Young Naturalists

Teachers Guide

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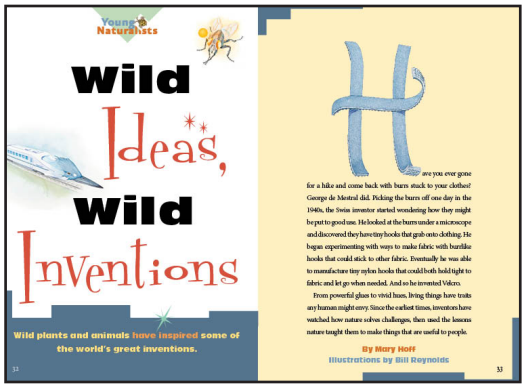
"Wild Ideas, Wild Inventions" Multidisciplinary Classroom Activities

Teachers guide for the Young Naturalists article "Wild Ideas, Wild Inventions" by Mary Hoff. Published in the September–October 2011 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/wild_ideas.



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 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

Plants or animals in the wild have inspired many modern-day inventions. Readers will learn about how nature played a part in the development of Velcro, aspirin, paper, the first successful flying machine, the bullet train, and more. This article will be a welcome addition to your science and engineering curriculum.

Suggested reading levels:	intermediate through middle/junior high school grades
Total words:	1,103
Materials:	Examples or photos of the inventions in the article, velcro, magnifying glasses, 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:

"Wild Ideas, Wild Inventions" may be applied to the following Minnesota Department of Education standards:

Language Arts

Reading Benchmarks

Informational Text K–5; 6-12
- Key Ideas and Details
- Craft and Structure
- Integration of Knowledge and Ideas
- Range of Reading and Level of Text Complexity

Foundational Skills K–5
- Phonics and Word Recognition
- Fluency

Writing Benchmarks K–5; 6–12
- Text Types and Purposes
- Writing Process (6–12: Production and Distribution of Writing)
- Research to Build and Present Knowledge
- Range of Writing

Speaking, Viewing, Listening and Media Literacy Benchmarks K–5
- Comprehension and Collaboration
- Presentation of Knowledge and Ideas
- Media Literacy

Language Benchmarks K–5
- Conventions of Standard English
- Knowledge of Language
- Vocabulary Acquisition and Use

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

Social Studies

Grades 4–8
- World History: III, E, 4, 4 (Students will demonstrate knowledge of scientific, political, economic and social changes starting in the 17th Century, including the Enlightenment.)

Science

Grade 3
- 3.1.3.2.1: Interactions Among Science, Technology Engineering, Mathematics, and Society
- 3.4.1.1.1: Structure and Function in Living Systems
- 3.4.3.2.2: Evolution in Living Systems

Grade 4
- 4.1.2.2.1; 4.1.2.2.2; 4.1.1.1.3: The Practice of Engineering
- 4.1.3.3.1: Interactions Among Science, Technology Engineering, Mathematics, and Society

Grade 5
- 5.1.3.2.1: Interactions Among Science, Technology Engineering, Mathematics, and Society
- 5.4.1.1.1: Structure and Function in Living Systems
- 5.4.2.1.2: Interdependence Among Living Systems

Grade 6
- 6.1.2.1.1: The Practice of Engineering
- 6.2.3.2.2: Energy

Minnesota Academic Standards Applications continued:

Grade 7
7.4.3.2.3: Evolution in Living Systems

Grade 8
8.1.3.3.3: Interactions Among Science, Technology, Engineering, Mathematics and Society

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

Before students survey the article, pass around enough pieces of Velcro and magnifiers so pairs of students can examine them closely. Ask students to imagine what inspired this invention and hint that the inspiration came from the plant kingdom. You may also use the **KWL** strategy (Ogle, 1986) to find out what your students already know **(K)** about inventions based on designs in nature, 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 **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, which may be used to record 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 math, 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 *http://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).

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 2, 4, 6, 7, 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 write an essay describing one or more of the inventions in the article. (2) Students may write multiple-choice, true-false, or short-answer questions. Select the best items for a class quiz. (3) Poster presentations may display one of the inventions and the plant or animal that inspired it. (4) Do all of the nine inventions described in the article use the plant or animal adaptations in the same or similar manner as the plant or animal does? Challenge your students to make this analysis in a short essay.

Extension activities

1. Invite your students to take the Youth Challenge at the website on page 39 (biomimicryinstitute.org/education/k-12/biomimicry-youth-challenge.html).
2. See Web Resources for links to the inventors and/or inventions described in the article. Challenge your students to expand and to share their knowledge in written or poster presentations.
3. "Damsels and Dragons," a Young Naturalists article with teachers guide, is a good companion piece for "Wild Ideas, Wild Inventions."
4. Invite an engineer or inventor to your classroom to talk about product development and the creative process. See: www.mnstudentinventors.org/ (Minnesota Student Inventors Congress).
5. Use this article in your life science unit on evolution to explore how plants and animals adapt to environmental conditions.

