REPRESENTING DATA GRAPHICALLY /INSTRUCTOR INFO

Summary

This lesson includes vocabulary, content examples and activities to help students learn and understand tables and graphs. Using data collected from the OCEARCH Global Shark Tracker™, students will be able to represent real-life data in tables, line plots, bar graphs, and pictographs.

Part 1. Data
Part 2. Tables
Part 3. Graphs
Activity 1. Organizing and Graphing Shark Data

Goals & Objectives

The students will:
- Understand that data is information that can be used to understand or solve problems;
- Learn how to display data into tables;
- Learn how to display data graphically using line plots, bar graphs, and pictographs;
- Learn how to answer questions using tables and graphs.

Helpful Tips

1. The content in this lesson is based on the conservation work of OCEARCH™ and the Global Shark Tracker™. Spend a few minutes getting familiar with the website and the tracker if you have not done so already. The Global Shark Tracker™ is also available as an app for iPhone and Android

2. This lesson plan is designed to be adaptable to suit your specific needs. Use the entire lesson plan or just parts of it. This material can be expanded to be an entire unit or condensed for just one day in the classroom.

3. Vocabulary words will be underlined as they first appear in the lesson plan. A complete list of vocabulary words is included as well.

4. Answers to questions and prompts for discussions will appear in italics.

5. Optional activities and content (side notes) will appear in a box. Use these to enhance your lesson and adapt it to suit your needs!

6. Have questions for OCEARCH Expedition Leader, Chris Fischer? Email info@OCEARCH.org to schedule a Skype session and let your students/child talk directly to Chris and the OCEARCH crew!

7. Email all questions about this lesson to info@OCEARCH.org.

// STANDARDS

STEM

This lesson plan aims to assist teachers in implementing a STEM-based program into their classroom while inspiring the next generation of explorers, scientists, and stewards of the ocean. Based on real science and the Global Shark Tracker™, "Representing Data Graphically" is intended to promote environmental awareness and to prepare students for STEM careers.

This lesson aligns with the following Common Core Science Standards:

3rd Grade Math: MD.B.4
4th Grade Math: MD.B.4, MD.A.1
5th Grade Math: MD.B.2

This lesson aligns with the following TEKS:

Grade 3 Math: 1A, 1B, 10, 13A, 13B, 14A, 14B, 14C, 14D
Grade 3 Math (Revised): 1A, 1B, 1C, 1D, 1E, 2C, 2D, 8A, 8B
Grade 4 Math: 1A, 1B, 10, 13B, 14A, 14B, 14C, 14D
Grade 4 Math (Revised): 1A, 1B, 1C, 1D, 1E, 2C, 9A, 9B
Grade 5 Math: 1A, 1B, 4, 13C, 14A, 14B, 14C, 14D
Grade 5 Math (Revised): 1A, 1B, 1C, 1D, 1E, 2B 8A, 9A, 9C

This lesson aligns with the following Next Generation Science Standards:

Framework
1. Asking questions and defining problems.
4. Analyzing and interpreting data.
8. Obtaining, evaluating, and communicating information.

3-5 Structure and Properties of Matter

Science and Engineering Practices
Using Mathematics and Computational Thinking
• Measures and graph quantities such as weight to address scientific and engineering questions and problems. (5-PS1-2)

Crosscutting Concepts
Scale, Proportion and Quantity
• Natural objects exist from the very small to the immensely large.
• Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

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REPRESENTING DATA GRAPHICALLY /VOCABULARY

Bar Graph – A graph that uses bars to compare both numeric and categorical data.

Data – A collection of information. The most important part of a table or graph is the information, or data, it represents.

Categorical Data –Data that can be grouped into categories.

Dependent Variable – A variable that is influenced and changed by other variables.

Graph – A drawing or diagram used to display information.

Independent Variable – A variable that is not influenced or changed by other variables.

Line Plot – A number line that encompasses all numbers in a set of data, showing a dot or other mark over the position corresponding to each number. Line plots show the frequency (how often) a variable appears in a set of data. It is sometimes called a dot plot.

Numerical Data – Data that can be measured.

Scale – A set of numbers that represent the data.

Table – Information organized in columns and rows.

Title – Explains what a table or graph is illustrating.

X Axis – The horizontal axis of a graph; usually the independent variable.

Y Axis – The vertical axis of a graph; usually the dependent variable.

