



One in a Thousand: Those Amazing Sea Turtles

Contributing Authors:

Maia McGuire, PhD

Ruth Francis-Floyd, DVM, MS, DACZM

Mark Flint, BVSc, BSc (Hons), MAppSc, MPhil, PhD

Jaylene Flint, BSc, Grad Dip Ed

Words in **bold** throughout can be found in the glossary, and are suggested for use as Word Wall words while the book is being read.



This project was funded by a grant awarded from the Sea Turtle Grants Program. The Sea Turtle Grants Program is funded from proceeds from the sale of the Florida Sea Turtle License Plate. Learn more at www.helpingseaturtles.org.

This book and its accompanying lesson plans can be downloaded from <http://stjohns.ifas.ufl.edu/sea/seaturtlecurriculum.html>



Table of Contents

<u>Chapter 1: Sea Turtle Biology</u>	1
<u>Chapter 2: How Do Scientists Identify Turtles?</u>	7
Leatherback Sea Turtles.....	9
Loggerhead Sea Turtles.....	10
Green Sea Turtles.....	12
Hawksbill Sea Turtles.....	14
Kemp’s Ridley Sea Turtles	16
Olive Ridley Sea Turtles	17
Flatback Sea Turtles	18
<u>Chapter 3: Sea Turtle Evolution and Anatomy</u>	21
<u>Chapter 4: How Does the Environment Affect Sea Turtle Nests?</u>	26
<u>Chapter 5: Growing Up as a Sea Turtle</u>	30
<u>Chapter 6: How Do Human Activities Affect Sea Turtles?</u>	36
<u>Chapter 7: Natural Threats to Sea Turtles</u>	41
Climate Change.....	42
Sea level rise	44
Ocean acidification.....	45
Harmful Algal Blooms	47
<u>Chapter 8: How Do We Protect Sea Turtles?</u>	51
<u>Chapter 9: Turtle Tracking</u>	57
<u>Chapter 10: Helping Sick or Injured Sea Turtles</u>	61
How we can tell if a sea turtle is sick	62
Common reasons that turtles need to be rescued.....	63
What happens when a hurt, sick or stranded sea turtle is found?	68
Releasing sea turtles.....	70
What we can do	72
<u>Glossary</u>	74
<u>Image Credits</u>	83



This page intentionally left blank



Sea Turtle Biology

All turtles are **reptiles**. They have scales, breathe air and lay eggs on land. Reptiles do not have hair!

There are about 180 freshwater turtle **species**, 62 types of land turtles (tortoises) and 7 kinds of sea turtles.

Turtles are sometimes grouped based on where they live. In different parts of the world, these groups can be given different names. In the U.S., **sea turtles** live and swim in the ocean.

Terrapins spend time on land and in water. They live in **brackish** water, often in swampy areas. **Tortoises** live on land. They have stubby feet and are not good swimmers. They are not **streamlined**. Instead they have high domed shells. Most terrapins, freshwater turtles and tortoises can pull their heads and feet into their shells. They do this when they feel threatened.



Florida red-bellied cooter, a freshwater turtle.



Diamondback terrapin



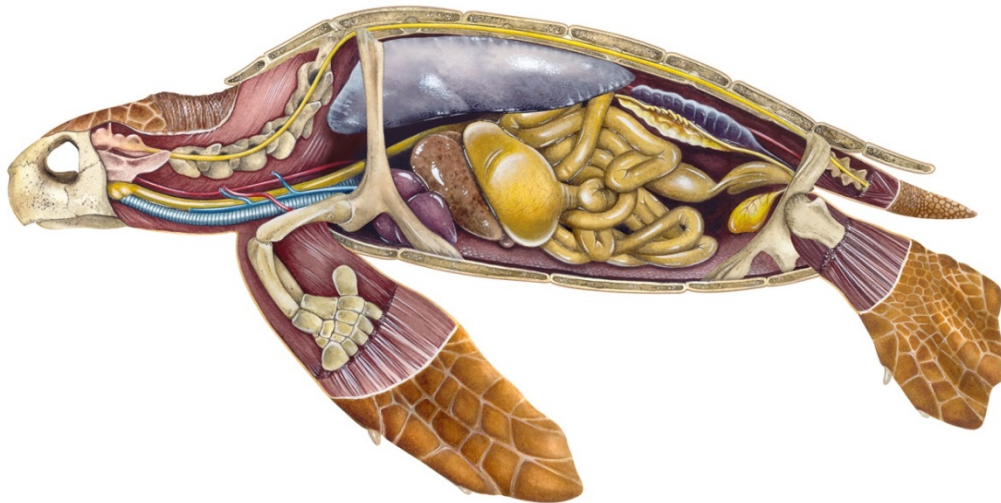
Gopher tortoise with head and feet tucked into its shell.



Galapagos tortoise



Sea turtles are **adapted** for swimming. They have a streamlined body and long, paddle like flippers. The most obvious part of a turtle body is their shell. The shell protects the soft inner body parts (muscles and organs). The shell is made up of two parts. The top shell, which covers the back of the turtle, is called the **carapace**. The bottom shell is called the **plastron**. Unlike other types of turtles, sea turtles cannot pull their heads, **flippers** or tails into their shells.



Sea turtle flippers are paddle-like. There are two large front flippers and two smaller rear ones. Sea turtles use their front flippers for **propulsion** (swimming). Their rear flippers are used as **rudders** (for steering). Some other adaptations include **camouflage**, which helps sea turtles hide. Sea turtle carapaces are dark in color. If something is looking down at it, the turtle will blend in with the ocean floor or **substrate**. A sea turtle's plastron is light in color, making the turtle harder to see from the bottom when looking up.

Sea turtle skulls are solid. Their jaws do not contain teeth. Instead, sea turtles have beaks that are adapted to their diet. Sea turtles locate food using smell and vision. They open their mouths slightly and draw water in through their nose to smell.

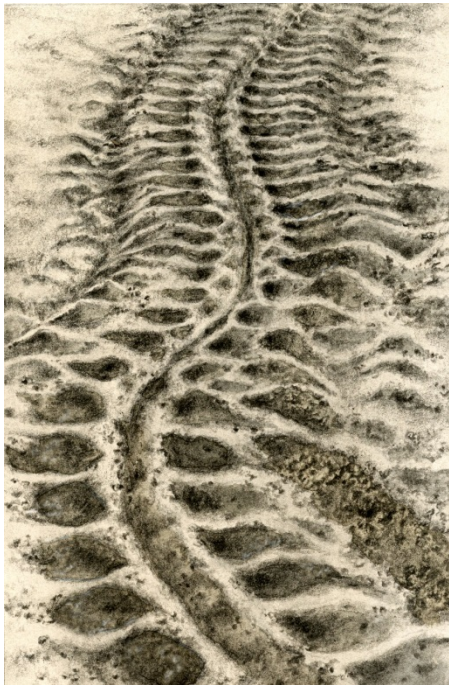


Water is not swallowed, but is pushed out through the mouth.



Sea turtles do not have externally-visible ears. Their ears are hidden inside their heads. Sea turtles can hear **low frequency** sounds and vibrations underwater. Sea turtle eyes can see very well underwater. However, they cannot see very well in the air.

Sea turtles become adults when they are between 10 and 30 years old, depending on the species. During mating season males and females gather offshore. When a female is ready to lay her eggs, she will crawl out of the water onto a sandy



Sea turtle tracks on the beach.

beach. She usually does this at night, when it is cooler. Sea turtles are very strong swimmers, but they are not so good at crawling on land. The female turtle must drag herself up the beach using her front flippers. Since some sea turtles can weigh over 1,000 pounds, this is a lot of work!

People can tell where sea turtles have laid their eggs by finding tracks on the beach in the morning. The tracks look like a tractor tire has rolled up and down the sand. Each type of sea turtle leaves tracks with a different pattern. The pattern is made by the front flippers, the rear flippers, the plastron and, sometimes, the tail.

The female turtle wants to get to the upper part of the beach. She needs to lay her nest above the high tide line, usually near the sand dunes. She will prepare an area for her nest. The first thing she does is to use her front and rear flippers to sweep the loose sand aside. This leaves a section of moist sand which is called the “body pit.” She will use her back flippers to scoop sand and dump it to the side. She will use one flipper at a time to do this. She will continue digging a hole this way until her back flippers cannot reach any more sand.

The female turtle is now ready to lay her eggs. The eggs do not have hard shells. Instead they have a flexible, leathery covering. When an egg is laid, it can fall about 18 inches to the bottom of the hole. If it had a hard shell, it could break. The leathery covering allows the egg to survive the fall. On average, a sea turtle



will lay about 100 eggs in a single nest. Different types of turtles will lay different numbers of eggs.



When she has finished laying her eggs, the mother turtle still has work to do. She must cover the nest. She will use her back flippers to take the **damp** sand and put it back in the hole, on top of the eggs. She will pat the sand down. She will then use her front and rear flippers to fling the dry sand back over the nest area. This helps camouflage the nest. Finally, she must drag herself back into the ocean.

A female turtle will rest for about two weeks, and will then repeat the whole nesting process. One female turtle can lay between three and seven nests in a season. She will then take one or two years off before nesting again.



Tracks leading up to and back from a sea turtle nest.

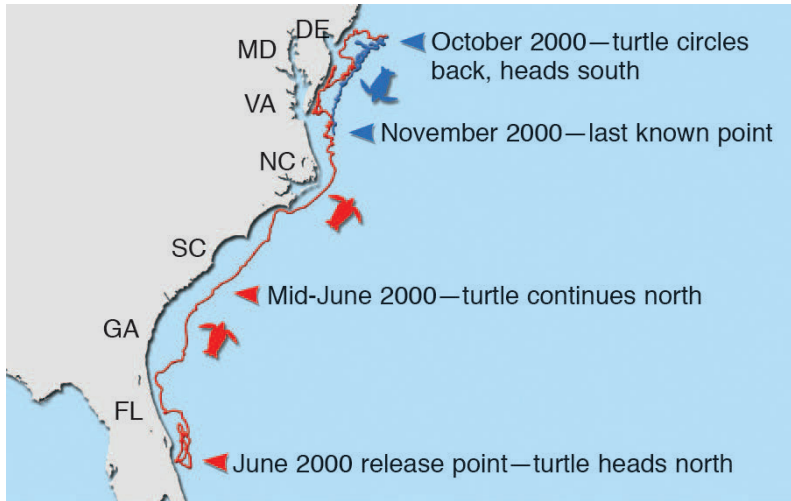


Sea turtle eggs **incubate** for about 60 days. We will learn more about the hatching process in chapter five. Before the **hatchlings** leave the beach, they **imprint** on the location so they can return to the same area as adults. The baby turtles will never knowingly see their parents. Unlike many animals, sea turtles give no parental care to their young.



Sea turtles are **ectothermic** or cold-blooded. This means that they rely on the outside temperature to keep them warm. Partly because of this, most sea turtles are limited to living in the **tropical, subtropical** and **temperate** waters of the world. If they get too cold they can become **cold-stunned** and will become **stranded** or die.

Adult sea turtles migrate between **foraging** and nesting grounds. These migrations can cover hundreds, sometimes thousands, of miles. Sea turtles are known to nest in tropical and subtropical regions around the world. Both males and females migrate to special areas to breed and lay eggs. The female turtles



An example of a sea turtle's migration along the east coast of the United States.

migrate to the nesting region where they were born. Scientists do not know exactly how turtles are able to do this. They believe that sea turtles use a number of clues to find their way. These clues may include ocean currents, earth's magnetic fields, **topography**, and water chemistry.



How Do Scientists Identify Turtles?

Biologists are scientists who study living things. **Organisms** are broadly grouped as plants or animals. Some animals have backbones, they are called **vertebrates**. The vertebrate group includes animals we are very familiar with. Mammals, birds and reptiles are all examples of vertebrates. Sea Turtles are reptiles. Reptiles are cold-blooded and most lay eggs. There are three big groups of reptiles: 1. Alligators and Crocodiles; 2. Lizards and Snakes; and 3. Turtles (including sea turtles).

Biologists often need to identify organisms and place them in groups. To do this, they use a tool called a **dichotomous key**. A key helps biologists compare an animal's characteristics one by one. For example, the mouth can be used to help identify a sea turtle. There is only one sea turtle that has a mouth that looks like a bird's beak. Any sea turtle with that characteristic would be a hawksbill turtle.



A simple dichotomous key for sea turtles would compare just a few things. For example, turtles might be round or oval. They might have a beak or not. In this chapter, we will learn about these characteristics of the different sea turtles:

- Length
- Carapace (shell) – shape, number of scutes
- Head – shape, size, presence of scales

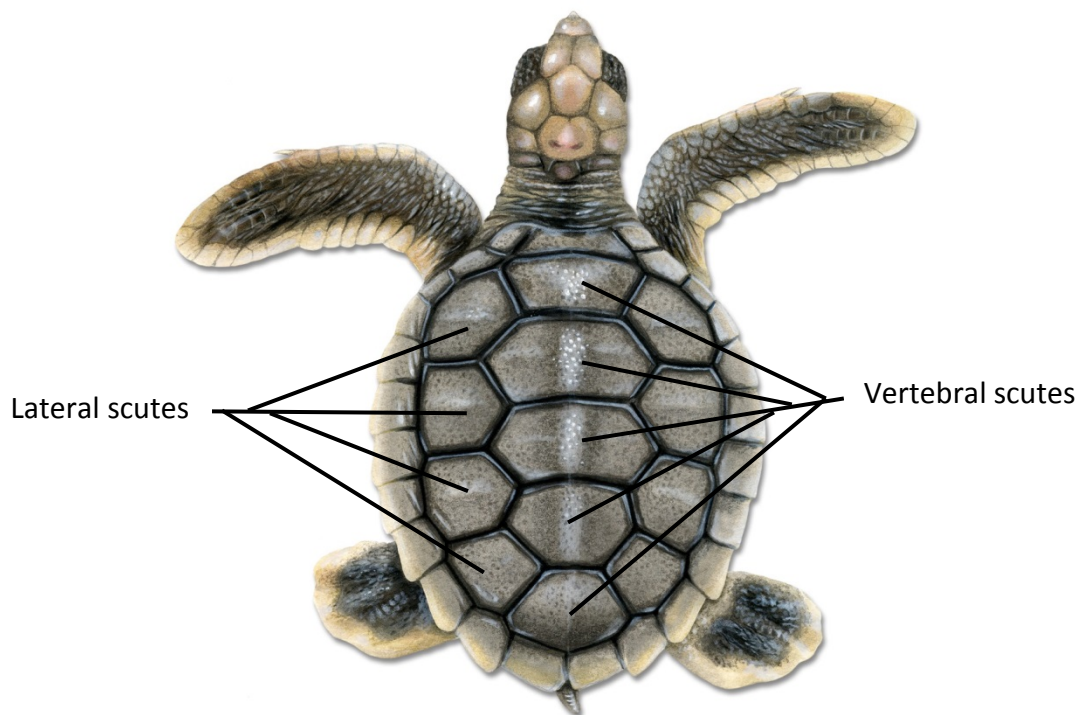
Different Kinds of Sea Turtles

There are seven different kinds of sea turtles. They swim in different parts of the world's oceans. Some of the turtles are big ocean swimmers. Some of the turtles enjoy living near coral reefs. There are several ways that you can learn to identify



them. We are going to learn how biologists identify sea turtles. We are also going to learn about the **life history** of each of the seven different species.

In order to tell the turtles apart, biologists start by looking at the outside of the animal. They use **external anatomy** to help tell the turtles apart. To do this, they mostly look at the turtle's shell. As we learned in chapter 1, the back of the turtle's shell is called the carapace. The part of the shell that covers the turtle's belly is called the plastron. The shell is made up of smaller pieces which are joined together. These smaller pieces are called **scutes**. Different species of turtles can have different numbers of scutes. The **vertebral scutes** are on the top of the backbone of the turtle. The **lateral scutes** are on each side of the vertebral scutes. Scientists use scute patterns to identify sea turtles.