Web resources

Biomimicry
biomimicryinstitute.org
www.ted.com/talks/robert_full_learning_from_the_gecko_s_tail.html

Inventors Organizations
www.mnstudentinventors.org
www.minnesotainventorscongress.org
www.invent.org/hall_of_fame/1_0_0_hall_of_fame.asp

Inventors and Inventions
www.enchantedlearning.com/inventors
www.kyrene.org/schools/brisas/sunda/inventor/main.htm

VELCRO
www.velcro.com/index.php?mact=News,cntnt01,detail,0&cntnt01articleid=3&cntnt01origid=64&cntnt01returnid=245

Web resources continued

Aspirin
www.ncbi.nlm.nih.gov/pubmedhealth/PMH0000802
www.ncbi.nlm.nih.gov/pubmed/10763200

Paper
www.fcgov.com/recycling/pdf/history-papermaking.pdf

Airplanes
www.ueet.nasa.gov/StudentSite/historyofflight.html
www.loc.gov/exhibits/treasures/wb-timeline.html

Bullet Trains
www.railway-technology.com/features/feature1216
www.time.com/time/nation/article/0,8599,1892463,00.html
www.history.com/videos/high-speed-french-train-takes-on-japans-bullet-train#high-speed-french-train-takes-on-japans-bullet-train (video)

Solar Panels
www.biomimicrynews.com/research/Insect_eyes_inspire_improved_solar_cells.asp

Wetlands
www.dnr.state.mn.us/wetlands/index.html
www.floatingislandinternational.com/
www.npwrc.usgs.gov/resource/plants/mnplant/index.htm

Woodpeckers
creagrus.home.montereybay.com/woodpeckers.html
www.mnzoo.com/animals/animals_pwoodpecker.asp
www.wvdnr.gov/Wildlife/Woodpecker.shtm
juneauempire.com/stories/101609/out_505488033.shtml

Super-Water-Repellent Fabric
www.youtube.com/watch?v=9CFNleAxw9E (video)
thefutureofthings.com/news/1097/super-water-repellent.html

Dragonflies and Biomimicry
www.asknature.org/strategy/51b1ad882ccc3fce497b5ac6d493ef41

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

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.

September-October 1960
"State Birds–The Belted Kingfisher"
webapps8.dnr.state.mn.us/volunteer_index/past_issues/article_pdf?id=3303

March-April 1990
"Our Wetlands"
webapps8.dnr.state.mn.us/volunteer_index/past_issues/article_pdf?id=1152

January-February 1995
"What's Making a Racket?" (YN article)
www.dnr.state.mn.us/young_naturalists/woodpeckers/index.html

July-August 1996
"Damsels and Dragons"
www.dnr.state.mn.us/young_naturalists/dragons/index.html (YN article with teachers guide)

March-April 1998
"Minnesota Ducks that Dabble or Dive for Dinner"
www.dnr.state.mn.us/young_naturalists/ducks/index.html (YN article)

January-February 2004
"The Nature of Feathers"
www.dnr.state.mn.us/young_naturalists/feathers/index.html (YN article with teachers guide)

March-April 2006
"The Hole Story"
www.dnr.state.mn.us/young_naturalists/cavity_nesters/index.html (YN article with teachers guide)

November-December 2006
"Wild Engineers"
www.dnr.state.mn.us/young_naturalists/wild_engineers/index.html (YN article with teachers guide)

May-June 2007
"Ants"
www.dnr.state.mn.us/young_naturalists/ants/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 "Wild Ideas, Wild Inventions" by Mary Hoff. Published in the September–October 2011 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/wild_ideas.

Name _____Period _____Date_____

1. What did George de Mestral invent? _____ Explain what inspired his invention. _____

_____

_____

_____.

2. Who was Hippocrates? _____

What does he have in common with Native Americans? _____

_____

3. Close observation of _____ led Cai Lun to invent _____.

4. Leonardo da Vinci and the Wright brothers have something in common. What is it? _____

_____

_____

5. What is Eiji Nakatsu famous for? _____

_____

6. The next time you see a common housefly what might you think of? _____

Why? _____

_____

_____

7. Explain how Bruce Kania is helping clean up the environment. _____

_____

_____

8. List some products woodpeckers are inspiring engineers to develop. _____

_____

_____

_____

9. Ducks feathers are composed of tiny _____. What product is designed like a duck's feathers? _____

10. Match the invention with the animal or plant that inspired it.

Invention	**Inspiration**
football helmet _____	a. willow
airplane _____	b. wasp
waterproof fabric _____	c. woodpecker
bullet train _____	d. kingfisher
nitrogen and phosphorus absorber _____	e. burr
Velcro _____	f. duck
paper _____	g. fly
solar panel _____	h. wetland plants
aspirin _____	i. bird

Challenge: What animal inspired the design of the helicopter? Justify your answer. _____

_____

_____

_____

_____

_____

Study Questions Answer Key

Teachers guide for the Young Naturalists article "Wild Ideas, Wild Inventions" by Mary Hoff. Published in the September–October 2011 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/wild_ideas.

