



Education Dept.
Georgia Aquarium
225 Baker Street NW
Atlanta, GA 30313
404.581.4198

Undersea Investigators

Teachers Guide

Grades 6th-8th

Program Description: Undersea Investigators is an inquiry-based program where students become researchers for the day. During this time they will learn about aquatic animals and ecosystems through observation and collecting data. During this program students will also be introduced to conservation efforts and research being conducted in partnership with the Georgia Aquarium.

Enduring Understandings for Undersea Investigators:

- ◆ Research is the process of scientific investigation that helps scientists learn more about living organisms and their environment.
- ◆ Humans can have a positive or negative impact on the quality of water in aquatic ecosystems.

Objectives:

Students will;

- ◆ Understand the relevance, purpose and process of scientific investigations.
- ◆ Learn how research can improve our knowledge and understanding of animals and ecosystems.
- ◆ Investigate how living things are connected and the impact of humans on aquatic ecosystems.

Georgia Performance Standards Addressed:

Sixth Grade

S6CS1 Students will explore the importance of curiosity, honesty, openness, and skepticism in science and will exhibit these traits in their own efforts to understand how the world works.

- Understand the importance of – and keeping – honest, clear, and accurate records in science.

S6CS8 Students will investigate the characteristics of scientific knowledge and how it is achieved. Students will apply the following to scientific concepts:

- When similar investigations give different results, the scientific challenge is to judge whether the differences are trivial or significant, which often requires further study. Even with similar results, scientists may wait until an investigation has been repeated many times before accepting the results as meaningful.
- As prevailing theories are challenged by new information, scientific knowledge may change and grow.

S6CS9 Students will investigate the features of the process of scientific inquiry. Students will apply the following to inquiry learning practices:

- b. Scientists often collaborate to design research. To prevent bias, scientists conduct independent studies of the same questions.

S6E3 Students will recognize the significant role of water in earth processes.

- a. Explain that a large portion of water of the Earth's surface is water, consisting of oceans, rivers, lakes, underground water, and ice.

M6D1 Students will pose questions, collect data, represent and analyze data and interpret results.

- a. Formulate questions that can be answered by data. Students should collect data by using samples from a larger population (surveys), or by conducting experiments.

Seventh Grade

S7CS1 Students will explore the importance of curiosity, honesty, openness, and skepticism in science and will exhibit these traits in their own efforts to understand how the world works.

- a. Understand the importance of - and keeping - honest, clear, and accurate records in science.

S7CS5 Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.

- a. Observe and explain how parts can be related to other parts in a system such as predator/prey relationships in a community/ecosystem.
- b. Understand that different models (such as physical replicas, pictures, and analogies) can be used to represent the same thing.

S7CS8 Students will investigate the characteristics of scientific knowledge and how that knowledge is achieved. Students will apply the following to scientific concepts.

- a. When similar investigations give different results, the scientific challenge is to judge whether the differences are trivial or significant, which often requires further study. Even with similar results, scientists may wait until and investigation has been repeated many times before accepting the results as meaningful.
- b. As prevailing theories are challenged by new information, scientific knowledge may change and grow.

S7CS9 Students will investigate the features of the process of scientific inquiry. Students will apply the following to inquiry learning practices:

- b. Scientists often collaborate to design research. To prevent bias, scientists conduct independent studies of the same questions.
- c. Accurate record keeping, data sharing, and replication of results are essential for maintaining an investigator's credibility with other scientists and society.

S7L4 Students will examine the dependence of organisms on one another and their environments.

- c. Recognize that changes in environmental conditions can affect the survival of both individuals and entire species.

d. Categorize relationships between organisms that are competitively or mutually beneficial.

M7D1 Students will pose questions, collect data, represent and analyze the data, and interpret results.

a. Construct frequency distributions

g. Analyze and draw conclusions about data, including describing the relationship between two variables.

Eighth Grade

M8D4 Students will organize, interpret, and make inferences from statistical data.

a. Gather data that can be modeled with a linear function.

