



**EDUCATIONAL ENHANCEMENT ACTIVITIES
FOR THE
CULTURE OF CONSERVATION VIDEO SERIES
GRADES 6-12 AND BEYOND**



VIDEO

Building a Culture of Conservation: Iowan to Iowan

A Culture of Conservation encourages us to not take our environment or our resources for granted. The adoption of conservation practices on our farms and in our cities is shown to reduce nonpoint source pollution in Iowa. Fertile soil and clean water are essential for sustaining life and the quality of life in Iowa.

6TH-8TH GRADE

Focus questions

- What did Iowa look like 200 years ago? How has it changed?
- What does it mean that we never actually act alone?
- What does it mean to be a good steward of the land?
- How do reusing, reducing and recycling affect water quality?

HIGH SCHOOL AND BEYOND

Assignment/group discussion ideas

PERSONAL HISTORY AND THE LAND

Students will research the cultural and natural history of where they currently live or a place they have lived in the past. Encourage them to utilize libraries, Internet, historical societies, etc. to gain an understanding of how and why the land has changed over time.

Questions to consider

- How has your identity been shaped by where you've lived and/or currently reside?
- What kind of influence have you had on the land in return?
- What can be done to leave the land in better shape for future generations?
- Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas. Highlight differences between experiences (e.g., growing up in urban vs. rural areas).

A LEAKY SYSTEM

The video talks about today's farming practices in Iowa as a "leaky system." Start a discussion on what this means and the personal impact it has.

Questions to consider

- What are the two ways water leaks out of fields during high precipitation events?
- What changes in the landscape cause this "leaky system"?
- What are the problems associated with surface runoff? Subsurface drainage?
- How can the effects be stopped or reversed?
- Discuss some positive and negative effects of our collective actions related to soil and water quality. How can we help mitigate the negative effects?

Water is Life

VIDEO

All the water that will ever be exists right now in the Earth's biosystem. The Earth's water is in constant motion, in the process known as the hydrologic cycle. How much are we willing to change our lives to ensure the water we use is clean, pure, readily available and affordable to all?

6TH-8TH GRADE

Background materials

- The Water Cycle – page 18
- Precious Water – page 19

Focus questions

- How much of the earth's water is available for drinking water?
- Why do humans alter water systems?
- Who or what does that affect?
- What contributes to the contamination of water?

Related activities

- Investigate Your Own Water Usage – page 33
- Personal Water Use Worksheet – pages 33-34
- Pollution: Where Might Pollutants Enter the Water? – page 33

HIGH SCHOOL AND BEYOND

Assignment/group discussion ideas

WATER AND QUALITY OF LIFE

Discuss the connection between the lack of safe water, hunger, disease and poverty throughout the world.

Questions to consider

- How does the abundance of clean water enhance your life here in Iowa?
- What mechanisms are in place to provide water and ensure its safety?

Assign online research in water monitoring and treatment practices and/or coordinate a field trip to a local water treatment facility. Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas.

WATER USE AND CONSERVATION

Have students consider how much water they use on a daily, weekly, and/or monthly basis by completing a questionnaire on the United States Geological Survey website at: <http://ga.water.usgs.gov/edu/sq3.html>

They should consider other uses that add to their consumption (e.g., lawn/garden, livestock/pet care, cleaning home/auto).

Questions to consider

- How much water do you use daily on average? How much for a week and month?
- How much water does everyone consume in town? Are there personal changes you could make to conserve water? For what reasons should you?
- Have students discuss ideas or write a 1-2 page paper with thoughts and findings.

VIDEO

We All Have a Place in the Watershed

No matter where you are, you are standing in a watershed. Our homes, work, where we grow our food and where we play, all exist in watersheds. A watershed is an area of land that drains to a common point such as a lake, river or marsh.

6TH-8TH GRADE

Background materials

Watersheds – page 18
Iowa Watersheds Map – page 20
Point and Nonpoint Source Pollution – page 23

Questions to consider

What is a watershed?
What problems do high levels of nitrogen and phosphorus cause? Who or what does that affect? How?
What is the difference between point source and nonpoint source pollution? Give an example of each.

Additional resources

NRCS site with additional information about many of Iowa's watersheds: <http://www.nrcs.usda.gov/wps/portal/nrcs/main/ia/technical/dma/rwa/>
Facts on drinking water from the EPA: <http://water.epa.gov/learn/kids/drinkingwater/index.cfm>
Rock Your Watershed! online game: www.waterrocks.org

Related activities

Find Your Watershed Address – page 31
What's in my Watershed? – page 31
Visit EPA's "Surf Your Watershed":
<http://cfpub.epa.gov/surf/locate/index.cfm>
Build a Watershed – page 32

Follow-up questions

What are some possible sources of pollution in your watershed?
What other impervious surfaces besides parking lots can cause excessive runoff in a watershed?
What can be done to reduce our impact on watersheds and their environment?
What is the quality of water in the rivers, streams and lakes in your watershed?
Using a map of the area around your house and EPA's "Surf Your Watershed," identify where the runoff from your driveway will end up. Can you track the path of potential pollution to a large body of water (e.g., ocean)?

HIGH SCHOOL AND BEYOND

Background materials

Watersheds – page 18

Assignment/group discussion ideas

KNOW THE FLOW

Discuss the concept of watersheds with students. Have them utilize the EPA website: <http://cfpub.epa.gov/surf/locate/index.cfm> to locate and learn more about the watershed in which they live. At the site they can learn about bodies of water deemed "impaired" by EPA within their watershed and why.

Questions to consider

What is a watershed?
What is the name of your watershed?
What are the major bodies of water within it that are close to where you live?
What impairments, if any, are present within any of the water sources?
What are potential causes of these impairments?
In what condition do you predict these water bodies to be in 20 years? Why?

Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas.

Related activities

Conduct a Water Survey – page 40
Global Changes in the Water Cycle – page 40

SLOW THE FLOW

Examine and discuss a watershed illustration shown on page 18.

Questions to consider

What are the roles of wetlands, grassy borders and waterways within a watershed?
How can some farming practices and the urbanization of Iowa land impact the flow of water and contribute to the potential of flooding?
Are there any changes you can make in your life impacting water flow?
Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas.

WATER POLLUTION

Lead a class discussion and/or assign research and a 1-2 page paper on causes and effects of water pollution in your local watershed.

Questions to consider

What are point and nonpoint sources of water pollution?
What practices threaten the safety of your water?
How can you know the safety level of the water you drink?
What practices can you do to help ensure quality of water?

VIDEO

Don't Call it Dirt: A Passion for Soil

It takes thousands of years for rock to develop into soil and hundreds of years for rich organic layers to build up. Keeping soil in place is only the beginning of soil conservation.

6TH-8TH GRADE

Background materials

Soil Food Web Graphic and Narrative – page 21
Prairie Plants and Roots Graphic – page 25

Questions to consider

Name some ways humans use soil.
How quickly does soil build up?
How quickly can soil be depleted?
What materials make up soil?
How does mulch improve soil?

Related activities

Map Your Schoolyard – page 31
Schoolyard Soil Sampling – page 31
Ways to Hold Soil in Place – page 36

HIGH SCHOOL AND BEYOND

Background materials

Soil Food Web Graphic and Narrative – page 21
Analyzing Soil Health – page 22

Additional resources

Morgan, R.P.C., 2005. *Soil Erosion and Conservation*
3rd edition, Wiley-Blackwell Publishing, Malden, MA, USA
ISU Agronomy Extension: <http://www.agronext.iastate.edu/>
Master Gardeners website:
http://www.ahs.org/master_gardeners/
Natural Resources Conservation Service Soil Health
web page: <http://soils.usda.gov/sqi/>
Environmental Working Group report “Losing Ground”
website: <http://www.ewg.org/losingground/>

Assignments/group discussion ideas

TYPES OF SOIL

Discuss different types of soil:

- Sand (large particles feeling gritty)
- Silt (medium particles feeling silky)
- Clay (smallest particles feeling sticky)

Loam is an equal mixture of the three.

Questions to consider

What is the function of each type of soil?
Why is loam the best for plant growth?
Consider the types of soil in different parts of the world. How does each type support plant growth and human life?
Which type is mostly found in your watershed?

Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas.

EROSION

Discuss the impact of soil type, soil health, and ground cover on erosion. Research types and examples of erosion and erosion prevention. Ask students to walk/drive around the area to find examples of erosion and of conservation practices in place.

Questions to consider

Give an example of erosion happening in your neighborhood.
What agent or force is causing the erosion?
Where is the eroded material going?
What can be done in order to reduce the amount of erosion?
What is an example of conservation in your area?

Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas.

COMPOST AND MULCH

Consider ways we can conserve and improve soil. Discuss benefits of composting, mulching, and planting ground cover. Invite a local member of Master Gardeners or Iowa State University Extension and Outreach to speak to your class.

VIDEO

The Work of Our Hands

Ecosystem services are defined as “the benefits provided by ecosystems to humans.” Many key ecosystem services provided by biodiversity, such as nutrient cycling, pest regulation and pollination, sustain agricultural productivity. Promoting the healthy functioning of ecosystems ensures the resilience of agriculture as it intensifies to meet the stress of growing demands for food production.

6TH-8TH GRADE

Background materials

The Work of Our Hands – page 22

Questions to consider

How have humans transformed the land?
What contributes to the loss of productive soil?
What is an example of living within the environment?
What is an example of shaping the environment?

Related activities

Resilience Thinking – page 37
Creating Your Preferred Future – page 37

HIGH SCHOOL AND BEYOND

Assignments/group discussion ideas

ECOSYSTEMS

Investigate an occurrence of a change or misfortune such as the floods in Iowa or the Dust Bowl. Track what changes took place, and how the system recovered from it.

Additional resources

Resilience Thinking: Sustaining Ecosystems and People in a Changing World. By Brian Walker and David Salt
The Resilience Alliance: <http://www.resalliance.org/>
The Leopold Center for Sustainable Agriculture:
www.leopold.iastate.edu
Sustainable Agriculture Research and Education: www.sare.org

Questions to consider

What is an ecosystem?
How does an ecosystem impact and relate to agriculture?
How does agriculture affect the ecosystem? Give specific examples of each.
Why is it important to sustain and support resilience in ecosystems?

Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas.

SUSTAINABILITY AND RESILIENCE

Have students research the concepts of resiliency and sustainability as they apply to agriculture.

Questions to consider

What is sustainable agriculture?
What is resilient agriculture?
What is biodiversity?
How are the three related?
Give examples of sustainable and resilient agricultural practices.
Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas.

CHANGE

Research the occurrence and ramifications of the 1930's drought.

Questions to consider

What were consequences on the land due to the drought?
What was farming like in 1930's?
How did farming practices contribute to drought and dust storms?
What changes to agriculture resulted due to the Dust Bowl?
Consider sustainability and resilience in discussions.

Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas.

Reclaiming Stewardship

6TH-8TH GRADE

Questions to consider

What is meant by a culture of conservation?
Why should we care about water?
Who is responsible for soil and water conservation and quality?

