**Lesson 4: How Does the Environment Affect Sea Turtle Nests?**

Description: Students will learn how storms and temperature can affect developing sea turtle embryos.

Objectives:

By the conclusion of the activities, students will

- Be able to explain the influence of temperature, sand grain size and storms on sea turtle eggs and developing embryos.
- Have researched the potential impacts of climate change on sea turtles.
- Have designed engineering solutions to help protect sea turtle nests and hatchlings from environmental changes and will discuss the merits and challenges of each proposed solution.

You will need:

- Copies of Chapter 4, *How Does the Environment Affect Sea Turtle Nests?* for each student.
- Word wall words (pages 4-17 to 4-21)—printed, cut out and laminated (if desired)
- Internet access
- Activity 1 (for each group of 2-4 students)
    - sand sample (1/4 tsp. is plenty) in a small container or on a small plate
    - Petri dishes, small plates or small plastic cups
    - Mortar and pestle
    - Small cup of vinegar
    - Eye dropper
    - Magnifying glass
    - Small (approx. ½" paintbrush)
    - Plastic spoon
    - Magnet (magnetic wands work well)
    - *Sand Lab* worksheets (pages 4-7 to 4-8) for each student or group of students
- Activity 2:
    - Copies of *Sea Turtle Nesting Data Analysis* worksheets (pages 4-9 to 4-10) for each student
    - Graph paper for each student
- Activity 3 (this will depend somewhat on the experiments that the students come up with)
    - Foam cups
    - Play sand
    - Thermometers
    - Powdered tempera paint or food coloring
    - Water
    - Heat lamp or sunny windowsill/countertop
    - Copies of experiment worksheets (pages 4-12 to 4-14) for each student
- Copies of *How Big is That?* worksheet (page 4-15) for each student.

Standards:

Florida Sunshine State Standards –

*English Language Arts*

- **LAFS.5.RI.1.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.
- **LAFS.5.RI.2.4** Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.
- **LAFS.5.RI.3.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
- **LAFS.5.RI.3.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
- **LAFS.5.W.3.8** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
- **LAFS.K12.W.3.7** Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.
- **LAFS.K12.W.3.8** Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
- **LAFS.K12.W.3.9** Draw evidence from literary or informational texts to support analysis, reflection, and research.
- **LAFS.5.SL.2.5** Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.

*Mathematics*

- **MAFS.K12.MP.2.1** Reason abstractly and quantitatibrly
- **MAFS.K12.MP.3.1** Construct viable arguments and critique the reasoning of others.
- **MAFS.5.NBT.1.4** Use place value understanding to round decimals to any place.
- **MAFS.5.NBT.2.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.
- **MAFS.5.G.1.1** Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., *x*-axis and *x*-coordinate, *y*-axis and *y*-coordinate).

*Science*

- **SC.5.L.15.1** Describe how, when the environment changes, differences between individuals allow some plants and animals to survive and reproduce while others die or move to new locations.
- **SC.5.L.17.1** Compare and contrast adaptations displayed by animals and plants that enable them to survive in different environments such as life cycles variations, animal behaviors and physical characteristics.
- **SC.5.P.8.3** Demonstrate and explain that mixtures of solids can be separated based on observable properties of their parts such as particle size, shape, color, and magnetic attraction.
- **SC.5.N.1.1** Define a problem, use appropriate reference materials to support scientific understanding, plan and carry out scientific investigations of various types such as: systematic observations, experiments requiring the identification of variables, collecting and organizing data, interpreting data in charts, tables, and graphics, analyze information, make predictions, and defend conclusions.

NGSS -

- **5-ESS2-1.** Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- **5-ESS3-1.** Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
- **3-5-ETS1-2.** Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- **5-PS1-3.** Make observations and measurements to identify materials based on their properties.

Common Core Standards-

*ELA/Literacy*

- **RI.5.1** Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.
- **RI.5.4** Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.
- **RI.5.7** Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
- **RI.5.9** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.
- **W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
- **W.5.8** Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources.
- **W.5.9** Draw evidence from literary or informational texts to support analysis, reflection, and research.
- **SL.5.5** Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes.