Biologists also use life history to help them tell the turtles apart. Life history means studying how and where the turtles live. Feeding habits are an important part of life history. The seven kinds of sea turtles have different feeding habits. Adult green sea turtles are mainly **herbivorous**. They prefer to eat plants. The flatback turtle is **omnivorous**. It eats small animals and plants. The other species are all **carnivorous**. Although they all eat other animals, each species eats



different types of **prey**. This way they do not compete with each other when they live in the same area. Feeding habits may change as the turtles grow up. Baby turtles do not live in the same area as adults, so different foods may be available.

Different species of sea turtles may live in warm or cold water. The temperature they require is an important part of their life history. Some turtles, such as the hawksbill, are tropical. Tropical animals live in warm oceans near the earth's **equator**. Other turtles prefer colder water. Colder waters are called temperate. Most oceans around the United States are temperate. The leatherback turtle is an ocean swimmer that lives in colder water. None of the modern sea turtles live in **polar** waters. These are the icy oceans near the north and south poles.

Leatherback Sea Turtles

Leatherback turtles are unlike all other turtles in several ways. First, they are huge! Full grown leatherback turtles may weigh over 1,000 pounds and be over six feet long. This is a really big turtle! Second, leatherback turtles do not have a true shell. Instead, their carapace is covered by a leathery skin. There are tiny bones that hold the “shell” together. Leatherback turtles are true ocean voyagers. They live in cold water and never stop swimming.



Leatherback turtles are the only type of sea turtle that can survive in cold water. Their large body size helps them be less affected by the cold temperature. They also have a thicker layer of fat under their carapace than other turtles. This helps provide protection from the cold water. They are very unusual because they have some ability to make body heat while swimming. The leatherback turtle has adapted to cold water by being able to warm itself with this body heat.

Another very unusual thing about leatherback turtles is their diet. These turtles only eat jellyfish. Lots and lots of jellyfish! Some jellyfish can sting people. But the leatherback sea turtles do not seem to feel the jellyfish stings.



Leatherback turtles swim in cold ocean waters for most of their adult lives. When they are ready to nest, however, the females lay their eggs on tropical beaches. Little is known about young leatherback turtles. Scientists do not know what part of the ocean they live in. They think that the young leatherbacks stay in warm tropical water. They think adult turtles move into the colder parts of the ocean when they are about 16 years old.



Loggerhead Sea Turtles

Loggerhead sea turtles are common in Florida waters. They have the name “Logger-head” because of the large size of their head. These are the most common turtles that come ashore to nest on Florida beaches.



Young loggerhead turtles live in the ***Sargassum***. *Sargassum* is floating brown seaweed. This special seaweed provides cover for many young animals in the ocean. They can hide in the floating weeds and have some protection from predators. The small shrimp and crabs in the seaweed are easy prey for the young loggerheads.



A baby loggerhead next to a piece of Sargassum seaweed.

Loggerhead turtles are carnivorous. They have big, strong jaws. Adult loggerheads love to eat shellfish from the bottom of shallow coastal waters. They eat crabs, clams, and other **invertebrates** off the sea floor. When loggerhead sea turtles are in captivity, they are usually fed fish, often with some extra vitamins.

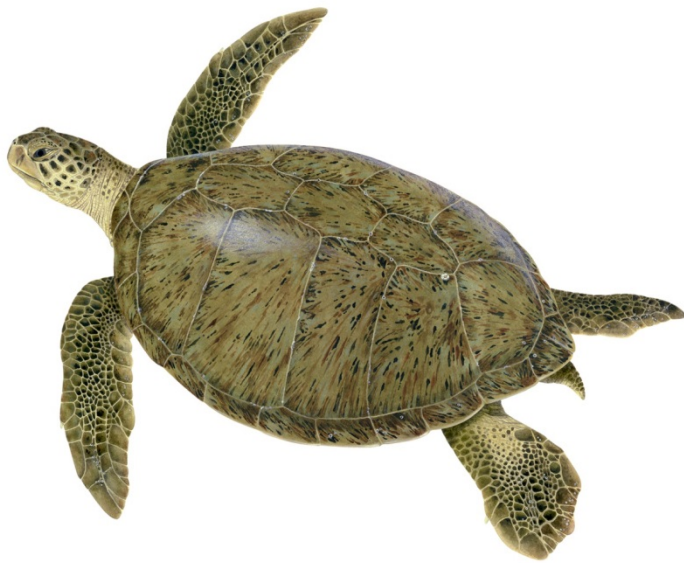


Adult loggerhead turtles are medium-sized to large. They may weigh over 300 pounds. The biggest loggerheads can have shells that are 3 ½ feet long. They are not the biggest sea turtles. Greens and, especially, leatherbacks get much bigger!

Although loggerhead turtles may swim far out into the ocean, they often prefer to stay closer to shore where food is easier to find. When a female is ready to lay her eggs, she usually returns to the area where she was hatched many years before. If the beach has changed, perhaps because of new buildings, it may be difficult for her to find a good place to dig her nest. When a female loggerhead is nesting, she will stay in the area near her **natal region** (this is the area she was born in) for several months. She may come ashore several times to lay her eggs.

Green Sea Turtles

Green sea turtles are the second largest sea turtles. Adults can weigh over 400 pounds. Adults have a carapace that can be up to four feet long. Green sea turtles live in warm, tropical waters. In Hawaii, green sea turtles have a special name. They are called “honu” in the Hawaiian language. The ancient Hawaiians admired green sea turtles for their navigation talents. Turtles leave home for years and yet are still able to swim back to the beaches near where they hatched.



Green sea turtles used to be hunted for food. They are now protected in most of the world. Their fatty tissues have a light green color, which is how they got their name. Adult green turtles are mainly herbivores; they eat seagrasses and **algae**. Plants in their diet may cause some of the green color found in their tissues. Young green turtles, with shells less than

10 inches long, may eat some animals. They may eat shellfish, crabs and small invertebrates. Young turtles also eat algae and seagrass like the adults. The beak of the green sea turtle is unique. It has sharp edges, almost like tiny teeth. This sharp beak helps the turtle cut off pieces of the plants.

Green turtles live in both tropical and temperate waters, and usually stay close to shore. They love areas with seagrass beds. They will graze on algae that cover rocks and other structures.





Green sea turtles will swim around in the ocean for about 25 years before they are ready to start nesting and laying their eggs. Female turtles try to return to their natal region to lay their eggs.

Green turtles are endangered worldwide. They can be killed by fishing gear and run over by boats. Their nests may be damaged by storms, predators (raccoons love turtle eggs!) and construction on or near their nesting beaches. Although protected, green turtles are still hunted (both legally and illegally) in remote parts of the world.

Green sea turtles are also at risk because of a serious disease. The disease is called “**fibropapillomatosis**.” Turtles with this disease develop very large **tumors**. The tumors grow on soft tissues like the skin, mouth and eyes. It can be hard for these turtles to eat. If their eyes are covered with the tumors, the turtles may not be able to see. Scientists do not know why green sea turtles get this disease. Occasionally other types of turtles get sick with this disease. A **virus** seems to be involved, but a great deal of research is still needed to understand this problem.



A green sea turtle with tumors around its neck, mouth, eyes and flippers.

Turtles with tumors are taken to special hospitals. Tumors can be removed if they are only on the outside of the turtle. When the tumors develop on internal organs it is very hard to help the sick animals. Many veterinarians and biologists work very hard to try to help these turtles.

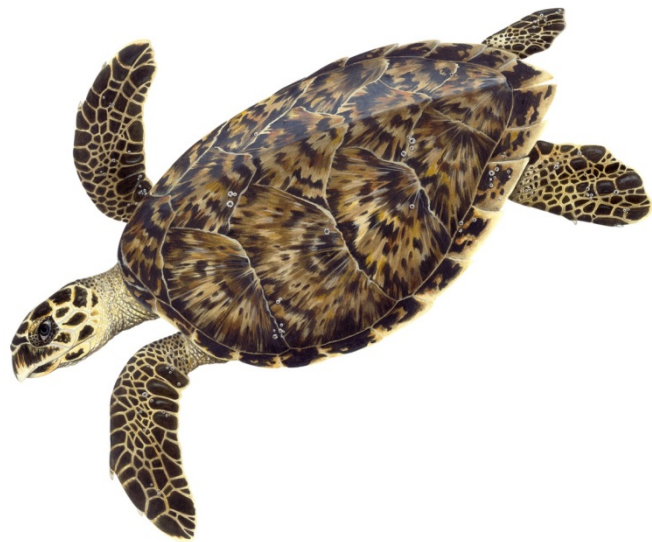
Hawksbill Sea Turtles

As the name suggests, hawksbill sea turtles have a mouth that is shaped like the beak of a hawk. These turtles are beautiful animals. For many years they were killed so that their shell could be taken to make jewelry and hair combs. Today, “tortoiseshell” jewelry is made from plastic. The turtles are protected by many



countries. It is illegal to hunt them in most of the world. Hawksbill turtles occasionally nest on Florida beaches.

Hawksbill turtles are medium-sized. They are usually two to three feet long and weigh 100-200 pounds. They are tropical turtles, and like to swim around coral reefs. They are found in the Atlantic, Pacific and Indian oceans. Today, many coral reefs are not healthy. It can be difficult for hawksbill turtles to find food in some areas. Hawksbill turtles are endangered. In some areas they are at a high risk of going extinct.



Hawksbill turtles are carnivorous. They like to eat sea sponges which are often found near and on coral reefs. The turtles can tear the tissue from the sea sponges with their sharp beaks. The point on the end of their beak allows them to reach sponges that live in the rocks. Because of the sponges they eat, the meat of this turtle can be poisonous to people. Unfortunately, hawksbills have been hunted for their beautiful shells.





Kemp's Ridley Sea Turtles

The Kemp's ridley was named for a Florida fisherman, Mr. Richard Kemp. Mr. Kemp provided the first description of this turtle. The Kemp's is the smallest of all the sea turtles. Full grown adults only reach a size of about two and a half feet long. These little turtles usually weigh less than 100 pounds.



Kemp's ridley turtles are carnivorous. Their preferred prey is crabs. These turtles can be found in shallow coastal areas or far out at sea. They do something very unusual. When they are ready to lay their eggs, all the female turtles come ashore at one time. These nesting colonies are called "arribadas." During an arribada thousands of adult female turtles will crawl up the beach at about the same time. The Kemp's ridley arribadas occur during daylight hours on a single stretch of beach in Mexico. In years past, hunters would harvest many of the nesting turtles and the eggs that they had laid. This heavy hunting pressure, and the removal of females from the population, resulted in



Kemp's ridley turtles becoming extremely endangered. Although populations show signs of recovery, these animals are still rare and are protected in Mexico and the United States.



Olive Ridley Sea Turtles

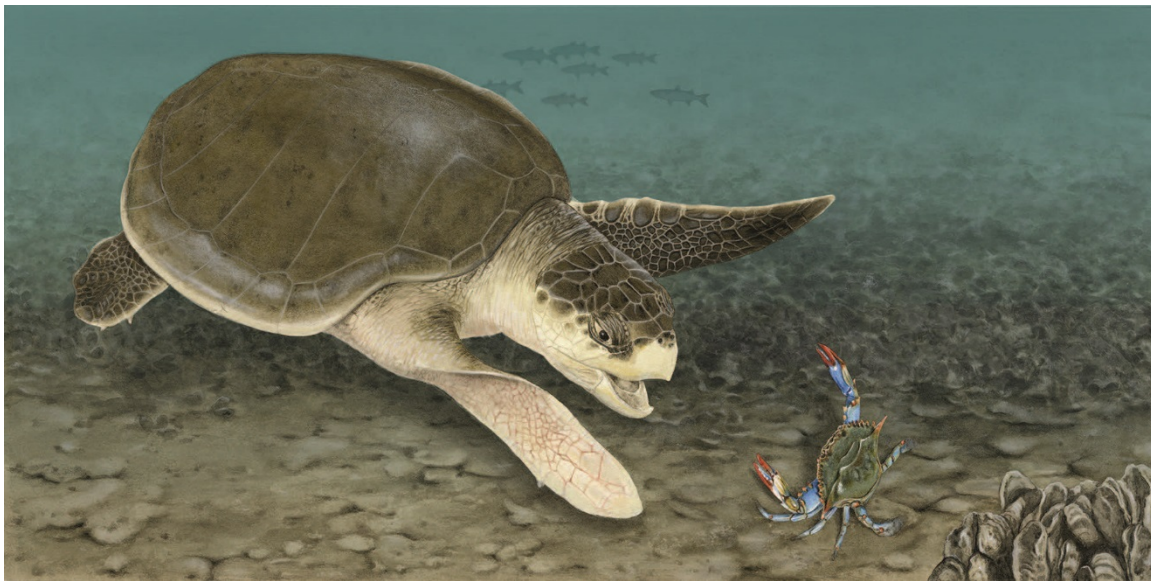


Olive ridley turtles are very similar to the Kemp's ridley turtles. These turtles are a very dark green, or olive, color. Young olive ridley turtles are charcoal gray in color. These turtles also form arribadas. They are easy to hunt when they come ashore in these large groups. Before they were protected, hunters killed the turtles and sold the meat. Their skin was used to make leather-like products.

Although they are protected by

law, these turtles may be poached in some places.

Like the Kemp's ridley, the olive ridley turtles are small. Adults are two to two and a half feet long. They usually weigh less than 100 pounds. These turtles are carnivorous. They have very strong jaws which they use to crush some of their prey. They like to eat crabs, shrimp, rock lobsters (very small lobsters) and jellyfish. Although often found in coastal areas, they can dive up to 500 feet. They hunt on the sea floor to look for their prey.





In the United States, olive ridley turtles are considered **threatened**. Globally, they are classified as **endangered**. This means that scientists are very concerned about these turtles. They are worried about the long-term survival of this species. Olive ridley turtles are protected in some parts of the world. However, they may come ashore in remote parts of the world where there may not be good law enforcement to protect them. Adult turtles and their eggs may be poached for human food. In addition, turtles can be caught in fishing gear. Beachfront development may damage or destroy nesting areas.

Flatback Sea Turtles

Flatback sea turtles occur only in the **southern hemisphere**. They nest on the beaches of northern Australia. They swim near many of the islands in the Indian and southern Pacific oceans. These turtles are coastal. They prefer to swim in shallow water, often less than 200 feet deep.

Flatback turtles are medium-sized. They can be up to three feet long, and weigh 150-200 pounds. These turtles are omnivores. This means that they eat animals and plants. Flatback turtles like to



eat invertebrates. Some of their favorite foods are sea cucumbers, jellyfish, crabs and prawns (large shrimp). They also eat plants and like to graze on seagrasses.

As you might guess, flatback turtles have a long, flat back. Their body shape is oval or somewhat round in appearance. The shell color is dark olive or gray with brown or yellow margins. The flippers are yellow-brown to white in color. The edge of the shell of this turtle is folded. It may appear to be somewhat scalloped, with non-overlapping waxy scutes.



Compared to other sea turtles, scientists know very little about this species. Scientists do not know if these turtles are endangered, but they are protected by the Australian **government**.

Niche Specialization

As we have seen, there are seven kinds of sea turtles. They all are similar in appearance, although leatherback turtles are much larger than the others. All sea turtles have a shell and big flippers. Leatherbacks also have a different kind of shell compared to other sea turtles. All sea turtles have to come to the surface of the water to breathe air. All sea turtles return to the region where they hatched to lay their eggs. All

hatchling sea turtles travel across the sand to reach the water. So, if all the sea turtles are so similar, what makes them different?

Niche is a word used by scientists. Animals may share the same habitat but not eat the same food. These animals have developed their own niche. This means that they have their very own place in the environment. Sea turtles can look very similar but eat different things. On a coral reef, hawksbill turtles eat sponges. Green turtles eat mainly algae. Loggerhead turtles eat shellfish. These different species of turtles can coexist because they are not using the resources needed by others.