Related activities

Where Did All the Water Go? – page 32
Waste Not – page 37
Don't Treat Mother Earth Like Dirt – page 37

HIGH SCHOOL AND BEYOND

Assignments/group discussion ideas

CONSERVATIONISTS

One of the speakers in the video described a good conservationist as having three important traits: being caring, creative, and curious.

Questions to consider

Do you agree with the speaker that these are the traits of a good conservationist?
What makes a good conservationist?
Think about and discuss your thoughts on the matter. Give specific examples to support your opinion.
Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas.

CULTURE OF CONSERVATION

Creating a culture of conservation requires making conservation a part of our everyday lives.

Questions to consider

How would you rate yourself as a conservationist today?
What things do you do that fit in a culture of conservation?
Are there choices you make that are counterproductive in a culture of conservation?
Are there any changes you are willing and ready to make today toward a culture of conservation?

Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas.

THE FUTURE

Have students consider the history and current condition of the “fertile crescent.” Compare what the land is like for agriculture now compared to when it was first cultivated. Have students consider the amount of topsoil lost in Iowa since the mid 1800's.

Questions to consider

What will Iowa land look like in another 100-300 years? Why?
What does ‘stewardship’ mean and how does the concept of stewardship come into play when thinking about the future?
Compare and discuss student opinions. Encourage them to consider knowledge they've gained and research they've done related to these videos.

DON'T TREAT MOTHER EARTH LIKE DIRT

Let's all respect Mother Earth, now.
Let us work shoulder to shoulder.
Treat her real kindly, don't use her blindly.
Look after her as she grows older.
Mother Earth has valleys that feed us.
She has rivers and lakes that refresh us.
Nothing's insaner, than to fail to sustain 'er.
Let's show her we know that she's precious.
Don't treat Mother Earth like dirt.
Erosion, pollution—they hurt!
So, swear by your best flannel shirt
That you won't treat Mother Earth like dirt.
Don't treat Mother Earth like dirt.

Mother Nature is very resilient.
In the long run, she can get better
If the people and plants, the birds and the ants
Will all work together and let 'er.

Mother Earth is a real special lady.
Let's show her we're thinking about her.
Let's show her we care, and tell her we swear
That we couldn't live here without her.

Don't treat Mother Earth like dirt.
This is a real red alert.
That is why I reassert:
Don't treat Mother Earth like dirt!

*Lyrics by Owen Kalt, music by Ann Staudt.
Performed by Smiling Stone Soup*

Additional resources

Peaceful Solution Character Education Incorporated (PSCEI): http://www.peacefulsolution.org/curriculum/products/sample_lessons.html

Troubled Waters

6TH-8TH GRADE

LIVING IN THE WATERSHED

Questions to consider

Do rivers follow human-created boundaries of cities, states, counties, etc.?
How are rivers managed by humans?
What is meant by biodiversity?
How does biodiversity contribute to healthy water systems?
Explain how wetlands are the kidneys of the landscape.
Remind students of the definition of a watershed.

Related activities

Find Your Watershed Address – page 31
What's in My Watershed? – page 31
River Writing – page 35
Common Good – page 38

HIGH SCHOOL AND BEYOND

Assignment/group discussion ideas

HISTORY OF A RIVER

Have students research the cultural and natural history of an actual river. Encourage them to utilize libraries, Internet, maps, historical societies, etc. to gain an understanding of how and why the river has changed over time.

Questions to consider

How have the towns/cities and land use around the river been shaped by the river?
What kind of influence have the cities and/or surrounding land use had on the river in return?
What conflicts have arisen around the uses of the river?

Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas. Highlight how human decisions have affected the river.

Additional resources

Mississippi River Discovery Packets from the National Park Service, including songs!
www.nps.gov/miss/forteachers/curriculummaterials.htm

COMMON GOOD

Questions to consider

What happens when the negatively affected group wants to have some control of the situation?
In what ways have these conflicts been resolved, both positively and negatively?
Has anything similar happened to the river closest to you?
Who is upstream and downstream from you?

Related activities

The Common Good – page 41

MAP RIVER COMPARISONS

Explore historical aerial photos of a river by using the Iowa Geographic Map Server: http://ortho.gis.iastate.edu/client_pls.cgi?zoom=900&x0=469163&y0=4653689&zlayer=ortho_1930&pwidth=600&pheight=450

Choose a segment of a stream or river that is a half-mile or less and download photos from that segment for a series of years. Students can compare maps from 1930's to the present.

Choose a location that is familiar to most students and compare maps from several years. Discuss changes in the course that the river has taken over time. Document changes in vegetation near the river, and along the river riparian area. Discuss the potential causes for the changes in the river over time.

Compare maps from before and after significant flooding events such as 1993, 2008, or 2010. Discuss how large scale events drastically change the river in a short amount of time compared to natural changes over a longer period of time.

THE LAND ETHIC

Background materials

“The Land Ethic” from *A Sand County Almanac*, Aldo Leopold

Questions to consider

What implications does the “Land Ethic” have for planning when it comes to rivers?

Human groups have the opportunity to speak up when they are being hurt by a decision that is made upstream. Do other beings have this opportunity?

What kind of feedback can we look for that tells us that we are impacting other beings in the rivers?

Related activities

The Land Ethic – page 41

VIDEO

Out to the Lakes

Iowa's lakes offer a host of recreational activities such as swimming, skiing, fishing, boating, and bird-watching. These types of activities can increase the health and quality of life for participating individuals. In fact, one out of six Iowans visits a lake each year. These recreational areas add to the state economy through job support and visitor spending. An estimated \$977 million is spent yearly by visitors to Iowa's lakes, with nearly 11,500 jobs being supported.

Lakes are a treasured natural resource and they deserve our care and protection. To be good stewards of our lakes, however, we must understand the context in which lakes exist—we need to look at watersheds.

WATERSHEDS

Background materials

Water Cycle Narrative and Graphic – page 18
Precious Water – page 19
Watershed Graphic and Narrative – page 19
Iowa Watershed map – page 20

6TH-8TH GRADE

Questions to consider

Name the two ways Iowa lakes are formed.
Name ways we use our lakes.
How is a lake a reflection of its watershed?
Can you always tell how polluted a lake is just by looking at it?
What contributes to poor water quality in our lakes?
What kinds of pollutants make their way into our lakes?

HIGH SCHOOL AND BEYOND

Related activities

Share Lake Experiences – page 35
Field Trip to a Body of Water – page 35
Create a Terrarium – page 33
Personal Water Use Worksheet – pages 33-34
Conduct a Water Survey – page 40
Global Changes in the Water Cycle – page 40

WATER POLLUTION

Background materials

Water Pollution – page 22
Point and Nonpoint Source Pollution – page 23
Soil as a NPS Pollutant – page 24

6TH-8TH GRADE

Related activities

Storm Drains and NPS Pollution – page 35
Silt and Sedimentation – page 36

HIGH SCHOOL AND BEYOND

Related activities

Silt and Sedimentation – page 36
Iowa's Impaired Waters – page 40

PRECIOUS SOIL

Background materials

Precious Soil – page 24
Soil Formation – page 24
Soil Erosion – page 24
Changing Landscape – page 25
Changing Waterways – page 25
Farming Practices to Reduce Erosion – page 25

6TH-8TH GRADE

Related activities

Defining Soil Erosion – page 35
Erosion Observation – page 36
Agricultural Soil Practices Field Trip – page 36
Farming Soil Management Practices – page 36

HIGH SCHOOL AND BEYOND

Related activities

Soil Functions – page 40
Human Connection to Healthy Soil – page 40
Agricultural Soil Management Practices – page 40

SPREADING CITY LIMITS/ PERSONAL RESPONSIBILITY

Background materials

Spreading City Limits – page 26
Reducing City Runoff and Erosion – page 26
Personal Responsibility – page 26

HIGH SCHOOL AND BEYOND

Related activities

What Should We Do? – page 41

Additional resources

2-3 min. presentation of water cycle stages: http://www.epa.gov/safewater/kids/flash/flash_watercycle.html

Interactive NPS Activity: <http://water.epa.gov/polwaste/nps/kids/whatswrong/index.cfm>

Water cycle diagram with short quiz about different stages: <http://earthguide.ucsd.edu/earthguide/diagrams/watercycle/index.html>

World water sanitation and global water facts: http://www.who.int/water_sanitation_health/hygiene/en/ and an interactive map: http://gamapserver.who.int/gho/interactive_charts/phe/total_percentage/atlas.html

Students can further study the state of global water concerns and share information learned via a written report, multimedia presentation, pamphlet, or poster.

VIDEO

Incredible Wetlands

Wetlands are crucial to life on earth. They provide numerous ecosystem services including water filtration, trapping of sediment, transformation of pollutants, carbon storage, wildlife habitat, and natural beauty. Whether they are called fens, sloughs, marshes, or prairie potholes, wetlands are one of Iowa's most important ecosystems.

6TH-8TH GRADE

Questions to consider

In what way(s) have wetlands in Iowa been misunderstood or undervalued?

What is the main reason wetlands have been drained in Iowa?

What kinds of animals have disappeared in Iowa?

How do wetlands improve water quality?

What services do wetlands provide?

Background material

The Water Cycle – page 18

Precious Water – page 19

Watersheds – page 19

Iowa Watersheds Map – page 20

Water Pollution – page 22

Changing Waterways – page 25

Incredible Wetlands – page 27

Biodiversity Pyramid – page 28

Denitrification Process – page 29

Waterfowl Flyways – page 30

Related activities

What's in My Watershed? – page 31

Field Trip to a Body of Water (wetland) – page 35

Biodiversity Pyramid – page 38

HIGH SCHOOL AND BEYOND

Assignments/group discussion ideas

RESTORING WETLANDS

Wetland restoration is taking place worldwide. Research wetland restoration to find out where it is happening, costs vs. benefits, and how wetlands help to mitigate the effects of human activity on the environment.

Questions to consider

Why is wetland restoration an important issue in the world?

Who is responsible for restoring wetlands and how are the decisions made?

Who or what is affected when wetlands are restored? Include people, plants and animals and both positive and negative aspects.

What are the costs (include economic and loss of cropland and/or habitat) and the benefits of wetlands construction and/or restoration? Who bears the cost? Include short-term and long-term benefits.

What would you say to a landowner who is skeptical of the importance of constructing a wetland on his/her property? What points would you stress in trying to convince him/her that the cost of taking land out of agricultural production (if necessary) is worth the environmental benefits?

Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas. Students can choose to focus on Iowa or worldwide issues.

BIODIVERSITY

Wetlands in Iowa are as biologically diverse as the rainforests in South America. Have students research the biological diversity of Iowa's wetlands.

Questions to consider

Biodiversity is evaluated by both species richness (the number of different species present) and relative abundance of the species (how many individuals present for each species).

Do large or small organisms provide the most diversity in Iowa's wetlands?

Are there some species that are more important to maintain than others? For what reason(s)?

Can the loss of one species significantly affect the ecosystem as a whole?

Is it important to preserve species of plants and animals that have no medicinal or economic benefits to humans? Why or why not?

What kinds of ecological processes does biodiversity help maintain?

What benefits are healthy wetlands to the entire ecosystem?

Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas.

Related activities

Why should we care about biodiversity? – page 41

ECOSYSTEM SERVICES

Have students research wetland ecosystem services.

