Young Naturalists

Teachers Guide

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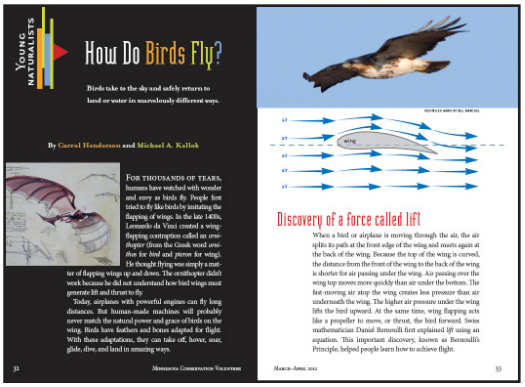
"How Do Birds Fly?" Multidisciplinary Classroom Activities

Teachers guide for the Young Naturalists article "How Do Birds Fly?" by Carrol Henderson and Michael Kallok. Published in the March-April 2012 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/bird_flight



Young Naturalists teachers guides are provided free of charge to classroom teachers, parents, and students. This guide contains a brief summary of the article, suggested independent reading levels, word count, materials list, estimates of preparation and instructional time, academic standards applications, preview strategies and study questions overview, adaptations for special needs students, assessment options, extension activities, Web resources (including related Minnesota Conservation Volunteer *articles), copy-ready study questions with answer key, and a copy-ready vocabulary sheet and vocabulary study cards. There is also a practice quiz (with answer key) in Minnesota Comprehensive Assessments format. Materials may be reproduced and/or modified to suit user needs. Users are encouraged to provide feedback through an online survey at www.mndnr.gov/education/teachers/activities/ynstudyguides/survey.html.*

New digital archives: All *Minnesota Conservation Volunteer* articles published since 1940 are now online in searchable PDF format. Visit *www.mndnr.gov/magazine* and click on *past issues*.

Summary

In "How Do Birds Fly?," readers will learn not only how birds fly, but also how human observation of birds led to the design of modern flying machines. A variety of avian adaptations for takeoff, flight and landing are described in text and photos. Teachers please note: Due to challenging vocabulary and physics concepts, this article is recommended for junior high through high school learners.

Suggested reading levels:	Seventh through high school grades
Total words:	1,570
Materials:	Feathers (may be purchased at craft stores or online; note that it is illegal to possess feathers of migratory birds except as permitted by regulations), paper, poster board, colored pencils, crayons, pens, markers, as well as print and online resources your media specialist may provide
Preparation time:	One to two hours, not including time for extension activities

Estimated instructional time: One or two 50-minute class periods (not including extensions)

Minnesota Academic Standards Applications: "How Do Birds Fly?" may be applied to the following Minnesota Department of Education standards:

Language Arts

Reading Benchmarks

Informational Text 6–12
- Key Ideas and Details
- Craft and Structure
- Integration of Knowledge and Ideas
- Range of Reading and Level of Text Complexity

Writing Benchmarks 6–12
- Text Types and Purposes
- Writing Process (6–12: Production and Distribution of Writing)
- Research to Build and Present Knowledge
- Range of Writing

Reading Benchmarks: Literacy in Science and Technical Subjects 6–12
- Key Ideas and Details
- Craft and Structure
- Integration of Knowledge and Ideas
- Range of Reading and Level of Text Complexity

Writing Benchmarks: Literacy in History/Social Studies, Science and Technical Subjects 6–12
- Text Types and Purposes
- Writing Process: Production and Distribution of Writing
- Research to Build and Present Knowledge
- Range of Writing

Science

Grade 7
- 7.4.3.2.3: Evolution in Living Systems

Grade 8
- 8.1.3.2.1; 8.1.3.3.3: The Nature of Science and Engineering

Grades 9–12
- 9.1.3.2.1; 9.1.3.4.1: The Nature of Science and Engineering
- 9.2.2.2.1; 9.2.2.2.3; 9.2.3.2.1: 9P.2.2.1.2; 9P.2.2.2.1: Physical Science

Arts

Grades K–12
1. Artistic Foundations: Visual Arts
2. Artistic Process: Create or Make: Visual Arts
3. Artistic Process: Perform or Present: Visual Arts
4. Artistic Process: Respond or Critique: Visual Arts

Current, complete Minnesota Academic Standards are available at *www.education.state.mn.us*. Teachers who find other connections to standards are encouraged to contact *Minnesota Conservation Volunteer*.