Pre-activity:

1) Tally of Treats

Students will understand the basic processes of scientific investigation by conducting a study of candy.

Post-visit activity:

1) Dolphin Identification and Tracking

Students will identify unique features and make hypotheses about Dolphins

TALLY OF TREATS

Grade Level: 6th – 8th

Objective: Familiarize students with the process of scientific inquiry through a study of diversity and make up of a bag of candy.

Duration: 45 minutes – 1 hour

Vocabulary: Research, scientific inquiry, observation, mean, median, mode.

Materials: Graph paper, small bags of small round multi-colored candies (one per group), one large bag of the same candy, copies of candy data collection sheet #1, one overhead copy of data collection sheet #1, and data collection sheet #2 for each student, white sheets of paper, popsicle sticks and scales.

Background: The process of scientific inquiry starts with a question. From there, the inquiry can take many different paths, but the underlying function is usually observation. Through this exercise the students will become comfortable with the process of scientific inquiry (questioning, observation, data analysis and conclusions) with a familiar subject, candy. Students will follow a process of data collection, and, apply this knowledge to estimate the qualities of a new bag by applying their data on weight, percentages of colors, and mathematical averages.

Procedure:

1. Make copies of candy data collection sheet #1 for each student.
2. Purchase enough bags of chosen candy for 1 bag per 2-3 students.
3. Photocopy the candy recording sheet onto an overhead sheet.
4. Introduce the activity by asking students how scientists find out how things work. (investigation, trial and error, record keeping)
5. Introduce the concept of scientific inquiry (questioning, observation, data analysis and conclusions).
6. **Inquiry:** Hold up a bag of candy and tell the students that they will be exploring this bag as scientists. Ask the students what they would like to know about the bag of candy. Record questions on the board. (How many are in the bag, what colors are they, etc.)
7. Ask the students if they could answer any of the questions without opening the bag of candy. Record any of their answers on the board next to the question.
8. Ask the students how they might be able to find out the answers to their questions and introduce the process of scientific inquiry (questioning, observation, data analysis and conclusions).
9. **Observation:** Divide the students into groups of 2-3 and assign them a group number.
10. Pass out a bag of candy, a blank white paper for a surface, a popsicle stick for sorting and a candy data collection sheet #1 for each student.
11. Have the students keep their bags of candy **closed** at first.

12. Have the students make an educated guess about the number of candies in their bag and the weight of their bag, then record their guesses on data collection sheet #1 (in the estimate row).
13. **Open** the bag. Have them fill out data collection sheet #1 with the number in of each color and total amounts in the bag.
14. **Analysis:** After the students have recorded their data, have them report the findings back to the full class. On the overhead data collection sheet #1, record all of the data collected. Have students fill out the data collected from the other groups in the class on their own sheets and tally the totals. Have the students find the mean, median, and mode for each color and record.
15. Next, find the percentage of each color found in the bag of candy and record on data collection sheet #2 (Have students show their math on the page!).
16. Discuss the findings and differences between bags. Ask what conclusions they may be able to make from their findings regarding the make up of the bags (similar/ different, do different colors cost more to manufacture, some colors may be easier to mix than others).

Advanced Analysis (if time permits and you have a larger bag of candy)

17. Using Scales, have the students weigh an individual piece of candy and record on data collection sheet #2
18. Compare the measurements on weight gathered and produce a method of calculating the number of total candies in a larger bag.
 - a. This should be based on the weight of the new, larger bag, divided by the weight of an individual candy.
19. Split the class into two groups.
20. One group will sort the candies according to color and count the number of each manually.
21. The second group will estimate the breakdown of colored candies in the large bag based on estimated total number of candies in the new large bag in step 18. Have students use the percentage of colors recorded on their data sheets to estimate the number of each color in the larger bag.
22. Record the findings of each group on data collection sheet #2 under large bag.
23. Discuss the accuracy achieved with the calculations and how they might improve the process.
24. Discuss how the class approached the smaller bags (estimates) in the beginning of the lesson differently than the larger one (scientific knowledge and calculation).
25. Eat the subject of the scientific inquiry.

