Minnesota Conservation Volunteer

Young Naturalists

Teachers Guide

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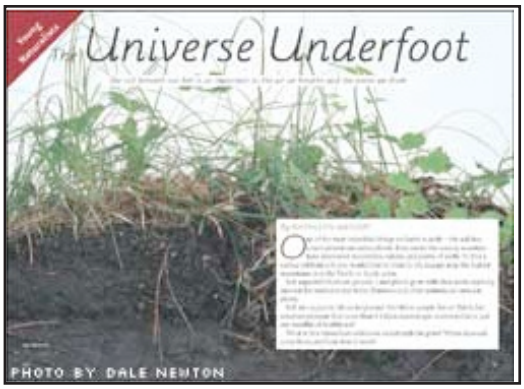
"The Universe Underfoot" Multidisciplinary Classroom Activities

"The Universe Underfoot" by Kathleen Weflen. Published in the September–October 2002 *Minnesota Conservation Volunteer*, or visit www.mndnr.gov/young_naturalists/soil.



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.*

Summary

What is the best soil for growing cultivated plants? How is soil created? What are soil horizons? What lives in the soil? These questions and more are answered in this article. Photographs and illustrations clarify key concepts.

Suggested reading levels: Intermediate elementary through ninth grade

Total words: 2,499

Materials: General classroom supplies, such as tag board or newsprint, scissors, colored pencils, paper, pens and pencils; overheads of study questions and vocabulary

Preparation time: About one hour (not including extension activities)

Estimated instructional time: Three 50-minute class periods

Minnesota Academic Standards applications: "The Universe Underfoot" may be applied to the following Minnesota Department of Education Academic 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

Grade 5

III. Earth and Space Science
- A. Earth Structure and Processes

IV. Life Science
- E. Biological Populations Change Over Time
- F. Flow of Matter and Energy

Grade 8

III. Earth and Space Science
- A. Earth Structure and Processes

Grades 7, 9-12

IV. Life Science
- B. Diversity of Organisms
- C. Interdependence of Life
- E. Biological Populations Change Over Time
- F. Flow of Energy and Matter

Arts

Artistic Expression
- D. 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.*

Preview

Choose from the ideas presented below:
1. Begin by establishing a purpose for reading the article. Skim the text and pictures. Use a KWL chart to record what students know about soil (K), What they want to learn (W) and, at the end of the lesson, what they learned (L). Post in the classroom. 2. Visit your local nursery or collect soil samples from your garden. Pay particular attention to sand, silt, and clay soils. Show students the soil samples you have collected. Initiate a discussion about soil types, healthy soil, where the soil was taken from, and how soil types may be different. 3. After talking about soil using the KWL approach, take the class for a walk around the schoolyard or nature area. Collect soil samples as you walk and talk. Post your observations on large pieces of tag board. 4. Mix the soil samples with water in a clear glass jar. Observe with your class the similarities and differences in the mixture, suspension, and settlement. Write class observation notes. Post these notes. 5. Invite a local Master Gardener (www.mg.umn.edu) into your class. 6. Make "dirt cake" with your class. A recipe can be found at www.recipes.com. Compare the dirt cake as you make it in class and eat it to students' experiences with playing in dirt, digging worms for fishing, or gardening. Gummy worms add a great touch. Use ideas from *The Amazing Dirt Book* by P. Bourgeois.

Vocabulary preview

See the copy-ready vocabulary list included in this guide. You may wish to break the list into smaller lists, since the vocabulary in this article may present significant challenges to your students. You may also wish to add words to or delete words from the list based on your knowledge of your students' needs. 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 below). Italicized terms have not been included on the list.

Connections to vocabulary in the article may also be made during KWL. If students are not familiar with some of the terms, include them in the W list. Other terms may be added to the W list as they read the article. Eventually they can be moved to the L list. You may write vocabulary from the article in green ink, while other ideas are written in black. Note: Some of the words in the vocabulary list definitions may require further explanation.

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

Vocabulary preview continued

a question or statement. Blanks are provided to allow you or your students to add new words or phrases.