Preview

Bring a variety of feathers to class (see note in the Materials section) and pass them around. Encourage students to speculate on the nature of feathers. How do feathers help birds fly? Before students read the article, survey the photos. Follow with the **KWL** strategy (Ogle, 1986) to find out what your students already know **(K)** about birds and flight. You might begin by asking small groups to brainstorm their ideas. Then combine the groups' data to make a class list. Repeat step one by asking what students would like to learn **(W)**. As you read and discuss the article you will begin to compile the **(L)** list, or what they learn while reading the article and related materials and participating in extension activities. Display your **K** and **W** ideas on poster board or paper (see Vocabulary preview). See www.teachnology.com/web_tools/graphic_org/kwl for a KWL generator that will produce individual organizers for your students. KWL gives you the opportunity to introduce interdisciplinary connections you will make during extension activities. If you use the article in science or art class, you may wish to focus your prereading discussion on academic standards that apply for that class.

Another strategy for accessing prior knowledge is a brainstorming web. You may download a printable web at www.teachervision.fen.com/tv/printables/TCR/0743932080_007.pdf.

Vocabulary preview

See the copy-ready vocabulary list included in this guide. You may wish to modify the list based on your knowledge of your students' needs or the subject you are teaching. Pretesting vocabulary individually, in small groups, or with your entire class can be an effective vocabulary preview strategy. You may then post-test at the conclusion of this activity (see Assessment section below). Italicized words are not generally included on the list or in the study cards.

You may wish to use the study cards found at the end of this guide. Cut along the horizontal line, fold in the middle, and tape or staple. Study cards (see *Strategic Tutoring*, Hock, Deshler, and Schumaker 2000) can be applied to any subject area. On one side of the card, in large letters, write a key word or phrase students are expected to know. In smaller letters, frame the word or phrase in a question or statement. On the other side of the card, in large letters, write the answer to the question. Finally, in smaller letters, frame the answer in a question or statement. Blanks are provided to allow you or your students to add new words or phrases.

Study questions overview

Study questions parallel the story (the answer to the first question appears first in the article, followed by the second, and so on). Preview the entire guide with your class before you read the article. You may wish to read the story aloud and complete the study questions in class, in small groups, or as an independent activity. The questions may be assigned as homework, depending on the reading ability of your students. Inclusion teachers may provide more direct support to special needs students (see Adaptations section). The study questions may be also used as a quiz. Note: Items with an asterisk require varying degrees of critical thinking.

Adaptations

Read aloud to special needs students. Abbreviate the study questions or highlight priority items to be completed first. If time allows, remaining items may be attempted. Peer helpers, paraprofessionals, or adult volunteers may lend a hand with the study questions. With close teacher supervision, cooperative groups can also offer effective support to special needs students, especially for extension activities.

Assessment

You may use all or part of the study guide, combined with vocabulary, as a quiz. Other assessment ideas include: (1) Students may write an essay describing one or more of the main ideas in the article. For example, essays could focus on birds' physical adaptations, strategies for takeoff and landing, how human flying machines resemble birds, or the physical forces involved in flight. (2) Students may write multiple-choice, true-false, or short-answer questions. Select the best items for a class quiz. (3) Poster presentations may supplement or take the place of essays. Students may work in small groups with each group focusing on a different main idea. (4) Have students complete the main idea and supporting details activity found at www.teachervision.fen.com/tv/printables/scottforesman/Math_2_TTM_25.pdf. You or your students can select main ideas. If you wish to include more than two main ideas, use more than one sheet.

