LESSON 2:
Tracking the Annual Cycle of Migratory Birds

Photo by Tim Romano, Smithsonian's National Zoo

LESSON 2:
TRACKING THE ANNUAL CYCLE OF MIGRATORY BIRDS

OVERVIEW

Lesson Two will introduce students to the technology of tracking. Students will compare and contrast several tracking devices and gain a better idea of how each device is used.

ENGAGE	How do we know where people are? How do we know where our things are?	Class has a group discussion on tracking technologies students may be familiar with and connects it to tracking technologies for birds.	5 minutes
EXPLORE	What kinds of tracking devices do scientists use to track birds?	Students are assigned groups and gather information about their assigned tracking device.	30 minutes
EXPLAIN	How do the tracking devices compare?	Students form "jigsaw groups" and share information with one another about their assigned tracking devices.	50 minutes
ELABORATE	How do we decide which tracking device to use?	Given a bird and a research question, students determine which tracking device to use.	15 minutes
EVALUATE	Written paragraph	Students write paragraphs describing why they chose a certain tracking device for a given scenario.	N/A

DISCIPLINARY CORE IDEAS

MS-LS2-5: Evaluate competing design solutions for maintaining biodiversity and ecosystem services.

OVERARCHING UNDERSTANDING

Scientists use different types of tracking technologies to figure out where birds are throughout their annual cycle.

Scientists attach a tracking device to a black-bellied plover
Photo by Tim Romano, Smithsonian's National Zoo

LESSON 2: TRACKING THE ANNUAL CYCLE OF MIGRATORY BIRDS

ESSENTIAL QUESTIONS

How can we use technology to track migratory birds?

RELATED MISCONCEPTIONS

Students may think technology is so advanced that we could put any kind of device on any bird (not taking into account size of bird, type of data we need, etc.).

KNOWLEDGE

Students will know...

- Some of the types of technology available to scientists for bird tracking.
- What kinds of data different tracking devices can collect.
- How scientists use tracking data to understand and solve problems.

SKILLS

Students will be able to...

- Name and describe five different types of tracking devices.
- Compare and contrast different tracking devices in terms of data collected and advantages/ disadvantages of use.
- Given a scientific question or problem, choose an appropriate tracking device to investigate or answer the question or problem.

PRIOR STUDENT KNOWLEDGE:

- Students should be familiar with the annual cycle of migratory birds.

SCIENCE AND ENGINEERING PRACTICES:

- Asking questions
- Using mathematics and computational thinking
- Developing and using models
- Engaging in argument from evidence
- Obtaining, evaluating and communicating information

CROSSCUTTING CONCEPTS:

- Structure and function
- Patterns

TERMS:

bird band • radio telemetry • global positioning system (GPS)
satellite telemetry • light-level geolocator • PIT tag

Refer to the Glossary in the Appendix

TEACHER BACKGROUND INFORMATION

There are many different types of devices used to track animals. The type of device scientists choose to use in a given study depends on the animal they are tracking, the scientific question, and the technological limitations of the device itself. In this lesson, students will look at five methods/devices for tracking birds, including bird banding, light-level geolocators, PIT tags, radio telemetry, and satellite telemetry. These are not all of the devices currently available to researchers but will provide students with a sampling of the variety of technologies used. Refer to the tracking descriptions on the Follow that Bird! website for more information. Students will use these descriptions in this lesson.

