

BIRDS  
OF  
NEW YORK



## LESSON FOR EDUCATORS

GRADES 6-12



The New York State Museum is a program  
of The University of the State of New York  
The State Education Department  
Office of Cultural Education

SCIENCE LAB

# EXPLORING EVOLUTION

BIRD SKELETONS ARE ADAPTED  
TO DIFFERENT FEEDING NICHES





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### OBJECTIVES

- 1 Students will use information about diet and habitat to predict birds' wing and leg lengths.
- 2 Students will measure bird wing and leg bones from museum skeleton specimens.
- 3 Students will interpret their bird wing- and leg-length data in the context of feeding adaptations.
- 4 Students will plot their data on a scatter plot and create a best fit line.



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### INTRODUCTION

Bird skeletons preserved as museum specimens are used to study the evolution of species. When skeletons from different kinds of birds are compared, researchers can see how their bodies are adapted to different feeding niches. For example, many different kinds of birds (swifts, swallows, nighthawks, and kites) evolved long wings and short legs as they adapted to capture and feed on flying insects. This process, where multiple, distantly related species independently develop similar traits, is called *convergent evolution*.

### ABOUT THIS LESSON

The New York State Museum developed new curriculum materials that accompany our *Birds of New York* exhibit hall. Below you will find instructions for leading a science lab with your students. On our webpage you will find the Student Handout part of the lab to print and distribute to your students, and the photos of bird bones from which the students will make measurements.

In this activity, we ask students to interpret the results of their skeleton comparisons within the framework of convergent evolution and adaptation to different feeding niches. The avian skeleton has been modified by natural selection as species have adapted to specialized feeding niches. The repeated evolution of similar morphologies in distantly related species is evidence of the power of natural selection to produce adaptations. These concepts support New York State P–12 Science Learning Standards.

In addition to this lab activity, find other classroom activities related to bird research and conservation on our website at [www.nysm.nysed.gov/education](http://www.nysm.nysed.gov/education).

The New York State Learning Standards met in this lesson are included at the end of this guide. For more information on the standards, visit [www.nysed.gov/next-generation-learning-standards](http://www.nysed.gov/next-generation-learning-standards).

### TIME:

- One to two 45-minute lab periods

### MATERIALS NEEDED:

- Rulers with millimeter graduations
- Scaled leg and wing bone photos of NYS Museum bird skeleton specimens
- Student Handout (Data Sheet/Instructions/Questions)
- Online access to [www.allaboutbirds.org](http://www.allaboutbirds.org) to answer pre-lab questions about foods and feeding behavior
- Classroom computer with projector for data pooling and graphing

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### DESCRIPTION

In this hands-on lab, students will learn about bird adaptations related to locomotion and different feeding behaviors. This activity is designed to help students better understand how scientists use specimens to study evolution, and to explore the topics of natural selection, morphological adaptation, and convergent evolution. Students will make predictions about the length of the legs versus the length of the wings. Then they will measure wing and leg bones from a variety of bird species, summarize their data, and pool it with data collected by other individual students or students working in small groups. The class can then generate a graph that will enable them to compare limb proportions of the different bird species, and make inferences about the ways that bird skeletons are adapted to different feeding niches.

### PART 1: PRE-LAB BIRD RESEARCH ACTIVITY

This activity makes use of the All About Birds website to introduce the students to the species for which they will measure bones in the Bird Skeletons Lab. Some time before beginning the lab, send students (individually or in groups) to [www.allaboutbirds.org](http://www.allaboutbirds.org), and ask them to fill in the Bird Research Table provided with this lesson with information they glean from these species' web pages.

### PART 2: LAB SET-UP

Set up your lab with five stations. Each station will have one skeleton photo printed at scale and a ruler. Alternatively, the photos can be displayed on student laptops or classroom computers, and sized so that the centimeter scale in the photographs are actual centimeters. The student teams can move from station to station until they have measured all the specimens. Give each group a copy of the Student Handout containing the instructions, diagrams, data sheet, and questions.

### PART 3: GRAPH BUILDING

You can build the graph with your students on paper; on a whiteboard; or on a computer with spread-sheet software, such as MS Excel, or using an online program like Google sheets. Below are instructions for building a graph from pooled classroom data using Excel.