Questions to consider

How do humans try to duplicate wetland ecosystem services? Include water filtration, trapping of sediment, cycling of nutrients, transformation of pollutants, carbon storage, wildlife habitat, mitigation of flooding, and beauty.

What are the costs of trying to duplicate these services, both short-term and long-term?

Are there ecosystem services that are more important than others? How would you decide that?

Are there ecosystem services we cannot duplicate?

How does the absence of these ecosystem services affect the land not only near the water but downstream as well?

Assign a 1-2 page paper and/or facilitate group discussion about findings and ideas.

Related activities

Wetlands Hard at Work –page 41

Additional resources

Downloadable Extension publication on Iowa wetlands; includes plants, animals, types of wetlands, ecology, policies on wetlands, and more: <https://store.extension.iastate.edu/Product/ian204-pdf>

Iowa Wetland Plant Identification—online flashcards: quizlet.com/23066320/iowa-wetland-plant-identification-for-reg-iv-delineation-class-field-sites-flash-cards/

Answers to many basic questions about wetlands in Iowa: www.reflectiveimages.com/WetlandsLC.htm

Wetland facts: <http://idahoptv.org/dialogue4kids/season6/wetlands/whycare.cfm>

CAPSTONE PROJECTS

6TH-8TH GRADE

Class projects

1. Write a short play on watershed issues. Perform the play for others in school or elsewhere.
2. Create an educational game about watersheds, lakes, or other information from this curriculum, and share it with other classes within the school or at a school carnival.
3. Create a public service announcement from knowledge learned about watershed issues.
4. Create an educational pamphlet to share with area citizens.
5. Find a soil erosion issue at your school or in your community; develop an action plan that could lessen the erosion problem.
6. Create a compost pile.
7. Plant a natural prairie. It may be helpful to take a class trip to a natural prairie in your area. A listing of Iowa public prairies to visit can be found on page 42 of this booklet.

Individual projects

1. Make a personal change that benefits your watershed and share what that change is with others in the class. Additionally, encourage others around you (family members and friends) to make personal changes as well.
2. Share what you have learned from this curriculum using new vocabulary terms and environmental facts through one of the following:
 - a. Report
 - b. Song
 - c. Poem
 - d. PowerPoint presentation
 - e. Diorama
 - f. Educational poster
 - g. Pamphlet
3. Write a short story about the future of our environment if no changes are made from current practices.
4. Create a board game, video game, or Jeopardy-style trivia game on lakes, watersheds, or water and soil quality.
5. Create a crossword puzzle of environmental terms.

HIGH SCHOOL AND BEYOND

Group projects

1. Write a short play about watersheds, lakes, or other information from this curriculum. Perform the play at a local library or elementary school.
2. Create an educational game to teach about watersheds, water quality, soil, and/or other related topics, and share the game with other students (same age or younger).
3. Create a public service announcement from knowledge learned about watershed issues.
4. Develop a watershed education booth for a community event.
5. Create an educational pamphlet to share with area citizens. Each student individually creates one; then the class votes on the best to share. Also determine as a class how to share this brochure with others.
6. Find a soil erosion or water conservation issue at your school or in your community; develop and implement an action plan that could help remedy the problem.
7. Develop and administer a survey to collect measurable data on watersheds, lakes, etc. Calculate and share results. Additionally, create a fact sheet on the topic to share with survey participants.
8. Create a rain garden, wildlife habitat, or natural prairie area at your school or in your community. Capture “before,” “during,” and “after” photographs to put together on a poster. Display the poster in a common school area for other students, instructors, and visitors to view.
9. Create a compost pile near the school kitchen and talk to kitchen staff about using it. Make a poster to display near the pile, and a pamphlet to give to staff, with guidelines in “feeding” the pile. Devise and implement a schedule for pile care (adding water and regular stirring).
10. Choose a local water body to adopt for a day. As a class, clean up litter and garbage from around and in the water. Consider doing two to four times per school year.

Individual projects

1. Share what personal changes you will adopt to benefit your watershed with others. Include why these particular changes have been chosen and how you feel these changes will help.
2. Encourage someone outside the class to make a personal change to benefit the watershed. Share this experience, including the following issues: What was the hardest thing about influencing change? Prior to your interaction, how educated was this person on environmental issues related to watersheds? What do you feel was the key element in invoking the change? How do you feel personally after the experience?
3. Write a short story about what the future holds for our environment if no changes are made from current practices.
4. Create a board game, video game, or Jeopardy style game on lakes, watersheds, etc. Share game with other students
5. Conduct an experiment related to healthy lakes, watersheds, etc. and share your results.

Additional resources for teachers

Illinois DNR lesson plans about biodiversity, including biodiversity quiz, excellent activity on ecosystem services, poetry lesson: dnr.state.il.us/education/ilbiodiversitybasics/section1.pdf

Various downloadable publications, including building a schoolyard wetland: www.wetlandsandstreamrestoration.org

USDA Natural Resources Conservation Service (NRCS), Wetlands Reserve Program website: www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/wetlands

United States Geological Survey document on the restoration, creation, and recovery of wetlands: water.usgs.gov/nwsun/WSP2425/restoration.html

Ramsar Convention on Wetlands, discusses benefits of restoring wetlands worldwide: www.ramsar.org/bn/bn4.pdf

National Conference of State Legislatures brief on state policy options for restoring and protecting wetlands: http://www.ncsl.org/documents/environ/Wetlands_brief_811.pdf

Iowa DNR website includes explanation of wetland types, roles, monitoring, threats, benefits, conservation and research: www.iowadnr.gov/Environment/WaterQuality/WaterMonitoring/MonitoringPrograms/Wetlands.aspx

NRCS publication shows a snapshot of Iowa’s wetland types, benefits, restoration processes and programs for land users. It includes maps with locations of restored/constructed Iowa wetlands, landowner reasons for restoring wetlands, and general wetland information: www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_006832.pdf

Environmental Concern, a group dedicated to restoring wetlands: <http://www.wetland.org>

Wow! The Wonders of Wetlands: An Educator’s Guide
Alan S. Kesselheim, Britt E Slattery, Susan Higgins, et al. 1995

Wetland curriculum, book list, fact sheets, activities: http://water.epa.gov/type/wetlands/outreach/education_index.cfm#activities

Ducks Unlimited *Teacher’s Guide to Wetland Activities*: <http://www.greenwing.org/dueducator/ducanadapdf/teachersguide.pdf>

North American Association for Environmental Education, wetland information: <http://eelink.net/pages/EE+Activities+-+Wetlands>

BACKGROUND MATERIALS

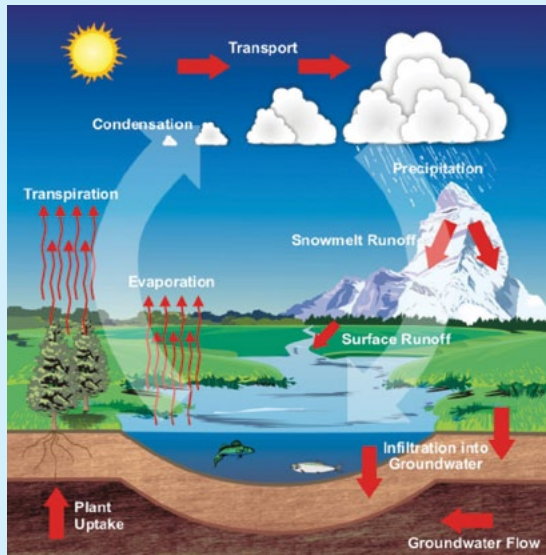
THE WATER CYCLE

From the National Weather Service Forecast Office

Something really special happens during the water cycle: Water is purified through evaporation, transpiration, and condensation. Water is also cleaned as it filters through rocks and soil. So, a natural water purification process is in place that humans do not have to operate or monitor. Does this mean Iowa's lakes and other water forms are always clean? Unfortunately, this is not the case. Due to pollution, some waters are unsafe and unhealthy.

The water cycle, also known as the hydrologic cycle, refers to the continuous movement of water between the earth and the atmosphere. There are many components to the water cycle, but only the most important ones will be discussed here:

- Evaporation and Transpiration
- Condensation
- Precipitation
- Runoff and Groundwater



EVAPORATION AND TRANSPIRATION

Evaporation is the process by which a substance changes from the liquid phase to the gas phase. Energy is required for evaporation to occur. Energy can come from the sun, the atmosphere or the earth. When energy is extracted from the atmosphere to evaporate liquid water, the atmosphere will cool. This is also true if water evaporates off a surface. An example is when you step out of a pool on a warm, sunny day. The water on your skin will evaporate, removing heat from your skin, causing your skin to cool. Evaporation is very important because it is how water vapor, which is needed for clouds and precipitation, enters the atmosphere. Transpiration is simply

the evaporation of water through plant membranes. It is another important way in which water vapor enters the atmosphere.

CONDENSATION

Condensation is the process by which a substance changes from the gas phase to the liquid phase. As air containing water vapor rises in the atmosphere, it will expand and cool. If it cools to its dewpoint temperature, the air will become saturated and condensation will occur. Condensation can be observed in the atmosphere as clouds, fog, dew, or frost form. When condensation occurs, the heat required to originally evaporate the water is returned to the atmosphere, causing the atmosphere to warm.

PRECIPITATION

Clouds are composed of millions of water droplets that have condensed. These water droplets grow into larger droplets by colliding and coalescing with one another. Eventually, the droplets grow large enough that they are not able to stay suspended in the cloud. When this occurs, they fall out of the cloud as precipitation. If the cloud's temperature is below freezing, it will contain ice crystals. Ice crystals collide and stick to other ice crystals and eventually fall from the cloud as snow. Precipitation is water, either liquid or solid, that falls from the atmosphere to the surface.