Study questions overview

Questions in the study guide parallel the story (the answer to the first question appears first in the article followed by the second, and so on). Preview the guide with your class before you read the article. A student handout and overhead are helpful. Explain how the guide parallels the story. This becomes a strategy to teach your students orientation to the assignment. You may wish to read the story aloud and complete the study guide 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 of this guide). The study guide may also be used as a quiz. Note: Items 3, 6, 10, 11, 13, 14, and 15 require varying degrees of analytical thinking.

Adaptations

1. Using a graphic organizer can help students remember the information. Try using a "worm path maze of facts." Create a maze that looks like worm tunnels with spaces for facts to be recorded. Another example could be a shoe shape with a title such as "step into soil facts." Title shoe parts Who, What, Where, When, How, or Why. A suspended segmented worm organizer is another novel idea to help memory. Using one of these graphic organizer ideas, assign a section of the story, such as "From Frosting to Bedrock" or "A Scientist Wonders about Worms and Soil." 2. Another study skill idea involves highlighters. Give students a highlighter and as they read, highlight the terms in the story that are defined in the story. Highlight the definition, too. Students who have positive peer relationships and work well with others could highlight the terms and definitions for students with special needs. The highlighted areas serve as a visual cue to the students with special needs. These areas could be read and discussed before, during or after reading.
3. You or your students could make a matching game such as "concentration" if the terms are important to your curriculum. 4. Create a word puzzle "bubble gram" with the theme phrase solved after the words are listed. Theme could be soil profile key with words and definitions including earth, dirt, soil, horizon, etc. (Consult the book by Alvermann and Phelps listed in the references for a picture of a bubble gram.) 5. Cut and paste the vocabulary list with or without terms from the article into a matching worksheet of word groups consisting of no more than five terms and their definitions. 6. Students may answer items 1, 2, 4, 7, 8, 12, 13, and 16, and then if time permits may try other items.

Assessment

1. The study questions and Minnesota Comprehensive Assessments practice items below can be used as an assessment. 2. The graphic and description on pages 42–43 of the article could be used as an assessment by providing students with the description and having them create a corresponding and appropriate drawing. 3. Students could have a copy of the horizons on page 46 of the story. Instruct students to provide the description. 4. Students could be told at the beginning of the lesson that they will be asked to answer the question "What is the Universe Underfoot?" Direct students to answer the question in five or more complete sentences. Provide students with a predetermined vocabulary list. This list helps students focus. Choose your vocabulary according to your lesson or curriculum emphasis. 5. Provide students with parts of the facts from a graphic organizer you used from the adaptations section of this guide. Instruct students to fill in the blank spaces. You may wish to include a word bank. 6. Create a "cloze" passage of a paragraph or more. Include a word bank. A cloze passage is a specific section of the story typed with a predetermined number of words deleted. The deleted words do not necessarily have to be targeted vocabulary. A general rule of thumb is approximately 50 words deleted. Have students fill in the blanks using the word bank.

Extension activities

1. Create your own or purchase a temporary home for ants or earthworms. Canning jars covered with black paper provide a dark, safe temporary home for observation by students.
2. Read the children's book *How Much is a Million?* by D. M. Schwartz. It helps students grasp years of time.
3. Assign students to create a children's book describing soil for a younger audience. An example may be *The Four Elements: Earth* by Carme Sole Vendrell and J.M. Parramon, or *The Amazing Dirt Book* by P. Bourgeois. This idea can also work well as an assessment if you require a detailed rough draft.
4. Use the GEMS River Cutters lesson plan to demonstrate changes in the landscape and silt. Find GEMS River Cutters at www.lawrencehallofscience.org/gems/GEMSrivercutters.html.
5. Have students locate parts of the scientific process in Darwin's experience highlighted on page 50 of the article.
6. Bring in books about the Plains States and Dust Bowls of U.S. History. Check into the "Students study the dirt at Civil War prisoner-of-war camp" at clla.tamu.edu/news/pathways/teaching.htm.
7. Compost scraps from the kitchen and students' bag lunches. Students could research the topic and plan. (Secure permission from your principal and other staff as necessary before trying this.) Perhaps a family in your class composts and you could plan a trip to see the process.