Coral reefs are **complex** environments. Reefs are like underwater **rainforests**. They grow in warm tropical waters. There are many types of living things on the reef. There are fish and sharks living on the reef. There are also many different invertebrates, including the corals. Tropical sea turtles may also live near the reef.



Different species of turtles eat different things. Because they do not need the same foods to grow, these turtles are not competing with each other. This allows animals that are very similar in appearance, to live and grow in the same area.



Loggerhead sea turtles are common near coral reefs. As carnivores, they eat small animals. Loggerheads eat small fish, crabs and shellfish. They really love to eat things that have hard shells, like lobsters, clams and shrimp. Green sea turtles, on the other hand, are mainly herbivores. They are not interested in the animals the loggerhead hunts. Instead, the green turtles spend many hours grazing on algae and plants. The hawksbill turtle also lives near the coral reef. Hawksbill turtles don't want the **vegetation** that the green turtles eat. They don't want the shrimp that the loggerhead hunts. The hawksbill turtles prefer to eat sponges. These are soft-bodied animals but they look like underwater plants. The hawksbill turtle uses its bird-like beak to bite off pieces of sponge living near the coral.

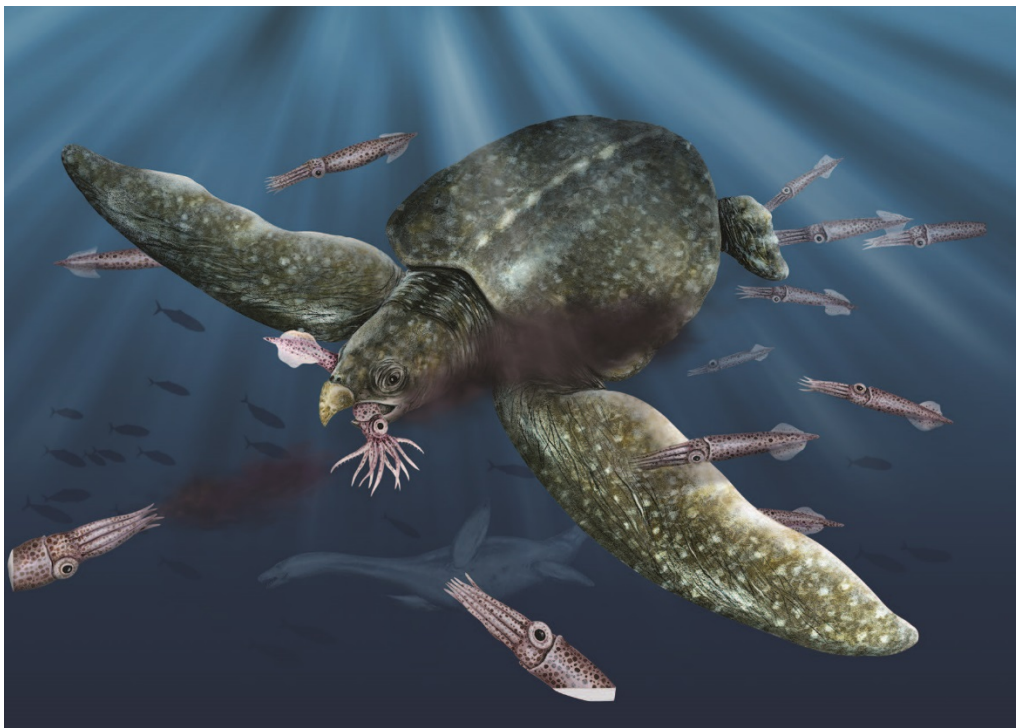
Each of these turtles has a preferred food. They all live in the same environment, but they each eat something different. This keeps them from competing with each other. We call this **niche specialization**.



Sea Turtle Evolution and Anatomy

The oldest relatives of the seven sea turtle species that are alive today lived 110 million years ago. There were other sea turtles that lived longer ago than this. Those older turtles are not ancestors of today's sea turtles. Sea turtles form good **fossils**. Their skeletons and bony shells are preserved in ancient rocks.

The leatherback sea turtle is the largest sea turtle alive today, but it is small compared to its **ancestor**. About 80 million years ago, a giant sea turtle called **Archelon** (*arr-keh-lon*) swam in the ancient sea. From fossil skeletons, we know that Archelon was about 13 feet long. The measurement from the tip of one front flipper to the other was over 16 feet. It probably weighed about 5,000 pounds. That's about the same as an adult white rhinoceros. Like the leatherback, Archelon probably had a leathery covering on its back. It may have eaten squid-like animals.



Archelon is most closely related to the leatherback sea turtle. The other sea turtles, which have hard shells, are more closely related to each other than to the leatherback. Archelon became **extinct** with the dinosaurs about 50 to 60 million years ago.



A model of an Archelon skeleton hangs from the ceiling at the Georgia Sea Turtle Center.

Sea turtles have several **adaptations** that help them live in the ocean. Their front limbs (like our arms) are long paddle-like flippers. They have the same basic bones in their flippers as people have in their arms. However, sea turtles cannot bend



A sea turtle “cries” to get rid of salt.

their flippers at the finger or wrist joints. The sea turtle’s body is **streamlined**. This allows it to swim quickly through the water.

Sea turtles have tear ducts. Instead of crying because they are sad, sea turtles cry to get rid of salt. The

salt is in the turtle’s body because it drinks sea water.



Sea turtles have an internal skeleton. The hard-shelled sea turtles have more bones than the leatherback. The extra bones help provide support for the shell. The shell forms an external skeleton. The ribs of hard-shelled sea turtles are **fused** to the spine and to flattened bones that cover most of the carapace. The scutes of the shell are made from **keratin**. This is the same material that makes up human fingernails. The hard part of the turtles' shells is actually the bone underneath the keratin. Sea turtle scutes will continually add and lose layers as they grow. Hard-shelled sea turtles have toenails that are modified into claws. They can have one or two claws on both the front and back flippers. Leatherback sea turtles do not have claws on their flippers.



This freshwater turtle skeleton shows the fused bones that cover the turtle's back.

Sea turtles have soft skin on their necks, shoulders and between their back flippers. Sea turtle skin turns a darker color in the sunlight. Animals that live in deeper water habitats often have pale skin. Those in shallow water have darker skin. The leatherback turtle's skin often looks pink. This might be because of high blood flow below the skin's surface. Sea turtles have strong muscles. Muscles are primarily used for swimming, crawling, feeding and breathing.

When a sea turtle eats, it uses its tongue to push food into its **esophagus** (*ee-soff-ah-guss*). The esophagus is a tube that connects the mouth and the stomach. It has soft finger-like spikes inside it. These are called **papillae** (*pah-pill-ee*). They point down towards the stomach. They keep slippery food items (like jellyfish) moving down towards the stomach.



Papillae inside a leatherback's throat.



The turtle's stomach starts to digest the food. The food then moves into the intestines where the digestion continues. The pancreas and liver add special chemicals called enzymes to the intestines to help with this. The sea turtle uses its intestines to absorb nutrients from the food. The nutrients are transported around the body in the turtle's blood.

Sea turtles come to the surface of the ocean to breathe. They can hold their breath for a long time (up to several hours). They push out old air from their lungs and gulp in fresh air through their nostrils and mouth. The air is breathed into the lungs. Oxygen from the air moves into the turtle's blood vessels, and is pumped around the body by the heart.



A green sea turtle taking a breath.

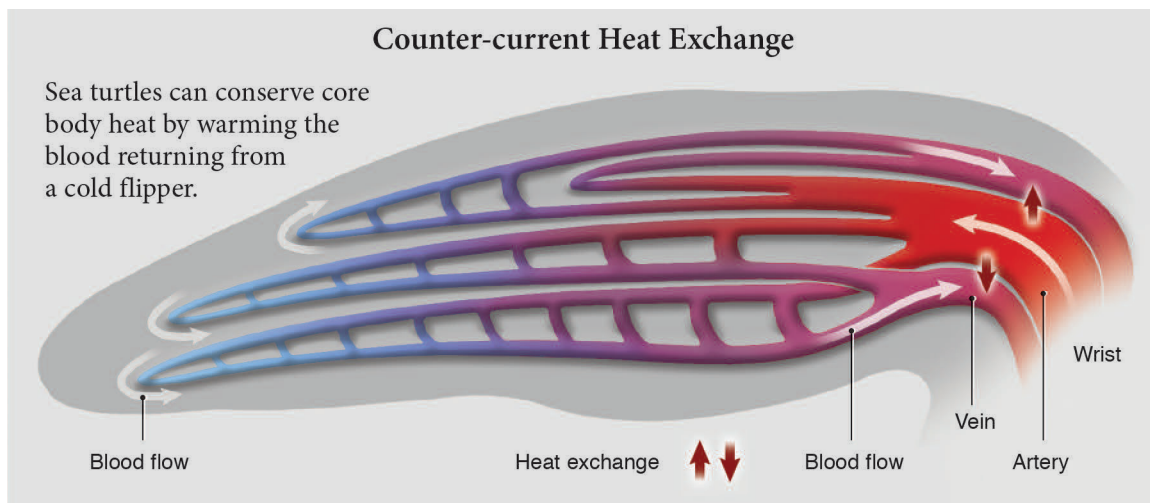
The sea turtle's brain has sections that coordinate the senses. Smell and sight are two important senses for turtles. Turtles seem to be able to smell under water and in air. They might use smell to help them find food. Some scientists think that sea turtles might use smell to help them find their way to their nesting beaches. Sea turtles can see in color. They use vision (their eyes) to help them find food. Sea turtles can hear, but they do not have external ear lobes. Sea turtles use their inner ear to orient themselves. This helps them tell if they are upside down or sideways. Sea turtles seem to have a sense of touch, but researchers do not know much about this sense. Sea turtles seem to have the ability to remember things, like the shape of the coastline where they hatched. Sea turtles may be able to sense the Earth's magnetic field. Scientists do not know how they do this, but they think that it helps sea turtles **navigate** in the ocean.

Sea turtles are cold-blooded, but they have ways of keeping warm or cool as needed. They can warm up by resting at the ocean's surface. In Hawaii, green sea turtles will crawl onto the beach during the day. This lets the sun warm their bodies.



Two sea turtles warm themselves on a beach in Hawaii.

Sea turtles can migrate to avoid cold water temperatures. They can also change their body temperature by controlling how much blood flows into their flippers. Warm blood in the flippers is cooled by the surrounding seawater. If a turtle wants to cool off, it can send more blood through the flippers.



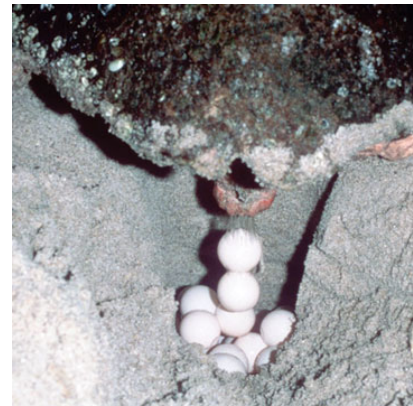
Warm blood (red) is cooled (blue) as it flows through the flipper.



How Does the **Environment** Affect Sea Turtle Nests?

Sea turtle eggs are not covered in a hard shell. Instead, they have a flexible, leathery covering. This allows the eggs to fall onto wet sand without breaking.

Different types of turtles lay different size eggs and different numbers of eggs. Examples of this are in the table below.

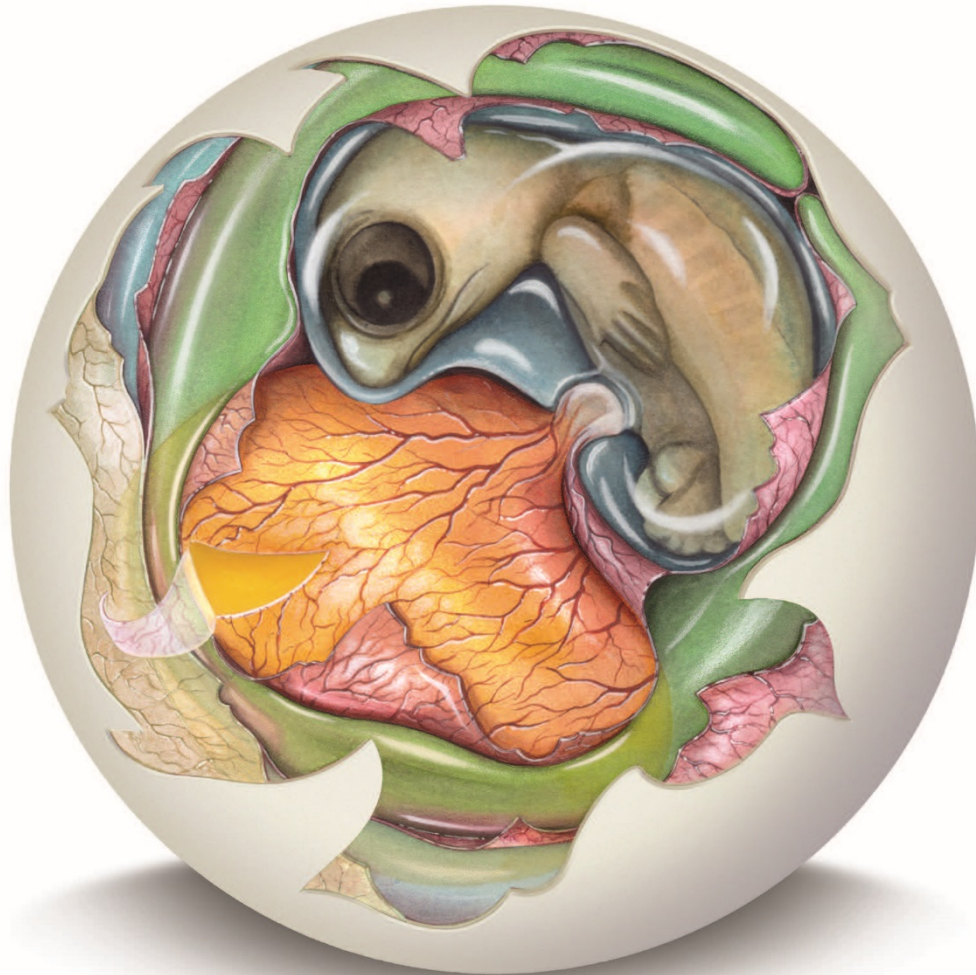


A loggerhead laying her eggs.

Type of turtle	Egg diameter (inch)	Average number of eggs per nest	Average size of turtle hatchling (inch)
Flatback	2.05	50	2.40
Green	1.73	112	1.97
Hawksbill	1.61	160	1.57
Kemp's ridley	1.54	110	1.69
Leatherback	2.08	80 fertilized + 30 unfertilized	2.32
Loggerhead	1.57	113	1.77
Olive ridley	1.54	105	1.69

Table 1: Sea turtle egg/hatchling information

Inside sea turtle eggs, the hatchlings (babies) start to grow. They need to breathe **oxygen**, but they are buried under a few feet of sand.



If you look at sand with a magnifying glass, you might see different sizes and colors of **sand grains**. The sand grains probably all look very small! On the beach, very fine, powdery sand does not have a lot of space for air in it. Sand with larger grains is better for baby sea turtles, because air can move through it and can bring oxygen to the eggs. Oxygen and other **gases** can pass through sea turtle egg shells. Sometimes people add sand to make a beach bigger. They need to be careful to use sand that has large grains. Otherwise, sea turtle eggs that are laid on the beach might not get enough oxygen and the babies could die.

