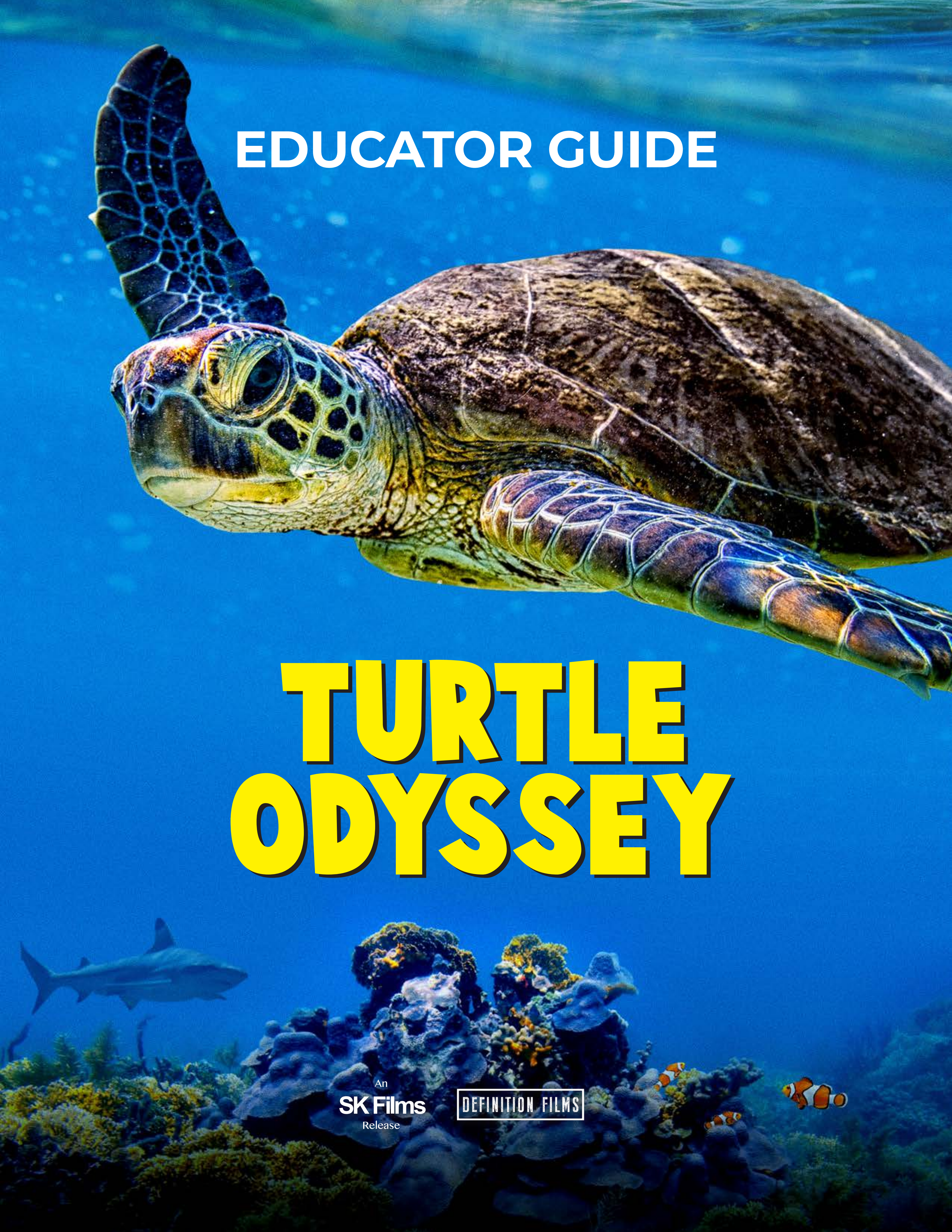
EDUCATOR GUIDE

TURTLE ODYSSEY



An SK Films Release

DEFINITION FILMS

Background Information for Educators

Sea turtles are one of our planet's most ancient species. They have existed on Earth for over 100 million years. During that time, there have been relatively few changes to these marine turtles. Despite their long history, sea turtles are now a vulnerable group in danger of becoming extinct. With sea turtles struggling to survive, we need to understand more about the environment and the condition of the Earth's ecosystems. As more research is done and more people become concerned about the sea turtles, we have an opportunity not only to save sea turtles from extinction, but also to protect some of the ecosystems that play a large role in humans' lives.

You might think, "I live in a landlocked state. Why should I care about sea turtles?" The impact of sea turtles extends far beyond what you might expect. Sea turtles are one of the few organisms that eat seagrass, in addition to jellyfish and a variety of other seafood. In order for a seagrass bed to stay healthy, it needs for the grasses to stay clipped and not grow out of control. Sea turtles and manatees are the primary maintainers of these beds. As long as seagrass beds are healthy, there are many other organisms that can make use of them for shelter, protection, and reproduction. Without these areas for fish, shellfish, and crustaceans, there would be a decline and eventual extinction of many organisms. This would include not only the organisms that directly make use of the seagrass beds, but also those parts of the ecosystem that are dependent on these organisms. Many of the marine animals that humans harvest would be lost.

Sea turtles also have an impact on the beaches and dune areas that humans enjoy for recreation. During much of the year, there are few nutrients in dune areas because sand does not retain nutrients well. Sea turtles nest on beaches and lower dunes, depositing many eggs in the sand. In a 20 mile stretch of beach along the Florida cost, sea turtles can lay 150,000 pounds of eggs. Not all of the eggs will hatch and not all hatched turtles will make it to the ocean. Any eggs or hatchlings that remain on the beach are an excellent source of nutrients that remain in the sand. These nutrients allow dune vegetation to grow, which stabilizes the dunes and prevents them from eroding away. As with any ecosystem, maintaining the dunes and their vegetation is important for the many organisms that live in the area.

Sea turtles are an important part of two ecosystems. In the marine ecosystem, they help to maintain the seagrass beds, which then allow many other organisms to survive and reproduce. Humans rely on many of these as a food source. Sea turtles are also part of the beach and dune ecosystem and help to maintain these areas. Humans use beaches for a wide variety of activities, including recreation. If sea turtles were to become extinct, it would negatively impact humans in multiple ways.

About Sea Turtles

There are seven species of sea turtles that scientists recognize. Six of the seven species are found in waters around the United States. Because sea turtles spend a lot of time underwater and migrate great distances, they can be difficult to study. However, scientists do know some information about their lives.

The seven species of sea turtles each have a common name and a scientific name. The common names generally come from characteristics of the turtle. Each species also has several interesting facts that are associated with it.

Green sea turtles (*Chelonia mydas*) are named for the green fat that is found under their shell. They have nesting sites in over 80 countries and when they are born, they are only 5 centimeters long. Unlike many other turtles, green turtles and other sea turtles cannot retract their heads into their shells.

Loggerhead turtles (*Caretta caretta*) are named because of their exceptionally large heads. They also have very strong jaws so that they can eat hard-shelled animals, such as horseshoe crabs. Male and female loggerhead turtles look the same as each other until they become adults, at which point the males have thicker tails and shorter shells than the females. There are more loggerheads in the waters around the United States than any other sea turtle species.

Leatherback turtles (*Dermochelys coriacea*) have a unique shell that is made of a thin layer of tough, rubbery skin covering thousands of tiny bone plates. The shell looks like it is made of leather and it is the only sea turtle with a "soft" shell (though it is still pretty tough). These are the largest turtle, and the fourth largest reptile, in the world. Leatherback turtles are the deepest divers, being able to reach 3,200 feet. That is farther than from the top to the bottom of the world's tallest building, the Burj Khalifa.

Hawksbill turtles (*Eretmochelys imbricata*) have a very narrow head and a beak that resembles a hawk's. They use their beak to grab food from crevices and corals. They are very picky eaters and eat sponges almost exclusively. This is interesting because sponges contain chemicals that are toxic to humans. Hawksbill turtles can eat over 1,000 pounds of sponges in a year, so hawksbill meat is toxic to humans.

ILLUSTRATIONS BY JOE RICHICHI

Olive ridley turtles (*Lepidochelys olivacea*) are so named because of the olive color of their shells. Like Kemp's ridley turtles, they nest in groups of up to 150,000 females. These groups are called arribadas from the Spanish word meaning "arrival." The arribadas are mostly found in Costa Rica, Mexico, and India.