1. What did George de Mestral invent? **Velcro** Explain what inspired his invention. **He noticed that the burrs had tiny hooks that stuck to the fabric of his clothing. He used this observation to create a product with nylon hooks, similar to those on burrs, that could attach to and release from fabric.**

2. Who was Hippocrates? **Hippocrates was a physician (medical doctor) in ancient Greece.** What does he have in common with Native Americans? **Both Hippocrates and Native Americans observed that chewing willow leaves relieved pain.**

3. Close observation of **wasps** led Cai Lun to invent paper.

4. Leonardo da Vinci and the Wright brothers have something in common. What is it? **They were both interested in flying machines and observed the design of birds' wings.**

5. What is Eiji Nakatsu famous for? **He designed a nose for the bullet train in Japan that was modeled on a kingfisher's beak. Nakatsu's design helped the train run more quietly and efficiently.**

6. The next time you see a common housefly what might you think of? **Solar panels**

Why? **A fly's eyes are composed of many tubes that allow the fly to capture more light than a single eyeball can. This idea is helping engineers design more efficient solar panels.**

7. Explain how Bruce Kania is helping clean up the environment. **He designed a kind of floating wetland from recycled plastic that he can put in lakes or ponds to clean up chemicals like nitrogen or phosphorus.**

8. List some products woodpeckers are inspiring engineers to develop. **Woodpeckers have four structures in their heads and beaks that absorb shock. Football helmets, race cars and spacecraft are using these designs to help prevent damage.**

9. Ducks feathers are composed of tiny scales. What product is designed like a duck's feathers? A super water-repellent fabric has been designed using duck feathers as its inspiration.

10. Match the invention with the animal or plant that inspired it.

Invention Inspiration

football helmet **c**

airplane **i**

waterproof fabric **f**

bullet train **d**

nitrogen and phosphorus absorber **h**

Velcro **e**

paper **b**

solar panel **g**

aspirin **a**

Challenge: What animal inspired the design of the helicopter? Justify your answer. **The helicopter is designed like a dragonfly or damselfly. It can hover, fly up, down, forward and backward. It is also shaped like a dragonfly or damselfly. See "Damsels and Dragons" under related articles.**

Minnesota Comprehensive Assessments Practice Items

Teachers guide for the Young Naturalists article "Wild Ideas, Wild Inventions" by Mary Hoff. Published in the September–October 2011 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/wild_ideas.

Name _____Period _____Date_____

1. Which animal described in the article has a springlike support for its tongue?
   A. wasp
   B. duck
   C. woodpecker
   D. kingfisher

2. Researchers in Hong Kong and Minnesota created
   A. waterproof fabric
   B. paper
   C. Velcro
   D. none of the above

3. Why do some inventors closely observe nature?

_____

_____

_____

4. Wetland plants soak up _____ and _____.
   A. oxygen and nitrogen
   B. phosphorus and oxygen
   C. nitrogen and phosphorus
   D. water and air

5. Acetylsalicylic acid is the main ingredient in
   A. Velcro
   B. aspirin
   C. paper
   D. solar panels

Minnesota Comprehensive Assessments Answer Key

Teachers guide for the Young Naturalists article "Wild Ideas, Wild Inventions" by Mary Hoff. Published in the September–October 2011 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/wild_ideas.

1. Which animal described in the article has a springlike support for its tongue? **C. woodpecker**
2. Researchers in Hong Kong and Minnesota created **A. waterproof fabric**
3. Why do some inventors closely observe nature? **Answers may vary, but should include the idea that plants and animals have solved difficult problems in unique ways. People can use plant and animal adaptations for developing products and tools to solve human problems.**
4. Wetland plants soak up **C. nitrogen and phosphorus.**
5. Acetylsalicylic acid is the main ingredient in **B. aspirin.**

Vocabulary

Teachers guide for the Young Naturalists article "Wild Ideas, Wild Inventions" by Mary Hoff. Published in the September–October 2011 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/wild_ideas.

aloft	high above the ground; in flight
hues	colors
mimic	imitate
nutrient	chemical an organism needs to live
nylon	synthetic fabric intended to replace silk
phosphorus	a chemical element plants need to grow
physician	medical doctor
water repellent	able to resist or keep out water
nitrogen	chemical element that is found in the air and also used in fertilizer
solar panel	an object that collects light from the sun to make electrical energy

Vocabulary Study Cards

Teachers guide for the Young Naturalists article "Wild Ideas, Wild Inventions" by Mary Hoff. Published in the September–October 2011 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/wild_ideas.

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 does **aloft** mean?	FOLD HERE	A bird **high above the ground, especially in flight**, is
Hues are	FOLD HERE	Another word for **colors** is
To **mimic** is to	FOLD HERE	To **imitate** is to
What is a **nutrient**?	FOLD HERE	A **chemical an organism needs to live** is a

What is **nylon?**	A **synthetic fabric intended to replace silk** is
What is **phosphorus?**	**A chemical element plants need to grow** is called
A **physician** may also be called a	A **medical doctor** may also be called a
If a fabric is **water repellent** it	If a fabric **resists or keeps out water**, it is
What is **nitrogen?**	**A chemical element that is found in the air and also used in fertilizer** is called

FOLD HERE

A
solar panel

FOLD HERE

What **collects light from the sun to make electrical energy?**

FOLD HERE

FOLD HERE

FOLD HERE

FOLD HERE