RUNOFF AND GROUNDWATER

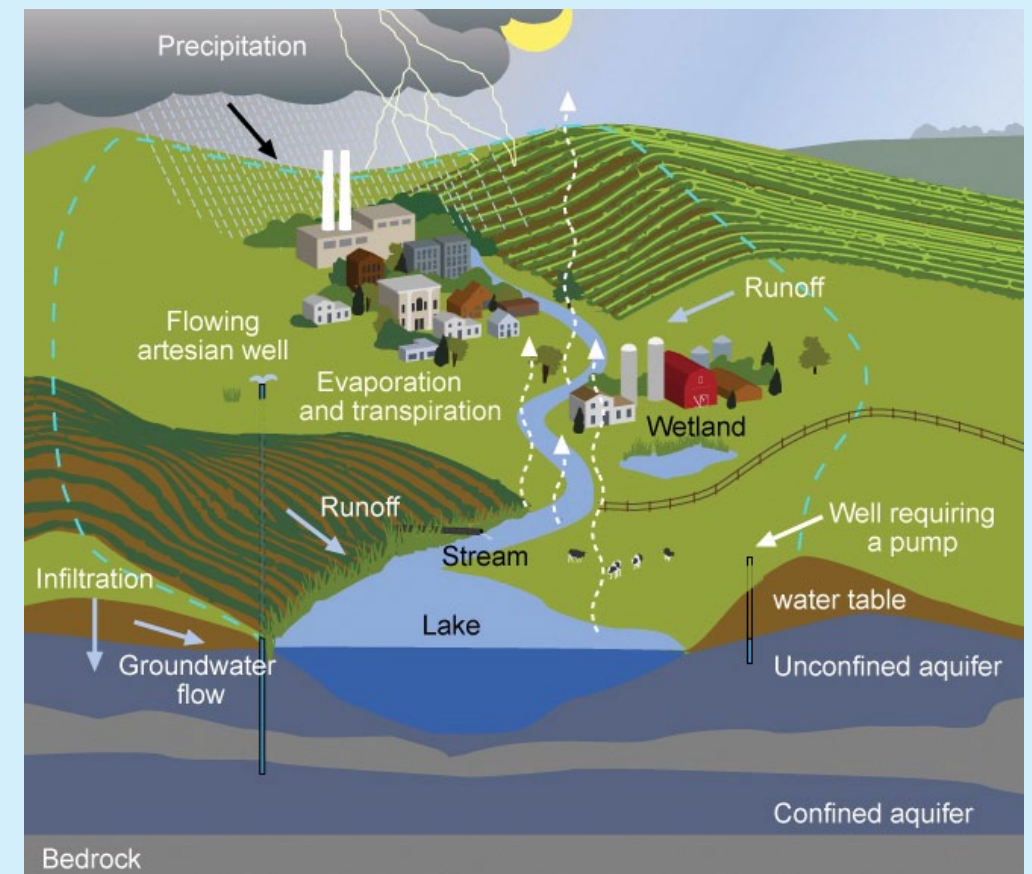
Runoff and groundwater are both driven by precipitation. When precipitation falls to the surface, it will either be absorbed into the ground (infiltration into groundwater) or, if the ground cannot absorb any more water, flow over the land surface (runoff). Eventually, even water that is absorbed into the ground will make its way into streams. The water in streams converges into rivers and flows back to the oceans. Finally, some of the runoff will be evaporated and some of the groundwater will be taken up by plants and then transpired.

WATERSHEDS

A watershed is the area of land that drains to one common point, such as a lake, stream or river. All land is divided into watersheds of different shapes and sizes and cross county, state, and national boundaries. They can vary from millions of acres, like the land that drains into the Mississippi River, to a few acres that might drain into a small pond.

All people, as well as animals, birds and fish, live in watersheds and are part of watershed communities. You influence what happens in your watershed—good or bad—by how you treat the soil, water, air, plants and animals within it. What happens in your small watershed also affects the larger watersheds. Small watersheds combine to form larger ones, and all of this water eventually comes together in rivers and lakes. It stands to reason, then, that healthy watersheds are important to maintaining clean, healthy rivers and lakes.

Healthy watersheds have good soil and healthy land which lead to high water quality in the lakes, rivers and groundwater. High quality groundwater translates to pure, healthy drinking water. Clean water bodies are crucial for the plants and animals that live in and around them.



PRECIOUS WATER

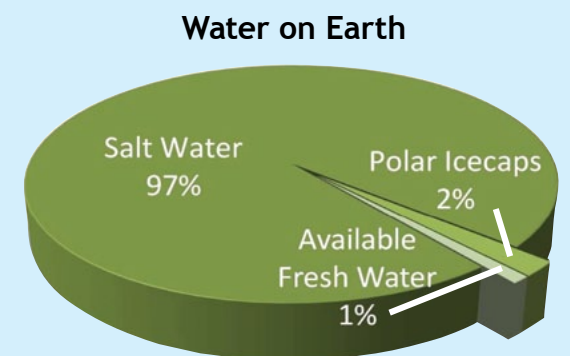
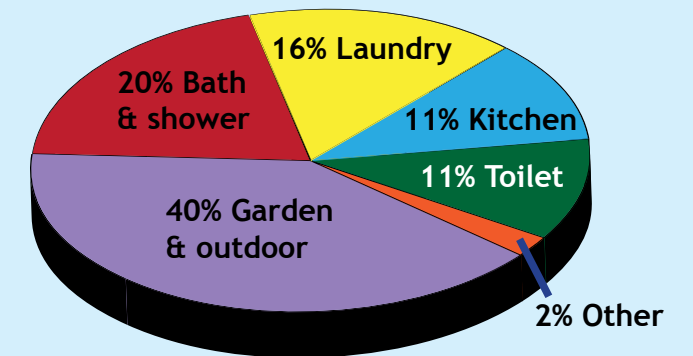
Water is necessary to live. Did you know the human body is made up of 50-75 percent water (depending on your age)? A person can survive about a month without food but only five to seven days without water! Think of all the different ways water is part of our lives: We drink it; we clean with it; we use it to grow and make many things; it provides habitat for fish and other animals and plants; and we have a lot of fun playing in it.

Keeping our water clean is important, especially when we consider that just three percent of the Earth's supply of water is fresh (97 percent is salty) and only about one percent is drinkable (the other two percent is frozen).

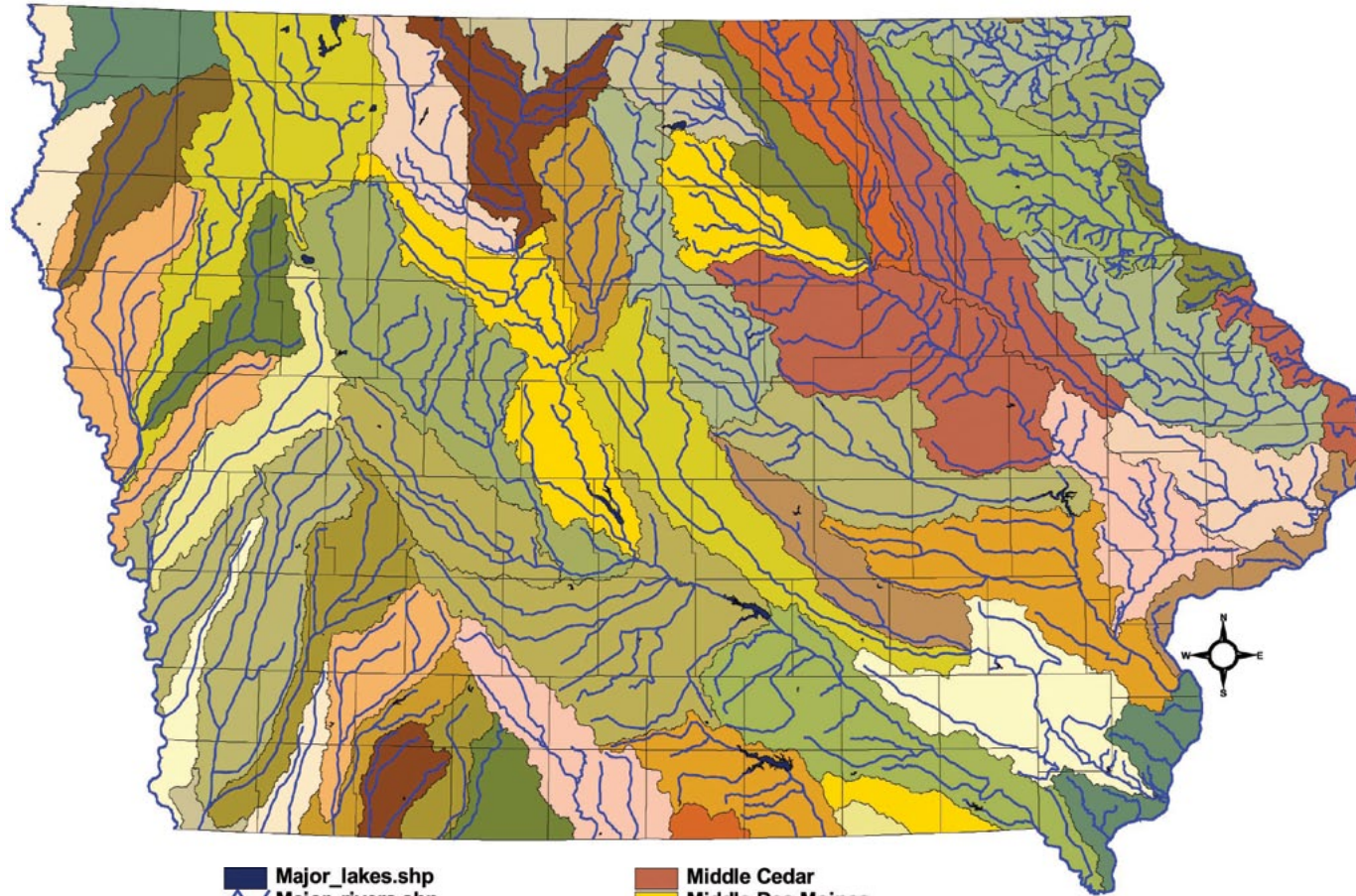
Consider these other interesting and important water facts:

- The average American uses 140-170 gallons of water per day.
- An average American family of four uses 881 gallons of water per week simply by flushing the toilet.
- Every day in the United States, we drink about 110 million gallons of water.
- A dairy cow must drink four gallons of water to produce one gallon of milk.
- 300 million gallons of water are used to make one day's supply of U.S. newsprint.

With only one percent of Earth's water suitable for drinking, it is wise to protect and use just the amount we need. Water, a precious resource, should never be taken for granted. Life depends on it, and if we all do our part to keep it healthy, it will continue to help sustain our lives and our planet.