#### Instructions for Building a Graph in Excel:

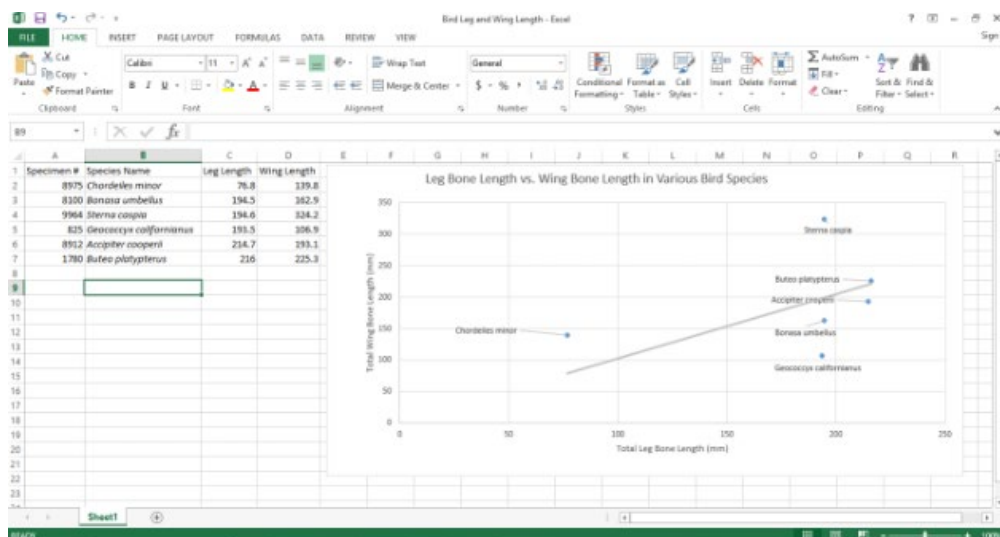
- 1 Enter all information into the Excel worksheet, with the specimen number in column A, species name in column B, leg length in column C, and wing length in column D.
- 2 Select all data in columns C and D by clicking on the top of the C column to highlight it, then hit the Shift key on your keyboard, and then click on the top of the D column. Both columns should then be selected.
- 3 Click the Insert tab in the tool bar at the top of the screen. In the Charts section, select the basic Scatter (X, Y) option, and an unformatted graph will appear in the center of the screen.
- 4 Click on the "+" button at the upper right of the graph and add the two axes titles and a chart title (See example table below for axes and chart titles).
- 5 To label each data point, click the "+" again, and select the "Data Labels" option. Excel will automatically label the point by its leg length. Double click each data label and appropriately label each data point with its species name.
- 6 To add a trend line, right click on one of the data points or click on the "+" button and on the "Trend Line" option, and click the arrow to the right and select "More Options." Make sure the trend line is linear, and then set the intercept at (0,0).



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Entering data from the entire class and creating a scatter-plot graph generates discussion about accuracy in data collection and enables students to visualize the differences among bird species. In the example above, measurements from a single group are plotted and a trend line added. Plot data from multiple student groups in a single graph to see how much their measurements differ.

Depending on the length of class periods, teachers may want to split this activity up over two days. For example, students could collect data on day 1, and on day 2 the class would pool the data, build and discuss the graph, and answer the discussion questions.

### EXPANDED DISCUSSION

Possible topics for expanded discussion and follow-up activities include

- Patterns of divergence between closely related species (e.g., the two hawks).
- Convergent morphology of birds with similar feeding niches (e.g., the tern and the nighthawk). Presenting and discussing the included phylogenetic tree (or the bird part of the tree of life at [www.onezoom.org/](http://www.onezoom.org/)) will help students see how distantly related birds have “converged” upon similar traits.
- The comparative method in evolutionary biology (rather than the experimental methods)
- “Repeatability of measurement” in conducting science experiments.

### ADDITIONAL RESOURCES

- For a good lesson in bird anatomy, including your chance to “Build a Bird,” visit [academy.allaboutbirds.org/features/birdanatomy/](http://academy.allaboutbirds.org/features/birdanatomy/).
- For information on convergent evolution, visit [evolution.berkeley.edu/evolibrary/resource/library.php](http://evolution.berkeley.edu/evolibrary/resource/library.php).



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- For interactive activities about evolution to prepare students for this Bird Skeleton Evolution Lab. (These pages are click-through interactives with worksheets and educator materials. The site uses bone comparisons between domestic chicken with dinosaurs and a cladogram to trace the shared ancestry of birds and other archosaurs and makes use of the linked film *Great Transitions: The Origin of Birds*.):
  - Comparative Anatomy of the Domestic Chicken ([hhmi.org/biointeractive/comparative-anatomy-domestic-chicken](https://hhmi.org/biointeractive/comparative-anatomy-domestic-chicken))
  - The Origin of Birds ([hhmi.org/biointeractive/origin-birds-quiz](https://hhmi.org/biointeractive/origin-birds-quiz))
  - Living Dinosaurs: Fact or Fiction ([hhmi.org/biointeractive/living-dinosaurs-fact-or-fiction](https://hhmi.org/biointeractive/living-dinosaurs-fact-or-fiction))
- For information on natural selection. (These pages include educator materials, student handouts, and graphing exercises to be used with the linked HHMI video resource, “The Origin of Species: The Beak of the Finch.” They are really cool – but some are pretty hard!):
  - [hhmi.org/biointeractive/natural-selection-and-evolution-darwins-finches](https://hhmi.org/biointeractive/natural-selection-and-evolution-darwins-finches)
  - [hhmi.org/biointeractive/evolution-action-data-analysis](https://hhmi.org/biointeractive/evolution-action-data-analysis)
  - [hhmi.org/biointeractive/sorting-finch-species](https://hhmi.org/biointeractive/sorting-finch-species)
  - [hhmi.org/biointeractive/beaks-tools-selective-advantage-changing-environments](https://hhmi.org/biointeractive/beaks-tools-selective-advantage-changing-environments)



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## New York State P–12 Science Learning Standards

- MS-LS1-4
- HS-LS2-2; HS-LS4-1; HS-LS4-2; and HS-LS4-4

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**WINTER 2021**

### **Museum Director**

Mark A. Schaming

### **Curator of Ornithology**

Dr. Jeremy J. Kirchman

### **Exhibition Planner**

Carrie Ross

### **Museum Educators**

James Jenkins & Hattie Langsford

### **Museum Editor**

Jessica Fisher Neidl

### **Graphic Designer**

Christopher Havens

### **Cover Photo**

*Terns, left to right: Caspian Tern juvenile and adult, Royal Tern adults in winter and summer plumage, Black Tern adult in summer, adult molting to winter plumage (in flight), and juvenile.*

Reproduction of original watercolor by  
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