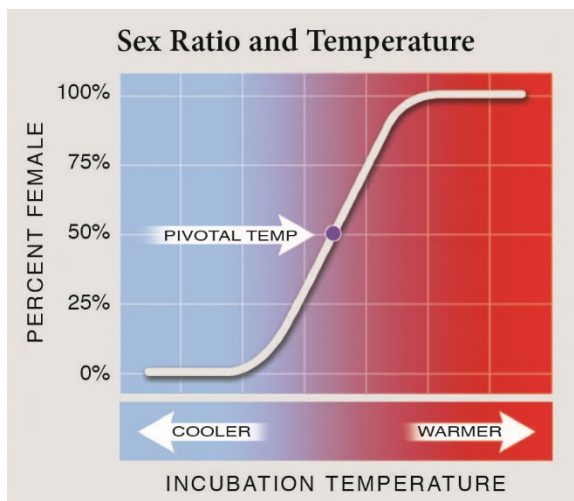


Mother turtles usually lay their nests above the **high tide line**. Sea turtle eggs will drown if the nest gets flooded with water. This can happen if a summer storm pushes sea water high up onto the beach. Storm waves can sometimes cause **erosion**—washing sand away from sea turtle nests. Sea turtle eggs that are uncovered might be eaten or might **overheat**, dry out and die.



Temperature is very important to baby sea turtles inside their eggs. If we keep sea turtle eggs warmer, they will hatch as female (girl) turtles. If we keep the eggs a bit cooler, the baby turtles will hatch as males (boys). To remember this, think

“Girls are hot, and boys are cool!” In general, eggs which are **incubated** at 86°F or higher will mostly hatch as female sea turtles. Eggs at 84°F or lower will be mostly male. Sea turtle eggs develop into boys or girls after about 20 to 40 days. They hatch after about 60 days. We cannot tell by looking at it if a hatchling sea turtle is a boy or a girl. Boy and girl turtles look the same until they become adults.



The graph shows that cooler sea turtle eggs are more likely to be males. Warmer eggs become females.



You may have heard the terms “**climate change**” or “global warming.” The world’s air and water temperatures have increased over the past 100 years. The increase is fairly small (a little more than 1°F). However, even a small temperature change can have a big impact on sea turtles. If the temperature warms too much, all the eggs in a nest might become girl turtles. As the ocean warms and **glaciers** melt, **sea level** is rising. Sea turtles will need to lay their nests higher up on the beach. But they do not want to lay their nests in the **sand dunes**. Roots from dune plants can grow into sea turtle nests and trap **hatchlings**.



Some scientists think that climate change might cause stronger storms. Most hurricanes form during sea turtle **nesting season**. If storms become stronger, there could be more beach erosion. This could uncover more sea turtle nests. As beaches erode, people will probably try to restore the beaches by adding more sand to them.

What will happen to sea turtles because of climate change? Will they **migrate** to cooler areas to nest? Will there only be female turtles one day? Will climate change make sea turtles extinct? We do not know.



Growing Up as a Sea Turtle

It is not easy being a sea turtle. Even before the eggs hatch, many things can happen to them. Some animals (like raccoons) will dig up turtle nests and eat the eggs. Eggs that get too hot can dry out and die. Eggs that get too cold might not develop. Eggs that are in nests which get flooded with water can drown. Harmful germs can sometimes get into the eggs. Hatching success is very variable. In some nests, about one quarter to one half (25-50%) of the eggs may not hatch.

Sea turtle eggs **incubate** for about two months. The type of sea turtle and the temperature both affect the incubation time. When baby turtles are ready to hatch, they have a tiny “egg tooth” on the top of their beak. They use this sharp egg tooth to break through the leathery egg shell. The egg tooth falls off soon after the turtle has hatched. The baby turtles do not all hatch at once. It may take a few days before all of them are out of their eggshells.

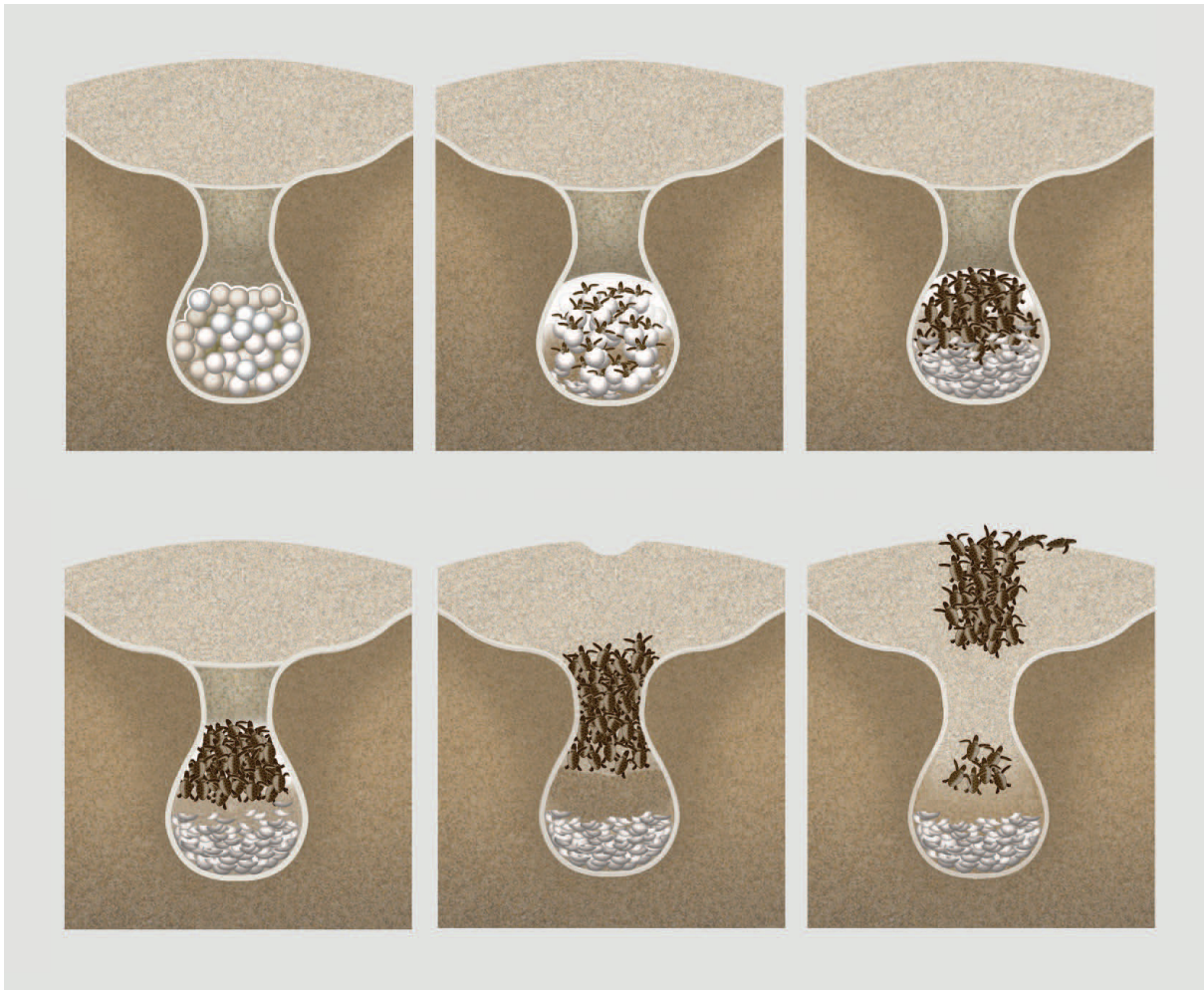


A newly-hatched Kemp's ridley sea turtle.

The newly-hatched sea turtles start to move around inside their sand nest chamber. As they move, some of the turtles knock sand down from the roof of



the nest. Other turtles knock sand off the sides of the nest. Turtles at the bottom of the nest press the falling sand down underneath them. As sand fills the bottom of the nest, the turtles are lifted closer to the surface of the sand. About 4-7 days after hatching, the baby turtles are ready to face their next challenge.

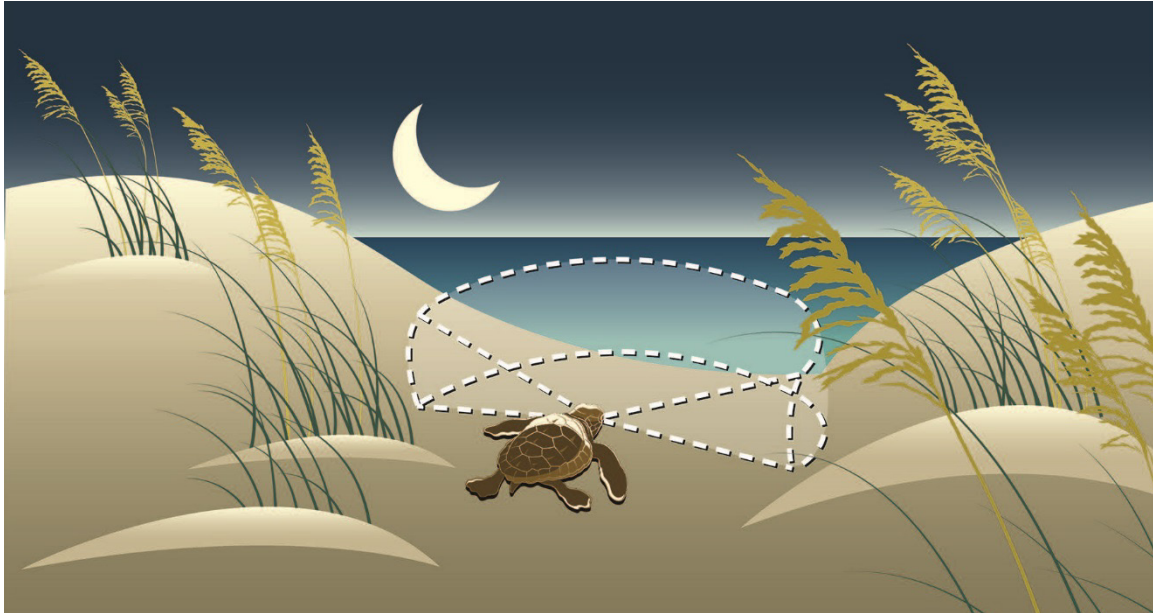


Hatchlings usually **emerge** from the nest at night. We think that they can feel the night's cooler temperatures. Sometimes rain will cool the sand and sea turtle hatchlings will emerge from the nest in the daytime. It is safer for the hatchlings to emerge at night as there are fewer **predators** then.





As the hatchlings crawl out of the nest, they turn towards the brightest reflected light. They are hopefully heading for the sea, guided by the reflection of the stars and moon.



A newly-emerged hatchling looks for the brightest reflected light.

Lights outside buildings or along streets sometimes reflect off the sand. This can make the baby turtles go in the wrong direction. **Disoriented** turtles can end up in dangerous places like swimming pools or roads. They may not be able to find their way to the ocean.



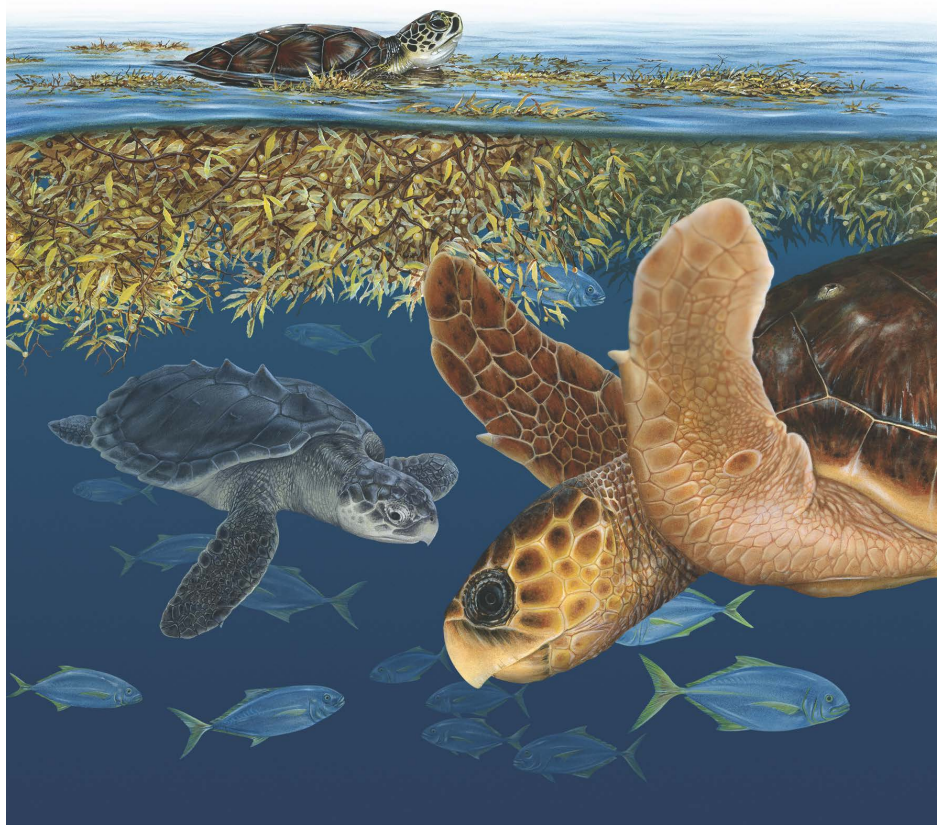


As they crawl down the beach towards the water, the hatchling turtles face many dangers. Predators like ghost crabs, raccoons and seagulls can catch them. Beach furniture, sandcastles, tire tracks or holes dug in the sand can all trap the hatchlings. If they make it to the water's edge, the turtles will start swimming.

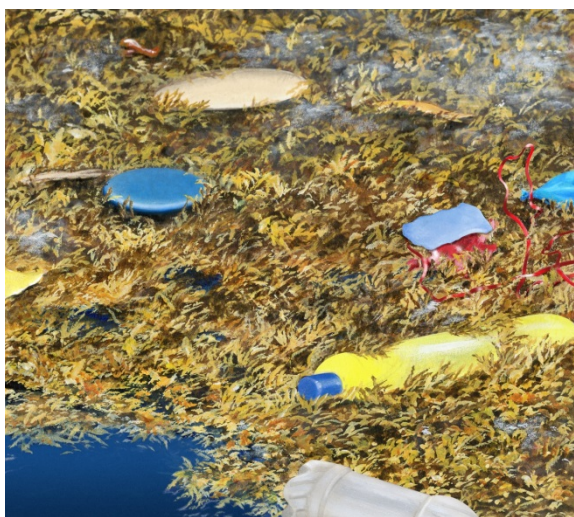
They seem to be able to use the earth's magnetic field to guide them. They will swim for about 24 hours without resting. Unlike all of the other sea turtles, young flatback turtles do not go out into the deep open ocean. Instead, they stay close to shore.

Why do the hatchlings swim for so long? Scientists think that it is to try and get as far away from the dangerous surf area as possible. Close to the beach, there are lots of predators—many kinds of fish (including sharks) and birds. Swimming away from the beach also gets the turtles to the ocean currents. What happens to the sea turtles over the next few years? For most sea turtle species, we do not know much about the **post-hatchling** and early **juvenile** years. Sometimes people refer to this time period as “the lost years.”

Researchers think that post-hatchling and juvenile loggerhead, green, hawksbill and Kemp's ridley sea turtles stay close to floating patches of brown *Sargassum* seaweed in the Atlantic Ocean.



In the Pacific Ocean, young turtles are often found near floating mats of **kelp**. The turtles might be able to rest by climbing onto the floating seaweed. There are many different types of crabs, shrimp and small fish that live in or under the seaweed. These are good food items for young sea turtles. Sometimes there are pieces of plastic mixed up with the seaweed. These are not good things for the



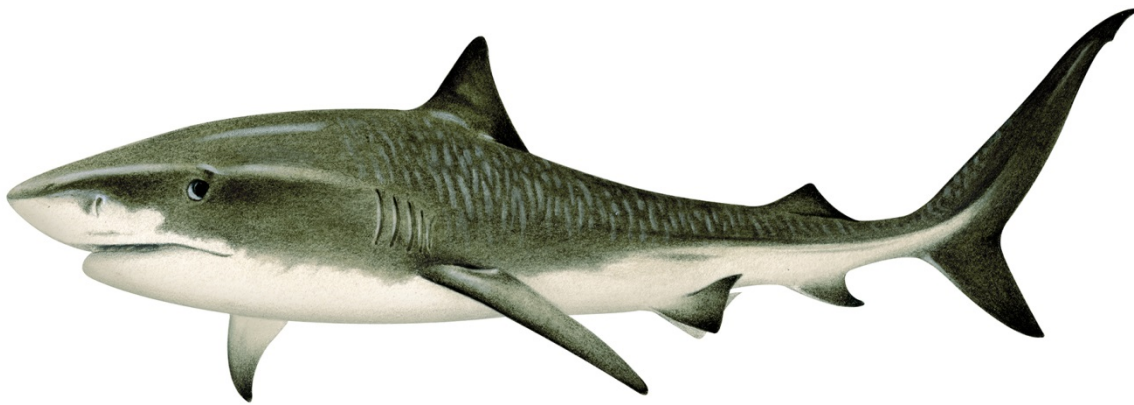
turtles to eat, but sometimes the turtles mistake pieces of plastic for food. If a turtle eats too much plastic, it can die.