IOWA WATERSHEDS



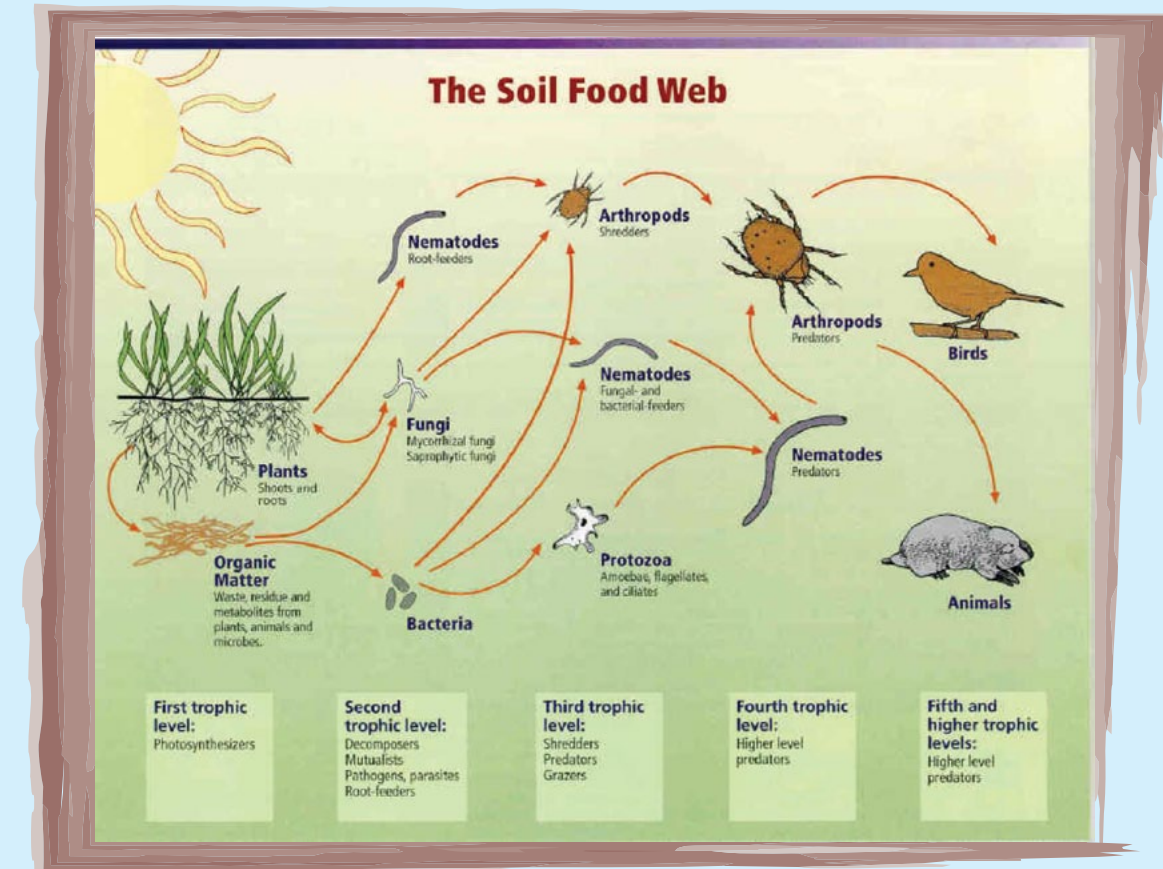
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| Bear-Wyaconda | Nodaway |
| Big Papillion-Mosquito | North Fabius |
| Blackbird-Soldier | North Raccoon |
| Blue Earth | North Skunk |
| Boone | One Hundred and Two |
| Boyer | Platte |
| Coon-Yellow | Rock |
| Copperas-Duck | Root |
| East Fork Des Moines | Shell Rock |
| East Nishnabotna | Skunk |
| Flint-Henderson | South Raccoon |
| Floyd | South Skunk |
| Grant-Little Maquoketa | Tarkio-Wolf |
| Keg-Weeping Water | Thompson |
| Lake Red Rock | Turkey |
| Little Sioux | Upper Cedar |
| Lower Big Sioux | Upper Chariton |
| Lower Cedar | Upper Des Moines |
| Lower Des Moines | Upper Grand |
| Lower Grand | Upper Iowa |
| Lower Iowa | Upper Wapsipinicon |
| Lower Wapsipinicon | West Fork Cedar |
| Maple | West Nishnabotna |
| Maquoketa | West Nodaway |
| | Winnebago |

SOIL FOOD WEB

The diverse ecosystems that are found in soil determine the productivity of our land. Without the billions of bacteria, millions of fungi and protozoa, and the thousands of other critters living under our feet, we would be hungry indeed. This micro-community—or soil food web—transfers nutrients through the

soil, makes other nutrients into forms plants can use, and helps protect crops from soil-born pathogens.

The very structure and health of your land is directly influenced by this complex set of biological and chemical interactions which decompose, retain, and recycle nutrients within the soil.



WHO IS PART OF THE IDEAL SOIL COMMUNITY?

Different groups of critters do different things in the soil. For example, bacteria and fungi take nutrients from the soil which are “non-available” (meaning plants can’t use them) and retain the nutrients as they grow. Their waste products (from the decomposition of plant material or residues) also retain those nutrients in non-leachable forms. The bacteria and fungi are then consumed by predators, releasing soluble, or plant-available, nutrients, making them usable for your crops.

Bacteria also build microaggregates, the smallest units of soil structure. If we think of the soil as a city being built, microaggregates act as the bricks. Fungi are the mortar that binds the individual bricks together, forming walls, ceilings and floors. The larger organisms like protozoa, nematodes and microarthropods construct the buildings. They rearrange the bricks to build the condominiums in the city that we call soil structure. All these organisms congregate around plant roots acting as a castle wall, and protecting the roots from disease organisms and/or pests.

Bacteria are mostly round or rod-shaped, and are vital for recycling nutrients in the soil.

Fungi help to hold and transfer nutrients directly to plants through symbiotic relationships. They also promote healthy soil aggregation.

Predators prey upon the bacteria and fungi and their predator-prey interactions are crucial to the processes of decomposition and the cycling of nutrients. There are far fewer predators in the soil than there are bacteria and fungi.

Protozoa feed on bacteria. This keeps the bacteria communities healthy and growing by preventing overpopulation and overuse of nutrients which would be detrimental to everyone in the soil community. As they digest bacteria, protozoa release excess nitrogen from the bacteria in plant available forms around roots.



Nematodes, shaped like tiny worms with pointed ends, hold and recycle the nutrients present in the organisms that they feed upon. There are beneficial and detrimental nematodes, which are distinguishable by their mouth parts.



Microarthropods (micro- meaning “very small” and -arthropod meaning “having jointed legs”) are quite simply very tiny insects. They are at the top of the microscopic soil food web, preying on bacteria, fungi, and nematodes. These creatures are food for larger predators like earthworms and bigger bugs. Predator-prey relationships between microarthropods and other soil fauna are necessary to foster a complete food chain within, and beyond, the soil.

Since different agricultural and land management practices affect these complex communities in different ways, the microbiology of your soil can be very insightful as to the long-term productivity of soil and how current practices are impacting this.

Adapted from Rodale Institute: <http://rodaleinstitute.org/2012/soil-life-microbiology-on-the-farm/>

ANALYZING SOIL HEALTH

Healthy soil is approximately 50 percent solid material (minerals and organic matter) and 50 percent pore space (water and air), thus allowing roots to penetrate and water to drain well. This 50/50 structure also allows the soil to better supply plants with the nutrients they need for growth and productivity. Maintaining organic matter is essential for good soil structure and health.

Organic matter enhances water and nutrient holding capacity and improves soil structure. Managing soil to increase organic matter can enhance productivity and quality, reducing the severity and costs of natural phenomena, such as drought, flood, and disease. In addition, increasing levels of organic matter can increase soil carbon and carbon storage and can reduce atmospheric CO₂ levels that contribute to climate change.

THE WORK OF OUR HANDS

Humans depend on ecosystem goods such as food, timber and medicines, as well as services such as water and air purification, carbon storage, pollination and soil formation.

The challenge is to sustain the resilience of ecosystems – the ecosystem’s capacity to cope with disturbances and maintain an adequate supply of goods and services. This is especially important in the face of global environmental change (such as climate change) which may cause more frequent and intense disturbances.

Diversity increases an ecosystem’s ability to be resilient. For example: in a healthy grassland, there are four or five species that can put nitrogen into the soil. If the temperature rises or falls, it may affect one or two of the species, but usually not all of them. So the system does not lose its ability to fix nitrogen.

WATER POLLUTION

Water pollution is the contamination of water forms. It occurs when unwanted materials, known as pollutants, are added to the water.

Types of water pollution include:

Toxic Substances—A toxic substance is a chemical pollutant that does not naturally occur in aquatic ecosystems. The greatest contributors to toxic pollution are herbicides, pesticides, and industrial compounds.

Organic Substances—Organic pollution occurs when an excess of organic matter, such as manure or sewage, enters the water. When organic matter increases in a body of water, the number of decomposers will increase. These decomposers grow rapidly and use a great deal of oxygen during their growth. This leads to a depletion of oxygen which can kill aquatic organisms.

Another type of organic pollution can occur when inorganic pollutants, such as nitrogen and phosphorus, accumulate in aquatic ecosystems. High levels of these nutrients, which are found in fertilizers, cause an overgrowth of plants and algae. As the plants and algae die, they become organic material in the water. The enormous decay of this plant matter, in turn, lowers the oxygen

level. The process of rapid plant growth, followed by increased activity of decomposers and depletion of the oxygen level, is called eutrophication.

Thermal Pollution—This can occur when water is used as a coolant near a power or industrial plant and then is returned to the aquatic environment at a higher temperature than it was originally. Thermal pollution can lead to a decrease in the dissolved oxygen level in the water.

Ecological Pollution—This takes place when chemical pollution, organic pollution, or thermal pollution is caused by nature rather than by human activity. An example of ecological pollution would be an increased rate of siltation of a waterway after a landslide, which would increase the amount of sediment in runoff water. Another example would be when a large animal, such as a deer, drowns in a flood and a large amount of organic material is added to the water as a result.

POINT AND NONPOINT SOURCE (NPS) POLLUTION

Sources of water pollution are generally grouped into two categories based on their origin:

- Point source pollution
- Nonpoint source pollution



Point source pollution can be traced to its original source and occurs when the polluting substance is dumped directly into the waterway.

Examples of point source water pollutants include:

- A pipe dumping toxic chemicals directly into a river
- River or oceanic oil spills



Nonpoint source (NPS) pollution cannot be traced to a specific original source. It happens when rainfall, snow melt, or irrigation water runs over land or through the ground, picks up pollutants, and deposits them into a water body. According to the Iowa Department of Natural Resources, major nonpoint source pollutants in Iowa include:

- Sediment—soil that is broken down into fine particles, known as silt, through weathering and erosion, which collects in water bodies. This is the leading NPS pollutant. Most sediment in Iowa comes from farming practices such as cropland tillage and livestock in pastures and feedlots. High levels of eroded sediment also come from construction sites, stream banks and lake shorelines.
- Nutrients—especially nitrogen and phosphorus. Nutrients can come from fertilizers used on residential lawns, golf courses, and farmland, as well as from organic sources such as manure and human sewage.
- Pesticides—chemicals used on farms and in urban areas to kill unwanted insects.
- Pathogens—bacteria and viruses.
- Auto oil and grease—leaked onto pavement or improperly dumped.



SOIL AS A NPS POLLUTANT

When soil erosion occurs at an accelerated rate the excess soil particles, known as silt, collect in lakes, streams, and rivers. This is the number one water quality problem in Iowa.

Silt decreases the amount of light entering water, which has a negative effect on aquatic animals and plants. Silt particles clog fish gills, smother fish eggs and make it difficult for aquatic animals to see their food. When large amounts of soil particles are deposited into lakes, rivers, and streams (a process called sedimentation), aquatic life habitat is destroyed and the ecosystem is changed. Sedimentation reduces the holding capacity of lakes and rivers, which leads to changing water temperatures, widening river channels, and increased flood potential. Many Iowa lakes have lost several feet of depth due to sedimentation. Damage from erosion exceeds \$54 million annually in Iowa.

Soil can also carry nutrients, particularly phosphorus, it picks up as it is eroded from city lawns and treated crop fields. When these nutrients collect in a water body, such as a lake, they fuel increased growth of algae. This algae reduces the oxygen level, which creates problems for other aquatic life, and can interfere with human enjoyment of water. The water is unappealing to swim in and there are fewer fish to catch.

PRECIOUS SOIL

Soil is an important natural resource. While you may be tempted to think “it’s just dirt,” pause and consider that all life is dependent on soil in some way. Green plants are at the beginning of the food chain and those plants rely on soil to grow and survive. As a member of the food chain, your food consists of items grown in soil or items that eat something grown in soil. Soil’s ability to grow food is probably the function of soil with which you are most familiar; however, this natural resource can affect you in other ways as well.

