Avian Olympics

Adapted with permission from "One Bird-Two Habitats." Wisconsin Department of Natural Resources.

Grade Level: upper middle school/ high school
Duration: up to three 40-minute class periods
Skills: vocabulary, discussion, team building, comparison, and collection and interpretation of data
Subjects: science, math, and physical education

Concepts:
- Shorebirds, like other animals, are adapted in three ways to survive: physically, physiologically, and behaviorally.
- Shorebirds have many physical, or morphological, adaptations to help them walk, find food, hide, and reproduce in their habitat, and to fly long distances during migration.
- Shorebirds are also adapted physiologically to their migrating lifestyle, particularly in their fat-loading abilities which enable them to maintain energy for long flights.

Vocabulary
- migration
- fat-loading
- stopover site
- flyway

Overview
By competing in physical and math/ science activities, students come to understand that shorebirds are incredibly adapted to long distance migration.

Objectives
After this activity, students will be able to:
- Define the term migration.
- Explain why shorebirds migrate.
- Give three examples of adaptations that help shorebirds successfully migrate long distances.
- Give two common reasons why shorebirds might not survive a difficult migration.
- Explain the relationship between calories, fat, energy, and stopover sites.

Materials
- Triple-beam balance or other scale
- Clock with second hand visible to the entire room or one stop watch per group
- World map with kilometer scale
- Student worksheet and answer sheet
- Fifty meter track or running area

Introduction
Most shorebirds are uniquely *adapted* to living in open spaces (often wetlands) that also provide an abundant supply of invertebrate foods. Their adaptations are both physical (the way they are built) and behavioral (the way they act). This activity focuses on the physical adaptations of *fat-loading* and long-distance flight.

Migration itself is considered an adaptation that allows shorebirds to take advantage of the abundant Arctic food resources in the spring and summer, yet escape to warmer food-rich southern climates for the winter.

For more information about shorebird adaptations, read *Shorebird Adaptations* and *The Magnificent Shorebird Migration* found in the *Shorebird Primer*.

Activity Preparation
1. Photocopy one student worksheet for each student or each team of three to six students.
2. Have the student worksheet answers available for your reference during the activity.

Procedure
1. Divide the class into teams of three to six students to compete against each other in math skills, speed, and endurance. Ask each team to select a mascot migratory shorebird group, such as plovers, oystercatchers, sandpipers, curlews, turnstones, godwits, or phalaropes. The object of each team is to get the most possible points. You may wish to shorten or lengthen the lesson by awarding points only to certain answers or doing some of the calculations as a class.

2. Hand out a copy of the student worksheet to each group. Work through each problem as a class. Award the teams points. All the teams that get the right answer are automatically awarded one point; the first team to get the right answer gets two points.

3. Go outside to complete *Problem 3: Fast Travel* and *Problem 4: Wing-flapping.*

4. Provide a reward to the teams for most points, best effort, etc.

Additional Activities
Mechanics of Flight
Have students research the mechanics of flight. Compare the flight of birds to the flight of bats, insects, or airplanes. What are the differences between fixed and mobile wings? Why don't birds flying in a flock run into each other when they change directions?

Energy of Flight
Ask students to research the following questions: What kind of energy transfer is involved in flight? How do birds transfer chemical food energy into mechanical flight energy? What role does oxygen play in the trapping of the sun's energy (photosynthesis) and the release of energy (respiration) in animals? What role do hollow bones, bone marrow, and air sacs play in respiration?

Shorebird Types
Have students research the main shorebird types (plovers, sandpipers, etc.) and list their identifying characteristics.

Scientific Names
Practice learning the hierarchical structure (i.e., Kingdom, Phyla, Class, Order, Family, Genus, Species) of the animal kingdom and scientific (Latin) names by tracing one or two species of shorebirds through the hierarchy.

Local Shorebird Olympics
Ask your students to develop additional math problems that focus on the feats of local shorebirds.

- First assemble a list of your local shorebirds using field guides or a local bird list
- Divide the class into teams and assign each a local shorebird species from the list. Use the Shorebird Sister Schools Web site, the *Shorebird Profiles* found in the *Appendix*, and shorebird field guides and texts from your local library to find interesting facts.
- Assemble a new Avian Olympics Worksheet that highlights shorebird of your area.
- Repeat *Avian Olympics* using this new worksheet.