*Mathematics*

- **MP.2** Reason abstractly and quantitatively.

- **MP.3** Construct viable arguments and critique the reasoning of others.
- **NBT.A.4** Use place value understanding to round decimals to any place.
- **NBT.B.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.
- **G.A.1** Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., *x*-axis and *x*-coordinate, *y*-axis and *y*-coordinate).

Vocabulary:

**Climate change:** A change in global or regional climate patterns.
**Environment:** The area in which something lives.
**Erosion:** The movement of sand, soil or rock by wind or water.
**Gas:** One of the three main states of matter. The other two are solid and liquid.
**Glacier:** [GLAY-shur] A large body of ice that moves slowly down a slope.
**Hatchling:** A sea turtle that has just come out of its egg.
**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.
**Incubate**: To keep eggs warm before hatching
**Migrate:** To move from one place to another, usually for feeding or breeding.
**Nesting season:** The time of year when sea turtles lay their eggs.
**Overheat:** To become too hot.
**Oxygen:** A gas that is necessary for life.
**Sand dune:** A hill of sand at the top of a beach.
**Sand grains:** The individual pieces of sand that make up a beach.
**Sea level**: The height of the surface of the ocean. This level is half way between low and high tides.

Procedure:

1. Add words for this lesson (4-17 to 4-21) to your sea turtle word wall. Review these words with students (definitions are given in Vocabulary, above).
2. Have students read "How Does the Environment Affect Sea Turtle Nests?" (Chapter 4 in *One in a Thousand: Those Amazing Sea Turtles*).
3. Pose the following questions to the class. Suggestion: Have students come up with their individual (or small group) answers first, then discuss each as a class.
    a. Climate change is causing air and water temperatures to rise. How might warmer temperatures affect sea turtles? *(Suggested answers include that there may be more female hatchlings and fewer male hatchlings; nests could produce all females and no*

*males; over time, there might not be any males left in the oceans; sea turtles might start nesting on beaches that are further north)*

b. As sea levels get higher, how might sea turtle nesting be affected? *(Suggested answers include that there might not be enough room on the beach for turtles to nest; nests might be drowned; more nests might be washed away/eroded; there will be fewer baby turtles hatching over time)*

c. Do you think that adding sand to an eroded beach is a good idea for turtles? Why/why not? *(Suggested answers include that it's a good idea because it gives the turtles more space to nest in; it's a bad idea because nests could be buried; it's a bad idea because the sand could be too fine and the eggs could suffocate)*

d. Do you think the color of the sand affects the nest temperature? In what way? How do you think sand moisture will affect nest temperature? What other factors might affect nest temperature? How could we find out? *(Light-colored sand will reflect heat and nests will stay cooler; dark sand will absorb heat and nests will be warmer. Wetter sand will stay cooler than dry sand. Shade from trees or buildings can reduce nest temperatures. Students might be able to suggest some simple experiments that could be conducted in the classroom—e.g. using different colors of sand and thermometers to test these effects.)*

4. How could nest temperatures be reduced? (What conservation activities could be done?) Challenge students to work in small groups to design ways to help protect sea turtle nests and/or hatchlings from climate change. Allow students to conduct internet research to help them support their ideas and have them provide sources for the information they cite. Some good climate change resources for kids are:

   a. http://climatekids.nasa.gov/ . Go to "guided tour of the big questions."

   b. http://www.epa.gov/climatechange/kids/index.html

   c. Student reproducible worksheet on climate change (Scholastic): http://teacher.scholastic.com/lessonplans/exploreyourearth/pdfs/repro1.pdf

Activities:

Activity 1. **Sand Lab** (pages 4-7 to 4-8). (This has been modified from *Secrets of Sand* by Pamela Borne Blanchard; http://lamer.lsu.edu/pdfs/SOAR_sand_folio.pdf). You will need small amounts of sand (ideally some from different locations/geologic types, but whatever is available locally is fine). If you have different types of sand, go ahead and put each one into a different container/bag and label it with a number or letter so you can identify it later. Allow about 15-20 minutes for students to conduct their sand investigations. You might want to preface this lab by showing your students some images of different sand samples taken under a microscope (e.g. http://www.microscope-microscope.org/applications/sand/microscopic-sand.htm). Ask the students if all of the sands look the same? What is different about them? (*colors, sizes, shapes, smooth/rough edges, etc.*)

Explain that they are going to perform some experiments on their sand sample to learn more about it.

You will need: (for each group of 2-4 students)

- sand sample (1/4 tsp. is plenty) in a small container or on a small plate
- Petri dishes, small plates or small plastic cups
- Mortar and pestle
- Small cup of vinegar
- Eye dropper
- Magnifying glass
- Small (approx.. ½" paintbrush)
- Plastic spoon
- Magnet (magnetic wands work well)
- Sand lab worksheets (4-7 to 4-8)

Give each student a sand lab worksheet and remind them to read all of the instructions CAREFULLY. Be aware that if students do not put their ground up sand sample into a dish before adding the vinegar, the vinegar will react with the ceramic mortar and will fizz, regardless of whether or not the sand sample contains calcium carbonate!

Extension for this lab—if available, use a microscope to show students what their sand samples look like at higher magnifications.

Activity 2. **Sea Turtle Nesting Data Analysis** (pages 4-9 to 4-10)**.** This is a graphing/math activity. The graph can be created as a point/line graph or as a bar graph. The teacher answer key is provided (4-10).

Activity 3. **What Affects the Temperature of a Sea Turtle Nest?** (pages 4-12 to 4-14). Help students design and conduct an experiment to test how different factors might affect the temperature inside a turtle nest. This could be done fairly simply using large plastic or foam cups of sand, thermometers, and a light source, a sunny window area or the outdoors. Factors that could be modified include the color of the sand (e.g. using food coloring or tempera paint), the moisture of the sand (adding different quantities of water to the cups) or the amount of shade provided. A student instruction guide is on pages 4-11 to 4-13. Students should record their data, and write up a research paper at the conclusion of their experiment. If you want, you can also have them create presentations to share their data with classmates (orally or in poster form).

Activity 4. **How Big is That?** (page 4-15). Students will convert egg and hatchling sizes from inches to cm. As an extension, they could then convert those measurements to mm.

Activity 5. "**Temperature Will Tell**" activity sheet from Newport Aquarium Educators Guide (pg 9). http://www.seaturtle.org/documents/Educators_Guide.pdf

Name: _____

# Sand Lab

Sand sample ID (if available):_____

Instructions

1. Use a spoon to put a tiny amount of sand onto a Petri dish or piece of paper. Use the magnifying glass to observe your sand. Answer the following questions about your sand sample.
    a. Is your sample many colors or all one color? _____
    b. Are the grains all about the same size? _____
    c. If the grains of sand are mostly all the same size, the sample is what geologists refer to as "well sorted". If there is a wide range of grain sizes, the sand is considered to be "poorly sorted". Is your sample well sorted or poorly sorted?

       _____
    d. Roundness and angularity (a big word that means how sharp the edges are) can tell the geologist how long a sand particle might have been in a stream or river.

       Are the grains smooth and rounded? _____
    e. What shapes are the grains of sand (round spheres, rods, flat discs, irregular blobs)?

       _____
    f. Is your sand sample all made of one type of grain or is it a mixture of different types of sand grains?

       _____
2. Sand that comes from volcanic rock often contains minerals that are magnetic. One student should hold the petri dish (or piece of paper) about a foot above the top of the table. Another student should take a magnet and carefully move the magnet across the bottom of the dish/paper. DO NOT PUT THE MAGNET IN THE SAND! Watch the sand sample. Can you see any pieces moving? If so, your sand sample might have come from somewhere where there are volcanoes!