Kemp's ridley turtles (*Lepidochelys kempii*) are named after the fisherman from Florida who discovered and studied them, Richard Kemp. These are the smallest sea turtle and the only species that nests mostly during the day. Kemp's ridley mainly nests in Mexico, with 95 percent of their nesting sites occurring along Mexican coasts.

Flatback turtles (*Natator depressus*) have, as one might expect, a very flat shell. They have the smallest distribution of any of the sea turtles and only nest in Australia. They are the only sea turtle species that does not live and nest around the United States. This is because they stay in waters shallower than 200 feet, meaning they do not migrate into the open ocean. They are eaten by the largest reptile on Earth, the saltwater crocodile.

Nesting Behavior

When sea turtles nest, the females leave the ocean and move to a dry part of the beach. She uses her flippers to move sand away and rotates her body to create a pit. She then lays a clutch of eggs in the pit. After she lays the eggs, she covers them with sand. Incubation takes about 60 days, but the exact time depends on the temperature of the sand. The sand temperature also affects the sex of the hatchlings, with warmer sands leading to more female turtles.

After hatching, the baby turtles dig their way out of the nest, emerging as a group. They orient themselves to the brightest horizon and dash toward the ocean. If they do not move quickly, they may become dehydrated or become food for birds or crabs. Once in the ocean, the turtles swim several miles offshore and are caught up in currents and seaweed that carry them even farther. Even in the ocean, there are threats such as sharks, big fish, and birds. About one in 1,000 sea turtles lives to adulthood.

Sea turtles spend about 90 percent of their lives in the water and may migrate 1,400 miles during that time. They can be found in warm and temperate waters around the world, but return to the beach where they hatched when it is time to nest. This is difficult to imagine in an ocean where there are few visible landmarks, especially as turtles can only raise their heads a few inches out of the water. How are they able to find their birth location years after they left?

The current theory of how turtles sense where they are is


SK FILMS

through magnetoreception, or detecting the magnetic field of the Earth. It is thought that sea turtles can detect the angle and strength of the Earth's magnetic field. This would allow them to know their latitude and longitude at any point and, as a result, they would be able to navigate easily.

Conservation of Sea Turtles: How Can You Make a Difference?

Choose Sustainable Sources

Global fish populations are diminishing rapidly due to high demand, loss of habitat, and unsustainable fishing methods worldwide. At the market, restaurant, or grocery store, be sure to choose seafood that is harvested sustainably. When it comes to many of our favorite seafoods, there are not plenty more fish in the sea. In fact, scientists estimate that up to 90 percent of large predatory fish (those that eat other animals—and usually end up on our dinner plates) have disappeared since humans began heavy fishing.

Marine animals are caught and sold for aquariums and as souvenirs. You can minimize damage by buying products that you know are sustainably harvested. Sustainable means that a species can maintain a healthy population and the natural balance is not disrupted by harvesting by humans.

Watch What You Eat Demand sustainable seafood at the grocery store and in your favorite restaurants. Always know what to order by downloading a sustainable seafood guide. Seafood Watch is a great resource and easily accessible app for iPhone and Android.

Choose Pets Carefully If you have a salt water aquarium, make sure you ask where and how the animals you buy were collected. Look for the Marine Aquarium Council's Certification in pet stores to find animals that were carefully harvested and well cared for. And never release an unwanted pet into the ocean or any waterway. Organisms that don't belong can crowd out the locals and disrupt the ecosystem.

Select Sea-friendly Souvenirs Steer clear of jewelry, mementos, and products made from marine animals or animal parts, including shells and especially coral.

Reduce Your Carbon Footprint

When we burn fossil fuels (like oil, gas, or coal) to power our homes, businesses, and cars, we are adding the gas carbon dioxide to the air. The blanket of carbon dioxide we've been building for over a hundred years acts like a greenhouse, trapping more of the sun's heat. More heat means a warmer ocean, which is taking its toll on marine life. It also causes the ocean to become more acidic, which makes it hard for organisms like corals and clams to build their skeletons and shells. You can help slow global warming and ocean acidification by reducing your "carbon footprint"—the amount of carbon dioxide released as you go about your daily activities.

Making little changes in the way we live can go a long way to reducing energy use—and carbon emissions. Try drying laundry on a clothesline or rack instead of in the dryer. Walk, bike, take the bus, or carpool to work or school. Replace light bulbs and older appliances with newer, more efficient models.

Reduce the effects of climate change on the ocean by leaving the car at home when you can and being conscious of your energy use at home and work. A few other ideas to get started today: switch to compact fluorescent light bulbs, take the stairs, and bundle up or use a fan to avoid oversetting your thermostat.

Not all energy comes from burning fossil fuels. Clean, unlimited energy can come from the sun, wind, or heat deep in the Earth (called geothermal). Call your power company or visit the Department of Energy's Buying Green Power page to find alternative energy programs near you.

Less Waste, Less Plastic

Plastics that end up as ocean debris contribute to habitat destruction and entangle and kill tens of thousands of marine animals each year. To limit your impact, carry a reusable water bottle, store food in non-disposable containers that can be used again, bring your own cloth tote or reusable bag when shopping, and recycle whenever possible.

Remember that trash we "throw away" doesn't actually disappear. It goes somewhere. Moving water—whether waves on the beach, the stream running through your neighborhood, or rainwater flowing toward the storm drain—can carry any loose trash to the ocean. Garbage, especially plastic, is a major hazard for marine animals. Sea birds, turtles, seals, and other animals can mistake floating plastic for food or become tangled in it and die. Help prevent this by curbing your family's throwaway habits.

Make a point to use reusable bags, beverage cups, and food containers. When you must use disposable items, reuse or recycle them whenever possible. Never litter (inland, on the beach, or from a boat), and participate in beach or waterway clean ups to help stop the flow of trash into the ocean. Avoid products with excess plastic packaging. Buy fresh and local foods. Buy from bulk bins and avoid packages with individually wrapped items. Reducing excess packaging and plastics reduces marine debris and helps save marine animals!

"We, as human beings, have a responsibility to do everything we can to look after these animals that have been here for so long."

— Dr. Ian Bell

Biography: Dr. Ian Bell

Ian Bell, Ph.D., is a marine biologist, and Senior Conservation Officer with Queensland's Department of Environment and Sciences. He is also the lead scientific advisor for the film *Turtle Odyssey* and his research is referenced in this guide!