Assessment: Have the students fill out both handouts completely and describe the methods used to calculate information. Have the students hand in these sheets.

Candy Data Collection Sheet #1

Group #	Weight	Total #	Green #	Yellow #	Orange #	Purple #	Blue #	Brown #	Red #
Estimate									
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
Total									
Mean									
Median									
Mode									

Data Sheet #2

Name: _____

Weight of Bag: _____

Individual Candy: _____

Show Your Math!

Percentages of colors:

Green: _____

Yellow: _____

Orange: _____

Purple: _____

Blue: _____

Brown: _____

Red: _____

The Large Bag

	Total #	Green #	Yellow #	Orange #	Purple #	Blue #	Brown #	Red #
Estimated Amounts*								
Actual Amounts								

* To be calculated based on formula determined.

DOLPHIN IDENTIFICATION AND TRACKING

Grade: 6th – 8th

Objective:

Students will:

- ◆ learn to associate dolphin tracking and behavior
- ◆ apply graphing and map skills to dolphin research
- ◆ hypothesize about dolphin life history

Duration: 30 minutes

Vocabulary: Pods, Cetaceans (cetacea), Ecology, Endangered, Pectoral fins, Flukes, Dorsal fin, and Conservation.

Materials:

- ◆ Animal worksheets:
 - Dolphin Fin Identification and Tracking (**print in color if possible**)

Background:

Dolphins belong to a group of mammals called **Cetaceans**. The Order Cetacea contains all marine mammals with torpedo-like bodies, **pectoral fins** and **fluke** (tail fin). Other animals in this order include whales and porpoises. TV shows, movies, zoos, and aquariums have made dolphins and whales one of the most easily recognize animals in the ocean. However, with that recognition has also come with some misconception about the species. One common misconception is that all marine mammals are **endangered**. For example, the Blue Whale and Northern Right Whale are endangered, but the Killer (orca) Whale and Bottlenose dolphin are not endangered. Even though Bottlenose dolphins are not endangered, they are still at risk due to human activities encroaching and polluting habitats. Dolphins can get caught in fishing gear (i.e. nets), hit by boats, become accustomed to hand feed, or eat contaminated prey that can harm or kill them.

In order to protect dolphins and other cetaceans we have to gain a better understanding of their life history. If we can understand dolphin behavior and movements in the wild we can protect them from risks and population decline.

Behavior and life history along with ecology helps us understand and identify individual animals in a population. **Ecology** is the study of how an animal interacts with the environment. Identification of an individual animal helps us understand population size, migratory routes, habitats, life spans, and reproductive histories. If we are able to identify an individual in a population, we can study its social interactions and structure within groups.

One way to tell bottlenose dolphins apart is by their dorsal fin. Over time a dolphin dorsal fin acquires unique markings. These markings vary from individual to individual and allow a non-invasive means for indentifying each dolphin. When a dolphin comes up for air, its dorsal fin is exposed. During that short period, a picture can be taken. These pictures can be catalogued and researchers are able to track dolphins based on were photos are taken. The use of photo identification can help us understand the lives of these animals. Understanding these animals ultimately leads to better **conservation** proposals and actions that can help cetaceans and other marine animals against the threats of disease, pollution, beach strandings, collisions with boats, and humans getting too close.

Dolphin Tracking and Identification Procedure:

1. **Introduction:** Explain to students that researchers often track and identify Bottlenose dolphins through the use of photo identification of dorsal fins. The reason for this is:
 - a. Dolphins are born with a completely smooth edged dorsal fin with smooth sides. Over time, interactions with other dolphins and humans cause superficial (external) scars, scratches, bumps and notches.
 - b. By comparing fin shape, color, and unique markings, researchers are able to distinguish individuals. (similar to a fingerprint)
 - c. Enough photos have been taken of dolphin fins that a dolphin fin database has been created.
 - d. Ask the students why we want to study dolphins even though they are not endangered? *Learn more and protect them from being endangered.*
 - e. What should you do if you see dolphins being abused? *Call police or park ranger.*
2. **Scenario:** Your students will be tracking two dolphins that have been seen in Daytona Beach and the surrounding area. Five (hypothetical) stations have been set up along the East coast of Florida (Palm Coast, Flagler Beach, Ormond Beach, Ponce Inlet, and New Smyrna Beach). Over a three day period, photos have been taken of dolphins that were seen at each station.
 - a. That information is compiled into photo sets to track catalogued dolphins in the area.
3. **Assignment:** As researchers, you are given 6 sets of photo data gathered from the 5 stations.
 - a. Each photo set provides the location, time, and dolphins seen.
 - b. Review the process (as a group) of plotting and tracking the dolphins using the example. (Example dolphin is outlined in red).
 - i. Looking at the dates, the Example dolphin was not seen until 5/15 - 5/18/ at Flagler Beach.
 - ii. The next time the Example dolphin was seen was 5/24 - 5/27/ at Ponce Inlet.
 - iii. Locate these two locations on the map and draw an arrow from Flagler Beach to Ponce Inlet.
4. Tell the students to use the Dolphin Fin Identification worksheet and maps to track Dolphins A and B. Use the maps to plot the location of Dolphins A and B.
 - a. Two maps are given to prevent confusion that comes with tracking two dolphins on one map.
 - b. **Remind** students to pay close attention to **dates, location, and dolphins identified.**

Hint: Start with the oldest date (4/10 – 4/13). See if your dolphin was present during that date range and location. If so, mark that location on the map for that dolphin. Move on to the next more recent date. If your dolphin is present at the next location, connect them on the map with a line and/or arrow. If your dolphin was not present on that next date, move on to the next more recent date.

Discussion

On their **flukes** (tail fins) and **dorsal** fins, dolphins have scars, nicks, notches, deformities, and tears. These accumulate over their lifetimes through interactions with other cetaceans, predators, and the environment. Make sure students are aware that these interactions are the main causes of dolphin fin shapes and scars and that these scars are superficial and do not hurt or affect the dolphin's behavior or life history, although inadvertent human interferences do cause some harm to dolphin fins.

- a. Ask the students what else could be done to track dolphins? *Satellite tagging. Capture and release. spotting pods (not individuals) by plane or helicopter.*
- b. A researcher finds a pod of dolphins in a high traffic area. What are some options to suggest to local governments where this could be an issue? *Reduce boating traffic to a certain time frame. Close areas to tourist and remain open for business only. Restrict boating traffic to certain times during the year and closed for other times. Require boater traffic to slow down during certain times or certain areas.*

BRAINSTORM ways that humans interfere with dolphins. What can you do to minimize or prevent harmful interactions with dolphins? *Common answers involve encounters with recreational boaters and fishermen, although hand feeding wild dolphins is a cause for concern.* See this website for more information: <http://www.dontfeedwilddolphins.org/>

How can you get involved?

The dolphin project has training sessions in preparation for monthly surveys.

<http://www.thedolphinproject.org/home.html>

Training: <http://www.thedolphinproject.org/training.html>

Survey Dates: <http://www.thedolphinproject.org/surveys.html>

References:

Wells, R.S. 2002. *Identification Methods*. Pp. 601-608. In: Perrin, W.F., Wursing, B., Thewissen, J.G.M. 2002. *Encyclopedia of Marine Mammals*. Academic Press, San Diego, CA.

BOTTLENOSE DOLPHINS - InfoBook Index." *SeaWorld/Busch Gardens ANIMALS - HOME*. Web. 29 Sept. 2010. <<http://www.seaworld.org/animal-info/info-books/bottlenose/index.htm>>.

