

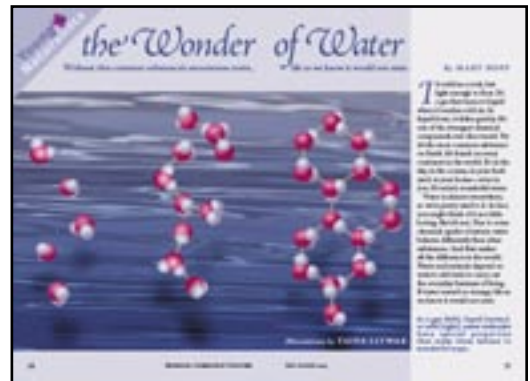
Teachers Guide

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“The Wonder of Water!” Multidisciplinary Classroom Activities

Teachers guide for the Young Naturalists article “The Wonder of Water” by Mary Hoff. Illustrations by Taina Litwak. Published in the July–August 2005 *Minnesota Conservation Volunteer*, or visit www.dnr.state.mn.us/young_naturalists/water.

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. There is also a practice quiz 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.dnr.state.mn.us/education/teachers/activities/ynstudyguides/survey.html.



Summary

“The Wonder of Water” provides excellent fundamental science information about the most basic necessity of life, water. Topics include molecular structure, phases, the water cycle, cohesion, adhesion, capillary action, surface tension, density, heat capacity, and solvency. Text is supplemented with illustrations of key concepts and suggested activities that demonstrate water’s unique properties.

Suggested reading levels:

third through middle grades

Total words:

1,804

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Materials: Paper, poster board, pencils, pens, markers, and print resources from your media center; magnets; and items (containers, pie tins, burners, celery stalks, food coloring, sugar, vegetable oil) to perform the activities suggested in the article.

Preparation time: One to two hours, not including time for extension activities

Estimated instructional time: Two 50-minute class periods (not including extensions)

Minnesota Academic Standards applications: “The Wonder of Water” may be applied to the following Minnesota Department of Education Academic Standards:

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

Social Studies

V. Geography Grades 4–8

- A. Concepts of Location
- B. Maps and Globes
- C. Physical Features and Processes
- D. Interconnections

Science

Grade 5

- A. History and Nature of Science, Scientific Inquiry

- B. Earth and Space Science, Earth Structure and Processes

Grade 6

- A. Physical Science: Structure of Matter, Chemical Reactions and Energy Transformations

Grade 7

- A. History and Nature of Science, Scientific Inquiry
- B. Life Science: Interdependence of Life and Flow of Energy and Matter

Grade 8

- A. History and Nature of Science, Scientific Inquiry
- B. Earth and Space Science: Earth Structure and Processes (students will investigate the impact humans have on the environment), the Water Cycle, Weather and Climate, and the Universe

Arts: Artistic Expression: Visual Arts

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

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Preview Begin your preview with a water KWL (Ogle, 1986). Use the KWL strategy to find out what your students already know (K) about water, what (W) they would like to learn, and eventually, what they learned (L) while reading the article and related materials and through participating in extension activities. Display your K and W ideas on poster board or paper (see Vocabulary preview, below). Add to your L list as you read and discuss the article. See www.teach-nology.com/web_tools/graphic_org/kwl.

Next, allow students time to skim the article before reading. Ask them to highlight the italicized words. These are the key concepts and should be discussed before reading. Perhaps some of these terms are included in your K list. If students are not familiar with some of the terms, include them in the W list. Eventually, these terms can be moved to the L list.

Vocabulary preview Vocabulary demands of “The Wonder of Water” are considerable. Therefore, you may wish to review the attached list and italicized words in the story, and add other words based on your students’ needs. Many connections to vocabulary in the article may be made during the KWL activity. For example, you may write vocabulary from the article in green ink, and other ideas in black. Key terms may also be written on flashcards for review.

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). This is an important organizational tool for students and should be emphasized before you begin working on the study questions. 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 or in small groups. 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, below). The study questions may also be used as a quiz. (Note: Items 4, 7, 11, and 12 require analytical 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. For example, items 2, 3, 4, 5, and 10 will give students some basic knowledge of water. 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: (1) Have students write an essay describing the water cycle, make a poster illustrating the movement of water molecules through the environment, or combine the poster with the essay or an oral presentation. (2) Provide a drawing of the water molecule. Ask

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Assessment continued students to label the atoms with the appropriate charge and then to explain, in a short essay, how water molecules stick together. (3) Ask students to relate the concept of universal solvency to water pollution in an essay or presentation.

