Life Science: Sharks by The Numbers

The Atlantic White Shark Conservancy

<http://www.atlanticwhiteshark.org/>

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Science Grade [Life Science] Grade 3

Unit Overview

This unit engages students in a study of the Great White Shark. Students will use multiple sources of information to understand White Sharks using data. By the numbers students will understand: sharks life cycle, the traits that led to their success as a species, shark tracking around Cape Cod, and Great White shark populations around the world. Students integrate the information they learned to create a product that communicates increased Shark “Awareness” by the numbers to be shared with our local community.

**Please provide us some background information on the unit development.** In order to help others who are interested in this topic understand a bit more about what you created, we will write a short introduction to each unit and provide some images, in addition to posting the completed units on the Cape Cod Regional STEM Network website ([www.capecodstemnetwork.org](http://www.capecodstemnetwork.org)). Please help us by answering the questions below after you have completed your unit.

1. Who helped to create this unit?

| Names | School (Grade/course taught) |
| --- | --- |
| Kate Skehill | East Falmouth Elementary School Grade 3 |
|  |  |

1. What were some sources of inspiration for this unit?

Recent Great White Shark activity on Cape Cod and finding a unit to cover the new 3rd grade life science standards while integrating math and technology.

1. In your own words, what are you hoping students learn—big picture—through this unit?

We want students to gain and awareness of great white sharks and their habits in order to increase safety and understanding of this key stone species.

1. What might students find exciting in this unit?

Exploration of shark teeth and using technology to track sharks and identify local hot spots.

1. What science standards or real-world content did you strive to emphasize?

Life Science Standards Grade 3

1. How would you say that this unit “matters” to the STEM community? Or to our community on Cape Cod? Or to the larger community?

It matters because ready or not the white sharks have returned to Cape Cod. By creating an understanding of how sharks develop, their unique characteristics, and where they are likely to hang out we hope to increase public safety and understanding. STEM: Focus on the interdependence of Science, Engineering, Math, and Technology and how they support each other. Tools and instruments are used to answer scientific questions while scientific discoveries lead to the development of new technologies.

1. What’s the most important lesson you learned as you created this?

There is SO MUCH conflicting information out there on white sharks! Data bases have old or incorrect statistics on everything from how long great whites live to estimated populations. One source indicated the white shark population in the pacific was 200 another source indicated it was around 7000! I was lucky to have the resources from Marianne and scientist at the AWSC to keep me on track.

8. Anything else you would like fellow teachers or others to know about this unit?

Population numbers are hard to nail down. In many areas populations studies are currently underway. The ranges are the best information we have at this time.

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| Stage 1 Desired Results | |
| --- | --- |
| **MA STE Standards**  **3-LS1-1. Use simple graphical representations to show that different types of organisms have unique and diverse life cycles. Describe that all organisms have birth, growth, reproduction, and death in common but there are a variety of ways in which these happen.**  **3-LS4-4. Analyze and interpret given data about changes in a habitat and describe how the changes may affect the ability of organisms that live in that habitat to survive and reproduce**  **3-LS4-5(MA). Provide evidence to support a claim that the survival of a population is dependent upon reproduction.**  **Mathematics**  **3.MD.B.3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs.**  **3.OA.A.4. Represent and solve problems involving multiplication and division. Apply properties of operations to multiply.**  **English Language Arts and Literacy**  **W3.2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.** | **ESSENTIAL QUESTIONS**  **EQ1 What is science and why is it important?**  **EQ2 How do we explain the interactions in our world through our understanding of science?**  **EQ3 What does learning, practicing, understanding and applying science mean to you and the**  **world in which you live?**  **EQ4 How do we use data to represent and solve problems?** |
| **UNDERSTANDINGS**  **U1 Different types of organisms have unique and diverse life cycles**  **U2 Some changes may force an organism to move or the organism may change its behavior to accommodate the change; not all changes in an environment lead to extinction.**  **U3 Scientific arguments rely on relevant evidence (data) and logical reasoning.**  **U4 Data can be analyzed to create understanding** |
| **TRANSFER**  ***Students will be able to independently use their learning to…***  T1 Study the interactions between and influence of the environment and human traits and  characteristics.  T2 Use data, evidence, and reasoning to analyze living systems.  T3 Use data, evidence, and reasoning to develop scientific claims and engage in discussions. |
|  | **Cross-Curricular Connections**  **Stability and Change:** In grades 3–5, students can measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change.  **Interdependence of Science, Engineering, and Technology:** In grades 3–5, students can describe how science and technology support each other. Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies.  **Math:** Students will collect, calculate, and analyze data to support ideas and use data to create graphs  **ELA:** Students will examine a topic to convey ideas and information clearly |
| **Stage 2 Evidence** | |
| **Formative Assessment Ideas:**  Science Notebook  Diagram  Shark tooth size calculations  Data Collection (Sharktivity APP)  Graph/ Graph Analysis  Teacher observations  Classroom discussions | |
| **Summative Assessment Ideas:**  **Curriculum Embedded Performance Assessment :**  Students will take on the role of research scientists and use their knowledge to create a public service message that shows cases awareness and understanding of Great White Sharks. Awareness inspires conservation. This informational message can be in the form of a brochure, slide show, poster, or video. Public Service message should include data about white shark characteristics as well as recent population data, graph, and analysis. Student’s will present their work to an audience and share their findings. | |
| **Stage 3 Learning Plan** | |
| **Summary of Key Learning Events and Instruction**  ***Engagement and Pre Assessment***  **Lesson One: KWL: The Life of A White Shark**  Have you ever seen a shark? What do sharks look like? Are there sharks around here? Create curiosity and assess background knowledge! Share ideas on where in the world’s oceans this creature lives, why this species has been so successful, and why we have seen a return of the great white shark to Cape Cod. Students will understand that different organisms have unique and diverse life cycles. Students will draw and label a diagram of the white shark life cycle including numbers (duration of stage, number of pups, etc.)  **Lesson Two: Sharknatomy: Anatomy of a Shark**  Students will investigate the traits that have made white sharks successful as a species. They will learn basic anatomy focused on measurement, weight, speed. etc. Students examine teeth. Students will measure the dimensions of the shark teeth and use a formula to determine the length of a shark based on the length of a tooth.  **Lesson Three: SHARKTIVITY!**  Students will learn about the numbers white sharks around Cape Cod and the Northwest Atlantic. Students will be introduced to the SHARKTIVITY App. run by the Atlantic White Shark Conservancy. Exploring with the app students can determine when, where, and how often white sharks are sighted around Cape Cod. Using SHARKTIVITY students will investigate, collect, and evaluate data about local shark sightings. Students will make a connection between awareness of white sharks and public safety.  **Lesson Four: We’re Baaack!**  Students will investigate populations of white sharks in our oceans. Understanding that much is still unknown about the white shark population and its migratory patterns students will map white shark “hot spots”. Students will create a data table, graph (bar, picture, or pie) and conduct a graph analysis on white shark populations using research estimates. Through graph analysis students will make claims about the need to research and conserve this species.  **CEPA:**  Students will use their knowledge to create a public service message that showcases awareness and understanding of the Great White Shark. Student products should include information on: sharks life cycle, the traits that led to their success as a species, local white shark activity, and population information. Students integrate the information they learned to create a product that communicates increased Shark “Awareness” using data. Students can choose to create a poster, slideshow, brochure, or video. | |