Some large fish can eat post-hatchling and juvenile sea turtles. Loggerhead sea turtles spend between seven and eleven years in the open ocean. We do not know how many years other types of sea turtles spend at sea. Loggerheads swim back to coastal waters when their carapace is



about 20 inches long. Green sea turtles and hawksbills seen near shore can be smaller than this. Leatherback and olive ridley turtles spend most of their lives in the open ocean. They come back to coastal waters during nesting season.

Sub-adult and adult turtles are too big for all but the largest predators. One such predator is the tiger shark. Tiger sharks can bite through the turtle's shell. They will even swallow the shell. Later, the tiger shark can turn its stomach inside out through its mouth to empty the cleaned shell from it. The shark will then re-swallow its stomach!



Large sea turtles can also be affected by diseases, **red tide**, cold temperatures, storms and many human impacts. We will discuss human impacts in the next chapter. Some of the natural impacts will be described in chapters seven and ten.

Most of the sea turtle eggs that are laid do not get to grow up into adult turtles. Only about one out of 1,000 hatchlings will survive to become an adult. Only one in 10,000 sea turtle eggs might survive to adulthood. You will learn about some of the ways that people can help protect sea turtles in chapter six.



How do Human Activities Affect Sea Turtles?

The ancestors of modern sea turtles were alive at least 100 million years ago. Sea turtles have survived for a very long time. But now all of the different types of sea turtles are in danger. Unfortunately, all sea turtle species have been harmed by things that people do.

In many places, people like to eat sea turtle eggs and meat. People have hunted hawksbill sea turtles for their pretty shells. “Tortoiseshell” (which is really hawksbill sea turtle shell) was used to make combs and hair decorations, small boxes, jewelry and other decorative items.



A hair comb made from the shell of a hawksbill sea turtle.

In the United States, and many other countries, sea turtles are protected. People are no longer allowed to hunt sea turtles or to dig up their eggs to eat. Plastic has replaced tortoiseshell. However, sea turtles are still hunted in some parts of the world. Sometimes people illegally harvest sea turtles. We call this **poaching**.

Sometimes sea turtles are caught by accident when people are fishing. This is called **bycatch**. Shrimp boats drag large nets called **trawls** through the water. When sea turtles get trapped in trawls, they can drown. Turtles can also get caught when people are fishing with hook and line. Sometimes the turtles will swallow fish hooks and fishing line. This can be dangerous for the turtles. Fishing line can get wrapped around the papillae inside the turtles’ throats. This can make it very difficult for them to swallow food. Hooks can cause injuries that can become infected.



Sea turtles sometimes get trapped in old fishing nets, ropes or pieces of fishing line that have been thrown or left in the ocean. This **entanglement** can drown the turtles.



Turtles that are crawling up the beach to nest can get tangled up in beach chairs, umbrellas or other objects that people have left on the beach. Hatchling turtles can fall into tire tracks, sandcastle moats or holes that people have dug on the beach. They can become exhausted trying to get out of these traps. If they are allowed on the beach, cars sometimes run over turtle hatchlings.





As discussed in chapter five, hatchlings can get confused when lights shine on the beach. Sometimes street lights, lights around swimming pools, or porch lights can look like the moon to a baby turtle. Hatchlings sometimes crawl towards these lights instead of to the ocean. Lights can bother adult turtles too. People should not shine flashlights at nesting turtles as this can make them turn around and go back into the water. Bonfires on the beach during the summer can scare nesting turtles or confuse hatchlings. Some places do not allow beach bonfires during sea turtle nesting season.

In the ocean, sea turtles sometimes eat pieces of plastic because the plastic looks like food. Plastic bags and balloons may look like jellyfish in the water. Small pieces of plastic can look like little shrimp. Pieces of fishing line might look like seagrass. When turtles eat plastic, they cannot digest it. If their stomachs fill up with plastic, they can starve.



When sea turtles come to the ocean's surface to breathe, they may only stick their noses out of the water. This makes it very difficult for people in boats to see them.





If turtles are hit by boats, they can suffer from head injuries. Sometimes their shells get cracked. The boat's propeller can cut into the turtle's back. These injuries can kill it.

Sometimes people build seawalls between their homes and the beach. This is done to try and stop the sea from **eroding** beachfront property. These walls can make it impossible for turtles to get above the high water mark on the beach. Sometimes they force turtles to lay eggs where the nests will drown. Some turtles may give up on nesting if they crawl up to a seawall.



Seawalls can stop sea turtles from being able to nest on the beach.

If beaches are eroding, we sometimes add sand to the beach. This is called **beach nourishment**. If the sand that is added to the beach is too fine (the grains are very small), sea turtle eggs will not be able to survive. Air (oxygen) cannot get through very fine sand to the eggs. Usually beach nourishment is not done during sea turtle nesting season.

Oil can get into the ocean in many ways. Sometimes there are accidents at sea that result in large amounts of oil being spilled from oil rigs or ships.



But most of the oil that gets into the ocean comes from **runoff** from land. If people throw oil from their car or boat into the trash, it can leak into the ground. When it rains, oil on or in the ground can get washed into rivers or the ocean. When oil is in the ocean for a long time, it turns into thick black sticky tar. Sea turtles that become covered in oil can die. Turtles also sometimes eat tar balls or swallow oil with their food. The oil is poisonous when it is eaten.



Natural Threats to Sea Turtles

In addition to dangers from humans, there are also natural problems for sea turtles. Our world is changing quickly. Some changes may not be good for sea turtles. You have already learned that temperature affects baby sea turtles. (Remember, “Girls are hot, boys are cool!”) Storms and high tides can make it hard for turtles to build nests. There are other things that are happening in the oceans.

Weather and Climate

Our **weather** is always changing. Sometimes it rains; sometimes it is hot and sunny. These events happen in a day or two and then it changes again. Many people listen to the weather report in the morning so that they can plan what they should wear that day. They may want to wear a jacket if it is cold. If rain is predicted, they may carry an umbrella. These day to day decisions reflect our response to changes in the weather.





Climate refers to **average** weather conditions over a very long period of time. For example, the North Pole is always expected to be very cold in the winter. Florida is usually hot and has a lot of rain in the summer.

Climate Change

Records of the weather have been maintained for a little more than the past one hundred years. These records have a lot of information about different parts of the world. They tell us that the warmest temperatures ever recorded have occurred in the past few years. This information shows us that the earth is getting warmer and warmer. The average climate is warming. This broad average change in the earth's weather conditions is referred to as climate change. Climate change is natural, but some human activities can make it worse.

Change can be good or bad. Scientists often talk about “winners” and “losers.” The “winners” are the animals that may benefit from changes that are taking place. In the oceans, a big “winner” seems to be jellyfish.



There are many reasons why the number of jellyfish is increasing. One of the sea turtles you are studying likes to eat jellyfish. Do you remember which one it is? It is the giant leatherback turtle! Would this turtle be a “winner” too? Scientists do not know the answer to this question.



Sadly, there are also “losers.” These are the animals that find it hard to change. Can you think of an animal that might be considered a “loser” when talking about climate change? People often think that polar bears will be a big loser. The polar bears need sea ice for



hunting. As the climate warms the sea ice is disappearing. This makes it very hard for polar bears to catch the seals they need for food.

When thinking about sea turtles, there are some things about climate change that might make them “losers.” If a turtle’s nest gets warm, more of the babies will be girls when they are born. If the nests get too warm, the eggs might not be able to hatch.

Sea turtles lay their nests in the spring. Hatchlings enter the ocean in the summer. The environment has to be just right for these important events to go well. We do not know how changes in the climate will affect sea turtle nesting.

Sea level rise

One of the biggest concerns for sea turtles in our changing world is loss of nesting beaches. The type of climate change that is currently in progress is also called global warming. This means that the entire earth is getting warmer. With global warming, our sea levels are rising. The glaciers and ice at the north and south poles are melting. This is putting a lot more water into the ocean. The surface of the ocean is slowly rising around the entire planet. This is called sea level rise.



As the sea level rises, the beach area shrinks. Many areas that sea turtles use for nests are popular beach areas for people. There may be a lot of buildings near the



ocean. The buildings prevent new beach from developing naturally from the wind and wave action. Instead, the beach area gets smaller and more of it is underwater at high tide. Even if a turtle lays a nest on such a beach, the eggs will not survive the flooding that occurs when tides are high.

In addition, with warmer oceans, storms are expected to get stronger. Warm water acts like an engine. Hurricanes tend to get much bigger, with stronger winds, when sea temperatures are warm. These bigger storms cause flooding and beach erosion. This means that a lot of the remaining beach is washed away each time there is a big storm event.



Erosion has washed away part of the beach. Can you see the white sea turtle eggs?

If there are more storms or flooding, there is a lot less beach available for the turtles to use for nesting. This would result in fewer hatchlings being born.

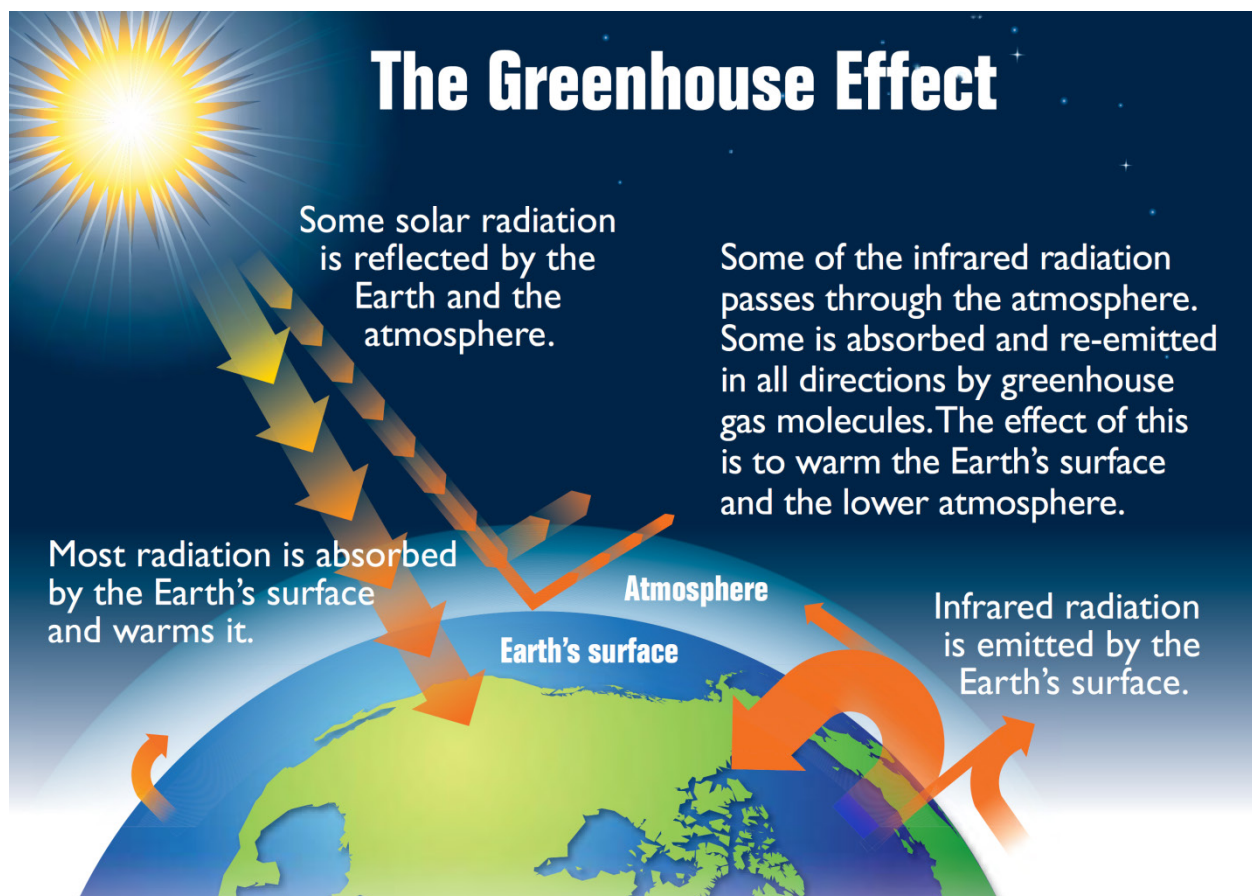
Ocean acidification

There is another climate change effect that has scientists worried. This is called **ocean acidification**. It is a very difficult problem.

Ocean acidification is complicated. Over the past two hundred years, our planet has been getting warmer. This is what most scientists are referring to when they



talk about climate change. This warming trend is related to a change that has occurred in the gases in our atmosphere. Over the past two hundred years we have had a very large increase in the amount of **carbon dioxide** in our air. Carbon dioxide is the gas that leaves your lungs when you breathe out. Carbon dioxide also comes from the tail pipes of cars. It is released by some factories. There are both natural and man-made sources of carbon dioxide. Pure carbon dioxide is poisonous. It also traps the heat from the sun. This is called the **greenhouse effect**. Carbon dioxide acts like a blanket and holds heat closer to the surface of our planet, making it warmer.



Carbon dioxide is a gas, but it is also causing changes in our ocean. Carbon dioxide mixes into water very easily. Over the past two centuries, the ocean has **absorbed** a lot of carbon dioxide. About one third of the carbon dioxide that has been released into our atmosphere is now in the ocean. This has been very helpful in keeping the extra gas out of the air. Moving carbon dioxide into the ocean has

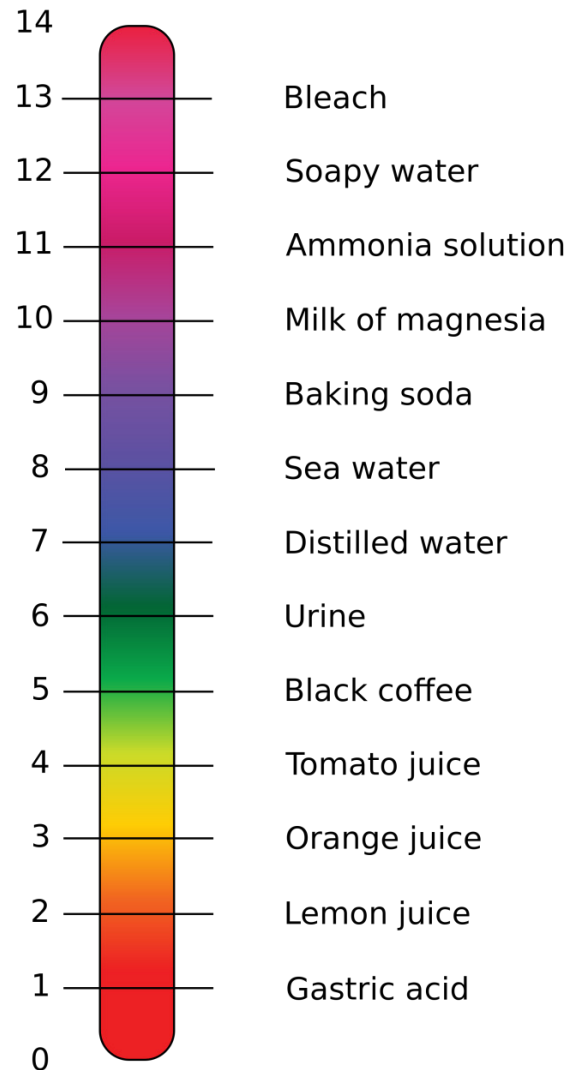


slowed climate change. Our planet is still getting warmer. The increase in carbon dioxide in the ocean is causing another problem though. When mixed into water, carbon dioxide acts like an **acid**. Examples of acids that you may have at home are orange juice and vinegar.