Soil helps to control the flow of water during a rainstorm and acts as a storage basin for the water. During a storm, rain is absorbed into the soil, and healthy soil will hold moisture for plants to use for many days following. This means it doesn’t need to rain every day in order for plants to thrive. Soil also acts as a filter—removing chemicals and excess nutrients from the water it absorbs, reducing the amounts that enter groundwater. This helps to keep our waters clean for drinking and recreation.

SOIL FORMATION

Soil is formed as rocks and minerals are weathered by wind and water and broken into smaller pieces. These pieces then mix with material from decaying animals and plants, known as organic material. The process of creating a single inch of soil can take 500 to 1,000 years depending on weather conditions and amount of organic material available. Iowa was once a vast tall grass prairie and over the years experienced the prairie life cycle: Prairie fires leaving behind dead, organic material followed by regeneration of new growth. This life cycle helped to develop the rich black earth known as topsoil. Unfortunately, this wonderful soil can be lost or destroyed at a much faster rate than it can be created.

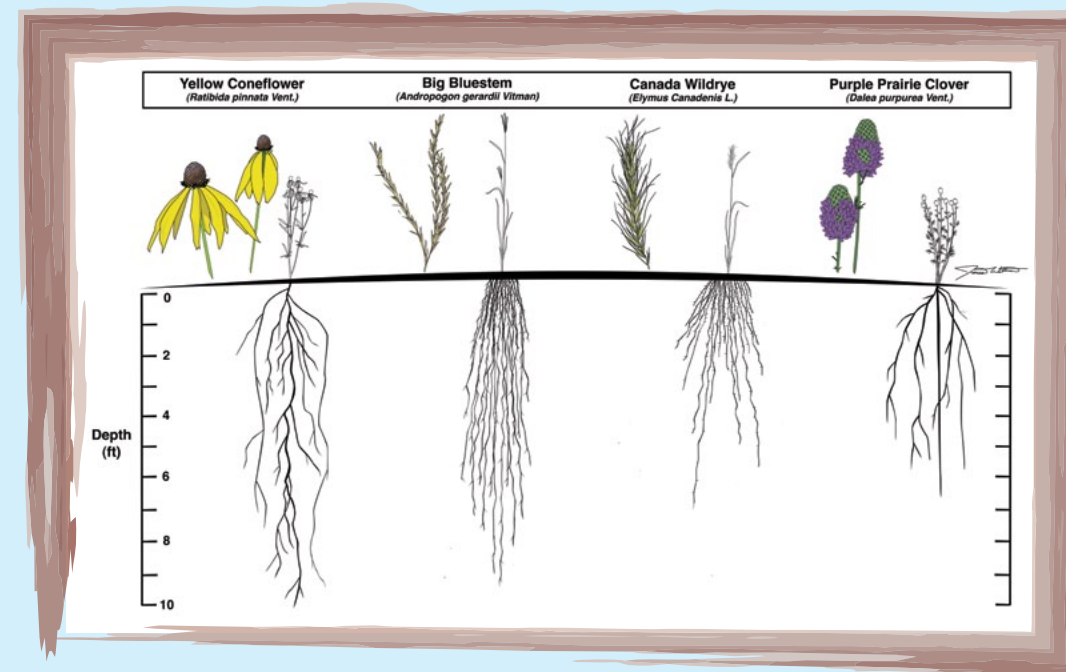
SOIL EROSION

Soil erosion is the physical weathering of the Earth’s surface resulting in surface soil material being moved. Wind and water are weathering elements that cause basic amounts of soil erosion to naturally occur. Changes to landscape and water flow can greatly increase the rate of erosion. Exposed soils are left vulnerable to erosion by wind and rain.

People have changed the Earth in many ways. Unfortunately, some of these changes can cause soil to be eroded more quickly than it naturally would.

CHANGING LANDSCAPE

In the past, Iowa’s prairie landscape was covered with a variety of plants which also had a variety of root systems. Some were shallow, some very deep, some chunky like a ball, others matted and knotted together. The varying root types increased the soil’s ability to absorb and retain water and minimized erosion by helping to hold the soil in place.



As Iowa’s land transitioned to row-crop production, more and more areas contain only one root type at a time (the planted crop). Today, less than 0.1 percent of Iowa’s natural prairie remains. Water’s flow over the land has been further changed by farming practices, such as channelization and tiling, and landscape changes due to spreading city limits.

CHANGING WATERWAYS

Streams and rivers naturally wind through the landscape. As farmers and urban developers seek to utilize more of their land, they manually straighten these waterways. This is a process known as channelization.

Water in channelized streams flows faster; after all, it is faster to run in a straight line rather than around obstacles. This faster water flow increases erosion and deepens the stream channel. Natural plant life around the stream is changed, further increasing erosion and affecting wildlife. The changed flow of water can damage bridges and increase the amount of flooding. Most of Iowa’s rivers and streams have channelized stretches, and over the years approximately 3,000 miles of Iowa’s rivers and streams have been lost to channelization.

Tiling involves installing a drainage system underground to remove excess water from the landscape. This drainage system changes the pathways of water flow by reducing the flow of water over the land surface. Water and nutrients, especially nitrogen, moving through the tile are short-circuited in their movement to streams. With the installation of subsurface drainage systems, most of Iowa’s wetlands have been drained.

With altered water flow pathways, rivers and streams move faster, leading to higher levels of soil erosion and less stable stream and river banks. More erosion means more NPS pollution in our water bodies.

FARMING PRACTICES TO REDUCE EROSION

There are many farm practices that can reduce soil erosion by controlling where rainwater and snow melt flow or slowing down the water so that more can be absorbed into the soil. These include:

- Planting cover crops—small grain or legume “green” crops seeded in early fall to protect and improve water quality during the “brown” winter months when row crops are not grown. The roots of these plants grow closely together and are left in the soil over the winter, helping to keep soil in place.
- Leaving above-ground crop residue—stalks and leaves—covering the ground after harvesting. This cover helps keep soil in place by absorbing impact of raindrops on the soil surface and lessens the amount of soil that can be removed by the wind blowing over the surface of the field.
- Reducing the number of times a field is plowed or “tilled,” or not tilling the field at all. This is referred to as conservation tillage or no-till farming, respectively. This leaves plant residue cover on the ground to help minimize soil erosion.
- Keeping grassy areas in valleys and other low areas. These grassed waterways catch soil that may be eroded from the hillside during a rainstorm.
- Creating terraces on steeper slopes of land, which resemble stair steps on the slope of the hill. This

changes water flow down the slope from a straight line to the bottom to a slower flow pattern.

- Planting crop rows along hills rather than up and down them. Planting rows which follow the curves of the land is called contour farming.
- If a field is next to a lake, river, or stream do not plant crops right up to the water bank; instead establish grassed buffer strips at the field edge. Grassed buffers help keep the water's banks strong and catch soil that may be flowing with rainwater to the water body.

It is estimated that these types of farming practices save the erosion of 52.5 million tons of soil per year in Iowa.

SPREADING CITY LIMITS

As cities grow, an increasing number of roads, parking lots and buildings cover the ground. These surfaces do not absorb water and they prevent rain and snow melt from soaking into the ground. Water instead moves over these surfaces to lower areas, gutters, and storm sewers, often times very quickly. This is referred to as runoff.

Because of the amount of these non-absorbing surfaces, runoff in cities can be quite high. In fact, a typical city block generates more than five times more runoff than a woodland area of the same size.

Water that flows through gutters and sewers reaches streams, rivers and lakes much faster than if that water soaked into the ground and passed through layers of soil. When this faster moving water reaches the waterways it damages the bank landscape and plant life which can increase erosion in these areas. If too much water enters the waterway at once, the banks overflow and flooding results.

With growing cities there are also lots of construction sites. These areas temporarily tear up the ground and plant life, leaving large areas of bare soil while construction is taking place. Any time soil is left uncovered it is at risk of being eroded by wind and precipitation.

REDUCING CITY RUNOFF AND EROSION

Farmers should not be the only ones concerned with reducing soil erosion and runoff. City runoff, containing soil particles and pollutants, also ends up in our lakes and rivers. Just as farmers are becoming educated on soil management practices, construction companies and city planners are adopting methods to control city erosion and runoff. These include:

- Conserving natural areas such as buffers and absorbing soils with good plant life
- Leaving trees in place, if possible, because they have large root systems and the canopy of leaves slows the fall of rainwater
- Covering exposed soil with straw at construction sites
 - Maximizing areas of water-absorbing landscape in the midst of concrete, including bioswales and rain gardens
 - Utilizing porous pavement systems, including modular permeable pavers or porous asphalt, that promote water infiltration and reduce urban runoff.

PERSONAL RESPONSIBILITY

Water and soil are important to all of us. These natural resources have very important connections to the foods we eat and staying healthy, but they also perform many crucial functions which keep our planet healthy and strong. Additionally, soil is the base for beautiful landscapes and water in our lakes and rivers provides a great place for fun and recreation.

The quality of these resources directly affects the functions these resources perform. Therefore, it is important for us to do our part to keep our water and soil clean and healthy in order to continue to enjoy what they do for us.

We all can be a part of reducing water pollution and soil erosion, and improving water quality in our state. Small changes by many people can add up to big results.

Some basic steps to follow include:

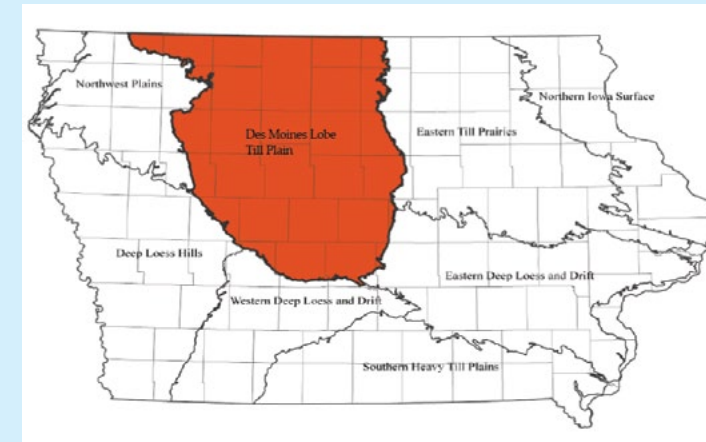
- Reduce fertilizer and pesticide use.
- Store and dispose of chemicals properly.
- Watch for and promptly repair auto leaks. Dispose of auto fluids properly.
- Use materials that allow water to pass through driveways and sidewalks, e.g., permeable pavement systems.
- Use native plants and wildflowers which have better root systems instead of grass lawns.
- Sweep driveways, sidewalks, and roads instead of cleaning with a hose.
- Use a variety of plants and root types in flower beds and mulch them.
- Do not connect rain spouts directly to the city's storm drain. Direct the water into the lawn or garden instead, or into a rain barrel.
- Do not flush medicines down the drain.
- Pick up and properly dispose of pet waste.
- Beautify a lake, river, or stream near you by removing trash or planting trees. Invite others to get involved too!
- Support state, national, and international organizations aimed at improving and protecting natural resources.