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REPRESENTING DATA GRAPHICALLY
/ PRE-LESSON ASSESSMENT

Use the following true/false, fill in the blank, and multiple-choice questions as an introduction/warm-up to the lesson topics. You can do this in a verbal or written format, as a game, individually, or as a whole class! A handout is provided if you wish to hand the questions out in a quiz format. The questions do not need to be graded. They are intended to give the students an idea of what they will be learning and to see what they already know.

1. True   or   False
A graph is a picture used to display data.
Answer: True

2. True   or   False
Tables are an easy way to organize data.
Answer: True

3. True   or   False
Line plots show how often the same variable appears in a set of data.
 Answer: True

4. What is an example of an independent variable? (Circle all that apply.)
a. Gender
b. Weight
c. Hair color
d. Length
e. Time
Answers: a, c, e

5. Which type of graph uses pictures to display or represent data?
a. Line Plot
b. Bar Graph
c. Pictograph
Answer: c

6. Every graph needs the following: (Circle all that apply.)
a. A descriptive title
b. Labels on the X and Y axis
c. Pretty colors
d. A key with a unit of measurement

e. A scale
Answers: a, b, d

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REPRESENTING DATA GRAPHICALLY

Select the correct answer(s) to each of the following questions.

1. True   or   False

A graph is a picture used to display data.

2. True   or   False

Tables are an easy way to organize data.

3. True   or   False

Line plots show how often the same variable appears in a set of data.

4. What is an example of an independent variable? (Circle all that apply.)
a. Gender
b. Weight
c. Hair color
d. Length
e. Time

5. Which type of graph uses pictures to display or represent data?
a. Line Plot
b. Bar Graph
c. Pictograph

6. Every graph needs the following: (Circle all that apply.)
a. A descriptive title
b. Labels on the X and Y axis
c. Pretty colors
d. A key with a unit of measurement
e. A scale

REPRESENTING DATA GRAPHICALLY /LESSON PLAN

PART 1. DATA **5 mins or less**

Data is a collection of information and is the most important part of a table or graph. There are two different types of data. Categorical data are data that can be grouped into categories. For example, gender and eye color. Numerical data are data that can be measured. For example, weight and height.

PART 2. PARTS OF A MAP **30-45 mins**

Tables are used to represent data. Tables make data more organized and easier to interpret than a long list of information. The information itself is very important, but without organization it can be hard to read. Below are two ways of listing data. Both options represent the exact same data. Which do you think is easier to read?

Option A:
There are 2 red skittles, 5 orange skittles, 3 purple skittles, 7 yellow skittles, and 4 green skittles in bag 1. In bag 2, there are 6 red skittles, 4 orange skittles, 3 purple skittles, 5 yellow skittles, and 1 green skittle.
There are five main parts of a map (Figure 2):

Option B:

Colors of Skittles in a bag

Bag #	Red	Orange	Yellow	Green	Purple
Bag 1	2	5	7	4	3
Bag 2	6	4	5	1	3

Option B is much easier to interpret because the data are organized into a table with a title and headings for each color.

Tables can help to organize more than just color and number. OCEARCH, as well as many other scientists, use tables to organize data as it is collected in the field! Afterwards, a table can easily be converted into a *graph*, which is a diagram that visually displays the data.

Below is a sample of data OCEARCH has collected on 6 great white sharks. Option A depicts what the data would look like without a table and Option B displays the same data, but in a table.

Option A:
Katharine, Female, 14 feet (4.3 m)
Maddox, Male, 14 feet (4.3 m)
Andre, Male, 9 feet (2.7 m)
Mary Lee, Female, 16 feet (4.9 m)
Geni, Female, 15 ft (4.6 m)
apart.

Option B:

Table 1. Great White Sharks Tagged by OCEARCH

Shark Name	Gender	Length
Katharine	Female	14 feet (4.3 meters)
Maddox	Male	14 feet (4.3 meters)
Andre	Male	9 feet (2.7 meters)
Mary Lee	Female	16 feet (4.9 meters)
Genie	Female	15 feet (4.6 meters)
Miguel	Male	10 feet (3.0 meters)

Option B. is much easier to interpret because the data are organized into a table with a descriptive title and headings for each variable.

Questions to ask the students referring to Table 1. See worksheet provided on the next page.

1. In meters, how long is Genie?
Answer: 15 feet (4.6 meters)

2. Is Maddox a male or female?
Answer: Male

3. In feet, how long is Mary Lee?
Answer: 16 feet (4.9 meters)

4. Is Katharine a male or female?
Answer: Female

5. Which shark is 9 feet long?
Answer: Andre

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Date: _____

TABLES

Tables are used to represent organized information, such as data. Tables make data more organized and easier to interpret than a long list of information.