- Extension activities**
1. One enlightening experience you can give your students is a tour of your local wastewater treatment facility. Treatment plants welcome visitors and are well prepared to answer questions. Water conservation follow-up activities can be found at www.H2Ouse.org (see Water Budget Calculator) and www.wateruseitwisely.com (see Family Water Audit).
 2. Contact April Rust (april.rust@dnr.state.mn.us, 651-297-4951), Minnesota Project WET (Water Education for Teachers) coordinator, for information about a Project WET workshop near you. Project WET offers many exciting water-related activities and projects for classroom teachers. See Project WET on the DNR’s Web site (www.dnr.state.mn.us/projectwet/curriculum.html) for more information.
 3. Your students can monitor NASA’s Water on Mars Web site (antwrp.gsfc.nasa.gov/apod/ap050401.html) for clues of the existence of water on Mars.
 4. Advanced students may do research on water-related issues with information from en.wikipedia.org/wiki/Water, waterontheweb.org and www.lsbu.ac.uk/water.
 5. Organize a class debate on who should control fresh water. Is water just another commodity, such as timber, oil, and coal, or does water belong to everyone?

Web resources

U.S. Geological Survey Water Science for Schools

ga.water.usgs.gov/edu

Environmental Protection Agency materials for educators

www.epa.gov/water/education.html

Missouri Botanical Garden water information

mbgnet.mobot.org/fresh

Kid Zone water cycle

www.kidzone.ws/water

University of Wisconsin water education:

www.uwex.edu/erc/eypaw/

Minnesota Ground Water Association

www.mgwa.org/education

Many related articles are available online at www.dnr.state.mn.us. Some recent *Conservation Volunteer* articles (see www.dnr.state.mn.us/volunteer) about water include:

January–February 2005

“Between Ice and Hard Times”

www.dnr.state.mn.us/volunteer/janfeb05/hardtimes.html

“The Wonder of Water”—Teachers Guide

November–December 2004

“Rivers Course”

www.dnr.state.mn.us/volunteer/novdec04/fnrivers.html

January–February 2004

“Groundwater”

www.dnr.state.mn.us/volunteer/janfeb04/mpgroundwater.html

July–August 2003

“Hey, How’s the Weather?” (Young Naturalists article with teachers guide)

www.dnr.state.mn.us/young_naturalists/weather

March–April 2003

“River Comeback”

www.dnr.state.mn.us/volunteer/marapr03/fnriver.html

January–February 2003

“Where’s Nature in the Twin Cities?”

www.dnr.state.mn.us/volunteer/marapr03/fnriver.html

September–October 2002

“Manure Matters”

www.dnr.state.mn.us/volunteer/julaug02/feedlots.html

“Cattails”

www.dnr.state.mn.us/volunteer/sepoct02/cattails.html

January–February 2002

“Mixed Messages”

www.dnr.state.mn.us/volunteer/janfeb02/endocrine.html

January–February 2001

“The Crossroads of Climate Change”

www.dnr.state.mn.us/volunteer/janfeb01/warming.html

References

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

"The Wonder of Water," by Mary Hoff. Illustrations by Taina Litwak

Minnesota Conversation Volunteer, July–August 2005

www.dnr.state.mn.us/young_naturalists/water

Name _____ Period _____ Date _____

1. Why is a compound as common as water considered a "weird" chemical substance? _____

2. Which atoms make up a water molecule? What holds the atoms in a water molecule together? _____

3. Water exists in three forms: _____, _____, and _____.

4. How does temperature affect water? _____

5. Explain how water molecules move through the water cycle. _____

6. Why does life on Earth depend on the water cycle? _____

7. Explain the difference between cohesion and adhesion. Give an example of each.

8. Water molecules move from a plant's roots to its leaves. How? _____

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9. Why don't water striders sink? _____

