

Teachers Guide

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“The Greatest of Feet” Multidisciplinary Classroom Activities

Teachers guide for the Young Naturalists article “The Greatest of Feet” by Mary Hoff. Published in the January–February 2011 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/feet.

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 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 a to suit user needs. Users are encouraged to provide feedback through an online survey at www.mndnr.gov/education/teachers/activities/ynstudyguides/survey.html. If you are downloading articles from the website, please note that only Young Naturalists articles are available in PDF.

Summary

In “The Greatest of Feet,” readers learn the similarities of different kinds of vertebrate feet and how feet are adapted to unique characteristics of habitats. Topics include sticky feet (treefrogs), heel-toe walkers (bear), hoofed feet (ungulates), toe-walkers (dogs, cats and birds), tool feet (bats, opossum, raptors, fox, badger), groomers (barn owls, herons, nighthawks, and beavers) and paddlers (ducks, geese, and beavers). The article concludes with a brief description of the physiology of warm feet in cold weather. *This article gives the teacher an excellent opportunity to introduce or reinforce the concept of adaptation as an evolutionary process.*

Suggested reading levels:
Total words:

Intermediate through middle/junior high school grades
1,029

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Materials: 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: “The Greatest of Feet” may be applied to the following Minnesota Department of Education standards:

Language Arts

- I. Reading and Literature
 - A. Word Recognition, Analysis and Fluency
 - B. Vocabulary Expansion
 - C. Comprehension

II. Writing

- A. Types of Writing
- B. Elements of Composition
- C. Spelling
- D. Research
- E. Handwriting and Word Processing

III. Speaking, Listening and Viewing

- A. Speaking and Listening
- B. Media Literacy

Science

Life Science

Grades 3, 5

- 3.4.1. Structure and Function in Living Organisms
- 5.4.1 Structure and Function in Living Organisms

Grades 3, 7

- 3.4.3. Evolution in Living Systems
- 7.4.3 Evolution in Living Systems

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

** Language Arts standards were undergoing a major revision at the time this article was published. Format and content will change significantly. 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 Your preview will depend on how you apply the content to the standards. For example, if you are reading the article in science you may ask students to survey the article. Examine the photographs and illustrations. Use the **KWL** strategy (Ogle, 1986) to find out what your students already know (**K**) about the animal feet in the article, what they would like to learn (**W**), and eventually what they learned (**L**) while reading the article and related materials, and through participating in extension activities. You might begin by asking small groups to brainstorm their ideas. Then combine the groups’ data to make a class list. Display your

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Preview continued K and W ideas on poster board or paper (see Vocabulary preview). Add to your L list as you read and discuss the article. See www.teach-nology.com/web_tools/graphic_org/kwl for a KWL generator that will produce individual organizers for your students. Individual organizers may be useful as students read the article for answers to W questions. KWL also gives you the opportunity to introduce interdisciplinary connections you will make during extension activities. If you use the article in an art class you may wish to focus your prereading discussion on the shape of animal feet and how the shape relates to function.

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). Pay particular attention to words in italics. Definitions are provided in the text.

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 that 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 4, 5, 9, and 14 and the Challenge 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 retell the story from Louie’s and/or George’s point of view in an essay. Require a beginning, middle, and end. You may also require a minimum number of words. (2) Students may submit multiple-choice, true-false, and short answer questions. The best items may be selected for a class quiz. (3) Poster presentations, including songs, may depict one or more scenes from the story. Students may work in groups or individually. (4) If you use “George and the Voyageurs” (See Extension activities), you may wish to use some assessment activities for that story.

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Extension activities

1. Invite a DNR nongame and/or wildlife biologist to visit your classroom to present information about the Minnesota birds and animals in this article. See <http://www.dnr.state.mn.us/eco/nongame/index.html> and <http://www.dnr.state.mn.us/fishwildlife/index.html>.
2. Take a field trip to a state park, school forest, local zoo, or scientific and natural area (SNA) for a wildlife-watching adventure. State park naturalists are eager to custom-design learning experiences to meet state and local academic standards. See <http://www.dnr.state.mn.us/snas/index.html> and http://www.dnr.state.mn.us/nature_viewing/index.html.
3. Several articles in the Related Articles section contain excellent photos and illustrations of feet in this article. Read these articles to expand students’ understanding of concepts featured in “The Greatest of Feet.”
4. Challenge students to learn more about animal adaptations. See Web resources. Adaptations can be related to climate change as animals extend their range to find food or favorable weather conditions.
5. Challenge students to find examples of other animals to fit the three foot types. Perhaps a class poster could illustrate each group. See Web resources for some excellent links to animal tracks graphics and activities.
6. Ask students to imagine a habitat and design a foot to fit that habitat. Groups or individuals may then present to others explaining why they chose the adaptations they did.
7. If you are teaching this article in winter take advantage of snow to go on a tracking expedition. Students may keep a journal, make sketches, or take photographs of tracks, which can then be categorized by foot design.

