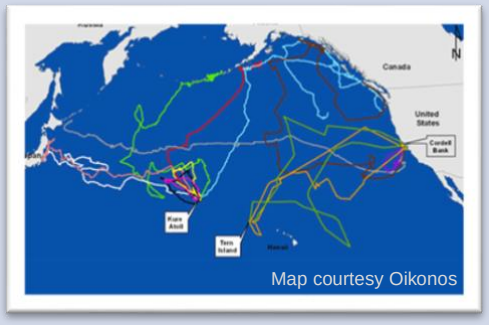
Office of National Marine Sanctuaries
National Oceanic and Atmospheric Administration
in collaboration with Oikonos Ecosystem Knowledge

Education



Map courtesy Oikonos

Grade Level

- 6-8, with options for 9-12

Timeframe

- Two 45-minute class periods

Materials

- Student worksheets
- Albatross tracking data tables – use a different track for each pair / group of students (12 unique tracks provided)
- Advanced Shearwater tracking data table
- Lesson 2 Presentation

Key Words

- Satellite Tracking
- Albatross
- Migration and Breeding Season
- Latitude and Longitude

WINGED AMBASSADORS
OCEAN LITERACY THROUGH THE EYES OF ALBATROSS

Lesson 2: Tracking Albatross Migrations

Activity Summary

Albatross are seabirds that make long ocean journeys, foraging for food to feed themselves and their chicks. In this lesson, students will practice their mapping skills by plotting the actual locations of albatross tracked by satellites. These explorations will also give students examples of the close links between science and technology, as well as the dynamic nature of research. Students will begin the lesson by observing some albatross migration routes, and then plotting authentic satellite tracking data. Next, students will read about satellite tagging and the advances in seabird research that have been made thanks to the advent of this novel technology. They will also consider the different areas of the sea through which the birds travel, and ask scientific questions about their paths.

Learning Objectives

Students will be able to:

- Plot authentic seabird location data using latitude and longitude coordinates.
- Compare and contrast albatross tracks and ask scientific questions.
- Explain the roles of science, technology and engineering in studying seabirds.
- Describe the reasons why biologists use satellite tagging to study seabirds.
- Explain how science and technology complement one another.

Outline

Engage – Navigating the Ocean
Explore – Plotting Albatross Locations
Explain – Analyzing Albatross Movements
Elaborate – Satellite Tracking
Evaluate – Other Seabird Movements

Background Information

Throughout history, humans have sought to learn about the natural world. They have invented technological tools, from magnifying glasses to satellites, to do so. Science, technology, engineering, arts and mathematics (the "STEAM" subjects) are truly interconnected. Technological tools are used to collect, process, analyze, and report data. Engineers design better tools to advance scientific discovery, e.g., how can we better observe the entire Earth from space?

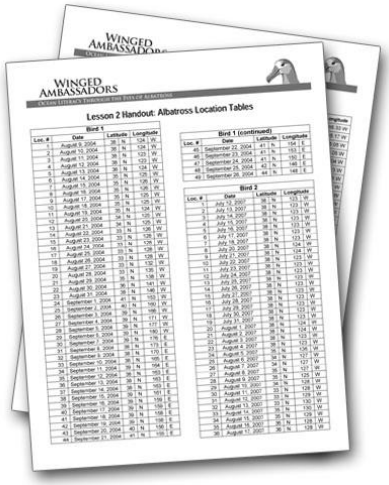
In this lesson, students consider the role of technology in the study of albatross. In fact, satellite tagging has shed light onto the secret lives of albatross. Small transmitters attached to the birds' feathers follow their movements in almost real time. The transmitter emits a signal which is received by a satellite and allows researchers to calculate the animal's position. The information is sent to a processing center, and is ultimately accessible to researchers via the internet.

The scientists take great care to choose technologies that will not harm the animals they are studying, or alter their behaviors, since those are the very behaviors under study. No design is perfect, however. The transmitters do not last forever. Batteries eventually die, and the transmitters sometimes fail prematurely for unknown reasons. Additionally, most studies can only track a few birds because the transmitters are expensive

Yet, this technology has led to amazing discoveries. Students will examine authentic tracking locations of albatross by plotting them on maps. By comparing and contrasting the tracks of individual birds, students are ready to ask scientific questions about the animals, their movements, and their habitats.

