is very delicate and can be easily injured by rough surfaces, just like human skin. You may have felt this if you put on a new pair of shoes that did not fit you correctly. After a while, your skin would become irritated and injured.

Another difficulty for Winter was coming up with a material that would cushion her tail and yet stick to skin that was much like a wet water balloon. In developing just the right material, scientists came up with “Winter’s Gel,” a material that is strong and flexible yet adheres to her skin and is very spongy. Now people benefit from using Winter’s Gel in the use of their prosthetics.

For this activity, research the types of prosthetic devices and how they benefit people.

Dr. McCarthy holds one of the prosthetic devices for Winter
LESSON FIVE

THIS INFORMATION IS CLASSIFIED

As scientists learn more about the creatures living on our planet, it is helpful to group them together into groups based on their similar body parts and ways they live. As we think about dolphins, it might be confusing to think about what group of animals they are most like. They swim like fish yet breathe air like horses. In this lesson we will take a closer look at dolphins’ bodies and how they live.

DOLPHIN ANATOMY

One of the ways scientists group animals together is by looking at their body design. The more we know about their bodies, the better information we have to group them with other animals that have similar structures. The science of studying the shape and structures of animals or plants is called anatomy. Because dolphins are swimming creatures, let’s take a look at a dolphin’s anatomy compared to the anatomy of a fish.

The body of a dolphin is torpedo-shaped so that it can move through the water with ease. About halfway along its back is a dorsal fin which helps to keep the dolphin upright. Directly behind the head are two pectoral fins, or flippers, which help the dolphin to steer its way in the water. The dolphin’s “tail” is made up of flukes which help to propel it forward. The flukes are powered by very large muscles in the dolphin’s peduncle, the stalk of its tail. Notice the orientation of the dolphin’s tail flukes in relation to its body. They are positioned horizontally, or side-to-side. As the dolphin moves its powerful tail muscles in an up-and-down motion, the flukes provide resistance in the water to help the dolphin “push” itself forward.

A dolphin’s forehead is called its melon, and it contains thick, fatty tissue to help the dolphin echolocate. Its upper and lower jaws extend forward from the melon and are called the rostrum. In Atlantic bottlenose dolphins, the rostrum extends many inches from the melon. Because dolphins cannot chew their food, they will use their rostrums to break up large pieces to be swallowed whole. Many people refer to the rostrum as the dolphin’s “nose,” which is interesting because their nose is nowhere near the rostrum. A dolphin breathes through an opening in its head called a blowhole. This perfect placement lets a dolphin barely stick its head out of the water in order to take a breath. If its nose was in its rostrum, its entire head would need to come through the water’s surface to breathe. This would require a lot of extra energy.

A dolphin’s color ranges from dark to very light gray for most species. They are usually much darker on their back, or dorsal, side, and are lighter on their stomach, or ventral, side. This is a type of camouflage called countershading, and it helps a dolphin to hide from predators and sneak up on its prey. When viewed from above, a dolphin’s darker color blends in with the darker ocean depths. When viewed from below, a dolphin’s lighter color blends with the sunlit shallow water.
Label the parts of the dolphin with the vocabulary words below.

Vocabulary words:
Dorsal fin  Rostrum  Peduncle
Pectoral fins  Blowhole  Melon
Flukes
Print this page onto cardstock. Color the dolphin. If you would like to make it more realistic, use countershading, coloring the top of the dolphin darker than the bottom of the dolphin. Cut out the mask and the eyeholes. Punch a hole on each side at the dots. Tie a one-foot piece of string to each side of the mask. Put the mask on by tying the strings together.
“Come on, fish!” That is what Dr. Ken McCarthy says with a wink and a smile as he encourages Winter to accept her new prosthetic tail. Yet, as a doctor, he knows that she is not a fish, though he keeps warmly referring to her as one.

Many people commonly mistake dolphins as fish. After all, both creatures swim in the ocean and have fins. Yet there are many differences between dolphins and fish. In the anatomy lesson above, you learned that dolphins move their tails in an up-and-down motion in order to swim. Fish swim with a side-to-side movement. Dolphins have a blowhole through which they breathe air with lungs, but fish use gills to breathe. They remove the oxygen gas that is dissolved in the water. Like dolphins, most fish swallow their food whole and use their fins for steering and propulsion.