Extension activities

1. "The Nature of Feathers" (www.mndnr.gov/young_naturalists/feathers/index.html), a Young Naturalists article with teachers guide, is an excellent companion piece for "How Do Birds Fly?"
2. *Minnesota Conservation Volunteer* has published 16 Young Naturalists articles and hundreds of other articles about birds of Minnesota. See Related Articles. You may wish to challenge students to compare and contrast birds' adaptations, or to write/speak/illustrate how specific adaptations provide advantages with respect to the bird's habitat.
3. Birds are descendants of dinosaurs. Invite students to find links to information on how birds evolved from dinosaurs.
4. Learn more about da Vinci, Bernoulli, and the Wright brothers. How did they contribute to the development of human flight?
5. Birds are not the only animals that fly. See Web resources and related articles for information that students may use to better understand how other creatures fly. Do flying squirrels really fly?
6. How do birds navigate during migration? See "Who's That Navigator?" in Related articles and the other links in Web resources to learn more.

Web resources

Minnesota DNR
www.mndnr.gov/eco/nongame/index.html
www.mndnr.gov/birds/index.html
www.mndnr.gov/livingwith_wildlife/index.html

Bats of Minnesota
www.mndnr.gov/mammals/bats.html
www.mndnr.gov/rsg/profile.html

Flying Squirrels
www.mndnr.gov/mammals/flyingsquirrel.html
www.flyingsquirrels.com/

The Flight of Birds
van.physics.illinois.edu/qa/listing.php?id=760
www.thewildclassroom.com/biodiversity/birds/aviantopics/avianflightandlocomotion.html
wings.avkids.com/Book/Animals/intermediate/birds-01.html

The Flight of Bats
wings.avkids.com/Book/Animals/intermediate/bats-01.html
www.earthlife.net/mammals/bat-flight.html

The Flight of Insects
wings.avkids.com/Book/Animals/advanced/insects-01.html
park.org/Canada/Museum/insects/insects.html

Bird Evolution
www.thewildclassroom.com/biodiversity/birds/aviantopics/originandevolution.html
www.ucmp.berkeley.edu/diapsids/avians.html
www.ucmp.berkeley.edu/diapsids/pterosauria.html
www.kidcyber.com.au/topics/dinoreptiles.htm

Leonardo da Vinci, Daniel Bernoulli, and the Wright Brothers
www.mos.org/leonardo
www.drawingsofleonardo.org/images/fly1.jpg
www.ucmp.berkeley.edu/history/vinci.html
plus.maths.org/content/daniel-bernoulli-and-making-fluid-equation
www.videojug.com/expertanswer/fun-science-demonstrations/what-is-bernoullis-principle (includes video)
www.wright-house.com/wright-brothers/Wrights.html
www.nasm.si.edu/wrightbrothers/index_full.cfm

Bird Migration
www.npwrc.usgs.gov/resource/birds/migratio/
www.birds.cornell.edu/AllAboutBirds/studying/migration/
www.naturia.per.sg/buloh/birds/migration.htm
nationalzoo.si.edu/scbi/MigratoryBirds/Fact_Sheets/default.cfm?fxsht=9

Minnesota DNR Teacher Resources
www.mndnr.gov/education/teachers/index.html
www.mndnr.gov/dnrkids/index.html

*Note: All websites were active at the time of this guide's publication. However, some may no longer be active when this guide is accessed.

Related Articles

In addition to the related articles listed below, every *Minnesota Conservation Volunteer* article published since 1940 is now online in searchable PDF. See *webapps8.dnr.state.mn.us/volunteer_index* to access hundreds of articles about birds.

September–October 1992 through November–December 2011
Sixteen bird-related YN articles were published between 1992 and 2011. See www.mndnr.gov/young_naturalists/birds/index.html to access all 16.

July–August 1994
"Butterflies: Flying Flowers"
www.mndnr.gov/young_naturalists/butterflies/index.html (YN article)

July–August 1996
"Damsels and Dragons"
www.mndnr.gov/young_naturalists/dragons/index.html (YN article with teachers guide)

September–October 2007
"Who's that Navigator?"
www.mndnr.gov/young_naturalists/navigator/index.html (YN article with teachers guide)

References

Hock, M.F., Deshler, D.D., and Schumaker, J.B. *Strategic Tutoring.* Lawrence, Kan.: Edge Enterprises, 2000.
Ogle, D.S. K-W-L Group Instructional Strategy. In A.S. Palincsar, D.S. Ogle, B.F. Jones, and E.G. Carr (Eds.), *Teaching Reading as Thinking: Teleconference Resource Guide*, pp.11–17. Alexandria, Va.: Association for Supervision and Curriculum Development, 1986.