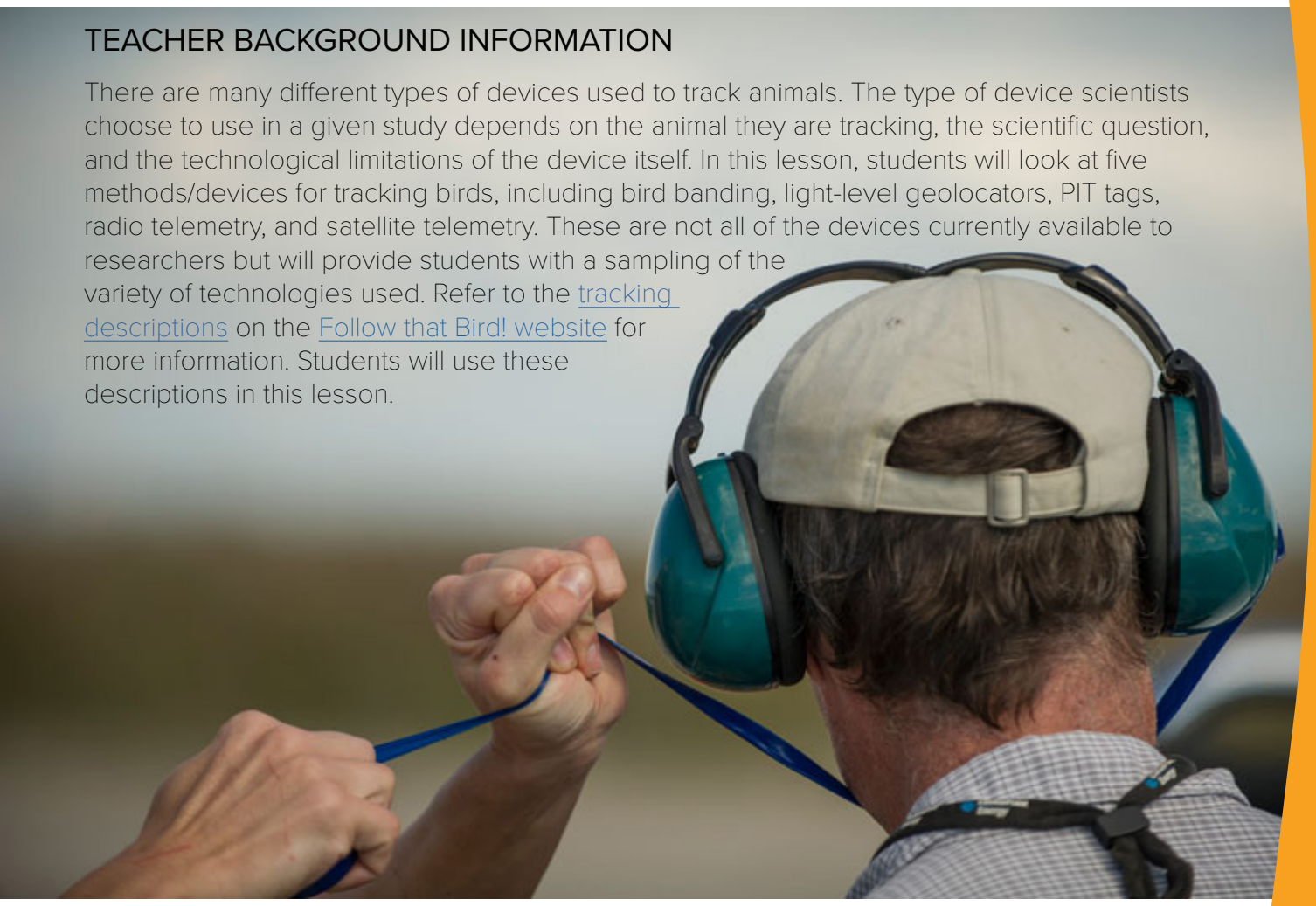


Photo by Tim Romano, Smithsonian's National Zoo

MATERIALS:

Activity 1: ENGAGE

- None

Activity 2: EXPLORE

- Internet access for each group of two to three students
- Journals or Activity Sheet 1: Tracking Device Questions

ACTIVITY 3: EXPLAIN

- None

Activity 4: ELABORATE

- Scenario Cards
- Scoring Rubric

Activity 5: EVALUATE

- None

ACTIVITY 1

ENGAGE - How do we know where people are?

As a whole group, discuss how we know where people are at any given point.

- Ask: *How do we know where a person is at any given moment? If you had to pinpoint a person's location, could you do it? How? Allow several students to answer.*
- Ask: *What if we needed to track an inanimate object - say, someone stole your computer, or cell phone, or perhaps a car - how could we do that?* If students do not mention GPS technology, prompt or introduce them to it.
- Discuss how GPS is used in cell phones, and in tracking technology on computers and cars (such as LoJack).
- Ask: *How can we use the same technology to determine where birds are at any given time during their annual cycle?* Take a few answers from students, then explain that they will examine several different methods of tracking migratory birds.
- Tell students: *By the end of the lesson, you will be able to determine which tracking method is best to use, depending on what information is needed or desired by the scientist.*