A. Answer the following questions about the table below:

Table 1. Great White Sharks Tagged by OCEARCH

Shark Name	Gender	Length
Katharine	Female	14 feet (4.3 meters)
Maddox	Male	14 feet (4.3 meters)
Andre	Male	9 feet (2.7 meters)
Mary Lee	Female	16 feet (4.9 meters)
Genie	Female	15 feet (4.6 meters)
Miguel	Male	10 feet (3.0 meters)

1. In meters, how long is Genie?

2. Is Maddox a male or female?

3. In feet, how long is Mary Lee?

4. Is Katharine a male or female?

5. Which shark is 9 feet long?

Name: _____

Date: _____

TABLES (CONT.)

B. Below is a list of data that needs to be organized into a table. Use the data provided and fill in the missing data in the table.

- •Katharine, Massachusetts, Female

- •Maddox, South Africa, Male

- •Andrea, South Africa, Male

- •Mary Lee, Massachusetts, Female

- •Genie, Massachusetts, Female

- •Miguel, South Africa, Male

Table 2. Location and Gender of Tagged Great White Sharks

Shark Name	Location Tagged	Gender
Katharine	Massachusetts	
	South Africa	Male
Andre		Male
Mary Lee	Massachusetts	
Genie		
Miguel	South Africa	

TABLES ANSWER KEY

A.

1. In meters, how long is Genie?
        15 feet (4.6 meters)

2. Is Maddox a male or female?
        Male

3. In feet, how long is Mary Lee?
        16 feet (4.9 meters)

4. Is Katharine a male or female?
        Female

5. Which shark is 9 feet long?
        Andre

B.

Table 2. Location and Gender of Tagged Great White Sharks

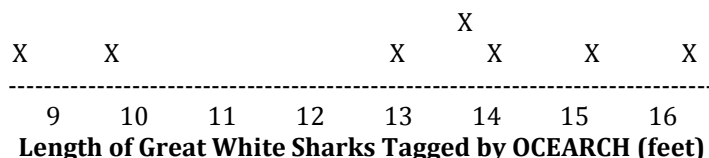| Shark Name	Location Tagged	Gender
Katharine	Massachusetts	*Female*
Maddox	South Africa	Male
Andre	*South Africa*	Male
Mary Lee	Massachusetts	*Female*
Genie	*Massachusetts*	*Female*
Miguel	South Africa	*Male*

PART 3. GRAPHS 30-45 min

INTRODUCTION 5 mins or less

Graphs are used to display data in a way that can be easy to interpret. There are several different types of graphs including line plots, bar graphs, and pictographs. Each type of graph can help to interpret data in different ways. Let's review each type of graph!

LINE PLOT 10 - 20 mins

First let's look at what parts are needed to make a line plot. The first part of a line plot is a title.   A <u>title</u> explains what the graph is illustrating. The second part of a line plot is a <u>scale</u>, which is a set of numbers that represent the data.

A <u>line plot</u> shows how often a variable appears in a set of data. Line plots are good for visualizing your data. To make a line plot, you need to first decide on the scale of numbers needed for the line by finding the smallest and largest values in your dataset. Then, simply place an "X" above the corresponding number each time that number appears in the data set. For simplicity the numbers in the data set can be rounded to nearest measurement.

```
                                    X
   X       X                X       X      X      X
---------------------------------------------------------------------
   9      10      11      12      13      14      15      16
```
Length of Great White Sharks Tagged by OCEARCH (feet)

For the above graph, how many sharks did OCEARCH tag that were 14 feet long?
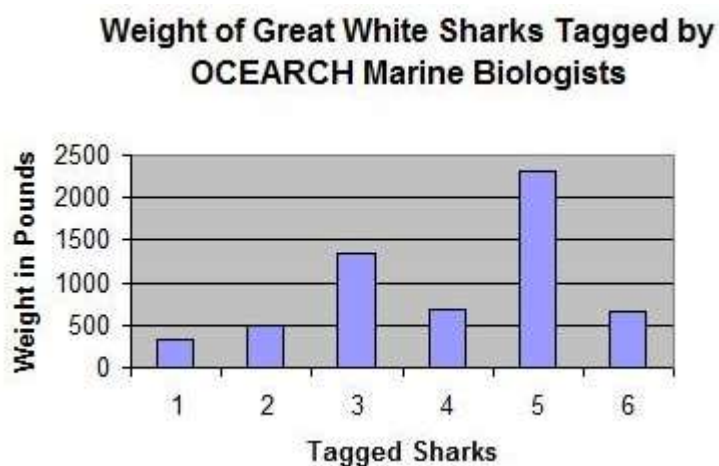
Answer: 2

BAR GRAPH 20-30 mins

With a <u>bar graph</u>, you can compare variables or track changes over time. Bar graphs display data using two axes, an x-axis and a y-axis.