Preparation

Make copies of the student worksheets and maps. Introduce seabirds to the class, if you have not completed Lesson 1.



Vocabulary

ENGINEER – one who designs technological solutions to problems

LATITUDE – measurements of distance from the equator to the poles; ranges from 0 to 90 degrees

LONGITUDE – measurements east and west of the prime meridian; ranges from 0 to 180 degrees

SEABIRD – a bird that spends most of its life at sea and relies on the ocean for meeting its needs

FORAGING – process of finding food and / or eating

TRANSMITTER – a device that sends an electronic signal

Learning Procedure

Engage

(15 minutes)

Read the first paragraph on the student worksheet as a class.

Using Question 1 of the student worksheet, conduct a "Think, Pair, Share" activity. Students first jot down their own ideas, then share with a partner, and finally the pairs share with the class.

? Ask students to think of examples of how new technologies have allowed humans to learn something new. They should then discuss their ideas with a partner.
Possible ideas include:

- *Microscopes – allow us to observe small objects.*
- *The internet – allows us to communicate around the world, find and share information, etc.*
- *Submersibles – allow us to explore the deep sea.*
- *Rockets – allow us to explore space.*

Explain that technology has helped wildlife biologists to better understand the movements of animals, including seabirds such as albatross.

Ask students:

? How do scientists learn about albatross?
Answers include:

- *Observe them at their nesting grounds.*
- *Dissect deceased birds (necropsy).*
- *Look for them at sea.*
- *Track them with transmitters*

? Where are most observations of albatross made?
They are observed on land, near nesting grounds, or close to shore—areas that are accessible to humans.

Show students the Engage portion of the presentation.

Explain to students that for a long time, scientists wondered where albatross traveled when away from their nesting grounds. They speculated about whether animals from different nesting colonies traveled to the same feeding grounds, or whether they dispersed widely across the ocean.

Note that technology has allowed scientists to follow animal movements. Satellite tags are attached to the birds, and their locations can then be detected.

Note: Students will learn more about satellite technology in the Explain section of this lesson.

Ask:

? Why do you think albatross travel?
Accept all answers at this point. Answers might include.

- *Feeding*
- *Finding mates*
- *Migrate with changing seasons*

Explore

(30 minutes)

Show students the slides as you explain that they will be plotting real albatross locations from a scientific study.

Review the concepts of latitude and longitude, as necessary. Note that several albatross crossed the dateline (longitude: 180 degrees W / 180 degrees E).

To get students started, model how to plot data points, i.e., using a document camera or overhead projector.