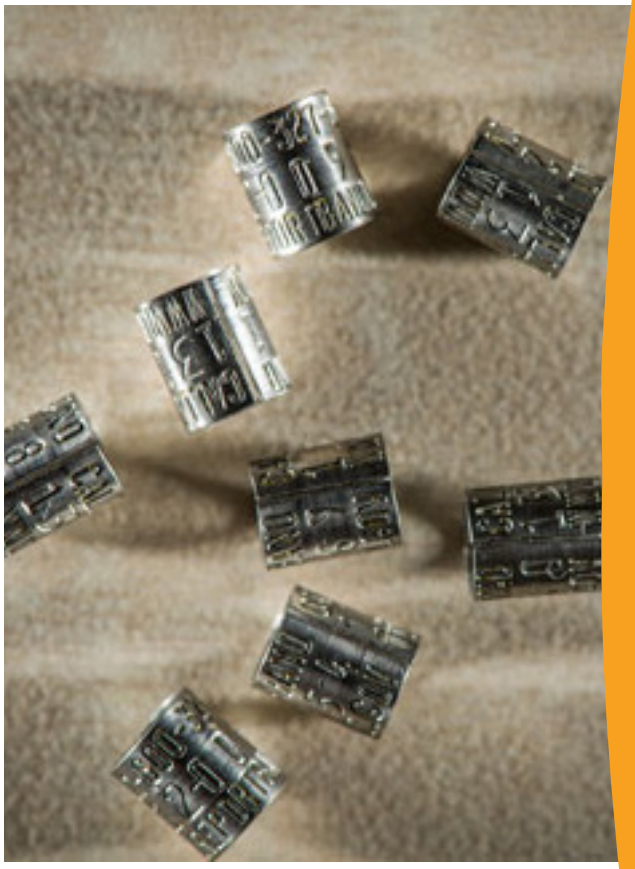
ACTIVITY 2

EXPLORE - What kinds of tracking devices do scientists use to track birds?

Divide students into Expert Groups.

- Divide students into five groups. Tell students: *These are your Expert Groups, where each group will become an expert on a tracking device.*
- Assign each Expert Group one of five tracking devices: bands, light-level geolocators, radio telemetry, satellite telemetry, or PIT tags.
- Have each Expert Group read about their tracking device by visiting the Follow that Bird! website.* Descriptions of each tracking device are located under the "Tracking devices" drop-down in the navigation bar.
- After reading about their device, have groups record answers to the following questions about their device in their journals or on Activity Sheet 1: Tracking Device Questions:
  - *How does this technology work?*
  - *What kind of data can be recorded?*
  - *How is it attached to the bird? Draw a schematic.*
  - *How much does it weigh?*
  - *What does it cost?*
  - *How is the data acquired by the scientist/ observer?*
  - *What are the advantages/disadvantages of using this type of device?*
- Tell students: *All members of the Expert Group should agree on the answers to these questions, as you are each going to be presenting the information to your Jigsaw Groups in the next portion of the lesson, so consistency and accuracy are important.*

*Alternatively, teachers can print the information for students to use in their Expert Groups.



Aluminum Bird Bands
Photo by Tim Romano, Smithsonian's National Zoo

ACTIVITY 3

EXPLAIN (Student-Centered) – How do the tracking devices compare?

1. Break up Expert Groups into "Jigsaw Groups" and have students share what they learned.
   - Place students into Jigsaw Groups such that each group contains one banding expert, one light-level geolocator expert, one radio telemetry expert, one satellite telemetry expert, and one PIT tag expert.
   - In their Jigsaw Groups, have students take turns sharing the information they gathered about their tracking devices in their Expert Groups until all students have shared, and each student has information about all five tracking devices.

2. Show a brief video about tracking the black-crowned night-heron.
   - As an example of how tracking devices can help scientists answer questions about migratory bird behavior, show a short video (4:07 minutes) about black-crowned night-herons at the Smithsonian's National Zoo: Wild Inside the National Zoo: The Great Night Heron Mystery.

ACTIVITY 4

ELABORATE - How do we decide which tracking device to use?

1. Have students choose a tracking device based on a given scenario.
   - Randomly assign one of the Scenario Cards to each student.
   - Given the bird information and the question the scientist wants to answer on the Scenario Cards, ask students to determine which tracking device would be best to use.
   - Have students write a brief paragraph explaining why they chose that particular device. Share the Scoring Rubric with students before they begin.