Web resources

Minnesota DNR

<http://www.dnr.state.mn.us/eco/nongame/index.html>
<http://www.dnr.state.mn.us/snas/index.html>
http://www.dnr.state.mn.us/nature_viewing/index.html

Animal Adaptations

http://www.uen.org/utahlink/activities/view_activity.cgi?activity_id=4750
<http://www.cotf.edu/ete/modules/msese/earthsysflr/adapt.html>
http://www.ecokids.ca/pub/eco_info/topics/climate/adaptations/index.cfm

Animal Feet Adaptations

http://www.brandywinezoo.org/games/animal_feet.pdf
<http://www.eduplace.com/kids/hmsc/activities/simulations/gr3/unitb.html>
http://animaldiversity.ummz.umich.edu/site/topics/mammal_anatomy/running_fast.html

Animal Feet Activities

http://www.aliceforteachers.org/animal_feet.htm
http://www.aliceforteachers.org/animal_agenda.htm

Animal Tracks

<http://www.bear-tracker.com/mammals.html>
<http://www.daniellesplace.com/images/animalprintssheet.gif>
<http://kaweahoaks.com/html/extras3.htm>
http://www.amug.org/~jbpratt/education/theme/animals/animals.html#Animal_Tracking
<http://42explore.com/animaltracks.htm>

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Web resources continued

Minnesota DNR Teacher Resources

www.mndnr.gov/education/teachers/index.html

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

Related articles

Related *Minnesota Conservation Volunteer* Young Naturalists articles are available online at www.mndnr.gov/volunteer/articles/index.html, including:

January–February 1995

“What’s Making that Racket?” (YN article with great photo of feet)

http://www.dnr.state.mn.us/young_naturalists/woodpeckers/index.html

September–October 1996

“Oh, Deer!” (YN article with teachers guide with life size tracks)

http://www.dnr.state.mn.us/young_naturalists/deer

November–December 1998

“Chickens that Wear Snowshoes” (YN article)

http://www.dnr.state.mn.us/young_naturalists/grouse/index.html

March–April 1998

“Ducks that Dabble or Dive for Dinner” (YN article)

http://www.dnr.state.mn.us/young_naturalists/ducks/index.html

March–April 2001

“Whoooo’s Watching?” (YN article)

http://www.dnr.state.mn.us/young_naturalists/owladventures/index.html

May–June 2001

“Six Slippery Salamanders” (YN article with teachers guide)

http://www.dnr.state.mn.us/young_naturalists/salamanders/index.html

January–February 2003

“Minnesota is Hopping with Hares” (YN article with teachers guide with great photo)

http://www.dnr.state.mn.us/young_naturalists/hares_rabbits/index.html

May–June 2003

“The Slinky, Stinky Weasel Family” (YN article with teachers guide)

http://www.dnr.state.mn.us/young_naturalists/weasels/index.html

March–April 2006

“The Hole Story” (YN article with teachers guide)

http://www.dnr.state.mn.us/young_naturalists/cavity_nesters/index.html

July–August 2007

“Hoot, Tremolo, Yodel and Wail” (YN article on Loons with teachers guide)

http://www.dnr.state.mn.us/young_naturalists/loons/index.html

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.

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Study Questions

Teachers guide for the Young Naturalists article “The Greatest of Feet” by Mary Hoff. Published in the January–February 2011 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/feet.

1. List three parts of feet that different animals walk on. _____

2. Why do arboreal frogs need sticky feet? _____

3. What is mucus, and how does it help frogs? _____

4. How are your feet are similar to a bear’s feet? How are they different? _____

5. Name an animal that walks on keratin. What advantage does keratin offer? _____

6. How does a deer’s feet help it move through mud or snow? _____

7. What part of their feet do digitigrade animals walk on? _____ What advantage does it offer?

8. Why do cats keep their claws hidden most of the time? _____

9. Explain how chickadees, woodpeckers, and owls use their toes in different ways. _____

10. List four ways feet can be used as tools, and name an animal for each. _____

11. How do peregrine falcons use their feet as tools? _____

12. How does countercurrent exchange help ducks survive? _____

13. How are a wolf's claws different than cat's claws? _____

14. Find the photos in the bottom right corner on page 39. Is the picture of the raven's right or left foot? How can you tell? _____

Challenge: If you could trade feet with an animal, which feet would you choose? Why? _____

Study Questions Answer Key

Teachers guide for the Young Naturalists article “The Greatest of Feet” by Mary Hoff. Published in the January–February 2011 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/feet.