The <u>x-axis</u> is the horizontal scale on the graph. <u>Independent variables</u>, or variables that are not influenced or changed by other variables, are placed on the x-axis. Great examples of independent variables are time, names of sharks, stage of life, or gender.

The <u>y-axis</u> is the vertical scale on the graph and is usually used to represent the <u>dependent variable</u>. The dependent variable is a variable that is influenced or changed by other variables. Examples of independent variables can include weight, length, or any other number that can change based on the variables.

Graphs also have a key, which labels the axis and gives the measurement. Without a key we wouldn't know what the bars represent.

Weight of Great White Sharks Tagged by OCEARCH Marine Biologists

Questions to ask the students referring to the bar graph above. See worksheet provided on the following page.

1. What is the independent variable?

Answer: Tagged Sharks

2. What is the dependent variable?

Answer: Weight of sharks

3. How many sharks did OCEARCH tag that weighed 500 pounds?

Answer: 2

4. How many sharks weighed approximately 2,300 pounds?

Answer: 5

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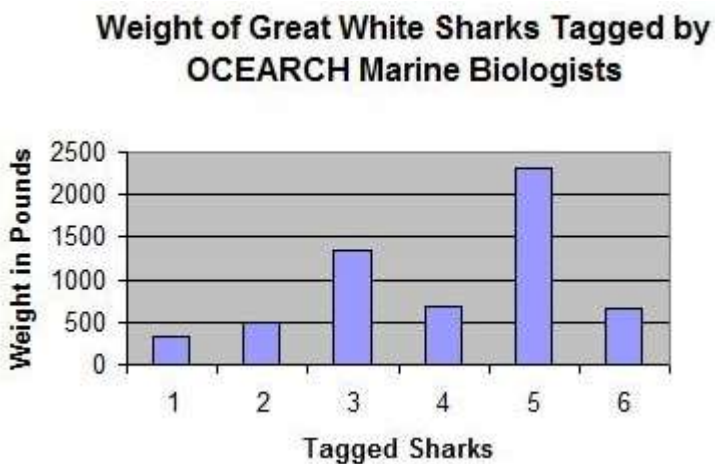EDUCATE   INSPIRE   ENABLE

Name: _____

Date: _____

BAR GRAPHS

Graphs are used to display data in a way that can be easy to interpret.

Answer the following questions about the bar graph:

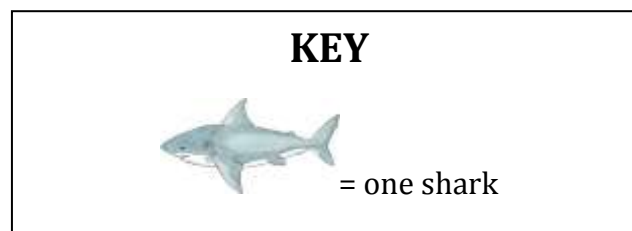**Weight of Great White Sharks Tagged by OCEARCH Marine Biologists**

1. What is the independent variable?

2. What is the dependent variable?

3. How many sharks did OCEARCH tag that weighed 500 pounds?

4. How many sharks weighed approximately 2,300 pounds?

PICTOGRAPHS **15-20 mins**

A pictograph is a fun and easy way to display or represent data using images. Images can represent a number of data. Below is an example of a pictograph that OCEARCH may use to determine how many sharks they tagged in one week.