Acids are substances that have a **pH** less than 7. The pH scale goes from 1 to 14. It is used to measure acids and **bases**. Anything with a number below 7 is called an acid. Anything with a pH value greater than 7 is called a base. Plain water is neutral and has a pH of exactly 7.

The ocean is supposed to be a little bit basic. It should have a pH value of 8, or even a little higher. In aquariums for saltwater fish, we usually want a pH of about 8.3.

In the past 50 years, the amount of carbon dioxide in our ocean has really increased. Humans burn lots of coal, oil and gas to make energy. This produces lots of carbon dioxide. The increased carbon dioxide levels have caused the pH of the ocean to start to change. This could be a really big problem! In some areas, the pH has started to drop and some animals are struggling. Change has not happened everywhere, and so far it is small. But scientists are worried. The decrease in ocean pH is expected to continue and get worse in coming years. This process is called ocean acidification. The ocean is huge, so it takes a very long time for things to change, but the water is slowly becoming more acidic. This could be very bad for many animals and for people too!



The pH scale. This gives examples of liquids that have different pHs.



Some types of rock dissolve in acids. A very important example is limestone. This is the material that makes up the hard surfaces of corals and sea shells. It is also in the shells of crabs and many types of **plankton**.



A baby snail (left) and crab (right) in the plankton.

When the ocean becomes more acidic, it is very difficult for shells to form properly. Some of the animals that need shells are at the very base of the **food web**. If they cannot make their shells, they do not survive. Scientists are worried that the food web itself will be damaged. This means that eventually there may not be enough food for the big animals.

Several of our sea turtles eat shellfish, crabs and other shelled animals from the bottom of the sea. Loggerhead and ridley sea turtles eat these animals. Hawksbill turtles eat sponges that mostly grow on coral reefs. Humans like to eat some of these animals too. Ocean acidification may mean that there will be less clams, oysters, crabs and shrimp for everyone.

Harmful Algal Blooms

Another natural problem is called “**harmful algal blooms**” or HABs. A bloom occurs when tiny algae that live in the water column start to grow very, very quickly. Sometimes there are so many algae that the water turns color. Bright green and reddish-brown algal blooms are not unusual. The blooms are sometimes called “red tide.” Some of these algae can release harmful chemicals



into the water. The chemicals can then get into the air. When these algae form blooms, they are called harmful algal blooms. HABs can make many animals very sick, including sea turtles and humans.



These chemicals get into animals that eat the algae. They can also stick to the surface of plants. Animals that eat poisoned fish or plants can get sick and die.

Red tide is an important cause of sickness in wild sea turtles. Turtles that are sick from red tide may be unable to swim properly. They can be very confused and not seem to know where they are or what they need to do. Sick turtles may swim in circles near the surface of the water. If these turtles are not rescued, some of them will die. They are at risk of starving because they cannot hunt properly. They may drown because they cannot swim properly. In some cases, they may be hit by boats while they are struggling at the surface.



Turtles that are sick from red tide do not all die. If they can swim away from the affected area they may recover. Some of these areas may be very, very large though, requiring the turtles to swim tens of miles to get away from the bloom. If the turtles are rescued and taken to a hospital, they will often recover. In a turtle hospital they can be kept in very small amounts of water so they will not drown. They can be given liquid food to help them until they are well enough to eat normally.



A sick sea turtle is kept in shallow water so that it will not drown.

Red tide can also be harmful to humans. If people breathe air that has red tide chemicals in it, their eyes will burn and they may start to cough. The chemical is very irritating. This is true for sea animals that breathe air too. If they come up to breathe, and the chemicals are thick near the surface of the water, it may be very hard for them to get a good breath.



A red tide bloom makes the ocean water red-brown in color.

There is another way that HABs can affect marine life. Algal blooms can lead to a loss of oxygen from the water column. When there is a large bloom, there are a lot of dead and dying algae in the water. These dead algae sink to the bottom. Bacteria eat the dead algae. This helps keep the environment clean. Unfortunately, the bacteria also use up a lot of oxygen when they do this. Other animals that live in the water, like fish, need that oxygen in order to breathe. The fish will leave the area if they can, but animals that live on the bottom are trapped. Shrimp, clams and oysters will all die in such a place.



How Do We Protect Sea Turtles?

There are many ways that we try to protect sea turtles. Most sea turtle **conservation** happens because of **laws**. There are more than 70 laws protecting sea turtles in different places around the world. Some of these laws make it **illegal** to kill or hurt sea turtles or their eggs. Other laws protect the **environment** that sea turtles live in.

More than 145 countries have signed the Convention of **International** Trade in Endangered Species (CITES). CITES does not allow people to sell endangered and threatened species between countries. This means that people cannot sell jewelry made from hawksbill shells, or meat from green sea turtles to people in other countries. This is the biggest international law affecting sea turtles. All seven species of sea turtles are considered to be "threatened with extinction." They are all protected by CITES. Sale or shipment of sea turtle products between countries is only allowed "in **exceptional** circumstances."



Lotion made from sea turtle parts cannot be sold or shipped between countries.



In the United States, all sea turtles are protected by the *Endangered Species Act of 1973* (ESA). The ESA makes it illegal to **harass**, hurt or kill sea turtles. Sea turtle eggs are also protected.

The U.S. government has written sea turtle **recovery plans**. There are plans for each of the sea turtle species found in U.S. waters. These are the loggerhead, green, leatherback, Kemp's ridley, olive ridley and hawksbill sea turtles. The plans

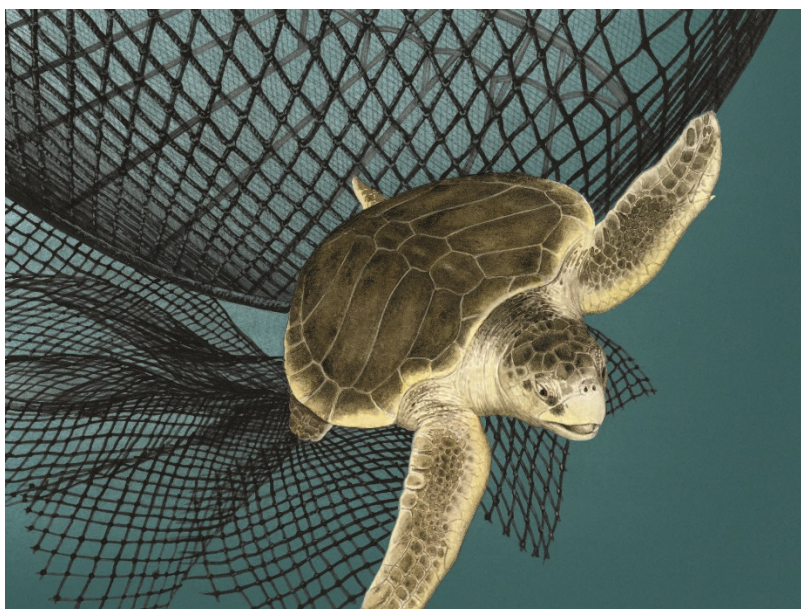


describe the threats to sea turtles, what actions are being taken to save them, and the goal for the species. A goal might say how many nesting females and hatchlings there should be. When the goals are reached, the U.S. can remove sea turtles from the endangered species list.

It would be easier to protect sea turtles if they stayed in one place. But sea turtles migrate over long distances (see chapters 1 and 9). One country might have laws to protect them. But the turtle could nest in a different country that does not have these laws. Sometimes countries do work together to protect sea turtles. For example, the U.S. and Mexican governments wrote and signed the recovery plan for the Kemp's ridley sea turtle together.

Many countries do have laws to protect sea turtles. There are also some regional **treaties** that make it illegal to catch or kill sea turtles. All of these rules were made to try and stop sea turtles from becoming extinct.

In chapter 6, we learned that sea turtles can get trapped in shrimp trawls. Shrimpers use special “escape panels” called **turtle excluder devices (TEDs)** in the top of their nets. These TEDs allow sea turtles and other large animals to get out of the net. Shrimp stay in the bottom of the net. This is good for the shrimpers and the turtles. Shrimpers do not want to hurt turtles, but they want to catch shrimp.





People living or working on beaches where sea turtles lay nests need to use special outside lights. These lights do not confuse nesting or hatchling sea turtles. The special light bulbs are often orange or red in color. Hatchlings will not crawl towards them. Some beach lights have a special cover around them so the light does not shine straight down. That lets the light reflected off the ocean be the one that attracts the turtles.

People do many things to try and help protect sea turtle nests. In the U.S. you must have a **permit** to do anything with sea turtles or their nests. In some places, the nests are marked using sticks and colored tape. Volunteers or park rangers, called the sea turtle **patrol**, will look for turtle nests in the early morning. They mark each nest by putting four sticks into the sand around it. They are careful not to put the sticks into the nest itself. They tie colored tape around the top of the sticks. This lets people know that they should keep away from that area. Sometimes a sea turtle nest sign is attached to the sticks. The date that the nest was found is also marked. This lets biologists know when the babies should hatch. The sea turtle patrol will check on the nests each morning. Marking the nests can help make sure that people do not stick umbrella poles or fishing rod holders down into them.



Sea turtle patrol volunteers marking a nest.



In some places, there are so many nests that the sea turtle patrol does not mark them. Instead they use **GPS** to record the nests' locations. Some parks put wire cages or mesh screens over the top of turtle nests. These help to keep predators, like raccoons and foxes, out of the nest. The holes in the cages are big enough for the hatchling turtles to get through. People have even put hot pepper powder on the sand over nests to keep predators away.



This sea turtle nest is marked with stakes and a sign. The mesh protects the eggs from predators.

Sea turtles sometimes lay their nests in places where the nest or hatchlings could be harmed. Biologists might decide to move those nests to safer locations. Sometimes, eggs from many sea turtle nests are moved into a **hatchery**. Although hatcheries are used in some places, they are not permitted in Florida. A hatchery is an area of beach that is fenced off to protect turtle eggs and hatchlings from predators. When the hatchlings emerge, they can all be released together. This seems like a good thing, but moving turtle eggs can have problems.

- If eggs are turned or shaken when they are moved, they might not hatch. Biologists can mark the tops of the eggs before removing them from the nest. They then know how to place the eggs in the new nest or hatchery.



- **Germ**s from the air or from people can get into the eggs. This can make the developing turtles sick.
- The temperature in the new nest or hatchery might result in more females or more males than there should be.
- Predators can learn where hatcheries are and wait for hatchlings there.
- Hatcheries are expensive.



Sea turtle patrol volunteers do a nest evaluation. The nest evaluation is done after the hatchlings have emerged. Volunteers count the number of hatched and unhatched eggs. Any remaining hatchlings can also be released.



In 2010, there was an oil spill in the **Gulf of Mexico**. Scientists were afraid that sea turtle hatchlings would swim into the oil. They decided to move 275 sea turtle nests from Florida beaches along the Gulf. Sand from the nesting beach was put into small coolers. The eggs from a turtle nest were carefully dug up and placed in each cooler.



Sea turtle eggs are put into a cooler with a tiny wire thermometer. This allows scientists to check the temperature of the eggs.

The coolers were all kept in a special building where the temperature could be controlled. When the turtles hatched, they were released in the **Atlantic Ocean**, far from the oil spill. 14,000 hatchlings were released. That's a lot of turtles! Most of them were loggerheads. zzzz

Everyone can help keep oil out of the ocean by **recycling** motor oil from things like cars and boats. Fishing line can also be recycled. Stores that sell fishing supplies often have fishing line recycling boxes. Sometimes there are fishing line recycling containers at **boat ramps** or **fishing piers**. These are usually white tubes with a curved opening at the top. If we recycle fishing line, it will not end up in the ocean and drown sea turtles. Recycled fishing line is used to make things like picnic benches and **tackle boxes**.

People can also help sea turtles by picking up trash that is on the ground. Even if the trash is a long way from the ocean, it could wash into a **storm drain** and get carried to the sea. It is a good idea to take an extra bag to the beach. People can put trash in it. When people dig holes at the beach, they





should fill them back up with sand when they leave. This will make sure that no mother or hatchling sea turtle gets trapped in the hole during the night.

There is another way that some people have tried to help protect sea turtles. There are a few places that raise sea turtles in captivity and then release the hatchlings.



Sea turtles in captivity being fed with floating pellets.

Like hatcheries, this seems like a good idea, but there can be problems. For example, in captivity there can be lots of turtles living close together. If a turtle gets sick, diseases can be easily spread to other turtles. However, sometimes it is not easy to see if a turtle is not healthy. Release of sick turtles can be very dangerous to wild turtles.



Turtle Tracking

Scientists sometimes **tag** sea turtles in order to learn about them. Some types of tags just allow people to identify individual animals. Other tags also help us learn where the turtle has been and what it has been doing.

Flipper tags are small plastic or metal U-shaped bands that are attached to a turtle's flipper. They are a bit like a hoop earring for pierced ears. The number on the tag is used to identify the animal. Scientists can tag female sea turtles on the beach after they have finished nesting. Sometimes young sea turtles are captured, tagged and released. Sea turtles that are tagged when they are young are sometimes seen again **decades** later when they are nesting.



A young green sea turtle with a tag on its left front flipper

Flipper tags can help us learn how long sea turtles live in the wild. They can also tell us where a turtle migrates. For example, a tagged turtle might be seen in one



location at one time. At another time, it might be seen in a different location. However, it is difficult to read the number on a tag when the turtle is swimming. This is easier to do if the turtle is nesting. Flipper tags are sometimes used to identify dead turtles.

Flipper tags can stay on for several years or more than a decade. Sometimes flipper tags can get torn off the flipper. Two tags are often used in case one falls off.

PIT tags are very small electronic tags (about the size of a grain of rice). They are injected under the skin of the sea turtle. These are similar to the micro-chips that can be used in dogs. These tags are used to identify individual turtles. They can be read using a special scanner. PIT tags are expensive. They are usually not used in hatchlings or very small turtles. PIT tags probably last for the life of the turtle.



A PIT tag next to a penny

Satellite tags are the most expensive type of tags. They also provide the most information. They are boxes containing special radio/computer equipment. An **antenna** sticks out of the tag. The satellite tag is attached to the back of a sea turtle. The tag cannot communicate with a satellite from underwater. To send information to the satellite, the antenna needs to be in the air. If a turtle comes to the surface for a quick breath, the tag can send its data. However, a satellite needs to be in the right location to pick up the tag's signal. Satellites circle around the Earth.

Satellites are machines that circle around the earth. They transfer information from one place to another. They let us make long-distance telephone calls. They also allow us to use Global Positioning Systems (GPS) to find our location.



A satellite circling the Earth.

There might not be a satellite overhead when a turtle comes to the surface. When a tagged turtle comes to the water's surface, or crawls onto a beach, the tag will try and send information to a satellite in space. The tag will report the turtle's location and whatever other information it has recorded. Sometimes it will tell how deep a turtle has been diving. Or it might report the water temperature where the turtle is swimming.

Once a satellite has received data, researchers can download the information to their computers. Satellite tags are designed to last up to 18 months. However, they might come loose and fall off the turtle sooner than that. Information from satellite tags helps scientists learn where turtles migrate and how fast they can swim.

It is a challenge to make the tags stick to the turtles' backs. If turtles have hard shells, strong glue called **epoxy** is used. **Fiberglass** (used in making many boats) can also be used.



A satellite tag stuck to the back of a loggerhead sea turtle.