Avian Olympics Student Worksheet Answers

Problem 1—Weigh-in

The average middle school student weighs 100 pounds or 45 kilograms. How many grams are in 45 kilograms?

Answer: 45,000 grams

Compare that to the weight of the Western Sandpiper, about 25 grams (less than 1 ounce). Find an object in the classroom that you think weighs 25 grams. Weigh your object on a triple-beam balance.

How many Western Sandpipers (at 25 grams) would it take to equal the weight of an average middle school student (at 45 kilogram)?

Answer:
45,000 g x 25 g = 1800 Western Sandpipers

Problem 2—Eating Like a Bird (Fat-loading)

One quarter-pound hamburger and fries is an average-sized meal for a student. Two or three burgers would be a huge meal. What is the largest number of quarter-pound hamburgers any of the students has ever eaten in a single meal?

What percentage of the average weight of a middle school student is this? (Assume a quarter-pound hamburger = 114 grams.)

Example answer:
If 3 is the number of quarter-pound hamburgers eaten:
3 burgers x 114 g (burger weight) = 342 g
342 g ÷ 45,000 g (student weight) = 0.0076%, or less than 1%

Compare this with the Pacific Golden-Plover which gains enough fat to increase its body weight by almost 30% for its migration from Hawaii to Alaska. If an average student weighing 45 kilogram were going to increase his or her body weight by 30%, how much weight would he or she gain?

Answer: 45 kg (student weight) x .30 = 13.50 kg or 13,500g

How many quarter-pound hamburgers is this equal to?

Answer: 13,500 g x 114 g (hamburger wt) = 118 burgers

Problem 3—Fast Travel (outside activity)

With each team entering its fastest runner, have a 50-meter dash to determine how long it takes a student to sprint 50 meters.

How long would it take this runner to cover 1 kilometer?

Example answer: If a student runs 50 meters in 15 seconds,

$\frac{15 \text{ seconds}}{50 \text{ meters}} \times \frac{Y \text{ seconds}}{1000 \text{ meters}}$

15,000 = 50X $\frac{15,000}{50}$ = Y seconds = 300 seconds

300 seconds ÷ 60 minutes = 5 minutes to cover 1,000 meters

Use a map of the world to estimate the distance in kilometers from the school to Lima, Peru. Using these two measurements, calculate how long it would take the fastest runner on your team to get to Lima. Assume your runner could travel in a straight line without stopping.

Example answer:
60 minutes ÷ 5 min/km = 12 km/hour
7500 km ÷ 12 km/hour = 625 hours, or
625 hours ÷ 24 hours/day = 26 days

Discussion: Compare these results with Sanderlings, which are able to migrate 7500 kilometer (4650 miles) between Oregon and Peru in 230 hours--or about 10 days!

Avian Olympics Student Worksheet Answers

Problem 4—Wing-flapping (outside activity)

Have each team select a representative. Using a clock with a second hand, ask each team to determine the highest number of arm flaps possible in 10 seconds. Give a point to the group whose representative flapped the fastest (most times per 10 seconds).

Using the time from Problem 3--Fast Travel, how many arm flaps would it take a person to fly to Peru?

Example answer:

For 11 flaps in 10 seconds,

$\frac{11 \text{ flaps}}{10 \text{ seconds}} = 1.1$ flaps per second

$1.1 \text{ flaps} \times \frac{60 \text{ seconds}}{1 \text{ minute}} \times \frac{60 \text{ minutes}}{1 \text{ hour}} \times \frac{24 \text{ hours}}{1 \text{ day}}$

= 95,040 flaps per day
1 day

95,040 flaps x 26 days = 2,471,040 flaps

Discussion: What assumptions were made to get this answer? What might affect the accuracy of our answer? We are comparing flaps (flying) with running time and comparing the abilities of two different students. We are assuming the same distance will be covered in the same amount of time in either way and that all students will perform at the same speed. In science, it is important not to "compare apples to oranges" and to be aware of all assumptions made.

Problem 5—Non-stop Travel

Which student can continue flapping his or her arms the longest?