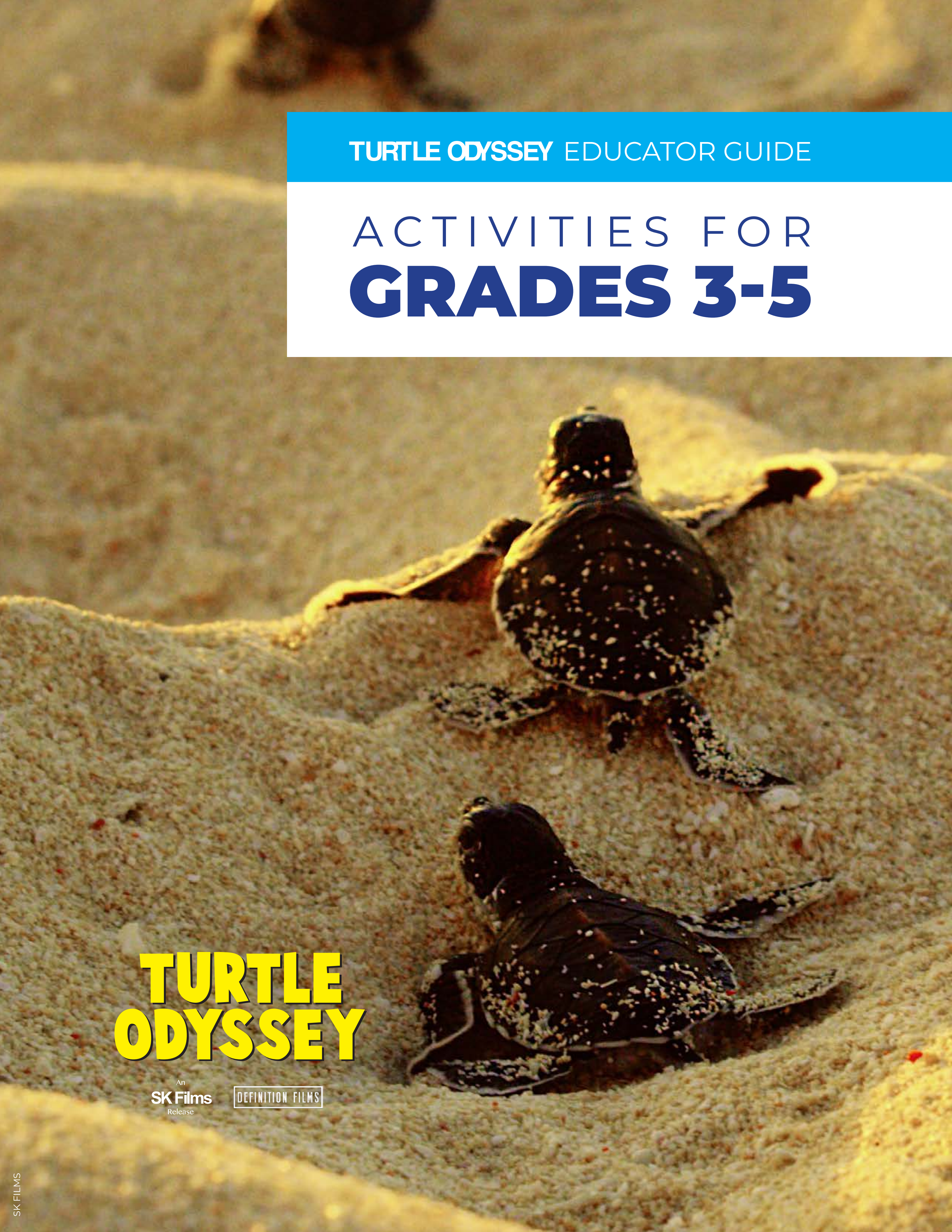
With 23 years of experience studying sea turtle populations, Dr. Bell now coordinates simultaneous projects to establish not only the life history parameters of marine turtles, but also population structure and distribution.

More recently, Dr. Bell has been working with indigenous communities in Australia and the Western Pacific to understand the trends and threats to local populations. When not working on remote and isolated islands far from human habitation, he is always looking for ways to raise awareness and educate the public on the challenges faced by these most ancient animals.

Dr. Bell is hopeful that one day there won't be a need to catch and tag turtles, and aspires for a future where human intervention into their conservation is no longer necessary. However, action needs to be taken now. Currently, many turtle populations are declining. Providing accurate data to the management agencies that implement protective measures is the best way Dr. Bell and his team can help make a difference to turtle populations.

Dr. Bell is very concerned about the impacts of climate change and warming oceans. The speed at which things are changing has caught a lot of people off-guard, especially the way marine ecosystems are responding. Dr. Bell equates his mission to preparing for a bushfire or a cyclone, in that we do not know when, or how hard, it is going to hit. Let's do everything we can now to protect these animals so that we can be prepared to face some of those threats that are rolling towards the turtle population.

SK FILMS



TURTLE ODYSSEY EDUCATOR GUIDE

ACTIVITIES FOR
GRADES 3-5

TURTLE ODYSSEY

An SK Films Release

DEFINITION FILMS

SK FILMS

Activity 1

What Makes a Turtle a Turtle?

Introduction

In the IMAX® movie *Turtle Odyssey*, you may have heard the narrator discuss the 7 different species of sea turtles. What makes sea turtles different from other animals that live in the ocean? How can you tell if an animal is a turtle?

Summary

In this activity, students will have an opportunity to learn more about turtles, particularly sea turtles and their habitats. They will make observations about different turtle species and connections between the structures that help turtles function in their own environments.

Materials and Preparation

- Display copy of *Master 1.1, Animal Pictures*. You may project the master or make a color copy for each group of 3 students.
- Card set of *Master 1.2, Turtle Pictures*, 1 set per group of 3 students. You will need to copy and cut apart the cards in advance of class. Color copies of the cards are preferred; however, if this is not possible, be prepared with a color version that you can project while students work.
- *Master 1.3, More About Turtles*, 1 per student
- Display copy of *Master 1.4, Sea Turtles*.

NGSS Performance Expectation

2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.

Procedure

1. Display *Master 1.1, Animal Pictures*. Ask students to talk with the members of their group about which of the animals are turtles.

2. Once students have had time to discuss their ideas, ask students which animals they picked and why they chose each one. As students share their ideas, ask other groups if they selected the same picture and what led them to select each. Develop a list of characteristics that define turtles as the groups share based on what they say.

3. Display *Master 1.2, Turtle Pictures*. Tell students that all of these are turtles, but not all of them are the same. Ask them to work with their groups to try to sort the turtles into groups. Tell them they can sort the turtles based on any ideas they have. For your reference, the names of the turtles and their positions on the master are as follows.

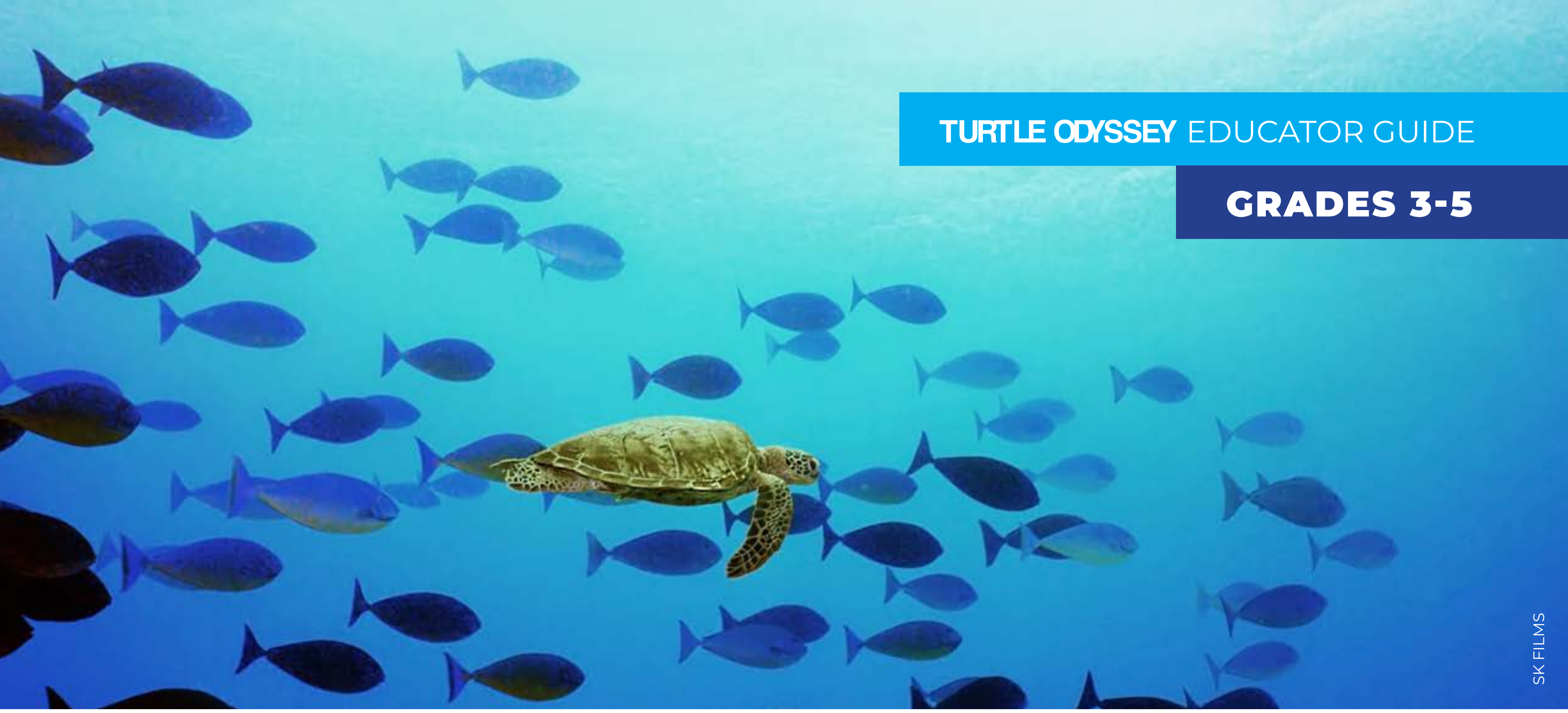
1 Galápagos tortoise	**5** Eastern box turtle
2 Matamata turtle	**6** Common padloper tortoise
3 Red footed tortoise	**7** Common snapping turtle
4 Hawksbill sea turtle	**8** Painted turtle

4. Hold a brief discussion of what criteria students used to sort the turtles. Be sure to have them share what the observations were that led to their criteria.