Are there any minerals in your sand sample that are attracted to a magnet?
_____

3. Carefully transfer your sand sample from the Petri dish/paper into the ceramic dish (this is called the "mortar"). You might want to use a paintbrush to help. Use the grinder (called a "pestle") to grind the sand into a fine powder. To do this, press down on the pestle and rub it along the bottom of the mortar. Use a paintbrush to carefully sweep the sand dust into a Petri dish (or small plastic cup). Add a few drops of vinegar to the sand dust. Watch carefully. Do you see any bubbles/fizzing? Vinegar reacts with limestone, which is what some marine animals use to make their shells. If you see fizzing, that is a clue that some of your sand probably came from living things.

   Did your sand come from living things? _____

4. Write a few sentences to describe your sand and what you have learned about it.

   _____

   _____

   _____

   _____

   _____

   _____

When you have finished, ask your teacher what to do with your equipment.

Name: _____

# Sea Turtle Nesting Data Analysis

This table shows the number of loggerhead sea turtle nests that were laid on a set of beaches in Florida. Sea turtle patrol staff and volunteers walk the beaches during nesting season. They count the nests that they find. Create a line or bar graph on a sheet of graph paper. Your graph should have the number of nests on the y-axis and the year on the x-axis.

| Year | # of nests | | Year | # of nests |
|---|---|---|---|---|
| 1989 | 39,000 | | 2001 | 46,000 |
| 1990 | 50,000 | | 2002 | 38,000 |
| 1991 | 53,000 | | 2003 | 41,000 |
| 1992 | 47,000 | | 2004 | 30,000 |
| 1993 | 42,000 | | 2005 | 35,000 |
| 1994 | 52,000 | | 2006 | 32,000 |
| 1995 | 58,000 | | 2007 | 28,000 |
| 1996 | 53,000 | | 2008 | 39,000 |
| 1997 | 43,000 | | 2009 | 33,000 |
| 1998 | 60,000 | | 2010 | 48,000 |
| 1999 | 57,000 | | 2011 | 42,000 |
| 2000 | 57,000 | | 2012 | 58,000 |
| | | | 2013 | 45,000 |

Use your graph to answer the following questions.

1. What year had the smallest number of turtle nests? _____
2. What year had the largest number of loggerhead nests? _____
3. What fraction of the years surveyed had more than 40,000 nests? _____
4. What fraction had less than 40,000 nests? _____
5. If the total number of nests was evenly distributed (there were the same number of nests each year), about how many nests would there be each year?

   _____

6. How would you describe the pattern of data from 2007 to 2013? How many nests do you think there will be in 2014? Justify your answer. Use the reverse side if needed.