10. Why doesn't ice sink? _____

11. How do the oceans help control Earth's climate? _____

12. Explain how pollution and water are related? _____

Study Questions Answer Key

“The Wonder of Water,” by Mary Hoff. Illustrations by Taina Litwak

Minnesota Conversation Volunteer, July–August 2005

www.dnr.state.mn.us/young_naturalists/water

1. Why is a compound as common as water considered a “weird” chemical substance? **Answers will vary, but should include that water does not behave like other substances. Examples might include that it changes form and defies gravity.**
2. Which atoms make up a water molecule? What holds the atoms in a water molecule together? **A water molecule is composed of one oxygen and two hydrogen atoms. They are held together by positive and negative electrons, called the hydrogen bond.**
3. Water exists in three forms: **solid, liquid and gas.**
4. How does temperature affect water? **As temperature rises water molecules move faster; at cold temperatures (below 0 degrees C) the molecules slow down enough to crystallize. At higher temperatures water evaporates and even boils (above 100 degrees C).**
5. Explain how water molecules move through the water cycle. **Water falls to Earth as rain or snow. Some soaks into the ground, some runs off into lakes, rivers, and wetlands. Water evaporates from surface waters (lakes, rivers, wetlands, and oceans), and returns to the atmosphere. It eventually falls back to Earth and the cycle continues.**
6. Why does life on Earth depend on the water cycle? **Water is spread around the earth to all plants and animals that need it.**
7. Explain the difference between cohesion and adhesion. Give an example of each. **Cohesion is water molecules sticking to each other (raindrops). Adhesion is water molecules sticking to other things (like your skin when you take a shower).**
8. Water molecules move from a plant’s roots to its leaves. How? **Capillary action (cohesion) pulls water molecules upward.**
9. Why don’t water striders sink? **Surface tension creates a skin on top of the water that small insects like the water strider can walk on.**
10. Why doesn’t ice sink? **Water expands as it freezes. Air is trapped in spaces between ice crystals, so ice is less dense than water.**
11. How do the oceans help control Earth’s climate? **During the daytime energy from the sun is absorbed by water in the oceans and slowly released at night, keeping the air temperature from getting too hot or too cold.**
12. Explain how pollution and water are related. **Water is a solvent, which means many chemicals harmful to the environment may be dissolved and carried to groundwater, lakes, rivers, and oceans.**

Minnesota Comprehensive Assessments Practice Items

"The Wonder of Water," by Mary Hoff. Illustrations by Taina Litwak

Minnesota Conversation Volunteer, July–August 2005

www.dnr.state.mn.us/young_naturalists/water

Name _____ Period _____ Date _____

1. Water is a strange substance because
 - A. it defies gravity.
 - B. in solid form it floats.
 - C. it's found everywhere.
 - D. A and B.

2. In a water molecule
 - A. there are one hydrogen atom and two oxygen atoms.
 - B. there are two hydrogen and two oxygen atoms.
 - C. there are one oxygen and two hydrogen atoms.
 - D. all atoms have negative charges.

3. The movement of water throughout the environment is called
 - A. surface tension.
 - B. the water cycle.
 - C. capillary action.
 - D. climate.

4. Plants use _____ to move water from the soil to their leaves.
 - A. surface tension
 - B. gravity
 - C. hydrogen bonds
 - D. capillary action

5. Because water dissolves more substances than any other liquid, it is called the
 - A. universal cleaner.
 - B. universal solvent.
 - C. oxygen solvent.
 - D. hydrogen solvent.

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www.dnr.state.mn.us/young_naturalists/water

1. Water is a strange substance because **D. it defies gravity and in solid form it floats.**
2. In a water molecule **C. there are one oxygen and two hydrogen atoms.**
3. The movement of water throughout the environment is called **B. the water cycle.**
4. Plants use **D. capillary action** to move water from the soil to their leaves.
5. Because water dissolves more substances than any other liquid it is called the **B. universal solvent.**

Vocabulary

“The Wonder of Water,” by Mary Hoff. Illustrations by Taina Litwak

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www.dnr.state.mn.us/young_naturalists/water

compounds substances with atoms of more than one element

defies opposes or resists

denser packed together more

nourish to feed or sustain

quirks odd behaviors

substance matter

traits qualities or characteristics that set something apart