5. Introduce students to the idea of a species. “Species” are how scientists group similar living things. For example, all humans are one species. Each card shows one species of turtle. Distribute *Master 1.3, More About Turtles*. Write the word species on the board and ask them to look for it as they read. Then have students read individually or using a group reading strategy.

6. Give students time to revise their ideas from the card sort based on what they read. Once they have revised, ask them to share what new information they got from the reading that changed their ideas. Have them share cards that they moved to a different category and describe why their thinking changed. Their categories should now be freshwater, land, and sea turtles.

7. Display *Master 1.4, Sea Turtles*. Tell students that *Turtle Odyssey* was about green sea turtles, but that there are 6 other species of sea turtles. Based on what they know about sea turtles, ask them the following questions.
   a. Which characteristics of sea turtles can you observe in the 7 different species?
   b. Are there other characteristics that you learned about from the reading that you cannot observe here? *If students are interested in learning more about how sea turtles migrate from and return to the beach where they were born when it is time to lay eggs, consider doing the activity,* How Do Animals Find Their Way? *with them.*



Activity 2

Why Can't a Camel Live in the Ocean?

Introduction

In *Turtle Odyssey*, you encountered a variety of animals swimming around with Bunji as she made her epic odyssey through the ocean. There were seabirds, ghost crabs, sharks, fish of all shapes and sizes, colorful coral, dugongs, and so many others. However, there were no encounters with camels, squirrels, or polar bears along the way! The oceans, beaches, coral reefs, and seagrass beds that are part of Bunji's grand adventure do not make great homes for all animals. In this activity, you will learn how and why these places are the perfect home for a sea turtle.

Summary

This activity will allow students to explore the wide variety of adaptations and abilities in the animal kingdom and determine why some organisms can do well in a particular habitat while others cannot survive in the same conditions. By making observations and doing background research, sorting organisms into particular habitats and delving into the differences, students will gain a better understanding of how the changing environment is affecting the ability of plants and animals to survive. Although the activity uses the word "organism" throughout, you may wish to use the term "living thing" instead, depending on the age of your students.

Materials and Preparation

- *Master 2.1, Organism and Habitat Cards*, cut apart, 1 set per class of up to 36 students. If you have fewer than 36 students, be sure to remove pairs of cards so that when students pair up to find the appropriate animal and habitat there will not be unpaired students.
- Printed resources or access to computers with Internet to research organisms and habitats (optional)

NGSS Performance Expectations

3-LS4-3. Construct an argument with evidence that in a particular habitat, some organisms survive well, some survive less well, and some cannot survive at all.

3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Procedure

1. Lead a class discussion on why students think Bunji is so good at surviving in the ocean. Consider asking some or all of the following questions to help students begin thinking about their ideas. As students share their thoughts, ask them to describe how her environment helped her carry out each of these activities. Create a chart to show any features Bunji has that help her survive in the ocean.
   a. How did Bunji move around?
   b. How did she eat?
   c. How did she find her way to other places and back to the beach where she was born?
   d. How did Bunji protect herself from predators?

Activity 2 *continued*

2. Give each student 1 card from *Master 2.1, Organism and Habitat Cards*. Some students should have organism cards while others will have habitat cards. Make sure that you have removed pairs of cards from the set so that all organisms will have a habitat represented in the room.
3. Ask students to begin making observations of their organism or habitat. They should write down their observations in a notebook or on a piece of paper.
   - Encourage students with organism cards to notice the physical characteristics of the animal or think about what it will need to survive.
   - Encourage students with habitat cards to notice what resources are available in the habitat and other factors such as the temperature they would expect the habitat to be.
4. (Optional) You may wish to give students an opportunity to do some additional research on their organism or habitat. If so, provide them with printed resources or access to computers with Internet. This can also be a good opportunity to have a media specialist present about how to conduct research.
5. Randomly pair students so that each pair has one organism card and one habitat card. An easy way to do this is to have all students with organism cards line up on one side of the room and all students with habitat cards line up on the other side of the room. Then have them pair up with the person directly across from them.
6. Once students have paired up, have them discuss whether the organism would survive well in the habitat and the reasons why it would or would not survive well. Have them write the organism and habitat down and make a 2-column chart. Use one column to list reasons the organism might survive well and the other column to list reasons it might not survive in the habitat. You may wish to highlight particularly good observations or questions before students do a second round to give them examples of what to discuss.
7. After a few minutes, have students change partners and repeat the process. They should list the habitat and organism and make another 2-column chart for the new pairing. You may wish to do another round or two if time allows.
8. For the last round, have students find the proper partner to make a correct pair with the card they have. To do this, have the students with habitat cards line up and hold their card in front of them. Have students with organism cards find the proper habitat for the organism.
9. Allow time for students to discuss why the habitat is the best one for the organism and list their ideas in their notebooks or on their paper. Ask them to be specific about the features of the organisms that let them live in a particular habitat.
10. Lead a class discussion about the activity. Have students share some of the things they noted about their pairing. Be sure that by the end of the discussion students understand the idea that habitats provide everything an organism needs to survive.
11. Remind students that habitats provide everything an organism needs. Then ask them to discuss what would happen if a habitat changed, such as the right type of food no longer being available or the temperature changing so that it is much hotter in the summer or much colder in the winter. They should focus on whether plants and animals would still survive.

Activity 3

First Steps

Introduction

In *Turtle Odyssey*, Bunji hatched from her egg and almost immediately began crawling and digging to get above ground. She then had to race to the sea. Many other animals begin walking within a few minutes of being born. Humans, however, take about a year to begin walking upright.

The rates at which animals grow and age are different, but have similar stages. How long does it take for a penguin to hatch? When does a giraffe first walk? How long until a fish can reproduce? In this activity, you will learn more about some of the milestones that happen in animals' lives. You will also compare how long it takes for different animals to reach the milestones.

Summary

In this activity, students will develop a model not only to show milestones in animals' lives, but also compare these events between the animals. Students will become experts on one animal and will place certain life milestones, such as fertilization or egg laying, walking, and reproduction, on a timeline. Placing the life stages on the timeline provides the students an opportunity to use mathematical thinking to determine the relationship among different animal life. Students will then compare and contrast the timelines.

Materials and Preparation

- *Master 3.1, Animals*, cut into 4 pieces, 3-4 copies of the same animal for each group
- *Master 3.2, Timeline*, 1 per group of 3-4 students
- Yarn or string, 2 pieces, each approximately 10 feet long
- Small pieces of yarn or string, preferably in a different color from the 10-foot pieces
- 5 different colors of index cards or small pieces of paper, 12 of each color
- Clothespins, paper clips, or binder clips, 60

NGSS Performance Expectations

3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

Procedure

1. Remind students that in the movie Bunji hatched and then had to get to the ocean quickly on her own. Ask students to consider whether a baby human could have accomplished this task. Students are likely to say no. Discuss why this would not be possible.

   Students are likely to say that newborn babies cannot walk or crawl. Some may know that babies do not have great eyesight. They may focus on the idea that human babies are not without their parents that early in their lives. Accept any reasonable idea.

2. Tell students that a big event in life, such as learning to walk, is called a milestone. Ask them to talk with a group of 2-3 other students about other milestones in their lives.

3. Have groups share ideas about human milestones. Make a list on the board or on large paper to include all the ideas. They may include ideas such as walking and talking, but might also add events such as learning to drive. Encourage them to think across the whole life of a human.

4. Ask students to tell which milestones they think animals would also have in their lives. Draw a star next to these milestones on the class chart. Add the approximate time frame to each milestone based on what students know about humans and your own information.

5. Tell students that they are going to have a chance to compare human milestones to some animals. Groups will become an expert on one animal then contribute to a class timeline.

6. Distribute one animal from *Master 3.1, Animals*, to each person in a group. Ask them to read about their animal. As they read, they should underline any milestone they find and circle the animal's age at that milestone.