| **Introductory Lesson**  Lesson that introduces the content. More teacher directed | **Constructing Lesson**  Lessons that engage students in building and linking together understanding. Guided/collaborative. Student/teacher or partners/small group | **Practice Lesson**  Lessons or activities that students can complete relatively independently | **Assessment Lesson**  Formative: Check-ins along the way to see if students “get it”  Summative: Students showing what they know, when you feel they are ready |
| --- | --- | --- | --- |

| **Stage 3 Learning Plan** | | | |
| --- | --- | --- | --- |
| **Summary of Key Learning Events and Instruction** | | | |
| **Lesson Name** | **Type** (Introductory, Constructing, Practice, and Assessment) | **Content Addressed** | **Standards Included (by number)** |
| 1. The Life of a White Shark | Introductory | life cycle |  |
| 1. Sharknatomy | Constructing | anatomy of a shark  tooth to length calculations |  |
| 1. Sharktivity! | Practice | understand shark activity around cape cod by collecting data |  |
| 1. We’re Baaack! | Constructing | world white shark population trends and data |  |
| 1. The Great White Awareness Project | Assessment | integration of information learned to promote awareness and understanding. |  |
|  |  |  |  |

**Lesson 1: The Life of a White Shark**

| **Overview of the Lesson:**  **Time (minutes):60 Min**  Have you ever seen a shark? What do sharks look like? Are there sharks around here? Create curiosity and assess background knowledge! Share ideas on where in the world’s oceans this creature lives, why this species has been so successful, and why we have seen a return of the great white shark to Cape Cod. Students will understand that different organisms have unique and diverse life cycles. Students will draw and label a diagram of the white shark life cycle including numbers (duration of stage, number of pups, etc.) |
| --- |
| **Standard(s):** What standards (s) will be the focus of the lesson?   * **3-LS1-1. Use simple graphical representations to show that different types of organisms have unique and diverse life cycles. Describe that all organisms have birth, growth, reproduction, and death in common but there are a variety of ways in which these happen.** * **3-LS4-5(MA). Provide evidence to support a claim that the survival of a population is dependent upon reproduction.** |
| **Essential Question(s):**   * What makes a white shark unique? * How do we explain the interactions in our world through our understanding of science? * How does understanding the life cycle of a white shark help us form a scientific argument for protection (conservation) of this species. |
| **Science Objectives**   * Students will identify the parts of a white shark’s life cycle. * Students will collect data on life cycle stages to form a scientific argument |
| **Language Objectives and/or Targeted Academic Language**  life cycle ovoviviparous  pups juvenile  adult life span |
| **Anticipated Student Preconceptions/Misconceptions (optional)** |
| **Instructional Materials/Resources/Tools**   * Life Cycle Diagrams * Chart Paper * 10 Facts About White Shark video <https://www.youtube.com/watch?v=F69uqDIhr60&t=64s>   Teacher Information:   * **Animal Fact Guide** [**https://animalfactguide.com/animal-facts/great-white-shark/**](https://animalfactguide.com/animal-facts/great-white-shark/) * **National Geographic Kids** [**https://kids.nationalgeographic.com/animals/great-white-shark/#great-white-shark-swimming-blue.jpg**](https://kids.nationalgeographic.com/animals/great-white-shark/#great-white-shark-swimming-blue.jpg) |
| **Assessment:** How will you know that the students got it?  Class Discussion  Science Notebooks  White Shark life cycle diagram |
| **Science and Engineering Practices included (put the included ones in bold):**  1. Asking questions (for science) and defining problems (for engineering)  **2. Developing and using models**  3. Planning and carrying out investigations  4. Analyzing and interpreting data  5. Using mathematics and computational thinking  6. Constructing explanations (for science) and designing solutions (for engineering)  **7. Engaging in argument from evidence**  **8. Obtaining, evaluating, and communicating information**  **Notes about Science and Engineering Practices included:** |
|  |
| **Opening/Engagement: 15 min**   1. Ask students: Have you ever seen a shark? Are there sharks around here? 2. We have heard lots of stories about how sharks can be dangerous. Do you think there is anything dangerous for a shark?   Turn and talk to your neighbor: After a minute have students share. Write their answers on chart paper.  Let students know that in fact Great White Sharks are listed as vulnerable on the IUCN Red List and are on the cusp of being endangered.   1. Introduce the essential question: How does understanding the life cycle of a white shark help us form a scientific argument for protection (conservation) of this species. |
| **During the Lesson: 30 min**   1. Introduce science notebook. Let students know that the information they collect here will be used to help them in their final project! 2. Watch 10 Facts About Great White Sharks Video: Have Students take notes. After, share notes writing key points on chart paper. 3. <https://www.youtube.com/watch?v=F69uqDIhr60&t=64s> 4. Present the life cycle diagram to students.   Great White Sharks are thought to give birth every two to three years.  **Stage One and Two:** White sharks begin as eggs inside the mother shark. White sharks are ovoviviparous. That means eggs develop and hatch inside the mother shark. While growing inside the mother shark, the developing sharks will eat the undeveloped eggs for strength and nutrients! The baby sharks are born after developing for 12-18 months.  **Stage Three:** Newborn sharks are called pups. They are born in small groups called litters. Litters have between 2-10 pups. Pups are born 4-5 feet in length weighing about 40 lbs. They leave their mom immediately so they don’t become her food! They have natural survival knowledge (instincts) and a full set of teeth. Even so not all make it through their first year. Pup survival rate is not know but estimated to be a bit better that 20%. They are slow growing and slow to mature. This stage lasts about 1 year. This age group can be referred to as YOY or Young of Year.  **Stage Four:** Juvenile white sharks are typically up to 9 feet long. This stage typically lasts till the shark is 2-19 years old. Their weight range varies greatly from a few hundred to thousands of pounds!  **Stage Five:** A white shark is considered a mature adult at 20 years of age once it is 10 feet in length. White sharks can grow as long 15-20 feet in length and weigh over 4,000 lbs! White sharks are thought to live up to 45-70 years and grow to 4x its birth length. At this stage the white shark can have pups of its own.   1. Students should create their own life cycle diagram (or use the diagram provided). Make sure to add numerical data (length of stage, number of pups etc) |
| **Lesson Closing 15 min**   1. Briefly discuss the shark life cycle and how it is similar to all life cycles in that it includes birth, growth, reproduction, and death. The survival rate is low for baby white sharks. They face danger inside their mom and when they are newborn from predators. A relatively small number of white sharks are born each year. Even if they do make it to adulthood they face dangers from humans as well as orcas and other big sharks. The white shark is an important part of the ocean ecosystem and it helps balance the food chain. By knowing the importance of the white sharks and having awareness of its life cycle we understand that the population can not grow quickly. An argument can be made for protecting this species. Awareness and understanding leads to conservation.   11. Note that they will be using a scientific notebook throughout the unit to record evidence and their ideas about awareness, understanding,  and safety as it relates to understanding great white sharks using data.  12. Introduce the CEPA: Students will use their knowledge to create a public service message that showcases awareness and understanding of the Great White Shark. Student products should include information on: sharks life cycle, the traits that led to their success as a species, migratory habits, and population information. Students integrate the information they learned to create a product that communicates increased Shark “Awareness” using data. Students can choose to create a poster, slideshow, brochure, or video. |
|  |