Epoxy and fiberglass will not stick to a leatherback's back. Instead, tags are attached to the carapace with wires.



Helping Sick or Injured Sea Turtles

Some sea turtles only come to shallow waters near the coast to nest. The leatherback is an example of this. Other species spend some of their early years in the open ocean. After a few years, they return to shallow coastal waters and stay there for the rest of their life. In some places, green sea turtles may crawl onto the beach to get warm. In most places, the only time that healthy sea turtles come up onto land is to lay eggs.

Sick turtles act differently. When turtles are sick, they may be too weak to swim away from the current. They may float at the surface of the water. Sometimes they wash up onto the beach. We call this **stranding**.



A stranded sea turtle.

Sea turtles are threatened. People care about sea turtles and want them to do well. They may travel many miles to watch wild turtles nest or to swim with them on reefs. Some people work to save individual turtles that are sick or injured. If sick turtles are found stranded on land or floating in the water, they may be taken to an animal hospital. These hospitals can be in a veterinary clinic, wildlife hospital, zoo or aquarium. The rescued turtles are tested to see what is wrong with them. Then they are treated so they can recover.



If only one or two turtles strand they are usually taken to an animal hospital. If a lot of turtles strand at one time, a temporary hospital may be built on the beach. When a lot of turtles strand at once it is called a mass stranding.

In this chapter, we will look at:

1. How we can tell if a sea turtle is sick,
2. Common reasons that turtles need to be rescued,
3. What happens when a hurt, sick or stranded sea turtle is found?
4. Releasing sea turtles, and
5. What we can do.

How we can tell if a sea turtle is sick

As sea turtles can't talk, it can be hard to tell if they are sick. Sick turtles are often found floating or stranded on the shore. A floating turtle usually cannot dive. If it tries to swim under the water it bobs back up to the surface.



This sea turtle cannot keep its body completely under the water.

If this happens for a long time, the turtle cannot eat and it loses weight. Algae and **barnacles** grow on its carapace. In Florida, this type of sick turtle is sometimes called a “Barnacle Bill.”



A loggerhead sea turtle covered in white barnacles.

Stranded turtles wash onto a beach and cannot get back off. They are usually found at the high tide mark. The waves push them onto shore and leave them stuck when the tide goes back out. This is different from a nesting turtle that crawls onto and off a beach despite the tide. It is also different from a **basking** turtle that swims into shallow water and crawls onto the beach during the day to soak up the sun. Nesting and basking turtles can return to the water when they want to. A stranded turtle is sick or injured and cannot get itself back into the water. It might not be strong enough to swim and could drown if put back in the ocean.

Common reasons that turtles need to be rescued

Reasons that sea turtles may need to be rehabilitated can include:



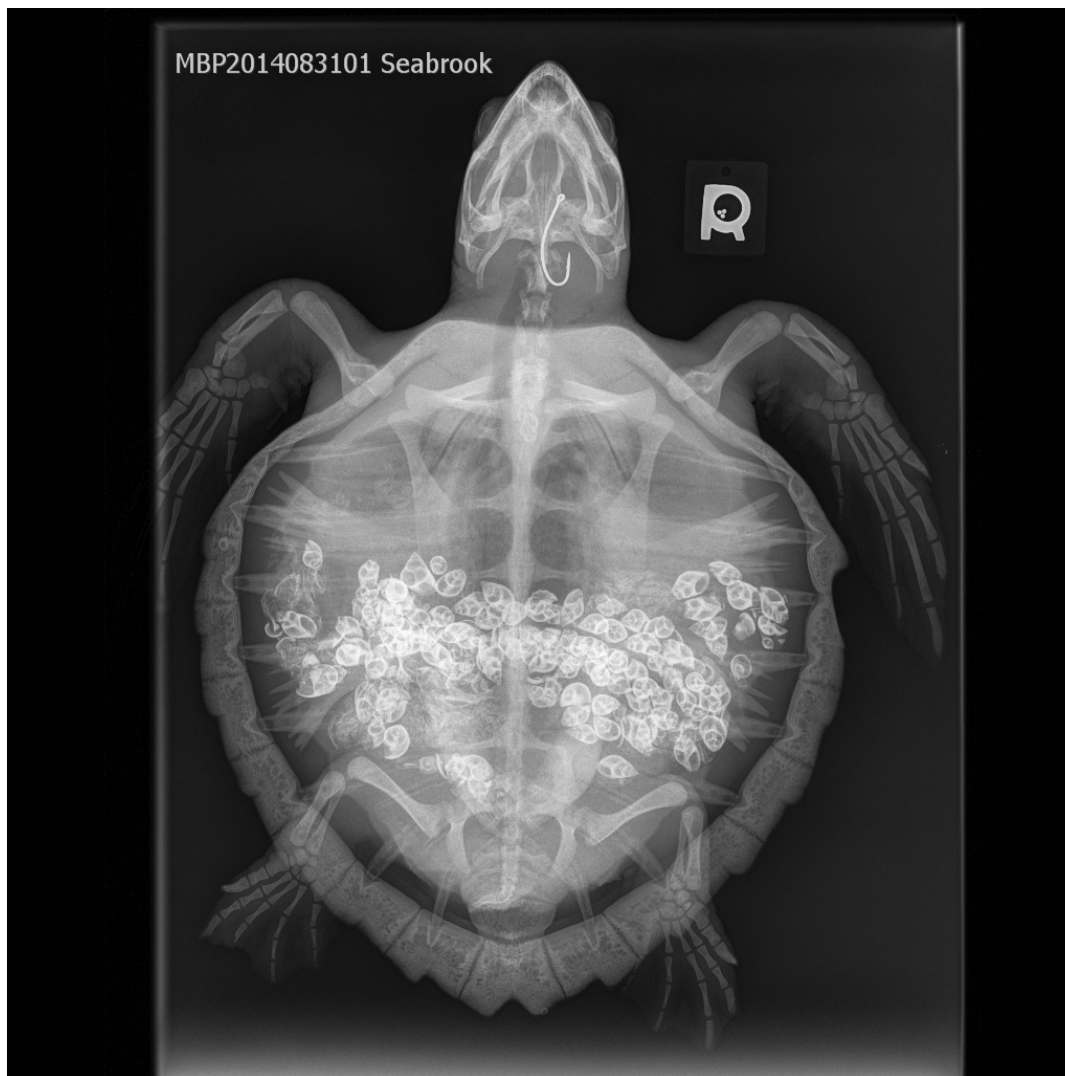
Dry drowning- This occurs when a sea turtle is held under water for a long period of time (hours). This can happen in a fishing net or on longline hooks.



The turtle will hold its breath until it goes unconscious. An unconscious turtle cannot take a breath. It 'drowns' without breathing in a drop of water! Sometimes these turtles are rescued before they drown. With time, and a chance to catch their breath, they can recover.



Fishing hook injury- This happens when a turtle swallows or gets caught by a fishing hook. The hook may have been discarded. Sometimes the hook is still attached to someone’s fishing rod. Turtles often get hooked in the mouth. If they swallow the hook, it can be very hard to get out. Sometimes they get “foul hooked,” which means the hook gets caught on their flipper or skin. When the hook is on the outside of the turtle it is much easier to get it loose.



In this x-ray you can see a fishing hook stuck in the Kemp's ridley sea turtle's throat.

Crab trap entanglement- Turtles sometimes learn to steal fish (bait) from crab traps. These turtles can get caught by the rope and **buoy** attached to the trap. Sometimes they just swim by and accidentally get tangled in the rope. Most turtles can swim with a crab trap, at least for a while. But when they are tangled



they cannot swim or dive normally. When pulling the extra load, feeding becomes very hard. These turtles will slowly starve to death if they don't get loose. Also, the rope can get very tight around their flippers, resulting in nasty wounds.

Cold stunning- When the water temperature drops suddenly, sea turtles can be "cold-stunned." Sea turtles are reptiles. They need environmental (outside) heat to maintain their body temperature. When they get cold, they become tired and sluggish. Their muscles don't work and they get very sick.



These green sea turtles stranded in cold weather.

Starvation- Starvation occurs when an animal is not eating well. The animal loses weight and muscle strength. Although this is not a disease on its own, turtles admitted to sea turtle hospitals are often starving. Starvation can result from any of the other problems on this list.

Diseases- Like all animals, sea turtles can get many diseases. These are caused by bacteria, viruses, parasites and fungi. Diseased turtles may not be able to swim, eat or function properly. A veterinarian has to figure out why they are sick before treatment is started.



- **Fibropapillomatosis** (*FIYE-bruh-PAH-pill-LOH-muh-TOE-siss*)- This is a disease that causes tumors to grow on sea turtles. The tumors are caused by a virus, but there is still a lot to learn. Turtles that are sick



from the virus may be very weak. If the tumors have grown inside the turtle's throat, it may be starving. If tumors are located only on the outside of the turtle, they can be removed. If tumors are internal the turtle will probably not recover.

Boat strike- Sea turtles swim just below the water's surface. When they take a breath, all that can be seen is their nose. Boaters often cannot see the turtle until it is too late. They can accidentally hit it. A turtle that is hit by a boat may have internal and external damage because of the impact from the bottom of the boat. Additional injuries can be caused if the boat's skeg or propeller cuts through the animal.





Red Tide – There are different kinds of plants in the ocean. Some of these are very tiny, single-celled plants called algae. Some algae produce poisons. If there are a lot of these algae in the water, they create a red tide. The water is discolored and many animals get sick. Turtles exposed to red tide may be confused and have trouble breathing. These turtles can strand, but if hospitalized they often recover with treatment.

All of these situations require specific treatments and specialized care before the sea turtle can be returned to the ocean.

What happens when a hurt, sick or stranded sea turtle is found?

If people find a sea turtle that needs help, they should call wildlife officials. Someone who is trained to rescue sea turtles can then come and check out the animal. They will carefully examine the turtle. They will identify the type of turtle, and may take photographs and measurements. If the turtle is acting normally, it might be able to be released.

Most of the time, a sea turtle that is washed ashore or found floating is not healthy. If it is visibly injured or acts like it might be sick, the turtle will probably be taken to a sea turtle hospital for further help. It may need some medical attention before it is taken to the hospital. All sea turtle hospitals have permits and are inspected. They have to follow a lot of rules to do a good job.





Sometimes sea turtles that wash ashore or are found floating are dead. These turtles might still be taken to a sea turtle hospital so that doctors can figure out why they died.

Once the sea turtle arrives at the turtle hospital, there are several steps that will be taken:

- *Identify what is wrong with the turtle (diagnosis)*—Finding the cause of illness is called a diagnosis. A **veterinarian** or biologist will do a **physical examination** on the turtle. This is similar to the way a veterinarian will check your cat or dog. The turtle is weighed and measured. There are normal values available that can be compared to the information from the sick turtles. The normal values are from healthy turtles. These are used to tell if the sea turtle weighs less than it should. Sick turtles are often very thin. As turtles have hard shells that do not move, it may not be easy to tell if they are skinny. When veterinarians examine turtles, they look at the areas around the front flippers and neck. These areas have skin and muscle. A skinny turtle will have skin that is wrinkled and sunken in. After the physical examination, the veterinarian may do some other tests. These could include taking blood samples or x-rays. A lot of work is done to determine whether the animal is sick or healthy. Good information results in a good diagnosis. The team can then do the best job possible to help the sick turtle.



A biologist takes a blood sample from a sick turtle.



- *Create a plan to treat the turtle (treatment)*—When the decision is made to treat a sick turtle, a plan is developed. If needed, the turtle will be given some special foods and fluids to help it gain weight. It will get special medicine if a disease is diagnosed. In a turtle hospital, treatment plans are strictly followed.



A young ridley sea turtle gets a shot of medicine.

- *Refine the treatment plan*—As the sea turtle gets better (or worse) the treatment plan is adjusted. Improving the treatment plan gets the animal well as quickly as possible.

Releasing sea turtles

After treatment, sea turtles are cleared by a veterinarian for release. They will be released at the same place where they were found. This can be the beach they stranded on or the part of the ocean from which they were caught. When a turtle



is released at the beach, there is a big celebration. Rescue workers want everyone to know about the turtle. It takes a lot of work to send them home.



A large crowd gathered to see this young green sea turtle's release. The turtle was found tangled in fishing line. Doctors had to remove its front right flipper, but the turtle could still swim well.

Wildlife care is bittersweet. Hospital staff spend many hours caring for a sick turtle. But they may never see their patient again once it is released.





Sometimes turtles are injured so badly they can never be released back into the ocean. If it is going to stay at a zoo or aquarium, special permits are needed for that. Many of the turtles you see at an aquarium are not healthy enough to go back to the ocean. When this happens, the sea turtles can become teachers. They help everyone learn about them and the ocean they call home.

What we can do

In a perfect world, sea turtle hospitals would not be needed. Sea turtles would not get sick, strand, be caught in fishing gear, or be hit by boats. Here are things we can all do to help sea turtles:

- Collect up all loose fishing line and hooks when fishing
- Look closely at the water ahead when boating
- Don't pollute--pick up trash when you see it on the ground
- Use less energy--change climate change!
- Protect beaches and waters where turtles nest and live
- Learn who to call if you find a stranded sea turtle



Glossary

Absorbed: In chemistry, when something soaks up something else. Example: The paper towel absorbed the spilled milk.

Acid: Something with a pH less than 7. Acids are often sour. Acids can dissolve metals and some rocks.

Adaptation: Something that has changed to allow a plant or animal to survive in its environment.

Adapted: A plant or animal that has changed to be able to survive in a particular type of place.

Algae: [*AL-jee*] A plant-like organism that does not have roots, flowers or stems. Algae live in water or damp places.

Ancestor: An animal in the past from which a modern animal developed.

Antenna: A wire or metal rod that is used to send or receive radio signals.

Archelon: [*ARR-keh-lon*] A type of sea turtle that lived with the dinosaurs.

Arribada: [*ahr-ee-BAA-duh*] Spanish word for “arrival.” This word is used to describe mass nesting by ridley sea turtles.

Atlantic Ocean: The ocean basin that separates the Americas from Europe and Africa.

Average: A number that describes what is true most of the time. In math, the average is the result of adding together all the possible values and dividing by the number of values.

Base: Something with a pH higher than 7. Bases often taste bitter.

Barnacle: A type of ocean animal that grows on hard surfaces. Most barnacles have a volcano-shaped shell. They use feather-like arms to catch food.

Basking: To lie or relax in a warm place.

Beach nourishment: Adding sand to a beach to replace sand that washed away.

Boat ramp: A slope that people back a trailer down to put a boat in the water.



Brackish: Water that is a mixture of sea water and fresh water.

Buoy: (American: *Boo-eeey*; British: *Boy*) A floating object used to mark a location.

Bycatch: Animals that are not what the fisherman is trying to catch.

Camouflage: Using shape or color to hide.

Carapace: [*KAHR-uh-pace*] The back, or top, shell of a turtle.

Carbon dioxide: [*CAR-bun die-OX-ide*] A gas produced when plants and animals breathe. It is also made when people burn gasoline or coal.

Caribbean: A region between South America and Florida.

Carnivorous: Eating only meat.

Climate: The average weather in a place over many years.

Climate change: A change in global or regional climate patterns.

Coexist: To live in peace with one another.

Cold stunned: When sea turtles get too cold, they stop moving and float at the water's surface. We call them "cold-stunned." They can become prey or get hit by boats. They might even die from the cold.

Conservation: The protection of things found in nature.

Coral reef: Habitats made by living animals called corals. Coral reefs form in tropical oceans. Coral reefs have many, many different types of plants and animals living on them.

Damp: A little bit wet.

Decade: A period of ten years.

Diagnosis: The act of identifying a disease from its signs and symptoms.

Dichotomous key: [*die-KOT-uh-muss*] A tool used by scientists. Pairs of questions are used to identify a plant or animal.

Disoriented: Feeling lost or confused.



Ectothermic: Cold-blooded. An animal whose body temperature varies with the environment.

Emerge: To come out or appear.

Endangered (species): A type of plant or animal that people think might become extinct.