7. After students have had time to read, they should discuss what they found with their group. Then, hold a class discussion to make sure they found all of the milestones. They should have an age for the following milestones. If they find a range for a milestone, have them use the midpoint of the range.
   - fertilization or egg laid
   - birth or hatching
   - walks or swims
   - eats solid food
   - reproduces
   - dies

8. Have the class develop a timeline model using one of the long pieces of yarn or string. Tell them that the yarn represents 100 years. Ask a volunteer to tie a small piece of different-colored yarn to show where 50 years would be on the line. Have additional volunteers tie small pieces of yarn to show 25 and 75 years. You may wish to have them add additional time divisions.

9. Write one milestone, such as WALKS, in large print on an index card, using the same color for all milestones. Then demonstrate how to add the milestones for humans. For example, they are born 9 months after fertilization (which is the 0 year) and walk about a year later. Use a clothespin or other connector to add each milestone to the timeline. Add all of the human milestones to the timeline. (Some milestones will appear right next to each other if they span a small period of the animal's lifetime).

10. Ask each group to add milestones for the animal they were studying. If you had several groups studying one animal, divide them milestones between them. Have each group use a different color of index cards to distinguish different animals. There will be many milestones nearer to 0 years because most animals have lifespans that are much shorter than 100 years.

11. Discuss the following questions.
    a. Do the milestones always occur in the same order for different animals?
    b. It is hard to compare the different animals on this timeline. Can you think of anything that would make it easier?

    Help students recognize that because the animals have different lifespans, it is harder to compare milestones. They may also come up with other ideas, such as having a longer piece of yarn.

12. Give each group a copy of *Master 3.2, Timeline*. Tell them that now instead of the timeline representing 100 years it will show the life of the animal they are studying. The beginning of the timeline represents fertilization or an egg being laid. The end of the line is when the animal dies. The students in the group should work together to label the time for these two milestones. They should then add the additional milestones with times to the line.

    Students may need additional support to understand how to add the milestones. Have them divide the line in half and then label that with a time that is half of the animal's life. They can then divide each half in the middle and calculate the time for quarters of the animal's life. Once they have these calculations marked, they should be able to estimate a placement for the milestone events.

13. While students work, mark the quarters of the yarn with different-colored yarn. Then have students add the milestones for their animal, again using different colors of cards for each animal.

14. Lead a class discussion about when different animals reach milestones in their lives. Be sure to discuss the following points.
    a. Do all animals have the same milestones? What is your evidence?
    b. Are there differences between when different animals reach milestones? What is your evidence?
    c. Why did the second timeline make it easier to compare the milestones for different animals?

Activity 4

Is It a Boy or Girl?

Introduction

In *Turtle Odyssey*, you saw Dr. Ian Bell and other scientists at work. These scientists have noticed a trend related to the number of males and females hatched each year. The number of females has increased dramatically over time. Dr. Bell has studied sea turtles in the wild to discover the impact that the Earth's increasing temperatures are having on the population.

Summary

In this activity, students will have an opportunity to graph the males and females in several animal populations. They will then determine the cause of the changes among sea turtles and make a prediction about what might happen in the future.

Materials and Preparation

- Graph paper
- *Master 4.1, Animal Birth Data*, cut into thirds, 1 data table per student
- *Master 4.2, Sand Temperatures at a Sea Turtle Nesting Site*, 1 per student

NGSS Performance Expectations

3-LS1-2. Use evidence to support the explanation that traits can be influenced by the environment.

Procedure

1. Ask students, "Think about the boys and girls that were born at the same time you were. Do you think there were more boys, more girls, or about the same?" As students give their ideas, ask them what led them to the idea, but do not correct them at this point.
2. After a brief discussion about their ideas, ask if they think that if you took all of one kind of animal born in a month, would there be more males, more females, or about the same?
3. Tell students they are going to have a chance to look at some data to see whether their ideas are correct. Distribute *Master 4.1, Animal Birth Data* to students along with a piece of graph paper. Have students gather in groups of 4. Ask students to choose an animal such that each group has 1 student studying each animal from giraffes, sea turtles, Emperor penguins, and lake sturgeon fish.
4. Tell students that on the data table they will find a table that tells the number of males and females born in 3 different years for each animal. Explain that these numbers come from scientists studying specific populations of the animal, not all of the individuals for that type of animal on Earth. They should draw a bar graph to show the data for the animal they chose. Note that you may have to scaffold students' creation of their graphs more or less depending on their experience with bar graphs. They should generate 3 paired bar graphs to show the results for each of the three years shown in the table.
5. Once students have had a chance to draw their graphs, allow them time to compare their work to other students who graphed the same animal. This will increase their confidence in their work before sharing with their group.

6. Give groups time to share their graphs with each other. Have them share one at a time and ask them to determine similarities and differences between graphs. They should notice that for all of the animals except sea turtles, approximately the same number of males and females were born each year.

7. Read the following information to the students and write the bulleted information on the board.

   For most animals, including humans, information passed down from the moms and dads determines if the animal is a boy or girl. For reptiles such as turtles, alligators, and crocodiles, there is a different way that babies turn out to be males or females. For these animals, the temperature at which their eggs are kept before they hatch determines the sex of the animal. Sea turtles lay their eggs in sand.

   - Sand > 87.6º F (30.9º C): female turtles are born
   - Sand < 81.9º F (27.7º C): male turtles are born
   - 81.9º F (27.7º C)< Sand < 87.6º F (30.9º C): both male and female turtles are born

8. Ask students to talk in their groups about what the data on the sea turtle births means. Students may have different ideas, but should say that the sand was warmer in 2017 than in 1997.

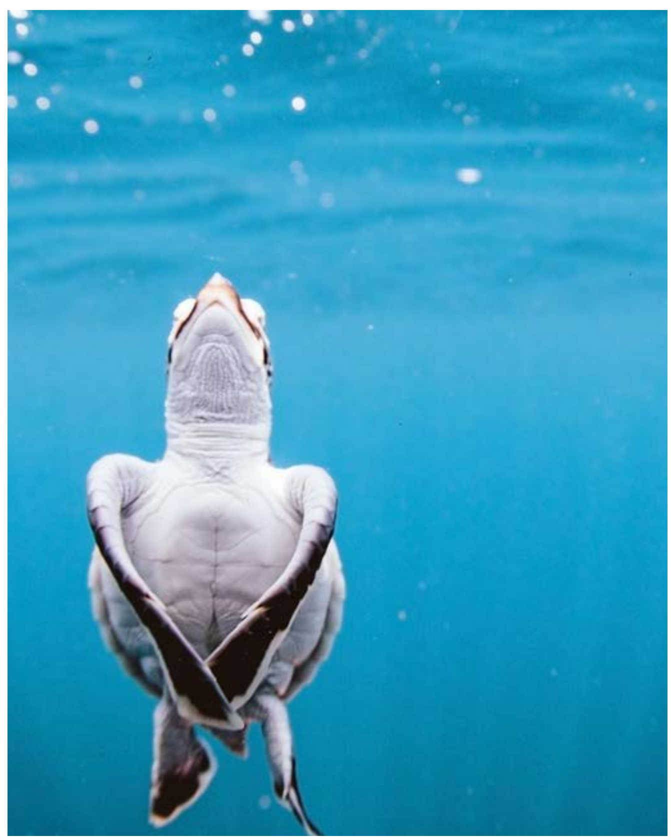
9. Tell students that they are going to have a chance to look at some additional data. Distribute copies of *Master 4.2, Sand Temperatures at a Sea Turtle Nesting Site*. Note that this is a different nesting site than the site on *Master 4.1, Animal Birth Data*.

10. Ask students to study the graph and answer the following questions, which are also printed on the handout.
    a. What is shown across the bottom of the graph (the x-axis)?
    b. What is the first year and the last year shown on the graph?
    c. What does the height of bars show (the y-axis)?
    d. What is the trend—the general change—that is happening to sand temperatures?
    e. Look back at the graph that someone in your group made about the number of male and female sea turtles. How does it relate to this graph? Focus on the relationship rather than particular data, as they represent two different nesting sites.