Dolphin Fin ID and Tracking

Use pictures, location and date to track dolphins in the Daytona Beach area



Dolphin A



Dolphin B



Example



Date: 5/15 – 5/18

Location: Flagler Beach



Date: 5/24 – 5/27

Location: Ponce Inlet



Date: 4/25 – 4/28

Location: Ormond Beach



Date: 5/20 – 5/23

Location: New Smyrna Beach



Date: 4/10 – 4/13

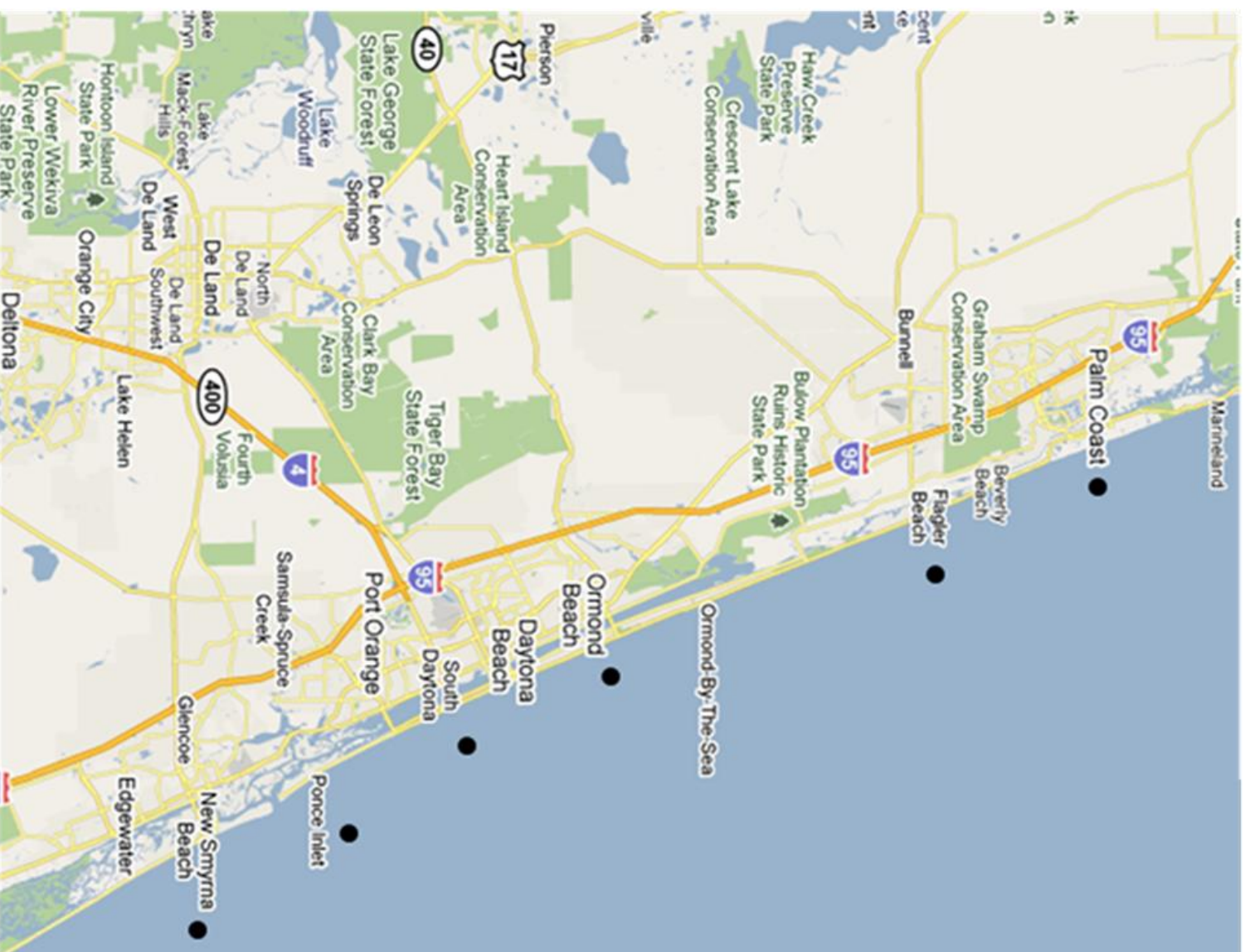