**Lesson 2: Sharknatomy: Anatomy of A Shark**

| **Overview of the Lesson:** Students will investigate the traits that have made white sharks successful as a species. They will learn basic anatomy focused on measurement, weight, speed. etc. Students will understand that much is still unknown about this species of shark. Students examine teeth. Students will measure the dimensions of the shark teeth and use a formula to determine the length of a shark based on the length of a tooth.  **Time (minutes): 60** |
| --- |
| **Standard(s):** What standards (s) will be the focus of the lesson?   * **3-LS4-1. Use fossils to describe types of organisms and their environments that existed long ago and compare those to living organisms and their environments. Recognize that most kinds of plants and animals that once lived on Earth are no longer found anywhere.** * **3-LS4-2. Use evidence to construct an explanation for how the variations in characteristics among individuals within the same species may provide advantages to these individuals in their survival and reproduction.** * **3.OA.A.4. Represent and solve problems involving multiplication and division. Apply properties of operations to multiply.** |
| **Essential Question(s):** What essential questions will be addressed in this lesson?   * What makes a white shark unique? * Are all shark teeth the same? * What information can a scientist learn from shark teeth? * How can we apply the data about white sharks and data calculated from shark teeth to help inform us about the area in which we live? |
| **Science Objectives**   * Students will understand white sharks are unique. * Student will make arguments that white sharks are unique that rely on relevant evidence (data) and logical reasoning. * Data can be analyzed to create understanding that tooth size is directly related to shark length and age. |
| **Language Objectives and/or Targeted Academic Language**  dorsal fin lateral line buoyancy  pectoral fin gills weight  caudal fin cartilage length  pelvic fin liver mass  denticles organism serrated |
| **Anticipated Student Preconceptions/Misconceptions (optional)** |
| **Instructional Materials/Resources/Tools**   1. What is a Shark? <http://www.atlanticwhiteshark.org/shark-curriculum-resources>   **Ted ed VIDEO: Why Are Sharks So Awesome** : <https://www.youtube.com/watch?v=svlEfxTyJQE>  **National Geographic Kids** : <https://kids.nationalgeographic.com/animals/great-white-shark/#great-white-shark-swimming-blue.jpg>  Math Lab Sheet  Magnifying Glass  White Shark Teeth (10) different sizes  Ruler  Calculator |
| **Assessment:**  Investigation Math Lab Sheet  Science Notebook  Observations during investigation  Class Discussion |
| **Science and Engineering Practices included (put the included ones in bold):**  1.  **Asking questions (for science) and defining problems (for engineering)**  **2. Developing and using models**  3**. Planning and carrying out investigations**  4.  **Analyzing and interpreting data**  5. **Using mathematics and computational thinking**  6. Constructing explanations (for science) and designing solutions (for engineering)  **7. Engaging in argument from evidence**  **8. Obtaining, evaluating, and communicating information**  **Notes about Science and Engineering Practices included:** |
| **Lesson Overview:**  Students will investigate the traits that have made white sharks successful as a species. They will learn basic anatomy focused on measurement, weight, speed. etc. Students examine teeth. Students will measure the dimensions of the shark teeth and use a formula to determine the length of a shark based on the length of a tooth. |
| **Opening/Engagement: 10 min**   1. Explain that in addition to their life cycle, white sharks have other characteristics that make them unique. For example, the white shark is so perfectly designed for speed that inventors have use models of their scales (dermal denticles) to create swim gear for swim competitions! 2. Students will watch What is a Shark? <http://www.atlanticwhiteshark.org/shark-curriculum-resources> and or   Ted ed VIDEO: Why Are Sharks So Awesome : <https://www.youtube.com/watch?v=svlEfxTyJQE>   1. Explain that today they will take a close look at the anatomy of a shark. They will take notes in their science notebook about the parts of a shark and create a model of a white shark with measurement labels. We will also collect data on white sharks’ speed, length, and teeth.   \*Inform the students that scientists can use observation as a tool during scientific investigations. They use their power of observation to observe fossilized shark teeth and compare them to an identification chart to determine what species of shark the tooth came from. |
| **During the Lesson: 35 min**   1. Students will use the chart or create one in their science notebook. Model this for students. 2. Display the information from National Geographic Kids and review this with students. Inform students that there is lots of conflicting data on white sharks. Scientists continue to study white sharks and new information is being learned. Some of this information can be used to complete the table and some is outdated. Model how to pick out important pieces of data and add them to the chart. Other information was provided by AWSC and can be found on the answer key. 3. Explain that students will observe and compare various white shark teeth. Introduce the lab sheets and student expectations. Using the lab sheet students will describe, diagram, and measure three different white shark teeth. 4. Explain that a rough formula for calculating the size of a shark, using its teeth, is to measure from the base of the enamel to the tip in **centimeters**, then divide that by 2.54. Finally, multiply by ten to calculate the total length of the shark in **feet**. This estimate only applies to large triangular-shaped teeth, but if you ever find one you will be able to estimate just how big the shark was that it came from! Third graders will need calculators for this exercise. It is a good idea to model the measuring/calculation process and how to complete the lab sheet with the whole class first. 5. Encourage students to choose teeth that are noticeably different in size. They will then use the measurement formula to determine the length of the shark (use the formula). Finally, using the length as a guide students will determine the estimated stage of life the shark was in when this tooth was lost. Remind students that when white sharks are juveniles their tooth shape changes from narrow and pointy to the typical triangular shape we are familiar with. 6. Have students work in small groups. Each group will have a few shark teeth, lab sheet, calculator, magnifying glasses, and a ruler. 7. Let students return to explore teeth and work on lab sheet. Observe student conversations and facilitate with questioning. What is the length of that tooth? Do you think that came from an adult shark? Encourage them to make detailed diagrams of the teeth (shading, enamel, serrations, etc) 8. Wrap up investigation and call group together. Ask “what did you discover?” Give students an opportunity to share length of teeth and sharks that they investigated. |
| **Lesson Closing 15 min**   1. Explainthat scientist use clues to tell them what they don’t know. One way they determine the length of a shark is by the size of its teeth. The size of the teeth can also roughly determine the sharks age. Why might a scientist want to know that information? (knowledge, understanding, conservation). 2. Have students add charts to their science notebooks. |
| **Instructional Tips/Strategies/Suggestions for Teacher:** |