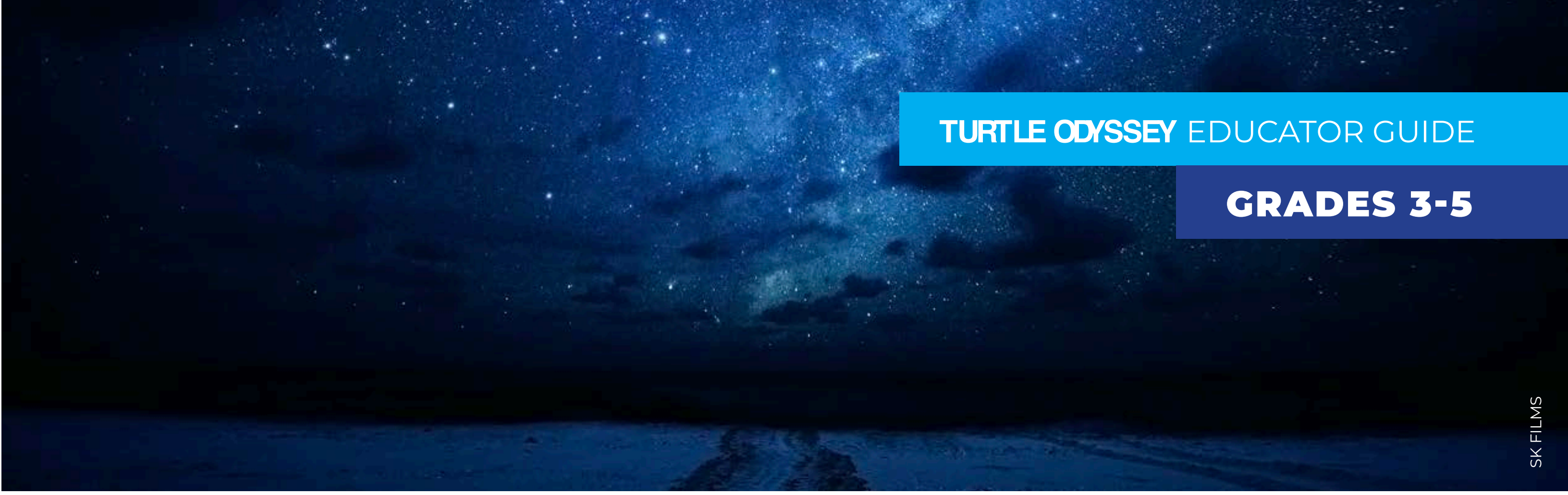
11. Lead a class discussion about the questions, particularly 10e. Ask students what will happen to sea turtles if the temperatures continue to stay high or rise? Students should understand that the first result will be that only female sea turtles are born. Help them understand that if that happens for many years, eventually there will be no male sea turtles and without male and female sea turtles, no baby sea turtles will be born.

    Also share with students that scientists have done controlled experiments to learn more about how temperature affects whether a turtle is male or female. It is not enough to correlate the temperature of the sand with the sex of the turtles that hatch and claim that there is a relationship. Because of controlled experiments on the sea turtles and other animals, scientists know that this phenomenon is present in reptiles and in some ray-finned fish.

    This discussion can lead into a lesson about climate change or about human impacts on environment if you would like to continue the discussion.



SK FILMS



SK FILMS

Activity 5

How Do Turtles Find Their Way?

Introduction

Sea turtles can migrate thousands of miles in their lifetimes. In the movie, Bunji traveled great distances in the ocean. During the first ten years of a turtle's life, they are in a phase of their lives where they migrate across the open ocean before becoming adults and returning to the place they were born to lay their own eggs. But how do turtles know where they have been and to where they should return when they reproduce?

Summary

In this activity, students will develop and use a model to help them understand how sea turtles keep track of where they are while migrating long distances.

Materials and Preparation

- Classroom obstacles, including desks, chairs, and other common objects
- Yarn, divided into lengths of approximately 50 feet, 1 length for each pair of students
- Blindfolds

NGSS Performance Expectations

4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

Procedure

1. Ask students how they find their way when they are going somewhere. They may list maps, street signs, familiar landmarks, and other ideas. Make a list on the board.
2. For each idea students list, ask them how the technique would work in the ocean. They should realize that there are not streets or street signs in the ocean. Familiar landmarks are likely to move around. Very little of the ocean has been explored, so there are not detailed maps like we have on land.
3. Then ask them to think about other animals and how they might get around. Students might think of dogs sniffing or ants following a trail. Make sure they understand that both of these rely on scents, then ask how well following a scent would work in the ocean. They should realize that any kind of scent trail would quickly be washed away and the chemicals dispersed.
4. Ask, "How do you think Bunji knows where she is and needs to go?" Remind them that Bunji traveled thousands of miles in her life and that she returned to the same beach where she was born when it was time to lay eggs. Have students discuss their ideas in their groups before sharing with the class. Students may remember from *Turtle Odyssey* that she follows the magnetic fields of the Earth. If they do not mention this idea, do not bring it up at this point.
5. Have students join with one partner from their group. Give each pair a length of yarn and a blindfold.
6. Ask pairs to decide who is going to play the role of the Earth and who will play the role of a sea turtle. Students playing sea turtles should put on the blindfold or turn their backs. Students playing the Earth should tie their yarn on to an object in the room, then make a path by moving a few feet, wrapping the yarn around another object, then moving in a different direction. After 3 or 4 turns they should stop. Be sure to provide enough room for groups or only have a few groups working at a time so the students do not get tangled up or trip.

7. The students playing the sea turtles should be blindfolded while the partner places the back of the "sea turtle's" hand against the yarn path. The blindfolded "sea turtle" should try to follow the path, always keeping the back of his or her hand touching the yarn. If the "sea turtle" loses the path, he or she should try to find it again with the back of the hand. It is important to use the back of the hand rather than holding the yarn because it will allow students to potentially get off course.
8. Lead a class discussion about how easy or hard it was to follow the path using the back of a hand.
9. Read the following information to students.

   All around the surface of the Earth, there is a magnetic field. The Earth has a molten iron outer core that causes the magnetic field. At different places on Earth, the strength and the direction of the magnetic field is different. [Show students a picture of Earth's magnetic field and help them understand that the direction of the field is different in one state versus another state. The top image at earthobservatory.nasa.gov/images/84266 may be helpful.] Turtles and some other animals can sense the magnetic field through a sense called magnetoreception. Scientists do not yet completely understand how this sense works.
10. Have them make sense of the yarn model that they made using an analogy map. Students should draw a table like the following one. They should complete the second and third column.

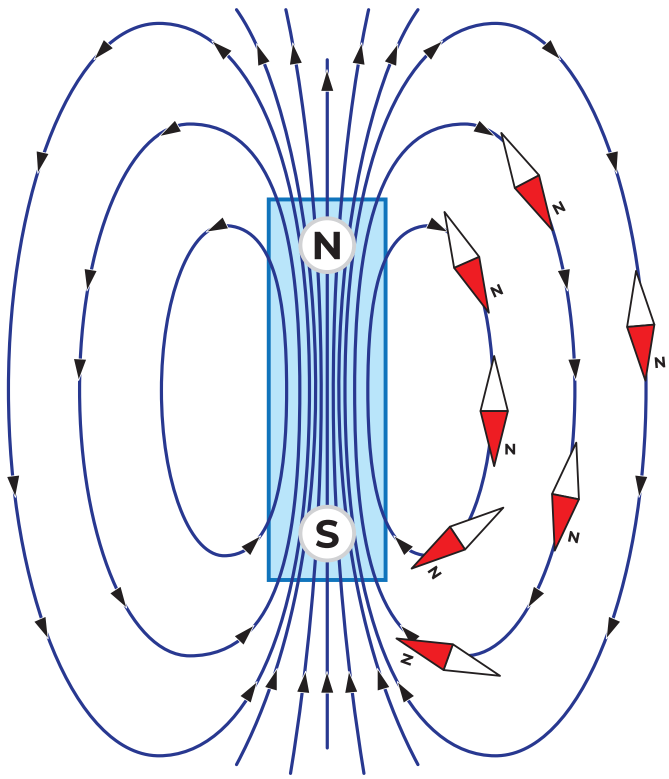
This part of the yarn model...	...is like this part of the real world.	They are alike because...
Student who created the path		
Student who followed the path		
Yarn		
Back of hand		

11. Lead a discussion on how students filled out the analogy map. They should understand the following.

This part of the yarn model...	...is like this part of the real world.	They are alike because...
Student who created the path	Earth	The Earth generates a magnetic field just like the student created the path. This is important because it shows that turtles do not respond to paths or trails that they generate themselves.
Student who followed the path	Sea turtle	Both the student and sea turtle follow a "signal" made by yarn in the model and the magnetic field for the Earth
Yarn	Magnetic Field	The yarn allowed a student to follow a path while the magnetic field of the Earth allows turtles to know where to go.
Back of hand	Magnetoreception	Both let an animal sense where they are going.