2. Discuss as a group in a "cognitive closure," aligned with objective(s).
   - Once the student answers from Activity 4: Elaborate have been collected, ask students to share the scenario they were presented with and which tracking device they chose.
   - Have them justify their answers to the class.

ACTIVITY 5

EVALUATE - Student Write-ups

Grade students' paragraphs.

- Use the provided Scoring Rubric to score each student's written justification for his/her chosen tracking device presented in Activity 4: ELABORATE.
- Adapt the rubric as needed to fit your class.

EXTENDING THE LESSON

1. Complete the following lesson on determining latitude and longitude, given sunrise and sunset.
   - Research American redstart, black-capped chickadee, red knot and wood thrush migration patterns.
   - Give students the sunrise and sunset information for a given area within one of these species ranges.
   - Have students determine latitude and longitude based on the sunrise/sunset information and explain what part of the annual cycle the bird is in. Refer to NOAA's Solar Calculator or sunrise and sunset at any given location.
2. Watch the career connection video (page 33).
3. Discuss what students can do to protect birds (page 33).

CAREER CONNECTION

SPOTLIGHT ON: AUTUMN-LYNN HARRISON, RESEARCH ECOLOGIST

LOVE NATURE? WANT TO TRAVEL THE GLOBE?

Maybe you have what it takes to be a Research Ecologist like Autumn-Lynn Harrison at the Smithsonian Migratory Bird Center. Her job has taken her to the Serengeti, beaches in Patagonia, Arctic Alaska and even a diamond mine in South Africa. In this career connection video, you will learn how scientists like Autumn-Lynn use the tracking devices you learned about to help save animals across the globe.

HOW CAN YOU HELP?

Taking Action to Protect Birds!

As you've learned in this lesson, there are many different ways to track animals. The simplest way is to observe them! **You can help** by learning more about birds and becoming a bird watcher. Learn more about birds and how to stay involved by visiting the Smithsonian Migratory Bird Center website (https://nationalzoo.si.edu/migratory-birds/public-outreach).

Name: _____

Tracking Device: _____

Tracking Device Questions

1. How does this technology work?

2. What kind of data can be recorded?

3. How is it attached to the bird? *Draw a schematic.*

4. How much does it weigh?

5. What does it cost?

6. How is the data acquired by the scientist/observer?

7. What are the advantages/disadvantages of using this type of device?

American Redstart

Weight: 6-9 grams

Migration:
long-distance migrant

The American redstart is a brightly colored songbird that, despite its very small size, migrates great distances every year. Studies of the redstart by the Smithsonian's Pete Marra have shown that the quality of habitat on wintering grounds in Jamaica affects how successful they are on their breeding grounds. Researchers from the Smithsonian and the Cornell Lab of Ornithology now want to determine where wintering redstarts in Jamaica spend their summers.

? Which tracking device should they choose? Why?

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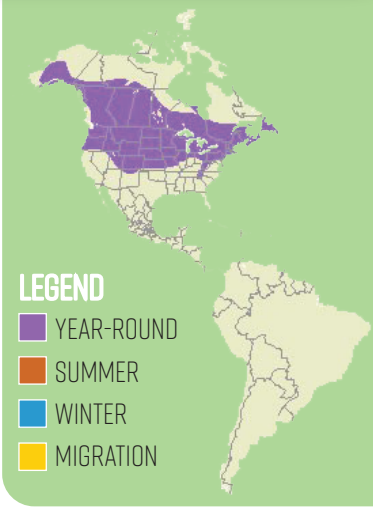
Black-capped Chickadee

Weight: 9-14 grams

Migration:
resident



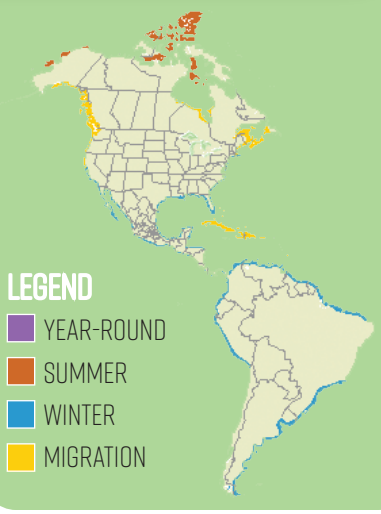
Many aspects of the daily lives of even common backyard birds remain a mystery. Scientists at Cornell University's Lab of Ornithology are trying to determine the relationship between weather and bird behavior. They will be conducting a study on how often birds feed at bird feeders in response to changes in weather. To do so, they will tag black-capped chickadees and count the number of times individuals use a bird feeder per day over a period of two years.