Web resources

Study of soil at Civil War camp
clla.tamu.edu/news/pathways/teaching.htm

Creating nature areas at school
www.evergreen.ca/en/lg/toolshed/allhands/index.html

Links to soil lesson plans
www.nscss.org/teach.html Conservation education
www.nrcs.usda.gov/feature/education/

Related articles

Many related *Minnesota Conservation Volunteer* articles are available online at www.dnr.state.mn.us/volunteer/articles/index.html including:

January–February 2000
"Life Under Ice and Snow"
www.dnr.state.mn.us/young_naturalists/snow

July–August 2000
"Mussel Bound in Minnesota"
www.dnr.state.mn.us/young_naturalists/mussels

January–February 2001
"Scampering Mammals" www.dnr.state.mn.us/young_naturalists/scamperingmammals

July–August 2002
"Life in a Jar"
www.dnr.state.mn.us/young_naturalists/pond_life

References

Alvermann, D., and Phelps, S. *Content Reading and Literacy:* Succeeding in Today's Diverse Classrooms (4 ed.). New York: Allyn and Bacon, 2004.
Bourgeois, P. *The Amazing Dirt Book*. Cambridge, Mass.: De Capo Press, 1995.
Schaffer, F. Classmate. Apr./May/June, 1986.
Schwartz, D., and Kellogg, S. *How Much Is a Million?* New York: HarperTrophy, 2004.
Vendrell, C., and Parramon, J. *The Four Elements: Earth*. Haupauge, N.Y.: Barrons Educational Series, Inc., 1989.

Study Questions

"The Universe Underfoot" by Kathleen Weflen *Minnesota Conservation Volunteer*, September–October 2002
www.mndnr.gov/young_naturalists/soil

Name_____Period_____Date_____

1. Most of Earth is covered with soil. T or F

2. Six billion microscopic creatures live in _____ _____ of soil.

3. Summarize the eight steps from bedrock to soil on pages 42–43. Use the first entry as a model.

First, glaciers scraped and rubbed bedrock into tiny pieces called particles or minerals.

Second,_____

_____

Third, _____

_____

Fourth, _____

_____

Fifth, _____

_____

Sixth, _____

_____

Seventh, _____

_____

Finally, _____

_____

4. List the three types of mineral particles in order from smallest to largest. _____ , _____, _____

5. What is a pore? _____

_____

6. Sand, loam, and clay are differentiated by _____

_____

_____

7. Keeping in mind the definition of soil on page 44 of the story, list the three soils in order from heaviest to lightest. _____ , _____, _____

8. What soil type is best for farming? Why? _____

_____

_____

9. What does the color of soil tell you about it?_____

_____

_____

10. Many tiny organisms, called microbes, live in soil. Why are microbes important?_____

_____

_____

11. Water bears are amazing creatures. Why? _____

_____

_____

11. Why shouldn't you throw left over fishing earthworms onto the ground? _____

_____

_____

_____

_____

13. Think back to the title. How is soil as important to our lives as water and air? _____

_____

_____

14. Can you imagine studying earthworms for _____ years like Mr. Darwin did during the mid to late 1800s? Why or why not? _____

_____

_____

15. Why is topsoil a problem when it is in lake and river water?_____

_____

_____

_____

Study Questions Answer Key

"The Universe Underfoot" by Kathleen Weflen *Minnesota Conservation Volunteer*, September–October 2002
www.mndnr.gov/young_naturalists/soil

1. Most of Earth is covered with soil. **T**

2. Six billion microscopic creatures live in **one handful** of soil.

3. Summarize the eight steps from bedrock to soil on pages 42–43. Use the first entry as a model. (Accept reasonable answers)

First, glaciers scraped and rubbed bedrock into tiny, pieces called particles or minerals.

Second, Seasonal changes, weather, and plants continue the process.

Third, Air enters between the soil particles.

Fourth, Moisture fills the pores.

Fifth, Dead animals and plants fall to the ground.

Sixth, Organic compost becomes humus and worms mix it with soil particles.

Seventh, Little creatures create pores for air and water.

Finally, Soil is rich for new plant life.

4. List the three types of mineral particles in order from smallest to largest. **Clay, loam, sand**

5. What is a pore? **A space between soil particles for air and water.**

6. Sand, loam, and clay are differentiated by **texture**.

7. Keeping in mind the definition of soil on page 44 of the story, list the 3 soils in order from heaviest to lightest. **Clay, loam, sand**.