**Teacher Information**

The Fins of a Shark:

Each and every shark has 5 types of fins

Pectoral Fin : help the shark steer, as well as provide additional lift in the water column

Dorsal Fin: provides stability for the shark, prevents them from rolling over

Anal Fin: Helps reduce drag caused by the caudal fin

Pelvic Fin: helps in balancing of the shark in the water

Caudal Fin: (tail) provides lift and thrust, propels it through the water, has an upper and lower lobe

NOTE: The size and shape of fins varies from one species of shark to another.

**Shark Teeth Teacher Information**

Sharks have numerous teeth that lie flat within the shark’s mouth. At one time most adult sharks have 50-100 functioning teeth.

The shape and size of the teeth differ from one species of shark to another. Teeth are designed to catch and consume prey. Because each species of shark has its own unique tooth shape making up the jaw, you can identify a specific shark species by tooth. The teeth are loosely embedded into the mouth of the shark. They are designed to easily fall out, because the shark has many replacements ready to move forward.

While sharks’ teeth do share the common traits described above, they have very different shapes and uses. There are four basic groups of shark diets and because of this there are four basic types of shark teeth.

**Shark Teeth Chart Info**

-Sharks that typically eat fish have **long, narrow, needle-like teeth** ideal for gripping something as slippery and streamlined as a fish.

-Sharks that are benthic feeders, eating bivalves and crustaceans, have **thick, plate-like teeth** perfect for crushing the shells of their prey.

-Tiger sharks, great white sharks, and other sharks that primarily eat seals and other mammals have **sharp, serrated cutting teeth** for tearing off chunks of flesh.

-Finally, we have the gentle giants of the shark family, the basking sharks and whale sharks, that eat krill and other forms of plankton. While they have many teeth, they are **tiny** and useless, as these sharks feed by filtering water through their gills.

<http://www.sharksavers.org/en/education/biology/shark-teeth1/>

A shark’s jaw is very unique. The upper jaw of the shark is attached to the skull, but it has the ability to detach itself when attacking prey. This allows the shark to thrust it’s mouth forward and upward to obtain prey.

**To order shark teeth:**

Contact the Aurora Fossil Museum in Aurora, NC

1(252) 322-4238

at the time of creating this unit a bag of 50 pieces was $2.50 + shipping

This is a mined natural resource, therefore, material availability is variable. Plan ahead!

Free [fossil kits](http://aurorafossilmuseum.org/post/44/fossil-kits-by-mail.html) are available by mail from the Aurora Fossil Museum and may contain shark teeth, as well as other fossils.

White Shark Data

|  | Pup | Adolescent | Adult |
| --- | --- | --- | --- |
| Weight (lbs) |  |  |  |
| Length (ft) |  |  |  |
| Speed (mph) |  |  |  |
| Dorsal Fin (in) |  |  |  |
| Tooth Size (in) |  |  |  |

ANswer Key: White Shark Data

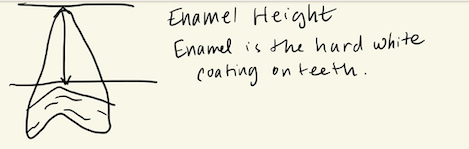
|  | Pup | Juvenile | Adult |
| --- | --- | --- | --- |
| Weight (lbs) | 40 | 1000 | 1500-4500 |
| Length (ft) | 4-5 | up to 9 | 10-20 |
| Speed (mph) | unknown | unknown | 35 |
| Dorsal Fin (in) | 4-6 estimate | 7-9 estimate | 10-14 |
| Tooth Size (in)  and Shape | ½ inch  pointy (eat small fish) | 1 inch  shape change from pointer to triangular | 2 inch  triangular/wider (eat seals) |

Great WHite SHark Tooth data

| Tooth Diagram | Height of enamel (cm) | Height in cm divided by 2.54 | Shark Length  Estimation  (previous column x 10= length in feet) | Stage of Life  pup 4-5 feet  juvenile up to 9 feet  adult 10 + feet |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

More on Measuring Teeth...