Study Questions

Teachers guide for the Young Naturalists article "How Do Birds Fly?" by Carrol Henderson and Michael Kallok. Published in the March-April 2012 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/bird_flight

1. People first tried to fly by hanging from huge kites. True False

2. Why didn't da Vinci's flying machine work? _____

_____

_____

3. When biologists talk about adaptations, what do they mean? _____

_____

_____

4. Explain how airflow over a wing creates lift. _____

_____

_____

5. A bird's wing flapping is like a _____ on an airplane.
It creates _____.

6. Match the bird species with its means of takeoff: hovering; beating wings; leaping

a. loon _____

b. bank swallow _____

c. egret _____

d. hummingbird _____

e. grouse _____

f. hawk _____

7. How does the force of the wind affect a loon's takeoff? _____

_____

_____

8. Describe how primary feathers differ from secondary feathers. _____

_____

_____

_____

9. How do a bird's tail movements affect flight? _____

_____

_____

10. Study the photos on page 38. Select two of the species pictured and explain how their wing adaptations increase their chances for survival. _____

_____

_____

11. What can airplane pilots learn from geese and ducks? _____

_____

_____

_____

12. What are alulas? How do they work? Name the part on an airplane wing that is like an alula. _____

_____

_____

_____

13. Large wings on a snowy egret are like _____.

14. Imagine a conversation between Leonardo da Vinci and Daniel Bernoulli about da Vinci's ornithopter. How might Bernoulli have helped da Vinci to design a flying machine that worked? _____

_____

_____

_____

Challenge: How do birds navigate to faraway places each year? _____

_____

_____

_____

Study Questions Answer Key

Teachers guide for the Young Naturalists article "How Do Birds Fly?" by Carrol Henderson and Michael Kallok. Published in the March-April 2012 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/bird_flight

*1. People first tried to fly by hanging from huge kites. True **False**

2. Why didn't da Vinci's flying machine work? **Da Vinci did not understand the physics of flight, or how birds' wings generate lift and thrust.**

*3. When biologists talk about adaptations, what do they mean? **Answers will vary. Adaptations are modifications in an organism's body (structure) or behavior that help them survive.**

4. Explain how airflow over a wing creates lift. **Air moves faster over the top of the wing than air moving under the wing, which creates a pressure difference. Higher pressure under the wing lifts the bird upward.**

5. A bird's wing flapping is like a **propeller** on an airplane. It creates **thrust**.

6. Match the bird species with its means of takeoff: hovering; beating wings; leaping a. loon **beating wings**,

b. bank swallow **leaping**, c. egret **leaping**, d. hummingbird **hovering**, e. grouse **beating wings**, f. hawk **leaping**

7. How does the force of the wind affect a loon's takeoff? **Taking off into the wind increases lift, thus decreasing the distance of the run across the water**.

*8. Describe how primary feathers differ from secondary feathers. **Primary feathers are longer and stiffer than secondary feathers. Primary feathers can be rotated to let air through, while secondary feather are fixed in a horizontal position. Secondary feathers are located closer to the bird's body, while primary feathers are on the outside half of the wing.**

9. How do a bird's tail movements affect flight? **When the tail is raised the bird rises. When the tail is lowered the bird descends. The tail also helps the bird slow down and turn left or right.**

*10. Study the photos on page 38. Select two of the species pictured and explain how their wing adaptations increase their chances for survival. **Answers will vary. Turkey vultures long, broad wings allow them to stay aloft for a long time looking for dead animals. A nighthawk's wings are adapted for quick movements, which help them catch insects. The greater prairie chicken's wings are cupped for quick takeoffs, enabling them to get away from predators. Indigo buntings also have wings adapted for quick takeoffs, but they are not cupped like the prairie chicken's, which helps them fly long distances. Hummingbird wings are shaped like oars. They can fly in any direction, even backwards.**