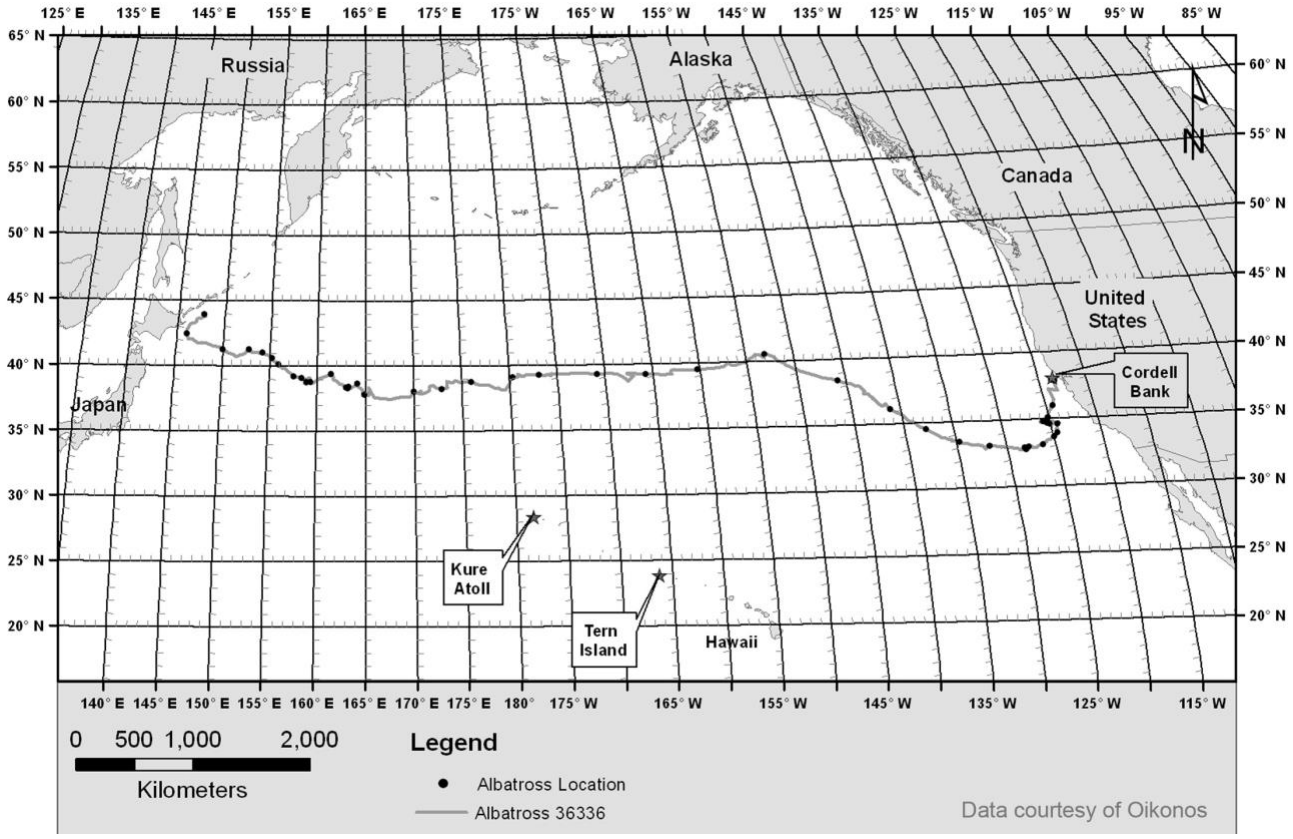
Students should work in groups of 2-4 for this activity. Consider naming the birds, perhaps based on their behavior (e.g., where they went). Note that scientists give animals ID numbers but sometimes they also name them to make the data and individuals easier to discuss and remember.

- Each student in the group will plot a different track on a different map, using a separate piece of paper.
- For 12 different birds, the table lists 12 noon points along their path for plotting.

Differentiation: For advanced learners and / or if time allows, a table is provided "L2-Advanced Handout" with every daily location along the bird's route.

You may also consider allowing students to plot several individuals on the same map, to look for track similarities.

Once students complete their tracking maps, they should answer questions 2 and 3.



Example of the noon locations of one Black-footed Albatross that traveled across the Pacific.

Explain

(25 minutes)

Students should work with their groups to compare their individual maps and answer the questions that follow.

Review students' work as a class. Some useful information:

- There are many species of albatross. The Black-footed Albatross was tracked in this study because the species is threatened by fishing and pollution, so scientists want to learn more about their movements.
- Some birds were tracked during the breeding season, when they forage to bring food back for their chicks at the colony.
- Other birds had finished raising young for the year, and were tracked during the post-breeding or migratory season.

Discuss:

? Why did albatross travel to similar locations, even though they were tagged at different locations?
Accept all answers. In general, these are areas of high productivity and therefore food availability.

Show students the first few slides of the migration tracks PowerPoint. Explain to students the following points:

- Each color represents a different individual animal.
- Birds were tagged at different locations to study multiple populations and compare their movements.

Explain that when scientists complete a study, it always leads to more questions. Assist students in writing scientific questions based on the maps they are observing. Some criteria to consider when writing scientific questions:

- Scientific questions should be testable through observation, investigation, and measurement
- Scientific questions should require scientific evidence to be answered
- Scientific questions should have a defined answer
- Non-scientific questions may depend on personal ideas or judgments
- Non-scientific questions cannot be answered through observation or investigation

Elaborate

(10 minutes)

As you show students the slides about satellite tracking of albatross, discuss the process:

? Why did scientists decide to use satellite tagging with albatross?
To determine where the animals travel. To learn about albatross movements in order to protect them.