Researchers have figured out a cool way to estimate the size of some sharks. By measuring the ENAMEL of the tooth, then using some basic multiplication, they can figure out just how big the shark could be.

PART 1: OBSERVE

What do you notice about the shark teeth on the table? What color are they? How big are they? How long do you think the sharks were that made them?

PART 2: MEASURE THE ENAMEL

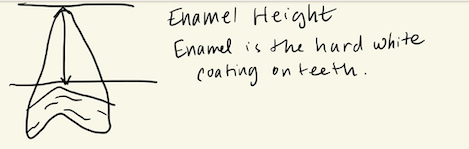
Use your ruler to measure the enamel height. Record your data on your data sheet.

PART 3: DIVIDE & MULTIPLY!

Divide that number by 2.54 and record the result. THEN, multiply that result by 10. This will give you the ESTIMATED length in feet of the shark the tooth came from!

**REMEMBER:**

MEASURE TEETH IN **CENTIMETERS**, DIVIDE BY 2.54, THEN MULTIPLY BY 10. ROUND THAT NUMBER TO THE NEAREST TENTH, AND THAT IS THE ESTIMATE LENGTH OF THE SHARK IN **FEET**.



**Tooth: EXAMPLE**

Enamel Height: \_\_\_\_\_\_\_\_\_\_\_\_\_ CM

Divide by 2.54: \_\_\_\_\_\_\_\_\_\_\_\_\_

Multiply by 10: \_\_\_\_\_\_\_\_\_\_\_\_\_

Estimated Shark Length: \_\_\_\_\_\_\_\_\_ FEET

(round to the nearest tenths place!)

**Lesson 3: Sharktivity!**

| **Overview of the Lesson: Time (minutes): 60 min**  Students will learn about the numbers white sharks around Cape Cod and the Northwest Atlantic. Students will be introduced to the SHARKTIVITY App. run by the Atlantic White Shark Conservancy. Exploring the app students can determine when, where, and how often white sharks are sighted around Cape Cod. Using SHARKTIVITY students will investigate, collect, and evaluate data about local shark sightings. Students will make a connection between awareness of white sharks and public safety. |
| --- |
| **Standard(s):** What standards (s) will be the focus of the lesson?   * **3-LS4-3. Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive.** * **3-LS4-4. Analyze and interpret given data about changes in a habitat and describe how the changes may affect the ability of organisms that live in that habitat to survive and reproduce.** * **Interdependence of Science, Engineering, and Technology: In grades 3–5, students can describe how science and technology support each other. Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies.** |
| **Essential Question(s):**   * How do we know Great White Sharks are returning to Cape Cod? * How do we find sharks to study? * How do we know how many sharks there are around Cape Cod? |
| **Science Objectives**   * Students will understand white sharks have returned to Cape Cod and their numbers are increasing. * Student will understand the idea of shark tagging and its purpose * Students will investigate AWSC’s Sharktivity App. * Students will recognize where the white sharks tend to show up around the cape. * Students will explain in writing their understanding of what information this app gives and how we can use it to increase public safety. |
| **Language Objectives and/or Targeted Academic Language**  Shartivity App detection  Shark Sighting Satellite Detection  Shark Alert Acoustic Detection  shark tagging |
| **Anticipated Student Preconceptions/Misconceptions (optional)** |
| **Instructional Materials/Resources/Tools**  **Swimming with Sharks: Eugenie Clark by Heather Lang (AWSC Kit)**  Sharktivity App  Livestream video (click on purple icon) from Sharktivity App or  Tracking Cape Cod White Sharks <https://www.youtube.com/watch?v=VDZWdBUNs2Y>  Map of Cape Cod  AWSC Safety Video <http://www.atlanticwhiteshark.org/public-safety/> |
| **Assessment:**  Student Discussions  Science Notebook writing  Map (locating frequent sightings) |
| **Science and Engineering Practices included (put the included ones in bold):**  1. Asking questions (for science) and defining problems (for engineering)  **2. Developing and using models**  **3. Planning and carrying out investigations**  **4. Analyzing and interpreting data**  5. Using mathematics and computational thinking  6. Constructing explanations (for science) and designing solutions (for engineering)  7.  **Engaging in argument from evidence**  8.  **Obtaining, evaluating, and communicating information**  **Notes about Science and Engineering Practices included:** |
| **Lesson Overview:**  Students will understand that there is shark research on Cape Cod. Students will learn about the numbers white sharks around Cape Cod and the Northwest Atlantic. Students will be introduced to the SHARKTIVITY App. run by the Atlantic White Shark Conservancy. Exploring the app students can determine when, where, and how often white sharks are sighted around Cape Cod. Using SHARKTIVITY students will investigate, collect, and evaluate data about local shark sightings. Students will make a connection between awareness of white sharks and public safety. |
| **Opening/Engagement: 20 min**   1. Ask students “Are there lots of white sharks around Cape Cod? How many would you guess there are? Where do they go? When are they there?” 2. Explain that we are going to learn about a way that scientists are trying to figure out this information. 3. Introduce the AWSC website and show how students can get on Sharktivity from their computer. Using an iphone for demonstration is ideal. 4. Explain shark tagging and how scientist use tags to get information about sharks. Tags send information acoustically to receivers or through satellite to give information about the location of a specific shark. By tagging sharks (like piercing your ear) scientist can learn information about where and when sharks are at Cape Cod. We can also tell what water conditions, and other interesting information. There is currently an ongoing population study with the AWSC and Dr. Gregory Skomal looking to answer the question: How many white sharks are in the Northwest Atlantic. 5. Show live stream video from Sharktivity App. or Tracking Cape Cod White Sharks <https://www.youtube.com/watch?v=VDZWdBUNs2Y> |
| **During the Lesson: 60 min**   1. Give students an opportunity to explore the app 2. Circulate and question: What do the different color icons mean? blue= sighting , orange= acoustic ping, green= satellite ping, red= alert 3. Where do you see most of the icons? Provincetown, Wellfleet, Monomoy, Chatham. What types of icons do you see the most of? sighting 4. Whole class: Discuss what students what information the app gives us. Where, when, and how often sharks are around Cape Cod waters. Write big ideas down on chart paper. 5. Give students map of Cape Cod. Mark of areas where sharks are more frequently sighted. Something like [this](https://www.google.com/maps/place/Cape+Cod,+Massachusetts/data=!4m2!3m1!1s0x89fb15440149e94d:0x1f9c0efa001cb20b?sa=X&ved=2ahUKEwjT6fLJiPX7AhU_FFkFHe86AhcQ8gF6BAgJEAE) will work. 6. How is this helpful to us? If we know where the sharks are people can make informed decisions about their safety. Where they may or may not want to go swimming etc. Write key ideas on chart paper. 7. Have students watch the safety video from the AWSC <http://www.atlanticwhiteshark.org/public-safety/>   Review and discuss safety information.   1. Have students write in their science notebook what they have learned about the Sharktivity App. What information does it give? How can we use that information? Research, Understanding, Safety |
| **Lesson Closing 10**   1. Students can volunteer to share their paragraphs with the class. 2. Classmates offer feedback in the form of compliments, comments, or questions. |
| **Instructional Tips/Strategies/Suggestions for Teacher:** |