12. Conclude the lesson by reminding students that sea turtles migrate long distances. It is thought that before they leave their nesting beach for the first time, they learn the magnetic signature of the location so that they can return when they are ready to lay eggs.

Activity 5 *continued*



Extension: If students are interested in this topic, consider bringing in one or more compasses to help them understand how humans can detect the Earth's magnetic field. A number of different videos are available on the Internet to help you understand how compasses work to help people navigate.

For more of a visual representation of magnetic fields, bring in a bar magnet and iron filings. Demonstrate how the iron filings align along the magnetic field surrounding the magnet. Have students draw this visual. Remind students that the magnet is meant to represent the earth and that the magnetic field's strength and directional pull varies around the globe.

If you do not have iron filings, place your magnet in the middle of a piece of paper. Using a compass, mark the direction the compass arrow points at different places on the sheet of paper. When you have enough points plotted and joined up you will notice that the magnetic field of the magnet is represented by the direction of the arrows—the compass arrow aligns with the magnetic field. The compass will point from the north pole towards the south pole of the magnet along the field.

MASTER 1.3 • More About Turtles

Now that you have seen some different turtles in this lesson, you can probably tell if an animal is a turtle pretty easily. They have four feet, scales, and a shell. The shell is part of their body. Their spine, or backbone, is part of the shell and the shell grows with the turtle. All turtles are reptiles, so they lay eggs and use the environment around them to keep their bodies at the right temperature. Turtles also tend to live long lives: they can live as long as humans.

Even though there are some parts of the body that all turtles have, there are a lot of different kinds of turtles. There are over 300 kinds of turtles in the world. We call each kind of turtle a different "species". There are turtles on all of the continents in the world except Antarctica. The turtles of our planet are divided into 3 main types.

- Sea turtles: There are 7 different species of sea turtles. Sea turtles are also called marine turtles.
- Land turtles: There are 49 species of turtles that live on land.
- Fresh water turtles: There are about 250 species of turtles that live in fresh water, such as lakes, rivers, and streams.

Turtles that live on land are also called tortoises. They are easy to spot because they have feet that look similar to elephant's feet. These thick, flat-bottomed feet help them walk on land. They often have more dome-shaped shells to help protect them. If a tortoise falls into the water it can drown. This means it is important to not pick them up and put them in water if you find one in nature. Sometimes people use the words turtle and tortoise to mean the same thing. However, now you know that all tortoises are turtles, but not all turtles are tortoises!

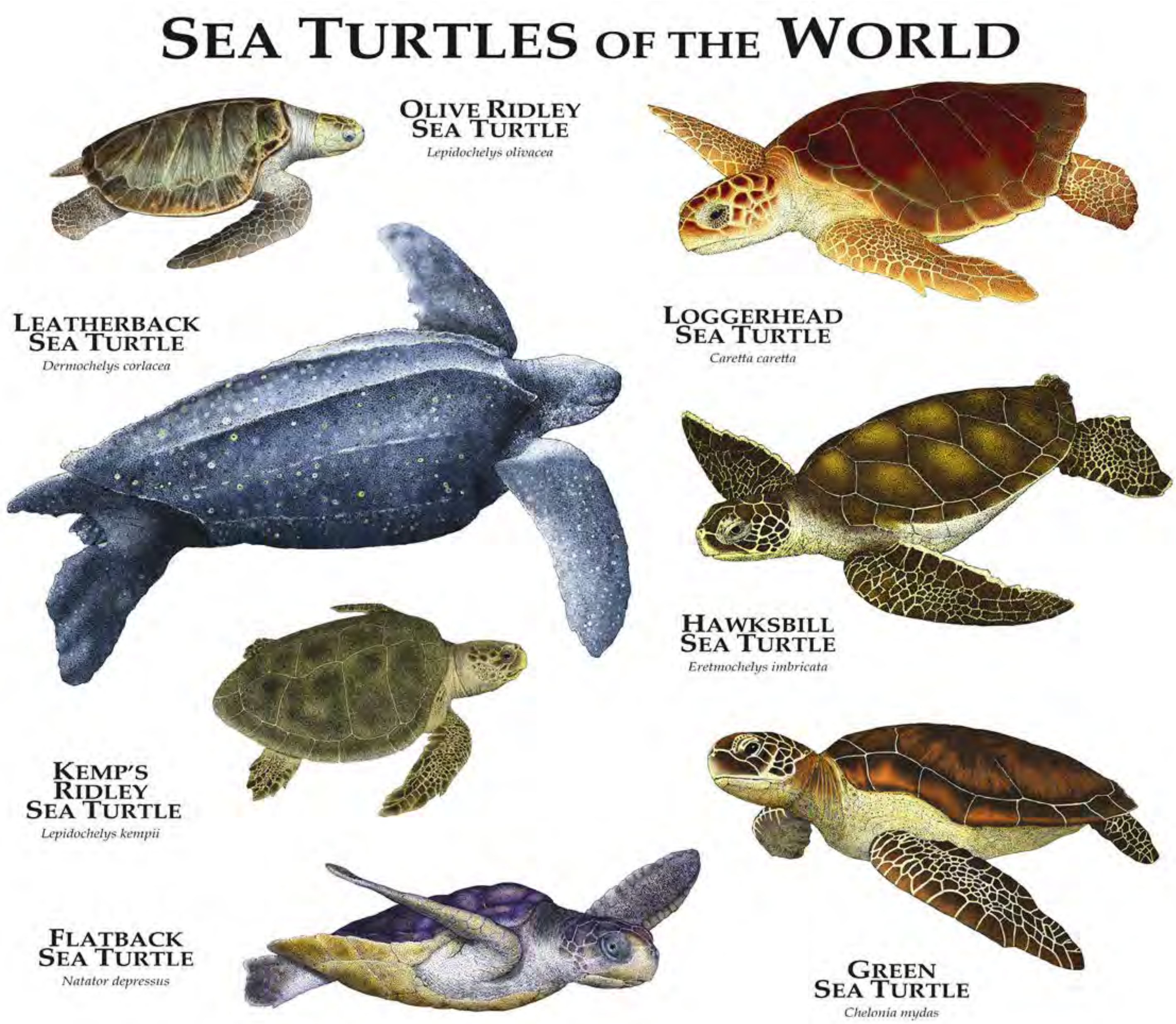
Freshwater turtles make up the largest group of turtles. Some of them spend most of their time in the water. Others spend some time on land and some in water. These turtles have flatter shells than tortoises and harder shells than sea turtles. They also often have more color on their shells. Freshwater turtles have webbed feet with claws on them. This helps them swim and climb onto land. The claws also help them dig holes where they can lay eggs.

SK FILMS

DAVID ADAM KESS, CC BY-SA 4.0

U.S. NATIONAL PARK SERVICE

MASTER 1.4 • Sea Turtles of the World



ROGER HALL

Green Sea Turtle

A green sea turtle egg hatches about two months after its mom buries it in the sand. When it hatches, the sea turtle crawls into the water. There, it begins to swim and eat. A young sea turtle mainly eats a diet of meat, such as jellyfish or small crabs, as well as fish eggs. As it ages, the green turtle will switch to a diet of sea grasses and other plants that live in the ocean. Once a green turtle reaches the age of 25, she begins to lay eggs. She will lay eggs every 2 to 3 years and can lay them up to 6 times in a season. A green turtle's lifespan is about 80 years.

SK FILMS

Giraffe

A baby giraffe is born 15 months after fertilization, when it first starts growing in its mother. When it is born, the giraffe drops 6 feet to the ground. It can then begin walking within a few hours. The young giraffe begins to eat its favorite Acacia tree leaves when it is 6 months old. When the giraffe is 6 years old, it may have its own calf. A giraffe lives about 25 years in the wild.