Dolphins use echolocation to communicate and find food. Fish have limited communication and cannot echolocate. Dolphins have a constant body temperature, regardless of the surrounding water temperature. Their thick layer of blubber helps maintain that temperature. This is called endothermic. Fish cannot control their body temperature, so their bodies fluctuate as the water temperature does. This is called ectothermic.

When reproducing, dolphins give birth to live young, while most fish lay eggs. Though some fish species give birth to live young (like sharks), they lay eggs internally and the young hatch inside their mother’s body. Dolphins feed their calves milk for the first year and care for and protect them. Most fish do not provide parental care for their young.

Using the information above, see if you can sort the differences and similarities between dolphin and fish in the diagram on the next page.
EVERYTHING IN ITS PLACE

Even though dolphins spend their entire lives swimming in the water, they are classified into a group of animals called mammals. The most common criteria for mammals are:

• Have hair or fur
• Give birth to live young
• Nourish young with milk
• Are warm blooded
• Possess large, complex brains as compared to their body size

Some mammals don’t exactly fit all of these criteria. For example, the platypus in Australia lays eggs, yet it is considered a mammal. Also, bats are considered mammals, though they can fly. You might be surprised to know that dolphins meet all of the above points, including having hair. Though there is not enough to comb or brush, dolphins have small hair follicles near their blowhole! Technically then, because their blowhole is where they get air, dolphins have mustaches on their heads!
A scientist who studies living things is called a **biologist**. As biologists learn about creatures, they sort the ones with similar features into groups. This is called **classification**. People classify items into groups every day. If you look in your kitchen, you will find that many items are sorted, or classified, into groups. Utensils, such as forks, knives and spoons are often kept together in the same drawer. Glasses and mugs are usually in the same cupboard. Why? Because they are similar in shape, size, and purpose. For example, you use glasses and mugs to hold fluids you drink. When we sort animals into groups like this, we are better able to understand them.

Below, color and cut out the images of toys and glue them onto the next page which divides them into three groups, or **classes**.
Sorting the objects was hopefully not too difficult, but lots of fun. But what about this item??

<table>
<thead>
<tr>
<th>TOYS WITH WHEELS</th>
<th>TOYS THAT NEED MORE THAN ONE PERSON</th>
<th>TOYS THAT MAKE NOISE</th>
</tr>
</thead>
</table>

In which class does it belong? It has wheels, it needs more than one person to be used, and it has a horn to make noise. Actually, it could belong to any of the three classes. These are issues scientists often face when they sort animals into classes. Sometimes an animal has characteristics that are similar to all the others, or it is so different that it needs its own category.
For centuries, scientists have been trying to sort living things into categories. Scientific classification of organisms, or taxonomy, is a branch of biology that involves looking at the internal and external anatomies of creatures and placing them in groups. Beginning with broad criteria, each group is subdivided into smaller groups based on continually specific details. Though scientists change classification categories from time to time, the major named categories of classification are: Kingdom, Phylum, Class, Order, Family, Genus and Species, with Kingdom being the broadest grouping and Species being the most specific. Research the name of the following classification levels for an Atlantic Bottlenose Dolphin like Winter.

**KINGDOM:**

**PHYLUM:**

**CLASS:**

**ORDER:**

**FAMILY:**

**GENUS:**

**SPECIES:**
WHAT DID YOU LEARN?

1. Explain in your own words why you think it is helpful for a dolphin to be torpedo-shaped in order to move through the water.

2. Where is a dolphin's “nose?”

3. What is countershading?

4. How do dolphins and fish swim differently?

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LESSON ONE: ANSWER KEY

BUOYANCY WORKSHEET CREATURE PLACEMENT

DOLPHIN
PLANKTON
JELLYFISH

JACK

BUTTERFLYFISH

FLOUNDER
CRAB
Match the vocabulary word with its definition:

**BUOYANCY**
- Small plants and animals that cannot swim against ocean currents

**DENSITY**
- A sample of water in the ocean, beginning at the surface and extending to the bottom sediments

**NEUTRAL BUOYANCY**
- Staying in one place in the water column, neither sinking nor floating

**SWIM BLADDER**
- The ability to float or sink in a fluid because of relative density

**BLUBBER**
- An internal, gas filled organ in fish which helps them to control their buoyancy

**PLANKTON**
- A feature of plankton which helps them stay afloat in the water column

**OIL DROPLETS**
- A layer of fat in dolphins which helps them to stay afloat in the water

**WATER COLUMN**
- Refers to the closeness of an object’s atoms and/or molecules
OTHER CREATURES IN THE WATER COLUMN

PORTUGUESE MAN-O-WAR – Physical features (a Float)
HERMIT CRAB – Habitat (intertidal zone)
KELP – Photosynthesis
SWORDFISH – Prey
BIG EYE TUNA – Prey
GOBLIN SHARK – Habitat
GULPER EEL – Habitat (deep ocean)

Note: The placement of some of these creatures may be switched and still be correct. For example, the swordfish and the big eye tuna often swim at the same depth. Very little is known about the goblin shark; some studies conclude that it is a mid-water shark and others consider it a bottom-dwelling shark. Because there are no physical barriers separating the levels of the water column, it is more important to place creatures in the correct general area, understanding that each creature has a wide zone in which it lives.
1. Name one ocean creature that spends its time at the bottom of the ocean. Why do you think it lives there?
   Some good examples are crab, flounder, shrimp, coral, and lobster. They live there because of their body design (non-swimmers or flattened shape) and the food they eat.

2. Name one ocean creature that spends its time at the top of the ocean. Why do you think it lives there?
   Some good examples are jellyfish, dolphins, and seaweeds such as kelp. Some live there to make energy from the sun, others to breathe air and find their prey.

3. Why is it important for creatures in the ocean to have body parts which keep them from sinking in the water?
   These features help them to stay in one part of the water column so they can better survive.

4. What do dolphins have in their bodies to help them stay afloat in the water?
   Blubber.

5. What is the special word we use that means “the ability to float?”
   Buoyancy.

1. What would happen if an organism designed to live on the deep ocean floor was brought to the surface of the ocean to live?
   It would likely not be able to survive due to the drastic changes in water pressure and light. It also would have a harder time finding its prey.

2. A small ball of steel will sink if it is dropped into water. Yet large ocean liners and aircraft carriers are made of millions of pounds of steel. Why don’t they sink? (Hint: check the information in Part 1)
   They don’t sink because the amount and density of the water that is pushed away is greater than the density of the ships. The shape of the steel is just as important as its density.

3. Now that you have learned about buoyancy and density, do you think it would be important for the designers of Winter’s prosthetic tail to consider these concepts in its design? Why?
   Absolutely! Not only do they have to consider the accurate shape of the tail so it is comfortable and will help Winter swim, it has to be nearly neutrally buoyant, so it will not try to sink or float while Winter is wearing it.
LESSON TWO: ANSWER KEY

NEMATOCYST DIAGRAM

- Prey's skin
- Cnidocil
- Operculum
- Thread
- Barbs
- Capsule
- Nematocyst
- Cell
LESSON THREE: ANSWER KEY

MAKE A MINIBOOK

Answers for the blanks in the book:

Page 2 – Flukes
Page 3 – Mammals
Page 4 – 40
Page 6 – Pod
Page 7 – Calves
Page 8 – Cone-shaped tooth should be circled
Page 11 – Growth rings
Page 12 – Bottle
Page 13 – Whistles

“IT’S COLD” VOCABULARY

WORD SCRAMBLE:

Unscramble the vocabulary words from this section below. See if you can write the definitions once you unscramble them.

**AMLOEDDOBRW**
Warm blooded – refers to animals who are able to maintain a constant body temperature

**IETMHOERHMCO**
Homeothermic – the scientific term for warm-blooded animals

**LBUREBB**
Blubber – a thick layer of fat to hold heat inside a dolphin’s body

**EIWTTUS**
Wetsuit – a suit made of neoprene to help divers stay warm in the water

**EEPONNER**
Neoprene – spongy material made of soft rubber

**RUNSILOAT**
Insulator - material that does not easily let heat pass through it
Find the vocabulary words from this lesson in the word find below.
LESSON FIVE: ANSWER KEY

DOLPHIN ANATOMY

DORSAL SIDE
- Dorsal fin
- Blowhole
- Melon
- Rostrum
- Pectoral fins
- Peduncle
- Flukes