| Great White Sharks | Tiger Sharks | Bull Sharks |

Number of Sharks Tagged In One Week

KEY
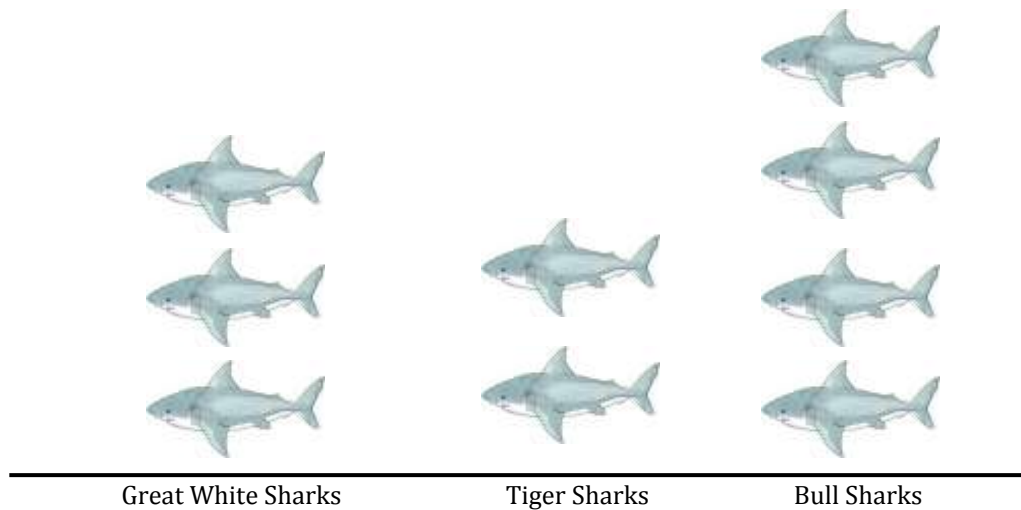
= one shark

Questions to ask the students referring to the pictograph above. See worksheet provided on next page.

1. How many great white sharks were tagged by OCEARCH in one week?
Answer: 3

2. How many tiger sharks were tagged by OCEARCH in one week?
Answer: 2

3. How many bull sharks were tagged by OCEARCH in one week?
Answer: 4

4. What type of shark did OCEARCH tag the most of?
Answer: Bull sharks

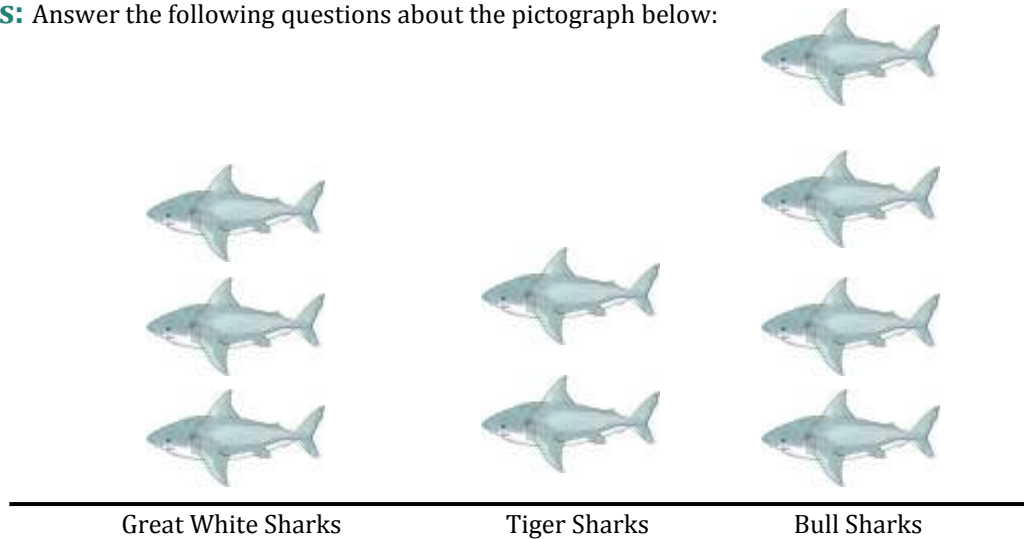5. How many total sharks were tagged by OCEARCH in one week?
Answer: 9

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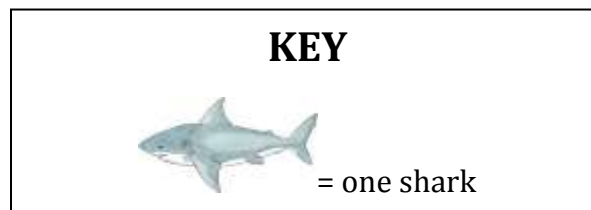EDUCATE INSPIRE ENABLE

Name: _____

Date: _____

PICTOGRAPHS

A pictograph is a fun and easy way to display or represent data using images.