Lesson Three

FROM AWSC:



**Shark Tagging**

*Facilitator Guide*

**Background Information:** Little is known about the behavior of white sharks or about how many white sharks there are in our oceans. Determining population size can be difficult because white sharks are migratory, have a sparse distribution, and not many aggregation sites are known. Cape Cod is the only known aggregation site of white sharks in the western North Atlantic. In 2004 Gretel, a white shark that became trapped in a coastal salt pond on Naushon Island and was tagged using the first high-tech tag in the North Atlantic (before she was helped back to the ocean). Since then, over 100 sharks have been tagged off of Cape Cod using acoustic tags, SPOT tags, or PSAT tags.

The SPOT tag allows for real-time satellite tracking and transmits GPS coordinates and temperature when the shark surfaces and the tag dries (at least 90 seconds out of water). The PSAT tag records water temperature, depth, and light penetration data for up to 12 months. After which it releases (ring on model represents the bobby-pin like part that attaches and releases from shark) and floats to the surface (bulb on receiver for floatation) where it transmits the data to a satellite and the tag can possibly be recovered. Because of these tags, researchers have learned that white sharks can dive up to 3,000 feet and tolerate 30oF water. The acoustic tag transmits underwater “pings” to receivers, which records the tag number and informs researchers as to which individual sharks have been within 300 meters of the receiver and at what time. Receivers are fixed at set locations off of the coast.

**Acoustic Tags:**

Acoustic tags transmit an underwater sound signal (ping) that sends identification information (tag number) to receivers when a tagged shark swims within 300 meters of the receiver. Receivers are set in fixed locations along the coastline. The black canister in the exhibit is the receiver, the cigar shaped tag is the acoustic tag, and the large yellow buoy holds the receiver and visually marks its location in the water.

**SPOT Tags:**

The SPOT tag works by transmitting a signal to a satellite orbiting the Earth, allowing for the shark’s current GPS coordinates to be determined.The dorsal fin of the shark must be out of the water for at least 90 seconds for the signal to be transmitted and received.

**PSAT Tags:** Pop-up Satellite Tags are data loggers attached to the shark just below the base of the dorsal fin. They record water depth, temperature and light penetration for 12 months. When the PSAT tag detaches from the shark it floats to the surface. Once on the surface it will transmit data to the satellite. The tags have shown that sharks can dive up to 3,000 ft and can tolerate water temps in the 30 degree Fahrenheit range

**Lesson 4: We’re Baaaack!**

| **Overview of the Lesson:**  Students will investigate populations of white sharks in our oceans. Understanding that much is still unknown about the white shark population and its migratory patterns students will map white shark “hot spots”. Students will create a data table, graph (bar, picture, or pie) and conduct a graph analysis on white shark populations using research estimates. Through graph analysis students will make claims about the need to research and conserve this species.  **Time (minutes): 60** |
| --- |
| **Standard(s):** What standards (s) will be the focus of the lesson?   * **3-LS4-3. Construct an argument with evidence that in a particular environment some organisms can survive well, some survive less well, and some cannot survive.** * **3-LS4-4. Analyze and interpret given data about changes in a habitat and describe how the changes may affect the ability of organisms that live in that habitat to survive and reproduce.** * **Mathematics** * **3.MD.B.3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step “how many more” and “how many less” problems using information presented in scaled bar graphs.** * **3.OA.A.4. Represent and solve problems involving multiplication and division. Apply properties of operations to multiply.** * **Cross-Curricular Connections** * **Stability and Change:** In grades 3–5, students can measure change in terms of differences over time, and observe that change may occur at different rates. Students learn some systems appear stable, but over long periods of time they will eventually change. * **Interdependence of Science, Engineering, and Technology:**  In grades 3–5, students can describe how science and technology support each other. Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies. |
| **Essential Question(s):** What essential questions will be addressed in this lesson?   * Where in the world’s oceans do great white sharks thrive? * How many great white sharks are there? |
| **Science Objectives**   * Students will recognize the interdependence of Science, Engineering, and Technology * Students will map the great white shark hotspots around the world * Given population ranges, students will create data charts and use the data to produce graphs. * Students will analyze the graphs and make 5 observations. |
| **Language Objectives and/or Targeted Academic Language**   * population |
| **Anticipated Student Preconceptions/Misconceptions (optional)** |
| **Instructional Materials/Resources/Tools**   * World Map * Population Data * Graph paper or graphing program |
| **Assessment:** How will you know that the students got it?  Class discussions  Completed world map  Completed charts, graph and graph analysis |
| **Science and Engineering Practices included (put the included ones in bold):**  1. Asking questions (for science) and defining problems (for engineering)  2. Developing and using models  **3. Planning and carrying out investigations**  **4. Analyzing and interpreting data**  **5. Using mathematics and computational thinking**  6. Constructing explanations (for science) and designing solutions (for engineering)  **7. Engaging in argument from evidence**  **8. Obtaining, evaluating, and communicating information**  **Notes about Science and Engineering Practices included:** |
| **Lesson Overview:**  Students will investigate populations of white sharks in our oceans. Understanding that much is still unknown about the white shark population and its migratory patterns students will map white shark “hot spots”. Students will create a data table, graph (bar, picture, or pie) and conduct a graph analysis on white shark populations using research estimates. Through graph analysis students will make claims about the need to research and conserve this species. |
| **Opening/Engagement: 15 min**   1. Tell students that important shark research is happening in many places. Scientist are trying to find out more about the Great White Shark’s behavior, migration, life cycle, and just how many great white sharks there are. The belief is that awareness inspires conservation. The more we know about sharks the better we can protect them and us! 2. Let students know that white shark population studies are ongoing and that we really don’t know how many white sharks there are in the world! In some areas of the world white shark populations appear to be on the decline but in others population appears to be growing. Why might that be? |
| **During the Lesson: 70**   1. Explain that OSEARCH is another organization that tracks sharks all over the world. They are based in Nantucket. Their method of tracking is different in that they bring the shark onto a submerged platform and raise them up for tagging. They use GPS tags and work with a satellite to provide real time GPS location of sharks. [Tagging Katherine of Cape Cod](https://www.youtube.com/watch?v=evotxXf5ePg) 2. Pass out the world map. Tell students there are areas in the oceans that scientists consider “hot spots” for white sharks. Have students use a crayon or highlighter to mark these areas: Pacific (along CA to Mexico), Mediterranean, Australia, South Africa, and the Northwest Atlantic (Cape Cod to S.Carolina). Students should label the area with population range estimates.  | Hot Spot Location | Estimated Population (range) Adult White Sharks | | --- | --- | | Pacific | 450-2400 | | Mediterranean | 100 (population unknown/estimated on the low side) | | Australia  Eastern  SouthWestern | 470-1030  760-2250 | | South Africa | 353-522 | | Northwest Atlantic | 350-600 |  1. Ask students, “What do you think about these numbers? Why do you think it is difficult to get an exact number? 2. Explain that you will use these population numbers to make a graph that shows worldwide shark population estimates. You can use low or high estimates for this activity. 3. Hand out White Shark Population data table 4. Have students create a table from the data in google sheets ( or by hand in science notebook). 5. Using the table have students insert a graph that showcases Shark Populations (bar graph or pie chart). 6. Have students add data table and charts to their science notebooks. 7. Students should answer questions about the data such as the following: How many more white sharks are there estimated to be in the Pacific than in the Northwest Atlantic? 8. Students should spend some time and analyze their graphs. They can add 5 facts or statements about their data. EX: The data shows that there are more sharks estimated to be living around Australia than South Africa. This can be done independently, in pairs, or as a whole group. |
| **Lesson Closing 5 min**   1. Gather together and share data analysis. 2. Explain that as population studies continue to give us more information our understanding of the numbers of great white sharks will change. We may find that there are many more sharks than initially thought, especially if conservation measures continue. Remember the numbers we looked at were for adult white sharks. If we were able to account for all pups and juveniles our numbers would likely increase by the thousands! |
| **Instructional Tips/Strategies/Suggestions for Teacher:** |