Staying connected to nature and all it has to offer can help to remind us in personal ways that our resources affect our lives, and our lives affect our resources. So, get out to our lakes, rivers, and streams: enjoy them, care for them, and pass them on healthy to future generations!

INCREDIBLE WETLANDS

Wetlands are areas where plants and animals live in water or saturated soil. It may be landscape that includes shallow standing water such as a marsh, prairie pothole, or a slough; it may be a place where the mucky, smelly soil is always wet or typically has water near the surface such as a wet meadow; or it may be a combination of both watery landscapes.

Wetlands were common across Iowa 150 years ago. A majority of them were located in central and northern Iowa, within a section of land called the Des Moines Lobe. Created by the last glacier to cover the state 10,000-15,000 years ago, this area was left flattened with thousands of indents when the ice receded. Deep indents became lakes, while most of the more shallow recesses became prairie pothole wetlands. In some places within the Des Moines Lobe, as many as 200 potholes could be found within one square mile section of prairie.



With development of land for railroads, communities and farms over the years, the majority of Iowa wetlands were drained and dried. Today a mere five percent of original Iowa wetland acres remain and only one percent of the prairie potholes can be found.

Reduced Iowa wetlands has meant lost habitat for thousands of plants, animals and invertebrates. In fact, most of Iowa's endangered species live in or are associated with wetlands. This is no surprise, as healthy Iowa wetlands sustain a dynamic ecosystem where a large variety of plants, animals and invertebrates can thrive.

WATER-TOLERANT PLANTS

Different types of wetlands support different kinds of plants. Deeper standing water can house submerged plants, such as sago pondweed and coontail, as well as floating plants, such as water lily and duckweed (the world's smallest flowering plant). Shallow waters are home to emergent plants such as cattail and horsetail. Soggy wetland soils support sedges, grasses and flowers, such as smartweed and jewelweed.

While prairie plants gather oxygen through their roots in the soil to distribute throughout the plant, water plants gather the oxygen they need via their leaves. This allows them to thrive in wet conditions that would otherwise choke off typical plants.

MAMMALS

Wetlands support many different mammals. Muskrats and beavers eat and make homes using emergent reeds and grasses. Brown bats feast on wetland insects, while mink and raccoon dine on bird eggs and shellfish.

BIRDS

Wetlands provide food and cover for nesting birds and waterfowl. Red-winged blackbirds can be found sitting atop a cattail not far from their nesting mates. Native mallards and wood ducks swim in the waters and nest on wetland shores. Wetlands are also crucial for the successful travel of hundreds of migratory birds.

HERPS

Wetlands provide perfect habitat for the life cycle of bull and leopard frogs, American toads, painted turtles and tiger salamanders, to name a few.

FISH

A few species of fish can survive in low-oxygen waters including bullhead and carp, depending on the depth of the water. Crawfish and clams can also be found.

INSECTS

Mayflies and dragonflies are common flying wetland insects. Water striders, whirligig beetles and backswimmers also make wetlands their home, along with thousands of others.

BIODIVERSITY PYRAMID

Biological diversity, also called biodiversity, is defined as all of the living things in a certain area. These living things exist together in what we call ecosystems: communities of living organisms and the nonliving components of their environment acting together as a system.

There are a number of different metrics for evaluating biodiversity.

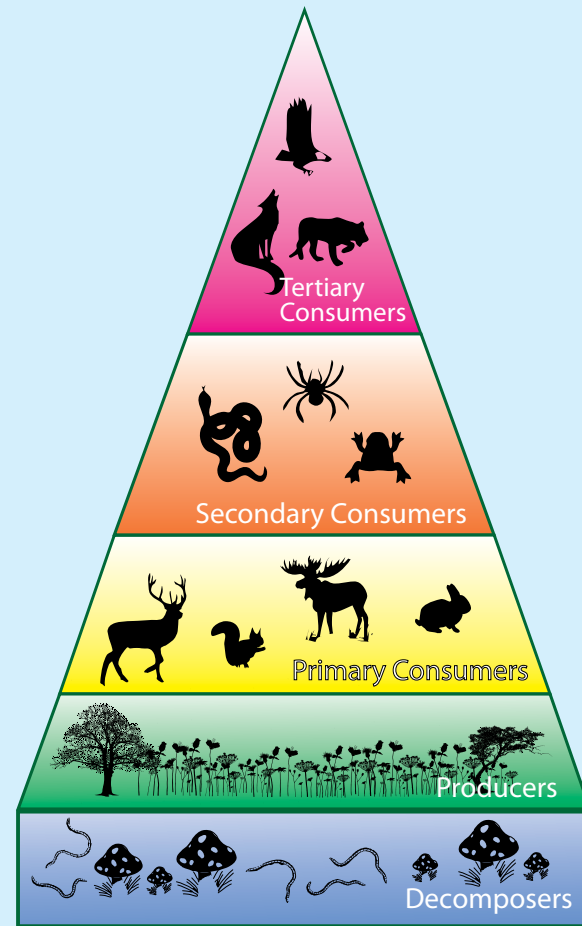
- Species diversity is measured in both species richness (number of different species present) and relative abundance of the species present (how many individuals present for each species).
- Genetic diversity is the differences in genes between individuals within a given species. Genetic diversity is important because diverse genetic traits help species cope with disease and environmental changes. More genetic resources help species survive difficult times. For species on the brink of extinction, the reduction in available genes makes it difficult for the species to return to full health.

Biodiversity provides stability and productivity. Stability is the measure of resistance and resilience (resistance to change and the ability to bounce back from disturbance).

Did you know? Iowa's wetland ecosystems are one of the most biologically diverse ecosystems in the world. When learning about biodiversity, we often think of far-off places that have been the subject of much media attention, like the Amazon rainforest and the coral reefs, but our wetlands right here in Iowa house the same levels of biodiversity!

All organisms perform their own role within an ecosystem; this role is called a **niche**. Many of these jobs or niches are related to what the organisms eat or who might be eating them.

All organisms are connected through the food web, which is often represented in pyramid format. Each trophic level, or feeding level, is represented as its own horizontal slice of the pyramid. The size of each slice provides a relative scale of the abundance of organisms in that trophic level.



The trophic levels include:

- **Producers** (includes plants, algae, phytoplankton)
These organisms produce their own food using carbon dioxide, sunlight, and water in the process of photosynthesis. They form the foundation of aquatic and terrestrial ecosystems.
- **Primary Consumers (pc)**
These organisms eat producers. They are also called herbivores or plant-eaters.
- **Secondary Consumers (sc)**
These organisms eat primary consumers. They are also called carnivores or meat-eaters. Some secondary consumers are also plant-eaters in addition, referred to as omnivores.
- **Tertiary Consumers (tc)**
These organisms are the so-called “top dogs,” eating secondary consumers, primary consumers, and/or producers.
- **Decomposers** (includes some bacteria, fungi, worms)
Decomposers bring the whole food pyramid full circle. They consume dead and decaying plant and animal material (from all trophic levels above), releasing nutrients and organic matter.

EXAMPLES OF FOOD CHAINS

Phytoplankton (producer) → herring (pc) → seal (sc) → polar bear (tc) → decomposers

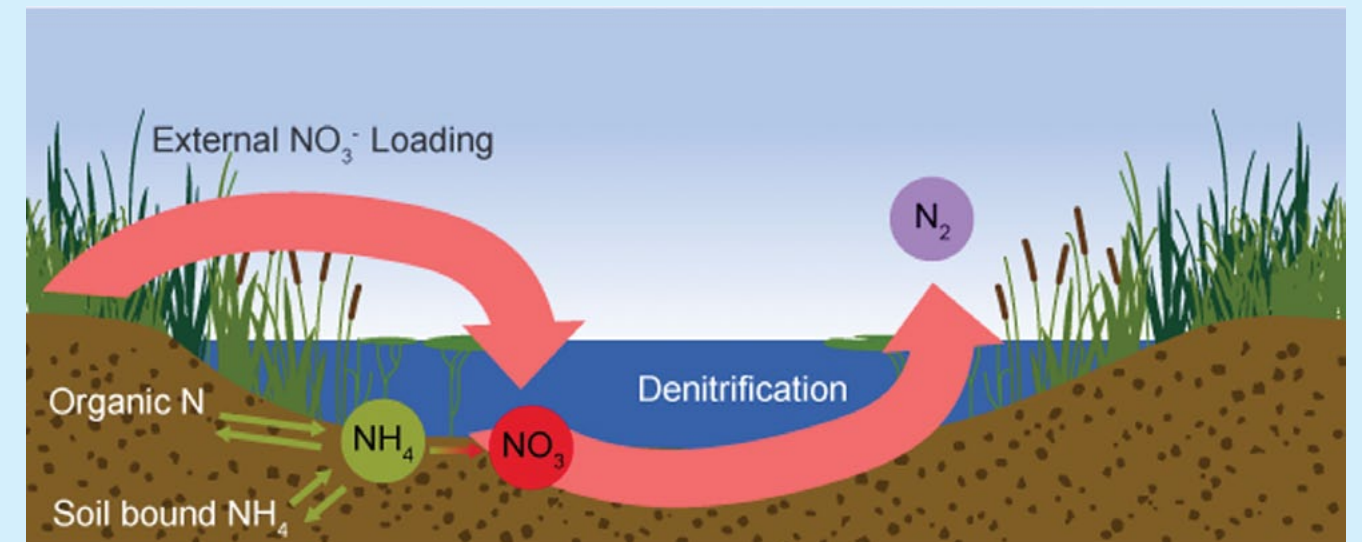
Phytoplankton (producer) → insect (pc) → bluegill (sc) → largemouth bass (tc) → decomposers

Grass (producer) → mouse (pc) → snake (sc) → red-tailed hawk (tc) → decomposers

Willow tree (producer) → moose (pc) → wolf (tc) → decomposers

Biodiversity is all about balance. If one species' population increases or decreases, this can cause a cascading or domino effect across the whole pyramid.