1. List three parts of feet that different animals walk on. **Animals walk on their toenails, toes and the soles of their feet.**
2. Why do arboreal frogs need sticky feet? **A frog’s feet help them hang onto surfaces.**
3. What is mucus, and how does it help frogs? **Mucus is a slimy, sticky secretion that many animals, including humans, produce. It helps a frog cling to surfaces by keeping its feet sticky.**
4. How are your feet similar to a bear’s feet? How are they different? **Bears and humans both walk on the soles of their feet. Bears have much longer, thicker, and sharper toenails than humans.**
5. Name an animal that walks on keratin. What advantage does keratin offer? **Deer (any ungulate will do) walk on keratin. New keratin keeps growing to replace old, worn-out keratin, so it keeps the deer’s feet in good shape.**
6. How does a deer’s feet help it move through mud or snow? **The deer’s toes spread out, giving it good traction.**
7. What part of their feet do digitigrade animals walk on? **They walk on their toes. What advantage does it offer? It gives them spring when they move up or forward.**
8. Why do cats keep their claws hidden most of the time? **They keep their claws hidden to keep them sharp. If they touched the ground when cats walked or ran the claws would wear down and become dull.**
9. Compare and contrast chickadee, woodpecker, and owl toes. **All three birds have four toes. Chickadees have three toes in front and one in back. Woodpeckers have two toes in front and two in back, and owls can move one toe from front to back.**
10. List four ways feet can be used as tools, and name an animal for each. **Some animals use feet for clinging or grasping. Bats can hang upside down and opossum have thumbs on their hind feet. Birds can perch on branches. Hawks and owls can catch their prey with their feet. Other animals, like foxes and badgers use their feet to dig holes in the earth. A third group, which includes barn owls and beavers, use claws as grooming tools. Finally, some animals, like ducks and geese use their webbed feet as paddles.**
11. How do peregrine falcons use their feet as tools? **Peregrine falcons use their feet in two ways. They close their talons into a fist to hit their prey and then they open their talons to grasp the stunned animal.**
12. How does countercurrent exchange help ducks survive? **Countercurrent exchange helps ducks keep their feet warm in very cold water.**
13. How are a wolf’s claws different from a cat’s claws? **A wolf’s claws touch the ground as it walks or runs, so its claws are worn down. A cat’s claws do not touch the ground as it walks, so its claws stay sharp.**
14. Find the photos in the bottom right corner on page 39. Is the picture of the raven’s right or left foot? **Left** How can you tell? **The middle toe points to the right.**

Challenge: If you could trade feet with an animal, which feet would you choose? Why? **Responses will vary. Students should justify their choice with an adaptive advantage the animal’s feet would offer.**

Minnesota Comprehensive Assessments Practice Items

Teachers guide for the Young Naturalists article “The Greatest of Feet” by Mary Hoff. Published in the January–February 2011 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/feet.

1. Which animal has heating pads in its feet?
 - A. tree frogs
 - B. wolves
 - C. peregrine falcons
 - D. none of the above.

2. Which animals have an odd number of toes?
 - A. zebras
 - B. horses
 - C. rhinos
 - D. all of the above

3. Why do you suppose woodpeckers have two toes in front and two in back? _____

4. How do some birds use their pectinate claw?
 - A. to grasp prey
 - B. to paddle in water
 - C. to perch on branches
 - D. to groom themselves

5. Why does a lynx have fur between its toes?
 - A. to keep their feet warm
 - B. to help them walk on snow
 - C. to keep them from getting blister
 - D. A and B

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Minnesota Comprehensive Assessments Answer Key

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1. Which animal has heating pads in its feet? **B. wolves**
2. Which animals have an odd number of toes? **D. all of the above**
3. Why do you suppose woodpeckers have two toes in front and two in back?
To help them cling to trees. To give them a strong base for pecking.
4. How do some birds use their pectinate claw? **D. to groom themselves**
5. Why does a lynx have fur between its toes? **D. A and B**

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Vocabulary

Teachers guide for the Young Naturalists article “The Greatest of Feet” by Mary Hoff. Published in the January–February 2011 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/feet.

cloven	split in two
digitigrade	walking on toes
habitat	home environment
keratin	key component of hair and nails
locomotion	refers to movement or travel
mucus	slimy secretion
pectinate claw	claw with serrated edge, used in grooming
plantigrade	walking on the soles of the feet
unguligrade	walking on hooves

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Vocabulary Study Cards

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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.

A **cloven**
hoof is

FOLD HERE

A hoof that is
split in two is

Digitigrade animals
are animals that

FOLD HERE

Animals that
walk on their toes are

An animal’s
habitat is its

FOLD HERE

An animal’s **home**
environment is its

What is
keratin?

FOLD HERE

The **key material**
in hair and
nails is

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What is
locomotion?

FOLD HERE

A word that means
movement or travel is

What is
mucus?

FOLD HERE

A **slimy secretion**
is called

The **pectinate**
claw is a

FOLD HERE

Some birds have a **claw with a**
serrated edge used in grooming
that is called the

Plantigrade
animals

FOLD HERE

Animals that
walk on the soles of their feet
are called

Unguligrade
animals

FOLD HERE

Animals that
walk on hooves
are called

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FOLD HERE

FOLD HERE

FOLD HERE

FOLD HERE

FOLD HERE