_____

_____

_____

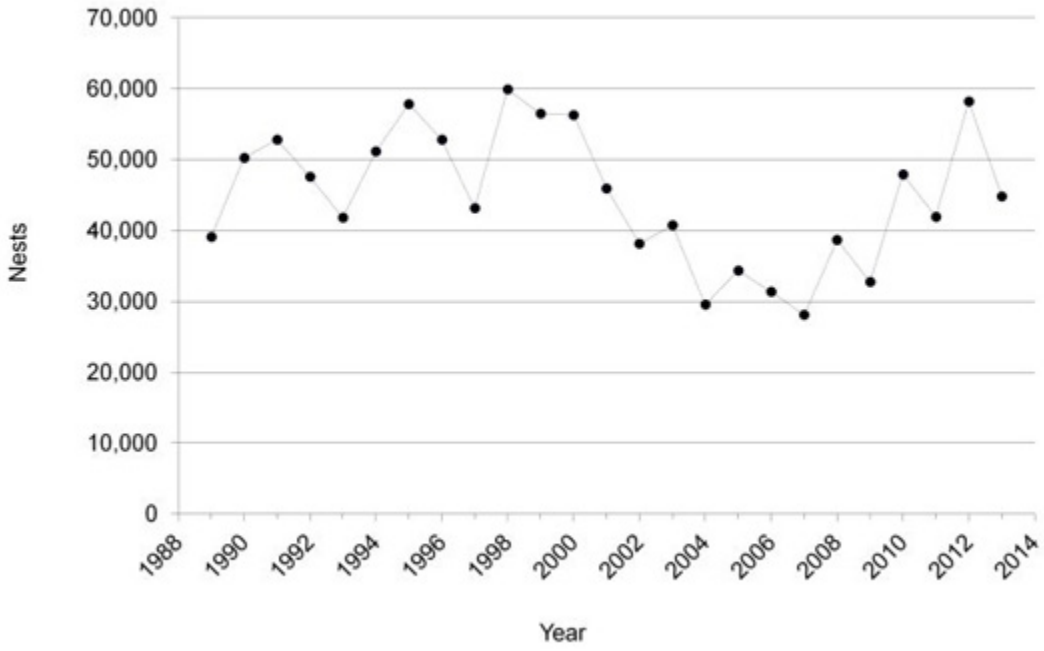
_____

_____

_____

_____

# *Sea Turtle Nesting Data Analysis* Answers




*Student graph should look something like the one above.*

1. What year had the smallest number of turtle nests? [2007]
2. What year had the largest number of loggerhead nests? [1998]
3. What fraction of the years surveyed had more than 40,000 nests? [17/25]
4. What fraction had less than 40,000 nests? [8/25]
5. If the total number of nests was evenly distributed (there were the same number of nests each year), about how many nests would there be each year? [best answer is about 45,000; acceptable values are between 43,000 and 47,000]
6. How would you describe the pattern of data from 2007 to 2013? [Overall, the number of nests increased. In 2007, the number of nests was very low, then it increased in 2008. The number decreased in 2009, but not as low as it was in 2008. In 2010, the number of nests was higher than in 2008. This low-high pattern is repeated, with each high and low being higher than the one before.] How many nests do you think there would be in 2014? Justify your answer. [If the pattern repeats, there could be 65-68,000 nests. But this is more than there have ever been, so may not be realistic. Almost any number of nests could be predicted…]

Name: _____

# What Affects the Temperature of a Sea Turtle Nest?

Let's create an experiment to find out!

1. Complete the following sentences:

I think that _____ will affect the

temperature of a sea turtle nest because _____

_____.

(This is your hypothesis.)

I am going to test my guess by making some pretend sea turtle nests. Each nest will be represented by a cup of sand. I will use a thermometer that is stuck into the sand to measure the temperature. The temperature is called my "dependent variable."

I will not do anything to change some of my nests. These will be called my "controls."

For the other nests, I will change the _____

_____

(this is called the "independent variable")

I will need to have more than one "control nest" and more than one "experimental nest." I am going to

use (how many?) _____ control nests and _____ experimental nests.

2. On another sheet of paper (or in a log book), write down your experimental plan (this is also sometimes called "procedure" or "methods"). Be careful to list how many, how much, how long… as appropriate. For example, how much sand will you use in each nest? How deep will you push the thermometer into the sand? How long will you let the nest sit before you record the temperature? Will you measure the air temperature as well as the sand temperature? Have your teacher check your plan and make any corrections that he/she suggests before you start your experiment.

3. Start your experiment. When you are running your experiment, make sure to write down your data in a notebook (scientists call this a "log book") so you can understand it later. You might want to create a table like the one below. When you have finished running your experiment, look at your data. What do they tell you? Look at your hypothesis. Did your data support your hypothesis? (In other words, was your guess correct or not? It's OK if your guess was not correct. It is common in science for our data NOT to support our hypothesis.) Why do you think your results came out the way that they did? Is there something that you would do differently if you had to repeat your experiment?