? What makes this a difficult process?
Answers include:
- *It is difficult to tag animals at sea.*
- *Sea and weather conditions can be rough.*
- *Satellite tags can fail quickly at times.*

Read the short paragraph about satellite technology as a class. If necessary, help students to consider the costs and benefits of other technologies so that they better understand the idea of cost/benefit analysis.

Students work on Question 7 individually or pairs. Then, review the question as a class.

Evaluate (10 minutes)

Evaluate the movements of a different seabird species, the Pink-footed Shearwater. This smaller species, related to albatross, nests only on islands off Chile. Scientists tagged this bird from a boat off California during its long distance migration.

Direct students to complete the Evaluate section of their worksheet. This task may also be assigned for homework.

Extension

Visit www.signalsofspring.net/aces and click on "Maps and Data" to see locations of a variety of marine animal species.

Resources

- Guides to writing good scientific questions: https://www.ecologyproject.org/about/blog/how-to-write-a-science-research-question
- Sea Turtle Satellite Tracking: http://www.seaturtle.org/tracking/teachers
- Information about Pink-footed Shearwaters http://www.pinkfootedshearwater.org/
- Polynesian Voyaging Society: http://www.hokulea.com/

Credits and More Information

This lesson was developed for NOAA's Cordell Bank National Marine Sanctuary and Papahānaumokuākea Marine National Monument, by Meghan Marrero of Mercy College and Oikonos - Ecosystem Knowledge.

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Please contact Oikonos or NOAA to request further use of any images, art, videos, data or text included in the Winged Ambassadors activities.

We appreciate feedback, corrections and questions.

Please email WingedAmbassadors@oikonos.org

Free Lessons and Resources Available at:

http://cordellbank.noaa/gov/education/teachers.html

http://oikonos.org/education

http://papahanaumokuakea.gov/education/wa.html

Education Standards

National Education Standards	NSES Grades 6-8: • Different kinds of questions suggest different kinds of scientific investigations. Some investigations involve observing and describing objects, organisms, or events; some involve collecting specimens; some involve experiments; some involve seeking more information; some involve discovery of new objects and phenomena; and some involve making models. • Current scientific knowledge and understanding guide scientific investigations. Different scientific domains employ different methods, core theories, and standards to advance scientific knowledge and understanding. • Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations. • Scientific investigations sometimes result in new ideas and phenomena for study, generate new methods or procedures for an investigation, or develop new technologies to improve the collection of data. All of these results can lead to new investigations. • Science and technology are reciprocal. Science helps drive technology, as it addresses questions that demand more sophisticated instruments and provides principles for better instrumentation and technique. Technology is essential to science, because it provides instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size, and speed. Technology also provides tools for investigations, inquiry, and analysis. • Perfectly designed solutions do not exist. All technological solutions have trade-offs, such as safety, cost, efficiency, and appearance. Engineers often build in back-up systems to provide safety. Risk is part of living in a highly technological world. Reducing risk often results in new technology. • Technological designs have constraints. Some constraints are unavoidable, for example, properties of materials, or effects of weather and friction; other constraints limit choices in the design, for example, environmental protection, human safety, and aesthetics.
Ocean Literacy Principles	• 7d New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles. • 7f Ocean exploration is truly interdisciplinary. It requires close collaboration among biologists, chemists, climatologists, computer programmers, engineers, geologists, meteorologists, and physicists, and new ways of thinking.
California	Grade 6: • 7b. Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data. Grade 7: • 7a. Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.
Hawai'i	Grades 6–8: 1. Collect, organize, analyze and display data/ information, using tools, equipment, and techniques that will help in data collection, analysis, and interpretation. • Develop conclusions and explanations showing the relationship between evidence and results drawn. • Describe how scientific inquiry is a way of knowing. • Identify good scientific explanations and justify their soundness based on evidence, logical and consistent arguments, and use of scientific principles, models, or theories. • Give examples where scientists used mathematics and technology to gather, quantify, and analyze results of an investigation • Give examples of how science advances through legitimate questioning. • Describe and exemplify the nature of scientific explanations. 2. Give an example of the interdependence of science, technology, and society and how it changed the course of history. • Give examples of societal influence on the development and use of technology and peoples' responses to these developments (e.g., development of dynamite). • Describe and exemplify how information and communication technologies affect research and work done in the field of science.