Discussion: How does this feat compare with the American Golden-Plover which flies nonstop for 48 hours as it migrates from Nova Scotia to South America? The Pacific Golden-Plover and some curlews and tattlers fly nonstop for two to three days from Hawaii and other Pacific Islands to Alaska.

How far do you think the best classroom runner can run without stopping?

Discussion: How does this compare with some plovers, curlews and tattlers which fly non-stop from Hawaii and other Pacific Islands to Alaska, a distance of over 3500 miles? The little Western Sandpiper flies over 250 miles per day between stopover points along the Pacific Coast flyway to Alaska.

Problem 6—Long-distance Travel

Which team member has lived farthest from his or her current home? Using a map, determine how many kilometers away that is?

Discussion: How does this compare with Sanderlings that fly over 11,000 kilometer twice a year from their high-Arctic breeding grounds to nonbreeding grounds in Peru?

Problem 7—Fuel-Efficiency

Humans burn about 60 calories by running one kilometer. At this rate, how many calories would a student need to run from here to Peru?

Answer: Use a map to determine how many kilometers it is from your town to Lima, Peru. Multiply this number by 60 calories.

Example answer:

60 calories x 7500 km = 450,000 calories

If one gram of fat yields 9 calories of heat, how many kilograms of fat would this student need to eat before making the trip?

Example answer:

450,000 calories ÷ 9 calories/g = 50,000 g
50,000 g x 1,000 = 50 kg

Discussion: Compare this with the Pacific Golden-Plover, which can travel 3900 kilometers (2400 miles) in 48 continuous hours of flying, using fewer than 60 grams (2.1 oz) of body fat. Does this bird burn more calories per kilometer or few calories per kilometer than a student?

Avian Olympics Student Worksheet

Directions
Answer the following questions one at a time. Do not proceed to the next question until your teacher tells you to. Show all your calculations (carrying your units through the calculations to see if your answer makes sense).

Problem 1 – Weigh-In
The average middle school student weighs 100 pounds or 45 kilogram. How many grams are there in 45 kilograms?

Compare the above weight to the weight of the Western Sandpiper, about 25 grams (less than one ounce.) Find several objects in the classroom that you think weigh 25 grams. Now weigh the objects and record which object comes closest.

How many Western Sandpipers (at 25 grams) would it take to equal the weight of an average middle school student (at 45 kilograms)?

Problem 2 – Eating Like a Bird (Fat-loading)
What is the largest number of quarter-pound hamburgers any person on your team has eaten in a single meal?

What percentage of the average weight of a middle school student is this? (Assume that a quarter-pound hamburger = 114 grams.)

If an average student weighing 45 kilograms were going to increase his or her body weight by 30%, how much weight would he or she need to gain?

How many quarter-pound hamburgers does this equal?

Problem 3 – Fast Travel
How long did it take the fastest student to sprint 50 meters?

Calculate how long it would take this runner to cover one kilometer.

Using a map of the world, estimate the distance in kilometers from your school to Lima, Peru.

Using your answer from above, calculate how long it would take the fastest student to sprint directly to Lima. (Assume he or she could run in a straight line without stopping.)

Avian Olympics Student Worksheet

Continued

Problem 4 – Wing-flapping
How many arm flaps can your group's representative do in ten seconds?

Using the time calculated in problem three, calculate how many arm flaps a student would make in a "flight" to Lima, Peru.

Problem 5 – Nonstop Travel
Which group member can continue flapping his or her arms the longest? How long?

How far do you think the best runner of middle school age can run without stopping?

How far do you think the average middle school student can run without stopping?

Problem 6 – Long-distance Travel

Which group member has lived the farthest away from his or her current home? How many kilometers away is that?

How does this compare with Sanderlings that fly over 11,000 kilometer twice a year from their high-Arctic breeding grounds to nonbreeding grounds in Peru?

Problem 7 – Fuel Efficiency
Humans burn about 60 calories by running one kilometer. At this rate, how many calories would you need to run from here to Peru?

If one gram of fat yields nine calories, how many kilograms of fat would you need to eat before making the trip?

How does this compare with the Golden-plover which can travel 3900 kilometers (2400 miles) in 48 continuous hours of flying using fewer than 60 grams (2.1 ounce) of body fat?