**Handouts**

**World Map:** [**https://www.printablee.com/post\_printable-labeled-world-map\_397072/**](https://www.printablee.com/post_printable-labeled-world-map_397072/)

**Great White Shark Habitat:** [**https://seethewild.org/great-white-shark-habitat-map/**](https://seethewild.org/great-white-shark-habitat-map/)

**White Shark “Hot Spots” Population Range**

| Hot Spot Location | Estimated Population (range) Adult White Sharks |
| --- | --- |
| Pacific | 450-2400 |
| Mediterranean | 100 population unknown estimated on the low side |
| Australia  Eastern  SouthWestern | 470-1030  760-2250 |
| South Africa | 353-522 |
| Northwest Atlantic | 350-600 |

* **NOTE: These ranges are estimates based on population studies that are ongoing. Studies using different estimation methods (Tagging, Fin Identification, DNA, etc.) can give a wide range of results. This data reflects current estimates and can be used to identify and compare known white shark “hot spots” .**

**Curriculum Embedded Performance Assessment (CEPA; if applicable)**

**The Great White Awareness Project**

Students will take on the role of research scientists and use their knowledge to create a public service message that shows cases awareness, understanding, and safety information about the great white shark.

Student products should include information on: sharks life cycle, the traits that led to their success as a species, local white shark activity, and population information. Students integrate the information they learned to create a product that communicates increased Shark “Awareness” using data. Products should focus on data and have 3-5 facts on sharks using numbers. Either local map or world population map should be included. This public service message can be in the form of a brochure, slide show, poster, infographic,or video. Public Service message should include Students will present their work to an audience and share their findings. Students can work independently, in pairs, or small groups according to your preference.

**Materials**

Student Science Notebook

Computer

Construction Paper for Brochure

Poster Board or Chart Paper

Video Recorder (optional)

crayons, markers, colored pencils

**CEPA: Time estimate: two 1 hour sessions**

**Instructions**

* Explain to students now that they have learned about great white sharks by the numbers, you will create a public service message to present your learning and create awareness.
* Show students the options:
  + Brochure: Show students examples of brochures. Students can create their brochure from construction paper or they can use a computer template.
  + SlideShow: Students should have prior experience with this application for this option to be considered. Students should have a title slide and at least 3 other slides presenting other information (no more than 8 is recommended)
  + Poster: Students can draw or print images for their poster and type or write information. Make sure students take size into account and write or adjust fonts as necessary. They should have a title that is visible at the top.
  + Infographic: using a sight such as canva.com, easel.ly, or piktochart.com students can use graphic design to create an infographic that has the appropriate number of facts and images.
  + Video: Students must create a script, rehearse, and create or obtain props. (maps, pictures). As a newscaster student(s) will go over informational points and safety tips.

All final projects will contain at least 3 facts or pieces of information regarding sharks using numbers as well as either a local hot spot map or world hot spot map. Your writing should be neat and carefully edited for spelling, grammar, and punctuation as well as factuality. Pictures should be neat and colorful with captions or labels. Make sure your project has an eye catching title and that your name is included somewhere that makes sense for your public safety piece.