JOONAS LYYTINEN, CC-BY-2.5

Sockeye Salmon

GETTY IMAGES

Sockeye salmon are a type of fish. One interesting fact about them is that they spend part of their life in freshwater and part of it in the ocean. Sockeye salmon usually lay eggs in the summer or fall. The females use their tails to cover the eggs with gravel. The eggs hatch in the winter, 90 to 150 days after they were fertilized. The baby fish stay in the gravel and get nutrients from the egg's yolk sac until spring. In spring, the fish swim out into freshwater rivers and lakes. They begin to eat plankton and insects. After 1 to 3 years, the fish swim to the ocean. At about age 5, they return to the freshwater to lay their own eggs. Sockeye salmon die within a few weeks once they have released or fertilized eggs.

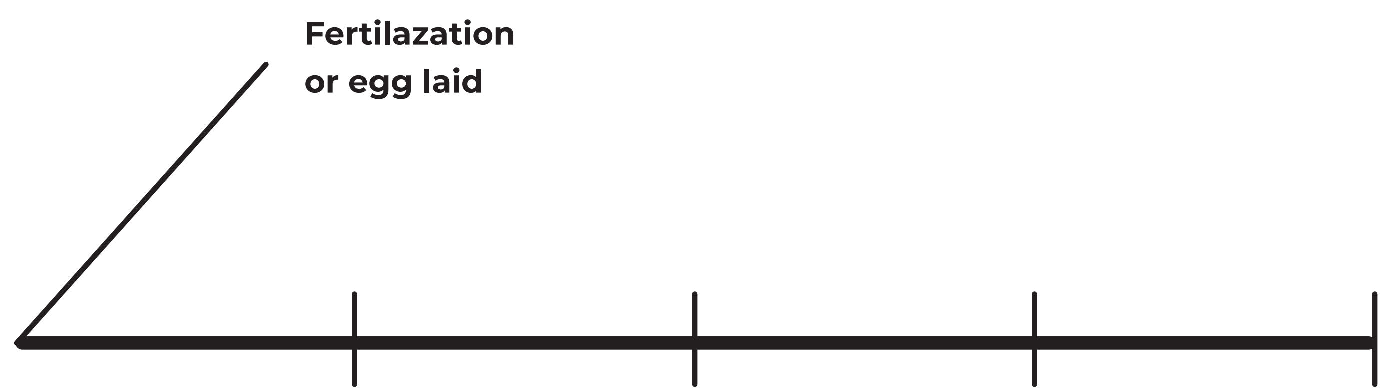
Emperor Penguin

GETTY IMAGES

Emperor penguins are the largest of the 17 penguin species. They live their whole lives on and around the continent of Antarctica. Their lives begin in an egg. After laying the egg, the mom transfers the egg to the dad. She then treks to the ocean to find food. For 60 days the dad incubates the egg between his feet and his body. After the egg hatches, the mom returns from the ocean with food for the baby penguin. At that point, the dad makes the long trek to the ocean to swim, feed, and find food for the baby. The parents continue to switch back and forth between feeding and caring for the penguin. This happens several times for about 140 days. Then the hatchling is ready to go to the water to swim and find its own food. By the time the penguin is 5 years old, a female can lay her own eggs. An Emperor penguin lives about 20 years.

MASTER 3.2 • Timeline

1. For the animal you are studying, write the total number of years it lives at the end of the line.
2. The three short lines that cross the timeline divide the animal's life into ¼, ½, and ¾ of its life. Label them with the age each would show.
3. Add in the animal's milestones along the timeline. You should add:
   - Birth or hatches
   - Walks or swims
   - Eats solid food
   - Lays eggs or has baby
   - Dies



MASTER 4.1 • Animal Birth Data

Animal Birth Data. These numbers show the number of males and females born in three different years. It shows some, not all, of the young animals born each year.

YEAR	1997		2011		2017	
Animal	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
Giraffes	304	327	262	239	220	208
Green sea turtles	67	433	5	495	1	499
Emperor penguins	286	367	312	279	258	291
Lake sturgeon	318	297	287	364	342	326

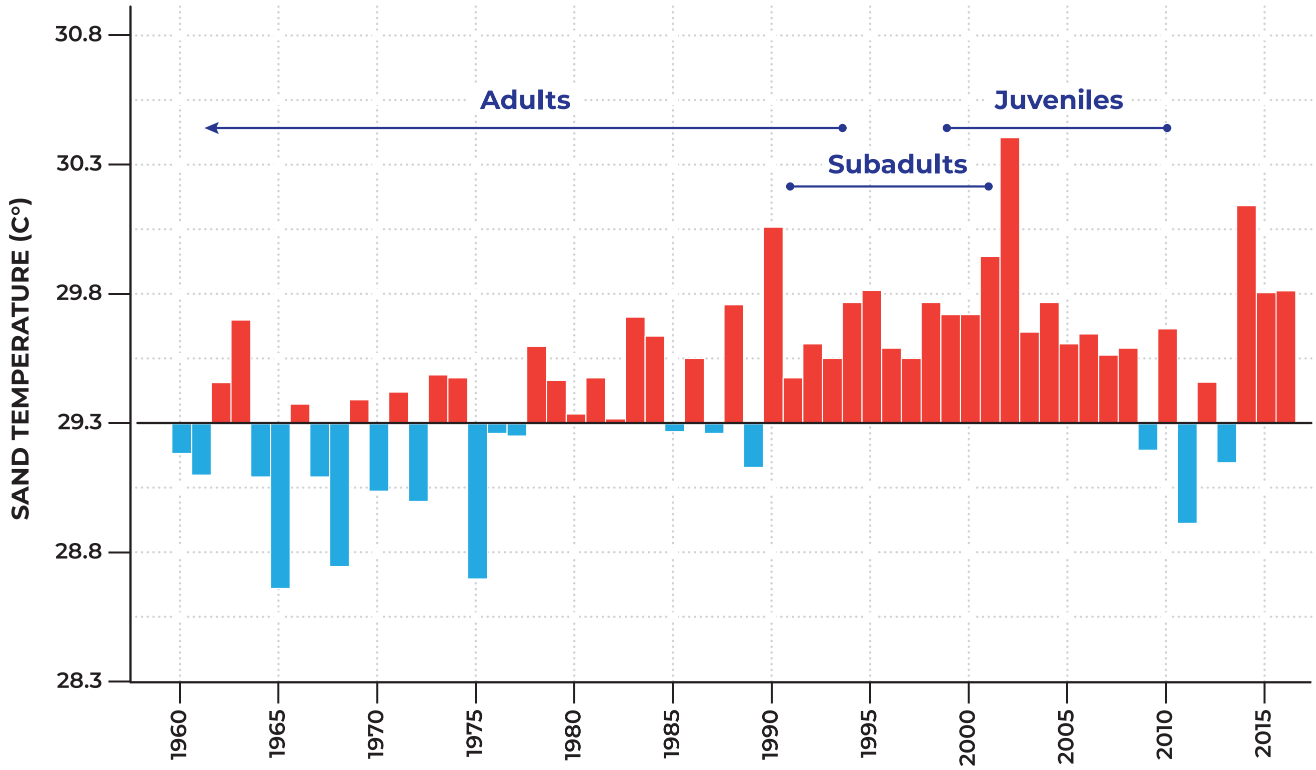
Animal Birth Data. These numbers show the number of males and females born in three different years. It shows some, not all, of the young animals born each year.

YEAR	1997		2011		2017	
Animal	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
Giraffes	304	327	262	239	220	208
Green sea turtles	67	433	5	495	1	499
Emperor penguins	286	367	312	279	258	291
Lake sturgeon	318	297	287	364	342	326

Animal Birth Data. These numbers show the number of males and females born in three different years. It shows some, not all, of the young animals born each year.

YEAR	1997		2011		2017	
Animal	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
Giraffes	304	327	262	239	220	208
Green sea turtles	67	433	5	495	1	499
Emperor penguins	286	367	312	279	258	291
Lake sturgeon	318	297	287	364	342	326

MASTER 4.2 • Sand Temperatures at a Sea Turtle Nesting Site



a. What is shown across the bottom of the graph (the x-axis)?

b. What is the first year and the last year shown on the graph?

First year:

Last year:

c. What does the height of bars show (the y-axis)?

d. What is the trend (the general change) that is happening to sand temperatures over time?

e. Look back at the graph that someone in your group made about the number of male and female sea turtles. How does it relate to this graph?