Location: Palm Coast



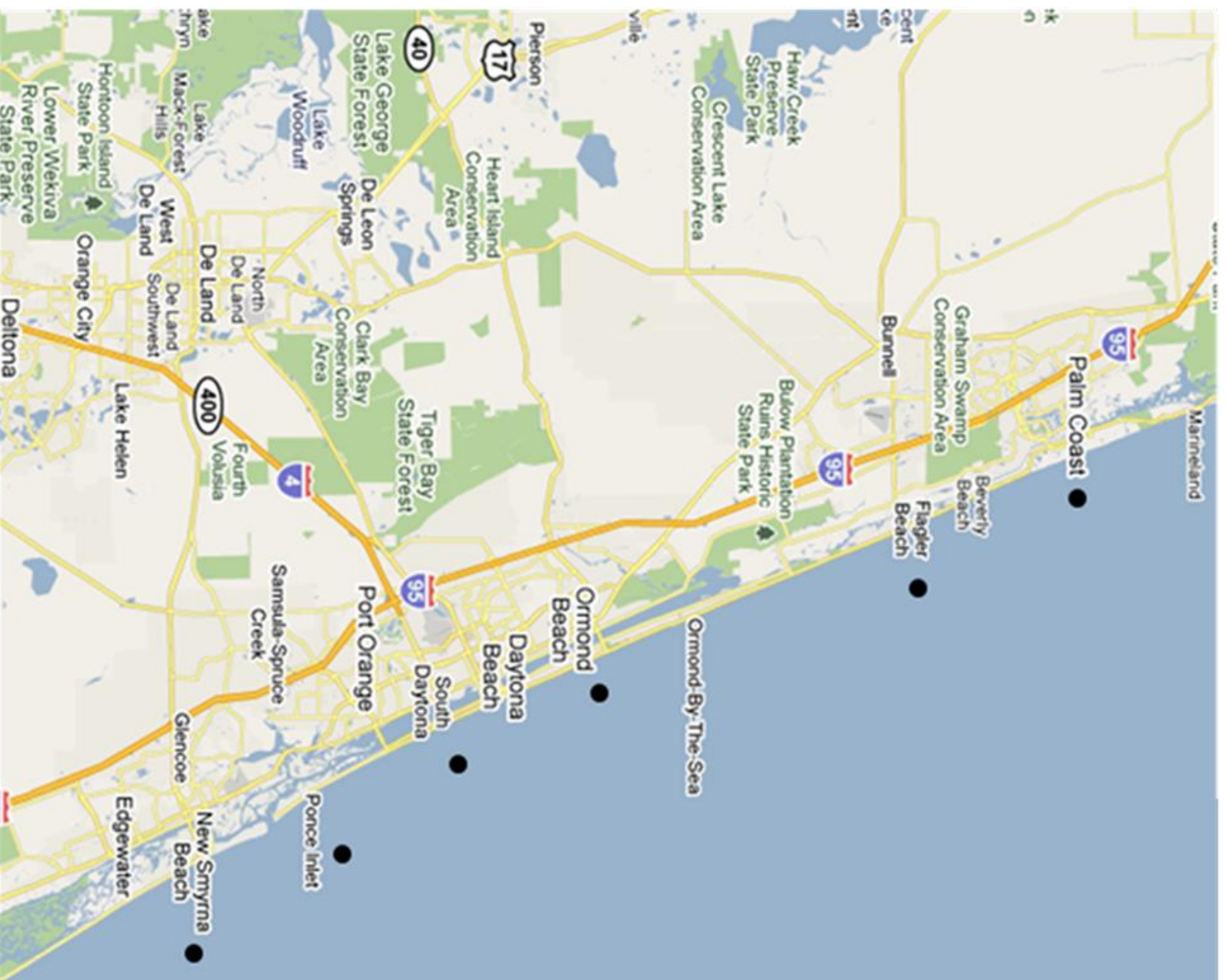
Date: 5/28 – 5/30

Location: South Daytona

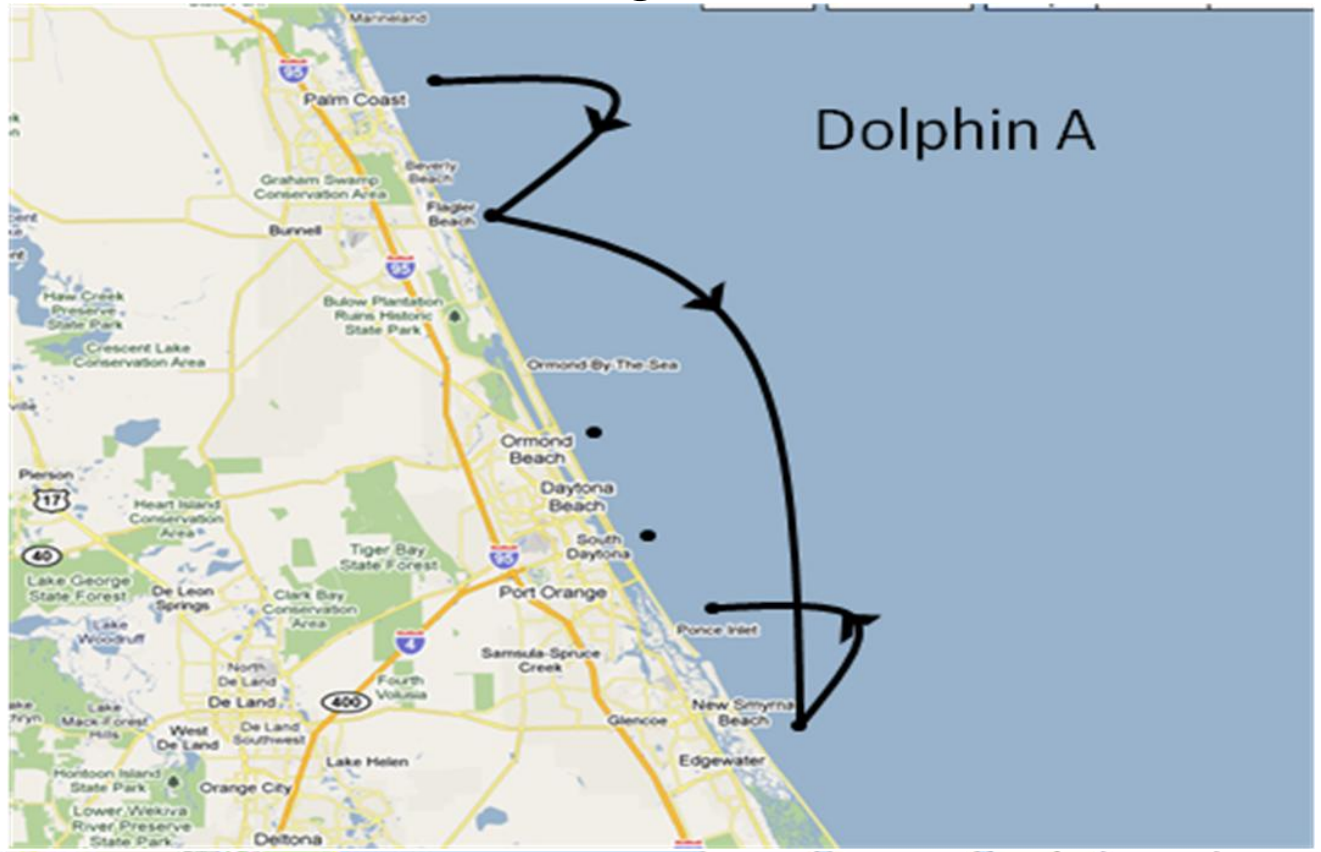
Connect the
locations where
Dolphin A was
photographed