* Final projects will be shared in class and other classrooms within the school as appropriate.
* Review CEPA Rubric with students

SHARK CEPA Rubric

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Scoring Rubric for Shark Presentation

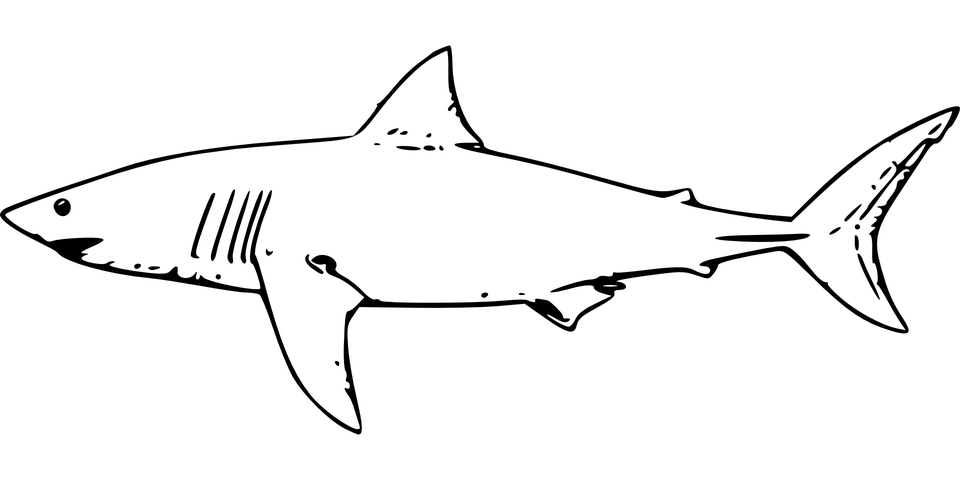
| **Category** | **Scoring Criteria** | **Total Points** | **Score** |
| --- | --- | --- | --- |
| **Organization**  **(15 points)** | Presentation is completed on time. | 5 |  |
| Information is presented in a logical sequence. | 5 |  |
| Presentation appropriately conveys information. | 5 |  |
| **Content**  **(45 points)** | Title is clear | 5 |  |
| Unit vocabulary is used and spelled correctly | 5 |  |
| Presentation contains accurate information. | 10 |  |
| Material included is relevant to the overall message/purpose. | 10 |  |
| Appropriate amount of material is prepared 3-5 facts on 1) shark anatomy/behavior and 2) shark safety | 10 |  |
| Presentation shows effort in spelling and neatness | 5 |  |
| **Presentation**  **(40 points)** | Speaker maintains good eye contact with the audience and is  appropriately animated (e.g., gestures, moving around, etc.). | 5 |  |
| Speaker uses a clear, audible voice. | 5 |  |
| Speaker shows an understanding of the information presented. | 5 |  |
| Good language skills and pronunciation are used. | 5 |  |
| Visual aids are well prepared, informative, effective, and not  distracting. | 5 |  |
| Speaker was able to answer questions about their presentation. | 5 |  |
| Information was well communicated. | 10 |  |
| **Score** | **Total Points** | **100** |  |

**Unit Resources**

**Information to Support Teaching Learning**

Atlantic White Shark Conservancy[www.atlanticwhiteshark.org](http://www.atlanticwhiteshark.org)

OCEARCH <http://www.ocearch.org/>



Lesson One

Shark Life Cycle Image: <https://www.shutterstock.com/image-vector/vector-cycle-shark-kids-256801057>

Lesson Two



White Shark Data

|  | Pup | Adolescent | Adult |
| --- | --- | --- | --- |
| Weight (lbs) |  |  |  |
| Length (ft) |  |  |  |
| Speed (mph) |  |  |  |
| Dorsal Fin (in) |  |  |  |
| Tooth Size (in) |  |  |  |

ANswer Key: White Shark Data

|  | Pup | Juvenile | Adult |
| --- | --- | --- | --- |
| Weight (lbs) | 40 | 1000 | 1500-4500 |
| Length (ft) | 4-5 | up to 9 | 10-20 |
| Speed (mph) | unknown | unknown | 35 |
| Dorsal Fin (in) | 4-6 estimate | 7-9 estimate | 10-14 |
| Tooth Size (in)  and Shape | ½ inch  pointy (eat small fish) | 1 inch  shape change from pointer to triangular | 2 inch  triangular/wider (eat seals) |

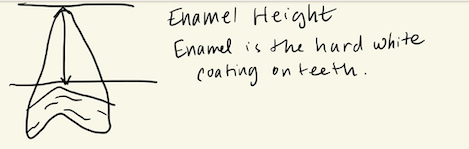
Great WHite SHark Tooth data

| Tooth Diagram | Height of enamel (cm) | Height in cm divided by 2.54 | Shark Length  Estimation  (previous column x 10= length in feet) | Stage of Life  pup 4-5 feet  juvenile up to 9 feet  adult 10 + feet |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Lesson Three Great White Sharks on Cape Cod

Image of Cape Cod - Recommend Google Maps

More on Measuring Teeth...

Researchers have figured out a cool way to estimate the size of some sharks. By measuring the ENAMEL of the tooth, then using some basic multiplication, they can figure out just how big the shark could be. 

PART 1: OBSERVE

What do you notice about the shark teeth on the table? What color are they? How big are they? How long do you think the sharks were that made them?

PART 2: MEASURE THE ENAMEL

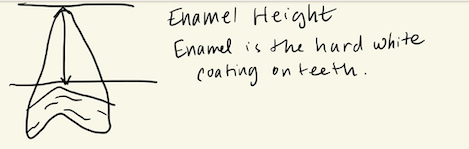
Use your ruler to measure the enamel height. Record your data on your data sheet.

PART 3: DIVIDE & MULTIPLY!

Divide that number by 2.54 and record the result. THEN, multiply that result by 10. This will give you the ESTIMATED length in feet of the shark the tooth came from!

**REMEMBER:**

MEASURE TEETH IN **CENTIMETERS**, DIVIDE BY 2.54, THEN MULTIPLY BY 10. ROUND THAT NUMBER TO THE NEAREST TENTH, AND THAT IS THE ESTIMATE LENGTH OF THE SHARK IN **FEET**.



**Tooth: EXAMPLE**

Enamel Height: \_\_\_\_\_\_\_\_\_\_\_\_\_ CM

Divide by 2.54: \_\_\_\_\_\_\_\_\_\_\_\_\_

Multiply by 10: \_\_\_\_\_\_\_\_\_\_\_\_\_

Estimated Shark Length: \_\_\_\_\_\_\_\_\_ FEET

(round to the nearest tenths place!)

**White Shark “Hot Spots” Population Range**

| Hot Spot Location | Estimated Population (range) Adult White Sharks |
| --- | --- |
| Pacific | 450-2400 |
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