8. What soil type is best for farming? Why? **Loam. Holds water and nutrients and drains well.**

9. What does the color of soil tell you about it? How much oxygen, water, and organic matter are present. **Minerals, such as iron, can give soil a reddish color.**

10. Many tiny organisms, called microbes, live in soil. Why are microbes important? **Bacteria decompose organic matter to release nutrients for plants to use.**

11. Water bears are amazing creatures. Why? **They can lie dormant for more than 100 years.**

12. Why shouldn't you throw left over fishing earthworms onto the ground? **Worms eat leaf litter that other plants and animals need to live.**

13. Think back to the title. How is soil as important to our lives as water and air? **Answers will vary, but should include that soil is the basis for life.**

14. Can you imagine studying earthworms for **29** years like Mr. Darwin did during the mid to late 1800s? Why or why not? **Answers will vary.**

15. Why is topsoil a problem when it is in lake and river water? **There is less soil for growing crops. Soil pollutes the water.**

Minnesota Comprehensive Assessments Practice Items

"The Universe Underfoot" by Kathleen Weflen *Minnesota Conservation Volunteer*, September–October 2002
www.mndnr.gov/young_naturalists/soil

Name _____Period _____Date_____

1. Decomposers that live in soil include:_____ .
   A. gophers
   B. insects
   C. molds
   D. B and C

2. How do gophers help create soil?
   A. They mix the soil particles.
   B. They decompose organic matter.
   C. They eat insects that harm the soil.
   D. None of the above.

3. What affects the texture of soil? _____

_____

4. Which of the following animals does not live underground?
   A. earthworms
   B. gophers
   C. robins
   D. annelids

5. Roots of plants help preserve soil by_____ .
   A. keeping other male frogs away
   B. attracting insect prey
   C. attracting female frogs
   D. A and C

Minnesota Comprehensive Assessments Answer Key

"The Universe Underfoot" by Kathleen Weflen *Minnesota Conservation Volunteer*, September–October 2002
www.mndnr.gov/young_naturalists/soil

1. Decomposers that live in soil include: **D.** B and C
2. How do gophers help create soil? **A.** They mix the soil particles.
3. What affects the texture of soil? **Answers will vary, but should include that percentages of sand, clay, and silt will determine soil texture.**
4. Which of the following animals does not live underground? **C.** robins
5. Roots of plants help preserve soil by **B.** holding soil in place.

Vocabulary

"The Universe Underfoot" by Kathleen Weflen *Minnesota Conservation Volunteer*, September–October 2002
www.mndnr.gov/young_naturalists/soil

compound	something made by the combination of two or more different thing
conservationist	a large class of animals that includes spiders and mites
enriched	made healthier or better
	full of activity; systems that change over time
landscape	what the earth looks like as far as the eye can see
parent material	original material something is made from
particle	very small piece
proportion	comparison between things by size or amount
segmented	divided into parts
mollusk	soft-bodied animals with or without shells, such as clams, snails, squid, or octopuses
universe	all things that exist

Vocabulary Study Cards

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www.mndnr.gov/young_naturalists/soil

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

What is a **compound**	FOLD HERE	**Something made by the combination of two or more different things** is a
A **conservationist** is a person who	FOLD HERE	A person **works for a better environment** is a
When something is **enriched** it is	FOLD HERE	When something is **made healthier or better** it is

Vocabulary Study Cards

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

The **landscape** is	FOLD HERE	**What the earth looks like as far as the eye can see** is the
The **parent material** of soil is the	FOLD HERE	The **original material soil is made from** is its
A **particle** of soil is a	FOLD HERE	A **very small piece** of soil is a

Vocabulary Study Cards

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

What does **proportion** mean?	FOLD HERE	The **comparison between things by size or amount** is the
What does **segmented** mean?	FOLD HERE	An insect's body, **divided into parts**, is
The **universe** is	FOLD HERE	**All things that exist** is called the

Vocabulary Study Cards

"The Universe Underfoot" by Kathleen Weflen *Minnesota Conservation Volunteer*, September–October 2002
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Cut along the horizontal lines, fold on the dashed vertical line and tape or staple. Blanks are provided to allow you or your students to add new words or phrases.

FOLD HERE

FOLD HERE

FOLD HERE