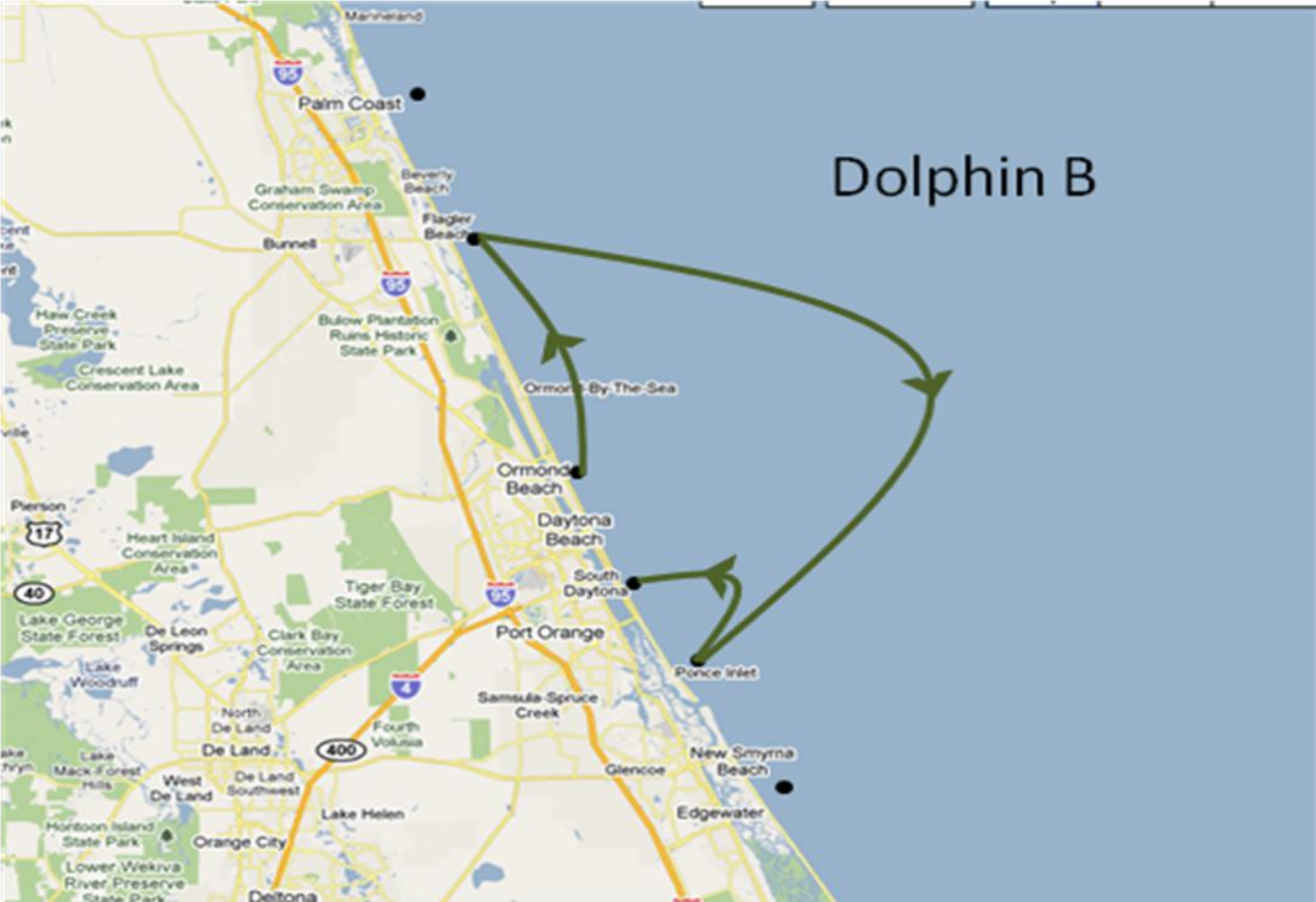
Connect the
locations where
Dolphin B was
photographed



Tracking Answers



Dolphin A



Dolphin B