VENTRAL SIDE

DOLPHIN VS. FISH

<table>
<thead>
<tr>
<th>Dolphins</th>
<th>Fish</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tail moves up/down</td>
<td>Tail moves side/side</td>
<td>Tail moves side/side</td>
</tr>
<tr>
<td>Lungs</td>
<td>No echolocation</td>
<td>No echolocation</td>
</tr>
<tr>
<td>Echolocation</td>
<td>Limited communication</td>
<td>Limited communication</td>
</tr>
<tr>
<td>Communicate</td>
<td>Ectothermic</td>
<td>Ectothermic</td>
</tr>
<tr>
<td>Endothermic</td>
<td>Most lay eggs</td>
<td>Most lay eggs</td>
</tr>
<tr>
<td>Live Young</td>
<td>Little parental care</td>
<td>Little parental care</td>
</tr>
<tr>
<td>Female provides milk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOYS WITH WHEELS</td>
<td>TOYS THAT NEED MORE THAN ONE PERSON</td>
<td>TOYS THAT MAKE NOISE</td>
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| ![Bicycle](image)  
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  ![Table Tennis](image)  
  ![Table](image) | ![Drum](image)  
  ![Maracas](image)  
  ![Trumpet](image) |
SCIENTIFIC CLASSIFICATION

Kingdom: Animalia  
Phylum: Chordata  
Class: Mammalia  
Order: Cetacea  
Family: Delphinidae  
Genus: Tursiops  
Species: truncatus  

NOTE: The genus and species names are customarily written in italics, and the species name is not capitalized.

WHAT DID YOU LEARN?

1. Explain in your own words why you think it is helpful for a dolphin to be torpedo-shaped in order to move through the water.
   A dolphin can move more easily through the water if it has less of its body “sticking out” to slow it down.

2. Where is a dolphin’s “nose”?
   A dolphin breathes through a blowhole on its head. It is not located on the front of its face like humans, so its “nose” is on top of its head.

3. What is countershading?
   Countershading refers to the coloring of a dolphin. They are darker colored on top of their bodies and lighter colored on bottom. This is so that when an animal looks at them from above, the dark color of their back blends in with the darker water below them. When an animal looks at them from below, the light color of their underside blends in with the lighter sunlit water above them.

4. How do dolphins and fish swim differently?
   Dolphins swim with their tails moving in an up and down motion. Their tail flukes are positioned horizontally so they can “paddle” in the water when their tail moves. Fish, on the other hand, swim with their tails moving in a side to side motion. Their tails are positioned vertically so they can “paddle” in the water when their tail moves.

5. Why is it sometimes hard to classify an animal into a group?
   Some animals have characteristics or body features that fit into more than one group. Other animals do not have body features that fit well into any groups.
WHAT DID YOU LEARN?

1. Explain how the keel of a boat is similar to a dolphin’s dorsal fin.
   A keel is a flat blade that sticks down into the water from a boat. Its main function is to keep the boat from being blown sideways. A dolphin’s dorsal fin helps it to stay upright while it swims, so both of these structures aid in stabilization.

2. Why can we technically say that a dolphin has a mustache on its head?
   Dolphins have small hairs in front of their blowholes. Since they breathe through their blowholes, that is the place where their “nose” is. And since there are hairs just below their nose, that could be called a mustache.

3. Discuss why countershading helps a dolphin camouflage itself.
   Because a dolphin is darker on its dorsal surface as compared to its ventral surface, it is counter-shaded. When an organism views it from above, its darker surface blends with the darker, deeper water below. When an organism views the dolphin from below, its lighter surface blends with the shallow, light-filled water.

4. What is the difference between endothermic and ectothermic organisms?
   Endothermic organisms have mechanisms to maintain a constant body temperature regardless of temperature of the surrounding environment. Ectothermic organisms cannot maintain a constant temperature, so their body temperatures will fluctuate with the surrounding environmental temperatures.

5. If you research classification of species, you will find that there are several ways to split up groups of organisms. Some scientists believe there should be five kingdoms (this is the traditional format). Today, some are suggesting a division of only three kingdoms, and still others suggest ten or more. Why do you think there is such difference of opinion?
   There are so many ways to organize organisms into groups because so many of them do not fit well into general criteria. There is always an exception to the rule. A good example of this is the duck-billed platypus which is warm blooded and has fur, yet lays eggs. Because there are so many ways to divide organisms into groups, there will often be differences of opinion.