11. What can airplane pilots learn from geese and ducks? **Geese and ducks land into the wind, which helps them maintain lift even as they slow down. Airplane pilots do the same thing.**

12. What are alulas? How do they work? Name the part on an airplane wing that is like an alula. **Alulas are small, feathered projections located about halfway between the wing tip and body on the leading edge of a goose's wing. Alulas force air over the top of the wing, which helps maintain lift as the goose slows down to land. On airplanes the Handley Page slat acts like an alula.**

13. Large wings on a snowy egret are like **parachutes**.

*14. Imagine a conversation between Leonardo da Vinci and Daniel Bernoulli about da Vinci's ornithopter. How might Bernoulli have helped da Vinci to design a flying machine that worked? **Answers will vary. Bernoulli could have explained how lift is created. He could have helped da Vinci design a wing that created lift. Airplane wings do not flap like bird wings. Could Bernoulli have helped overcome the issue of thrust? We don't know, but a machine with flapping wings, even if correctly designed for lift, most likely would have stayed on the ground. Perhaps they could have designed a successful glider.**

*Challenge: How do birds navigate to faraway places each year? **Answers will vary. How birds navigate is still a mystery. See extension activity 6 to learn more.**

*question involves critical thinking

Minnesota Comprehensive Assessments Practice Items

Teachers guide for the Young Naturalists article "How Do Birds Fly?" by Carrol Henderson and Michael Kallok. Published in the March-April 2012 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/bird_flight

Name _____Period _____Date_____

1. How do robins avoid crashes when they land in trees?
   A. They use their large wings like parachutes.
   B. They somersault three times to slow down.
   C. They pull their bodies and wings into an upright position.
   D. They first land on the ground and then climb the tree.

2. Pelicans have wings similar to
   A. indigo buntings.
   B. ospreys.
   C. grouse.
   D. none of the above.

3. How does a tern use its tail to help it migrate?_____
_____

4. Loons run across the water in order to
   A. take off.
   B. escape predators.
   C. catch prey.
   D. mate with other loons.

5. Daniel Bernoulli was the first person to explain the physics of thrust.
   A. True
   B. False

Minnesota Comprehensive Assessments Answer Key

Teachers guide for the Young Naturalists article "How Do Birds Fly?" by Carrol Henderson and Michael Kallok. Published in the March-April 2012 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/bird_flight

1. How do robins avoid crashes when they land in trees? **C. They pull their bodies and wings into an upright position**.
2. Pelicans have wings similar to **B. ospreys**.
3. How does a tern use its tail to help it migrate? **A tern can fold its tail back, reducing drag, which saves energy on its long migratory flights.**
4. Loons run across the water in order to **A. take off**.
5. Daniel Bernoulli was the first person to explain the physics of thrust. **B. False. Bernoulli explained lift**.

Vocabulary

Teachers guide for the Young Naturalists article "How Do Birds Fly?" by Carrol Henderson and Michael Kallok. Published in the March-April 2012 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/bird_flight

adaptation	change over generations in structure and/or behavior that increases a living thing's chances of survival
angular	thin, sharply defined; having an angle
horizontal	parallel to the horizon
hover	float in the air; fly in place
migratory	moving to another region and back every year
predator	animal that kills and eats other animals

Vocabulary Study Cards

Teachers guide for the Young Naturalists article "How Do Birds Fly?" by Carrol Henderson and Michael Kallok. Published in the March-April 2012 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/bird_flight

Cut along the horizontal lines, fold in the middle and tape or staple. Blanks are provided to allow you or your students to add new words or phrases.

What is **adaptation**?	FOLD HERE	**Change over generations in structure and/or behavior that increases a living thing's chances of survival** is called
Angular wings are wings that are	FOLD HERE	Wings that are **thin and sharply defined, and that have an angle** are described as
When a bird's or plane's flight is **horizontal** it is	FOLD HERE	When a bird or plane flies **parallel to the horizon** it is
To **hover** is to	FOLD HERE	To **float in the air or fly in place** is to

A
migratory
bird

FOLD HERE

A bird that
moves to another region and back every year
is

A
predator
is

FOLD HERE

an animal that kills and eats other animals
is a

FOLD HERE

FOLD HERE