| Cup number | What is the independent variable? | Initial sand temperature | Final sand temperature |
|---|---|---|---|
| 1 | Sand color (white) | 24°C | 26°C |
| 2 | Sand color (white) | 24°C | 25°C |
| 3 | Sand color (white) | 24°C | 27°C |
| 4 | Sand color (black) | 24°C | 29°C |
| 5 | Sand color (black) | 24°C | 30°C |
| 6 | Sand color (black) | 24°C | 29°C |

Write up your experiment as a research paper. You should use the following sections:

Background. The background section of the paper should contain information that you have learned about sea turtle nesting and climate change. How does temperature affect sea turtle eggs/babies? What might affect the nest temperature? What might happen to nest temperatures over the next hundred years? In this section, you should explain what you are going to test, and why. How do you think it might affect nest temperature? How might that be important in real life? If you talk about information from books or websites, make sure to list those in your bibliography.

Materials. Make a list of all the things you used in conducting your experiment. If someone wanted to do the same experiment, they should be able to use your materials list to collect everything they would need. Be sure to list the numbers/amounts of each item in your list (e.g. instead of just listing "cups", write "10 12-ounce foam cups.")

Methods. This should be a step-by-step listing of what you did, from the very beginning of the experiment to the very end. It can be numbered, or bulleted, or can be in short paragraph form. It should be written as instructions (e.g. 1. Gather all of your materials.) As with the materials section, it needs to be complete enough for someone else to be able to do exactly the same experiment. You can include a picture or drawing of your experiment.

Results. What happened? You can include your data table here, and any graphs that you have created. You will need to explain what you found out. Don't just put in a table or graph without any explanation. If possible, give average values for your data. (What was the average temperature of the control nests? The experimental nests?)

Discussion and Conclusions. Based on your data, can you answer the question that you started with? Did your independent variable affect the temperature of the nest? Why do you think it did or did not? Did anything happen in your experiment that you did not expect? How could scientists use the results of your experiment to help protect sea turtles? Why is nest temperature important to sea turtles?

Bibliography. This should be a list of all of the websites, books or other places where you got your information. You can use sources like www.easybib.org or www.bibme.org to create the proper format for your sources.

Name: _____

# How Big is That?

The table below shows the sizes of different type of sea turtle eggs and hatchlings in inches. What would these sizes be in centimeters? To find out, multiply each of the measurements in inches by 2.54. Round your answers to the nearest hundredth of a centimeter and write them in the appropriate box in the table.

| Type of turtle | Egg diameter (inch) | Egg diameter (cm) | Average size of turtle hatchling (inch) | Average size of turtle hatchling (cm) |
|---|---|---|---|---|
| Flatback | 2.05 | | 2.40 | |
| Green | 1.73 | | 1.97 | |
| Hawksbill | 1.61 | | 1.57 | |
| Kemp's ridley | 1.54 | | 1.69 | |
| Leatherback | 2.08 | | 2.32 | |
| Loggerhead | 1.57 | | 1.77 | |
| Olive ridley | 1.54 | | 1.69 | |

## *How Big Is That?* Answers

| Type of turtle | Egg diameter (inch) | Egg diameter (cm) | Average size of turtle hatchling (inch) | Average size of turtle hatchling (cm) |
|---|---|---|---|---|
| Flatback | 2.05 | 5.21 | 2.40 | 6.10 |
| Green | 1.73 | 4.39 | 1.97 | 5.00 |
| Hawksbill | 1.61 | 4.09 | 1.57 | 3.99 |
| Kemp's ridley | 1.54 | 3.91 | 1.69 | 4.29 |
| Leatherback | 2.08 | 5.28 | 2.32 | 5.89 |
| Loggerhead | 1.57 | 3.99 | 1.77 | 4.50 |
| Olive ridley | 1.54 | 3.91 | 1.69 | 4.29 |

# Climate change

# Environment

# Erosion

# Gas

# Hatchlings

# High tide line

# Incubated

# Glaciers

# Migrate

# Nesting season

# Overheat

# Oxygen

# Sand dunes

# Sand grains

# Sea level