? Which tracking device should they choose? Why?

Red Knot

Mass: 135 grams

Migration:
long-distance migrant



Red knots are a fascinating bird that travels incredibly far during its annual cycle. Migrating red knots gather in huge numbers to feed at stopover sites. One of the most important stopover sites is Delaware Bay, USA. Their migration coincides with the spawning of horseshoe crabs -- red knots eat the eggs of the crabs and *double* their body weight! This gives them the energy to complete their migration. Loss of horseshoe crabs due to human activity has led to a drastic decline in red knot populations in recent years. Smithsonian scientists plan to track individual red knots throughout the year to determine their precise location and survival.

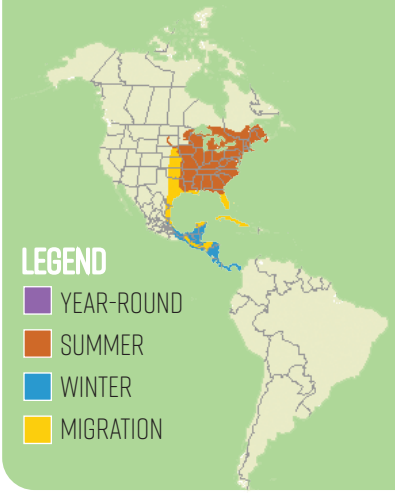
? Which tracking device should they choose? Why?

cut along dotted line

Wood Thrush

Mass: 40-50 grams

Migration:
long-distance migrant



Wood thrush are a migratory bird species that is predicted to have declined by over a half (62%) since scientists began recording population records in 1966. Wood thrush live in mature forests in eastern North America during the breeding season and winter in the forests of Mexico and Central America. Loss of their habitats in both regions is expected to be causing their decline. A graduate student at the Smithsonian hopes to help determine what is causing the decline. One of her research questions aims to figure out the amount of habitat that an individual wood thrush uses. She will travel to the forests of Indiana, USA to tag wood thrushes. She will track the movement of birds over a one month period of time.

? Which tracking device should they choose? Why?

Scoring Rubric

SCORE: 3

There is evidence in this response that the student has a FULL AND COMPLETE UNDERSTANDING of the question or problem, and how the chosen tracking device can help to answer the question or solve the problem.

- The supporting evidence is complete and demonstrates a full integration of scientific concepts, principles, and/or skills.
- The response reflects a complete synthesis of information, such as the data collected by the device, its suitability for the project, and justification for why it was chosen.
- The accurate use of scientific terminology strengthens the response.
- An effective application of the concept to a practical problem or real-world situation reveals a complete understanding of the scientific principles.

SCORE: 2

There is evidence in this response that the student has a GENERAL UNDERSTANDING of the question or problem.

- The supporting scientific evidence is generally complete with some integration of scientific concepts, principles, and/or skills.
- The response reflects some synthesis of information, such as data collected by the device, its suitability for the project, and/or justification for why it was chosen.
- The accurate use of scientific terminology is present in the response.
- An application of the concept to a practical problem or real-world situation reveals a general understanding of the scientific principles.

SCORE: 1

There is evidence in this response that the student has MINIMAL UNDERSTANDING of the question or problem.

- The supporting scientific evidence is minimal.
- The response provides little or no synthesis of information, such as data collected by the device, its suitability for the project, and/or justification for why it was chosen.
- The accurate use of scientific terminology may not be present in the response.
- An application to the problem, if attempted, is minimal.

SCORE: 0

There is evidence that the student has NO UNDERSTANDING of the question or problem.

- The response is completely incorrect or irrelevant.
- Alternatively, there is no response.

Research Ecologist, Autumn-Lynn Harrison releases a black-bellied plover during a trip to Texas for conservation field work.
Photo by Tim Romano, Smithsonian's National Zoo