Instructions: Answer the following questions about the pictograph below:

| Great White Sharks | Tiger Sharks | Bull Sharks |

Number of Sharks Tagged In One Week

KEY
= one shark

1. How many great white sharks were tagged by OCEARCH in one week?

2. How many tiger sharks were tagged by OCEARCH in one week?

3. How many bull sharks were tagged by OCEARCH in one week?

4. What type of shark did OCEARCH tag the most of?

5. How many total sharks were tagged by OCEARCH in one week?

REVIEW **10-15 mins**

Students should now understand why tables are used to organize data, recognize three different types of graphs, and understand that different types of graphs have unique purposes.

What type of graph would you use if you wanted to:
1. Show how often a variable occurs? Line plot
2. Compare variables or track large changes over time? Bar graph
3. Display or represent data using images? Pictograph

Students should have an understanding of vocabulary used in the lesson and of the following:

1. What is an example of a numeric variable?
Weight, length

2. What is an example of a categorical variable?
Stage of life, gender

3. What is an independent variable?
A variable that is not influenced or changed by other variables.

4. What is a dependent variable?
A variable that is influenced and changed by other variables.

5. What is typically labeled on the x-axis?
Independent variable

6. What is typically labeled on the y-axis?
Dependent variable

REPRESENTING DATA GRAPHICALLY
/ACTIVITY 1. ORGANIZING & GRAPHING SHARK DATA

INTRODUCTION

Students will create their own tables, line plots and bar graphs from data collected on the Global Shark Tracker ™. Each student will explore the Global Shark Tracker ™ to find and record the name, gender, length, and weight of six great white sharks into a table. Students will then use the table to answer a few questions about the tagged sharks and create their own graphs describing the data in the table.

MATERIALS

- Computer with Internet access
- Student handout (provided)
- Paper
- Pencil
- Colored pencils, crayons, or markers
- Rulers or straight edge

INSTRUCTIONS

Teachers may wish to have students do this activity individually or in groups.

First, the students will need to collect data about each shark including the name, gender, length, and weight. Instructions are included on the student handout on the following page.

Students will input their data in the table provided one the handout. After completing the table and answering the accompanying questions, students will then follow the instructions to create a bar graph that displays their data.

An handout and answer key has been provided below.

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Name: _____

Date: _____

ACTIVITY 1. ORGANIZING AND GRAPHING SHARK DATA

Part A.

1. Go to www.ocearch.org

2. Use the tool bar on the left side of the tracker to search for each shark listed on the table below. The sharks are listed in alphabetical order.

3. Once you have selected the shark, click "Track Sharks" at the bottom of the tracker tool bar.

4. Click on the shark's most recent ping (largest dot) to view the shark's profile.

5. Click "View More" for more details. Use the information found here to complete the table.

Table 1. Data for OCEARCH Great White Sharks

Name	Gender	Length (ft)	Weight (lbs)
Genie			
Courage			
Success			
Cyndi			
Louis Antonio			
Maddox			

1. How many female great white sharks were tagged?

    _____

2. How many male great white sharks were tagged?

    _____

3. Do females weigh more or less than males? How can you tell?

    _____

4. Which gender is longer? How can you tell?

    _____

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Name: _____

Date: _____

ACTIVITY 1. (CONT.)

Part B.

Graph the weights of the great white sharks using a bar graph. Use the space below to make your graph. You may want to color code your graph based on gender (females pink, males blue).

1.   What is the title of your graph? _____

2.   What goes on the x-axis? _____

3.   What goes on the y-axis? _____

ACTIVITY 1. (ANSWER KEY)

Part A.

Table 1. Data for OCEARCH Great White Sharks

Name	Gender	Length (ft)	Weight (lbs)
Genie	*Female*	15	2,292
Courage	*Male*	12	1,372
Success	*Female*	16	3,583
Cyndi	*Female*	14	2,257
Louis Antonio	*Male*	11	909
Maddox	*Male*	14	2,100

1. How many female great white sharks were tagged?
Answer: 3

2. How many male great white sharks were tagged?
Answer: 3

3. Do females weigh more or less than males? How can you tell?
Answer: Females weigh more

4. Which gender is longer? How can you tell?
Answer: Females are longer

Part B. Graphs should look similar to the one below.

1. What is the title of your graph?
Answer: Weight of Tagged Sharks
2. What goes on the x-axis?
Answer: Sharks or Names of Sharks
3. What goes on the y-axis?
Answer: Weight (pounds)