Entanglement: The act of becoming tangled up in something.

Environment: The area in which something lives.

Epoxy: A type of very strong glue.

Equator: An imaginary east-west line that circles the earth. It is half way between the North and South Poles.

Eroding: Being affected by erosion.

Erosion: The movement of sand, soil or rock by wind or water.

Esophagus: [*ee-SOFF-a-guss*] The tube that leads from the mouth through the throat to the stomach.

Exceptional: Unusual

External anatomy: The structures on the outside of the body.

Extinct: A species that no longer exists.

Fiberglass: A type of plastic with glass fibers in it.

Fibropapillomatosis: [*FIYE-bruh-PAH-pill-LOH-muh-TOE-siss*] A disease that causes tumors to grow on sea turtles.

Fishing pier: A dock sticking out over the water that people use to fish from.

Flipper: The parts of a sea turtle, whale or dolphin's body that are in the same position as human arms and legs.

Flipper tag: A piece of metal or plastic that is folded over. It gets clipped to a sea turtle's flipper. The tag is numbered so scientists can identify the turtle.

Food web: A diagram showing the flow of food energy through a group of plants or animals.



Foraging: [*FOHR-a-jing*] Searching for food.

Fossil: The remains of a plant or animal from long ago preserved in earth or rock.

Fused: Stuck or melted together.

Gas: One of the three main states of matter. The other two are solid and liquid.

Germ: A microscopic living thing that sometimes causes disease.

Glacier: [*GLAY-shur*] A large body of ice that moves slowly down a slope.

Government: A group of people who make the rules that people in an area live by.

GPS: Global Positioning System. A way for people to find where they are using satellites.

Greenhouse effect: The warming of Earth's surface and lower atmosphere caused by certain gases.

Gulf of Mexico: The body of salt water located between the southern United States and Central America.

Harass: [*huh-RASS*] To annoy someone, or an animal, over and over again.

Harmful algal bloom: A bloom forms when tiny plants that live in water grow very, very quickly. If those plants can make toxins, they form a harmful algal bloom.

Hatchery: A protected place for eggs to hatch.

Hatchling: A sea turtle that has just come out of its egg.

Herbivorous: A description for something that eats only plants.

High tide line: The area of the shoreline where the water reaches during high tide. It often has a line of seaweed left when the tide falls.

Illegal: Against the law.

Imprint: To learn something that will affect one's behavior.

Incubate: To keep eggs warm before hatching.



International: Involving two or more countries.

Invertebrate: An animal that does not have a backbone or spinal cord

Juvenile: Young. In sea turtles, juvenile usually refers to animals that are 1-5 years old.

Kelp: Brown, plant-like algae that grows in cool sea water. Kelp has gas bubbles that help keep it floating in the water.

Keratin: A type of protein that forms human hair and nails.

Lateral scutes: The rows of scutes on each side of the vertebral scutes on a sea turtle's carapace.

Law: Rules made by the government.

Life history: The changes in a plant or animal over its life.

Low frequency: Types of sounds often heard as a low rumble.

Migrate: To move from one place to another, usually for feeding or breeding.

Natal region: The beach or area where a sea turtle hatched.

Navigate: To make one's way about, over, or through.

Nesting season: The time of year when sea turtles lay their eggs.

Niche: A habitat that contains the things necessary for a particular plant or animal to live

Niche specialization: The process by which a plant or animal becomes better adapted to the specific characteristics of a particular habitat.

Ocean acidification: A process by which the ocean's pH decreases.

Omnivorous: Term for an animal that eats both plants and animals.

Organisms: Individual living things.

Overheat: To become too hot.

Oxygen: A gas that is necessary for life.

Papillae: Finger-like objects that stick out in a sea turtle's throat.



Patrol: People who walk the beach to protect sea turtles and their nests.

Permit: A license. A written statement that allows something to happen.

pH: A scale from 0 to 14 that is used to measure whether something is an acid, neutral or a base.

Physical examination: A doctor's examination of a patient's body

PIT tag: A tiny electronic device that can be inserted under an animal's skin. PIT tags can be "read" by a special receiver.

Plankton: Plants and animals that cannot swim against a current.

Plastron: The part of a turtle's shell that covers its belly.

Poaching: Hunting animals or their eggs illegally.

Polar: Referring to the North or South Poles.

Post-hatchling: Sea turtles that are between 24 hours and one year old.

Predator: An animal that hunts and eats other animals.

Prey: An animal that is hunted and eaten by other animals.

Propulsion: Pushing something forward in the water.

Rainforest: A place with lots of rain and large trees. Many different plants and animals live in rainforests.

Recovery plan: A written document. It has steps that will help sea turtles. If the steps are followed, sea turtles will no longer be threatened.

Recycling: Taking things and turning them into something else that can be used.

Red tide: Red tides form in the ocean. They are caused when some kinds of tiny algae grow really fast. Red tide algae make toxins. Red tides can kill fish and other animals.

Reptile: A group of cold-blooded air-breathing vertebrates. Reptiles usually lay eggs and have skin covered with scales or bony plates. Reptiles include snakes, lizards, turtles, and alligators.

Rudder: The part of a boat that is used for steering.



Runoff: Water from rain or snow that flows over the surface of the ground and finally into streams.

Sand dune: A hill of sand at the top of a beach.

Sand grains: The individual pieces of sand that make up a beach.

Sargassum: A type of brown seaweed. *Sargassum* can float in the ocean.

Satellite tag: A type of tag used to track animals. The tag sends signals to satellites. The signals let scientists know where the animal is.

Scutes: Individual sections of a sea turtle's shell.

Sea level: The height of the surface of the ocean. This level is half way between low and high tides.

Sea turtle: A type of swimming turtle that lives in the ocean.

Southern hemisphere: The part of the world that is south of the equator.

Species: A group of living things that are of the same kind. All individuals of the same species share a scientific name.

Storm drain: An opening along the ground that rainwater flows into. Storm drains are pipes that lead to a large body of water.

Stranded: Washed up on shore.

Stranding: A word used to describe what happens when a sea turtle washes up on shore. Dolphins and whales can also strand.

Streamlined: Designed to move through water or air easily.

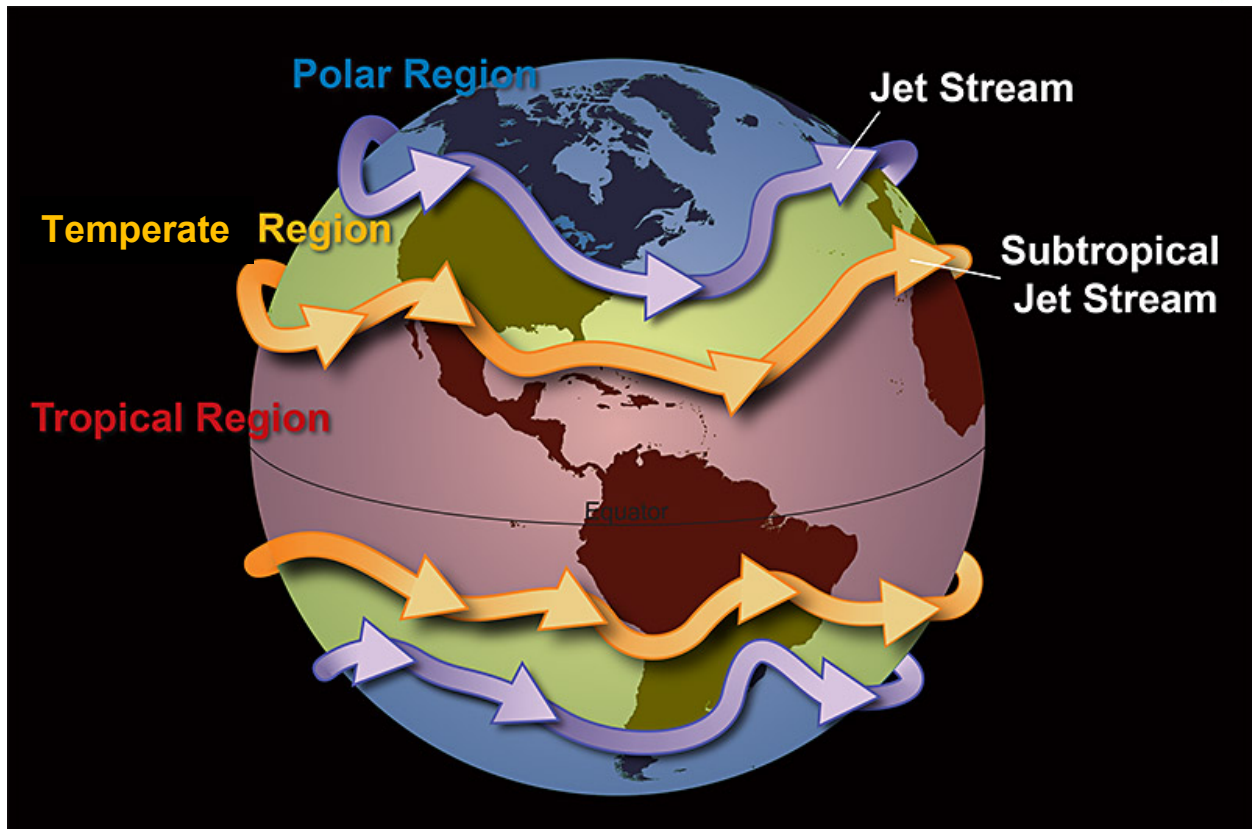
Substrate: The base which something lives on or moves over.

Subtropical: The part of the world that is not as hot as the tropical area or as cold as the temperate area.

Tackle box: A box used to hold hooks, weights and other items for fishing.

Tag: An object that is attached to an animal so that people can identify it.

Temperate: The part of the world between the tropics and the Arctic or Antarctic.



http://www.srh.noaa.gov/jetstream/clouds/height_max.htm

Terrapin: A type of turtle that lives in brackish water.

Threatened (species): A type of plant or animal that could become endangered.

Topography: The shape, ups and downs of the land.

Tortoise: A type of turtle that lives only on land.

Trawl: A type of fishing net that is dragged behind a boat.

Treaties: Agreements between different countries.

Treatment: The action a doctor takes to make a patient well.

Tropical: The part of the world between the two tropics. The tropical region includes the equator.

Tumor: A growth of tissue that is not normal.

Turtle excluder device: A special “door” used in shrimp nets to let turtles escape.

Vegetation: Plants



Vertebral scutes: The row of scutes down the middle of a sea turtle's carapace.

Vertebrate: An animal that has a backbone or spinal cord.

Veterinarian: A doctor who treats animals.

Virus: Tiny things that can cause diseases. The flu is caused by a virus.

Weather: The state of the atmosphere at any given time. Weather includes temperature, rainfall, wind and more.



Image credits. Many of the images used in this book are copyrighted and have been used with permission. Most may not be duplicated for other uses without first obtaining permission from the copyright holder.

Page	Credit
1	©Dawn Witherington (red-bellied cooter, diamondback terrapin)
1	Gopher tortoise in shell by © Hans Hillewaert, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=15253979
1	Adult Galapagos tortoise by Mfield, Matthew Field, http://www.photography.mattfield.com - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=4210424
2	©Dawn Witherington
2	Green sea turtle grazing by P. Lindgren- Own work, CC BY-SA 3.0 https://commons.wikimedia.org/wiki/File:Green_Sea_Turtle_grazing_seagrass.jpg
3	©Dawn Witherington
4	©Ed Perry (used with permission)
4	©Daisy Butler (used with permission)
5	Lisa Morse/Marine Photobank
6	©Dawn Witherington
7	©Dawn Witherington
8	©Dawn Witherington
9	Projeto Tamar Brazil/Marine Photobank
10	©Dawn Witherington
10	Leatherback hatchling ©Linda Schonknecht 2007/Marine Photobank
11	©Dawn Witherington
11	Loggerhead hatchling and <i>Sargassum</i> , NOAA
12	©Dawn Witherington
13	©Dawn Witherington (both images)
14	Hawaii green turtle with severe fibropapilloma tumors by Peter Bennett & Ursula Keuper-Bennett - Original photograph, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=11577233
15	©Dawn Witherington (both images)
16	©Dawn Witherington
16	Arribada; Toni-Torres-Gladys Porter Zoo, NOAA
17	©Dawn Witherington (both images)
18	©Dawn Witherington
19	Hannah Seward/Marine Photobank
20	©Dawn Witherington
21	©Dawn Witherington
22	Archelon skeleton; Maia McGuire
22	By Matthias Scholz-own work. CC BY-SA 3.0. https://commons.wikimedia.org/wiki/File:Sea_turtle_head.jpg



23	Freshwater turtle skeleton; Maia McGuire
23	NOAA
24	©Emily Montgomery (used with permission)
25	©Emily Montgomery (used with permission)
25	Countercurrent blood flow; ©Dawn Witherington
26	U.S. National Park Service
27	©Dawn Witherington
28	Florida Fish & Wildlife Conservation Commission
28	©Dawn Witherington (graph)
29	©Dawn Witherington
30	©Ed Perry (used with permission)
31	©Dawn Witherington
31	By Jeroen Looye-Mabibi-own work. CC BY-SA 2.0. https://www.flickr.com/photos/looye/6780166094
32	©Dawn Witherington (both images)
33	Florida Fish & Wildlife Conservation Commission
34	©Dawn Witherington (both images)
35	©Dawn Witherington
36	By Creative-museum-own work. CC BY-SA 3.0. https://commons.wikimedia.org/wiki/File:Peigne_en_%C3%A9caille.jpg
37	©Dawn Witherington (entangled leatherback)
37	Sea turtle stuck in beach chair; Episkopi turtle watch (used with permission)
38	©Dawn Witherington (both images)
39	Image Copyright N Chadwick. This work is licensed under the Creative Commons Attribution-Share Alike 2.0 Generic Licence. To view a copy of this licence, visit http://creativecommons.org/licenses/by-sa/2.0/ or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.
40	©Dawn Witherington
41	By Brocken Inaglory - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=2133657
42	©Dawn Witherington (jellyfish)
42	Polar bear by Arturo de Frias Marques - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=34567165
43	By go_greener-oz - Own work, CC BY-ND 2.0, https://www.flickr.com/photos/go_greener_oz/3047060508
44	Billy Shaw, U.S. Fish & Wildlife Service
45	U.S. Environmental Protection Agency
46	By Edward Stevens – Own work, CC BY 3.0. https://commons.wikimedia.org/wiki/File:PH_Scale.svg
47	Matt Wilson/Jay Clark NOAA



48	Jennifer L. Graham, U.S. Geological Survey
49	Florida Sea Grant
50	NOAA
51	Maia McGuire (lotion)
51	©Ed Perry (used with permission)
52	©Dawn Witherington
53	©Eastman Environmental (used with permission)
54	Ianaré Sévi – Own work. CC BY-SA 3.0. https://commons.wikimedia.org/wiki/File:Protected_Sea_Turtle_Nest_(Boca_Raton_FL).jpg
55	©Eastman Environmental (used with permission)
56	Jennifer Strickland, U.S. Fish & Wildlife Service
56	Maia McGuire (fishing line recycling container)
57	By Lhb1239 - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=17568200
58	Maia McGuire
59	By Dworshak National Fisheries Complex, CC 1.0. https://commons.wikimedia.org/wiki/File:PIT_Tag.jpg
60	NASA
61	NOAA
62	Jeff Pollin/Marine Photobank
63	Ruth Francis-Floyd
64	Jeff Pollin/Marine Photobank
65	Doug Helton, NOAA
66	Shane Boylan, South Carolina Aquarium (used with permission)
67	Florida Fish & Wildlife Conservation Commission
68	Green sea turtle with fibropapillomatosis. Lacey Price/Marine Photobank
68	Sea turtle hit by boat. Naomi Blinick/Marine Photobank
69	Shane Boylan, South Carolina Aquarium (used with permission)
70	Ruth Francis-Floyd
71	Shane Boylan, South Carolina Aquarium (used with permission)
72	Maia McGuire (both photos)