DENITRIFICATION



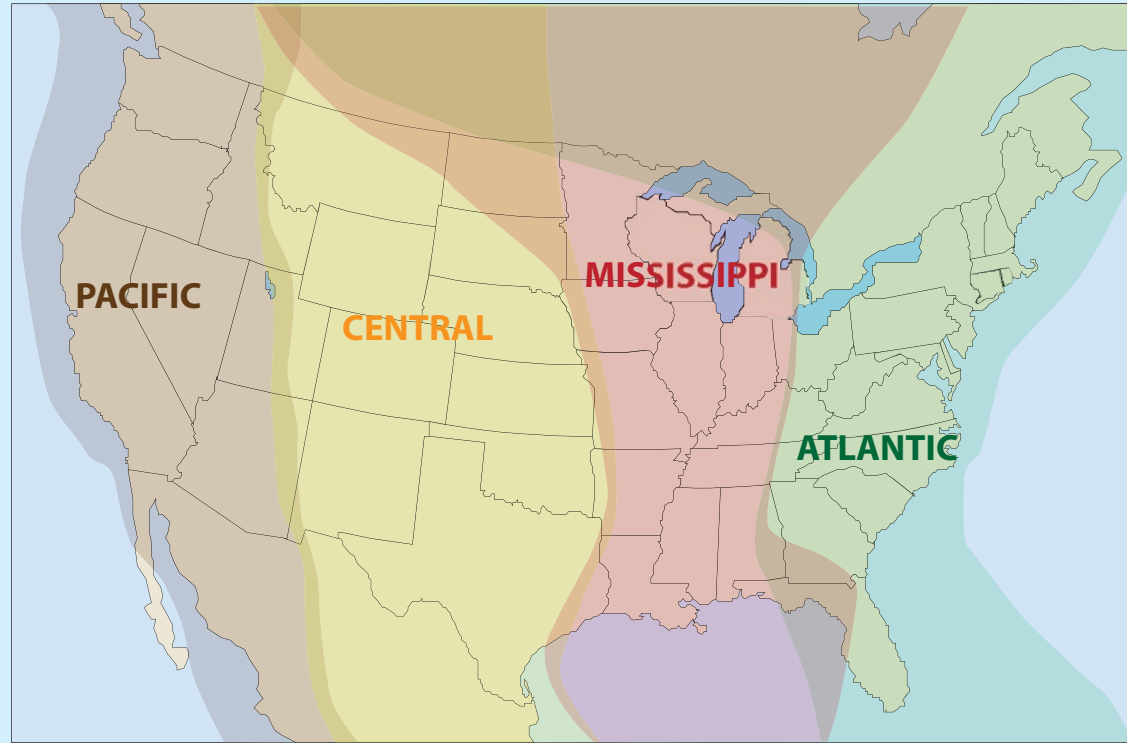
Microbes consume nitrate (NO_3), the way humans use oxygen when we breathe and respire, but this happens under anaerobic conditions. The microbes convert the nitrate to N_2 , an inert gas that makes up 80 percent of the atmosphere. This process is called denitrification.

Wetlands are ideal locations for denitrification to occur. In order to maximize denitrification rates, you want to have a saturated wet soil that will go anaerobic and you want to supply that system with a source of nitrate.

In the process of denitrification, the nitrate is not permanently

taken up by the plants. Instead, the nitrate is burned away, or respired, by those microbes in the sediment as they convert the nitrate to inert N_2 gas. Aquatic wetland plants help to provide surfaces on which those microbes might live, and they also provide organic carbon to help maintain growth and metabolism of the microbes.

The denitrification process is performed primarily by bacteria (such as *Paracoccus denitrificans*, *Thiobacillus denitrificans*, and some pseudomonads). However, scientists have also observed denitrification in some Archaea and benthic eukaryotes.



Migratory birds, butterflies, and insects travel long distances twice each year as they travel between their northern summer breeding grounds and southern winter feeding grounds. These creatures tend to travel along predictable routes year after year, and these routes are referred to as flyways or corridors. Just like humans travel on the highway, birds and other migratory creatures travel on the flyway.

As birds, butterflies, and other migratory species make their long journeys, wetlands are a critical stopping point along their way. On a long journey, wetlands are like a gas station, hotel, restaurant, and park all in one! Conservation of wetland areas in Iowa and beyond is critical for maintaining migratory flyways and corridors of habitat.

The United States has four major migratory flyways:

1. **Pacific Flyway** – Along the Pacific coast, west of the Rocky Mountains
2. **Central Flyway** – Over the Great Plains, east of the Rocky Mountains
3. **Mississippi Flyway** – Along the Mississippi River.
4. **Atlantic Flyway** – Along the Atlantic coast.

FIND YOUR WATERSHED ADDRESS

Watersheds are identified by the name of the body of water that they drain into, such as the Storm Lake Watershed or the Big Creek Watershed. Small watersheds are part of larger watersheds. For example, the Raccoon River Watershed is part of the Des Moines River Watershed, which is part of the Mississippi River Watershed.

Just as you have a mailing address, you also have a watershed address. The water that falls on your home in some form of precipitation either soaks in and becomes groundwater or becomes runoff. It then drains into nearby streams or rivers and continues to flow into larger rivers until it reaches the ocean. The route of the runoff is your watershed address. For instance, someone living in Carroll, Iowa would have an address of:

- Middle Raccoon River
- North Raccoon River
- Des Moines River
- Mississippi River
- Gulf of Mexico.

Use a large USGS topographic map for this activity, or a detailed map with rivers clearly marked. Find your home, then find the nearest downstream water body to your home. Record the waterway's name if it has one; otherwise, call it an unnamed stream. Follow that stream until it joins another stream or river. Record the name of that stream or river. Continue following the streams until you reach the end of the watershed—which will be the Gulf of Mexico for anyone living in Iowa. This list will be your complete watershed address!

WHAT'S IN MY WATERSHED?

Write the name of your watershed on the top of a piece of paper. Then list eight things that are interesting or important about your watershed. Pick one of those things and describe it in more detail—include all of the senses in your description.

Questions to help you think about what is interesting or important:

- What kinds of activities happen on the land around your watershed?
- Are there landmarks that people are familiar with?
- What landforms are in your watershed (hills, prairie pothole wetlands, etc.)?
- What is the history of the land (coal mine, flour mill, canning factory)?
- Are there parks, libraries, museums, trails? Do they have any connections to the water sources?
- Are there other links in your watershed besides water?

MAP YOUR SCHOOLYARD

Materials needed

- Paper
- Pencils, pens or markers

Procedure

Create a map of the schoolyard or school grounds, color coding by different types of land cover. Where is the soil exposed? Where is it “capped” by asphalt/cement or buildings?

SCHOOLYARD SOIL SAMPLING

Materials needed

- Schoolyard map
- Quart size zip-top freezer bags
- Permanent markers
- Spade or trowel
- Ruler

Procedure

1. Using the schoolyard map from the previous activity, identify and label 4-6 different locations on site from which you will obtain soil samples.
2. Label an individual zip-top freezer bag for each location. To collect the soil samples, remove as much surface debris (grass, plant residue, mulch, etc.) as possible. Using the spade or trowel, dig down into the soil to a depth of 6-8 inches.
3. Transfer each soil sample to the appropriately labeled freezer bag, collecting enough soil to fill each bag half full.

Compare and contrast the soil samples collected from different locations on site. What is the soil like now? Do some historical investigation. When was the school built? What was there before the school? What kind of land cover would there have been (prairie, woodland, etc.)?

What kind of soil is in your watershed? Does it erode easily? What kinds of conservation practices are being used to hold the soil in place?

BUILD A WATERSHED

This experiment illustrates the basic properties of a watershed: how water flows from higher elevations to lower elevations and how watersheds are interconnected. The students will understand how the placement of buildings, roads, and parking lots can be important to watershed runoff and how careless use and disposal of harmful contaminants can have a serious effect on downstream water bodies.

Materials needed

- 1 large plastic storage tote (about 1.5' W x 3' L x 1' H)
- 2 lb. modeling clay
- 3 lb. sand (any type of sand will do)
- 2 lb. aquarium gravel
- 1 roll of wax paper (or any other impervious, water repellent surface, tin foil, plastic wrap, etc.)
- ¼ cup of cocoa mix, iced tea mix, or other flavored drink mix (to represent chemicals)
- 1 spray bottle or bucket full of water

Procedure

- Wash the aquarium gravel carefully to remove any powdery residue that may add cloudiness to the water. Fill the container with about 2 inches of gravel. Slope the gravel slightly so, that at one end (down slope), the gravel is only about ½ inch deep and, at the other end (up slope), the gravel is about 3 inches deep. This gravel layer will represent the aquifer.
- Mix the clay and the sand. The consistency of this mix should be gritty, with slightly more clay than sand. This mixture should allow water to run freely over it, but if left standing, the water should slowly permeate the surface. Add this mixture to the container carefully, so as not to disturb the slope of the aquifer already placed. The slopes should be similar, with about 2 inches of sand/clay mix overlying the gravel already placed, and on the downhill end there should be about 3 inches of gravel left exposed.
- Carve a channel in the middle of the clay/sand layer, about ½ inch deep and about 1 inch wide. This channel will represent the main river of the watershed. Near the top of the slope, split the channel into two or three separate channels to represent tributaries. You may wish to add other tributaries along the main branch of the “river” to further illustrate other watersheds.
- With some extra clay/sand mix, build little hills between the tributaries. These hills separate the smaller watersheds, but when looked at as a whole, the entire “river” system is one watershed. You may also wish to add some small model trees or green felt to represent forests or fields. Buildings can be represented with small blocks of wood.
- Along the main river, flatten out an area that is about 8 inches by 3 inches. Cut out a piece of wax paper to be about 4 inches by 3 inches in size. Stick this down onto the clay sand mix, sloping it slightly towards the river. If necessary, use some clay to hold the edges down. Explain to students that this wax paper represents the impervious surface of a parking lot.

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- Fill the bottom of the container with about 2 inches of water. The water should fill all of the aquarium gravel “aquifer” area, and should just reach up to the lowest extent of the clay/sand mixture. Explain to students that the aquifer captures and transports water that seeps down through the soil.
- Using the spray bottle, simulate rain over the flattened soil area and the parking lot. Ask the students to note that the “rain” soaks through the soil, but runs off the parking lot to the river. Discuss with students what the effect would be if the entire watershed was “paved.”
- Have the students sprinkle some cocoa mix over the sides of one of the smaller watersheds. The cocoa represents pollution. Over one of the unpolluted “watersheds” cause some rain with the spray bottle (*it may be necessary to cause more rain by pouring water). Note that the runoff from the rain is clean. Now, make it rain over the polluted area. Ask the students to note how the pollution travels down through the watershed, contaminating all downstream areas. Discuss with the students why the pollution is a problem, and what can be done to fix the problem.

WHERE DID ALL THE WATER GO?

Students need and use water daily in many ways, and often in unrealized amounts. Water is used directly for drinking (a half-gallon a day). The sponges used will represent humans’ demands on the water supply on Earth.

Materials needed

- Big clear container with a wide mouth opening
- 4 sponges cut into 8 pieces each
- Water
- Bowl
- Marker or masking tape
- Paper towels
- Drawing paper

Procedure

- Put 4 cups of water in the container. Ask the students to imagine that the container represents the earth and the water represents all the available water.
- Ask students to brainstorm the ways we use water (drinking, irrigation, recreation, cleaning, processing, bathing, transportation, etc.). Write these on the chalkboard for student reference.
- With a marker or masking tape, mark the water level on the outside of the container. Drop a piece of sponge into the container as you share one personal demand you made on water today. Remove the wet sponge from the water level. It probably shows very little change.
- Ask students, one at a time, to name a personal demand they made on water today while dropping a piece of sponge in the container. The students may begin to notice a change in the water level. After all the sponges have been dropped in the container, soaking up as much water as possible, remove all of

them (don’t squeeze them out) and set them aside in a bowl. Draw attention to the dramatic change in the water level. Help students understand that the demands of a lot of people have more effect than the demands of a few people on natural resources.

- Ask: What happens to the water level as we put in more sponges?
What will happen if we keep using water at this rate?
What can we do about this situation? How can we give water back to the environment?
- Once the students have mentioned reducing, reusing, or recycling take 1 wet sponge, naming a way you can reduce or recycle, and squeeze the water out of the sponge back into the container. There is a change in the water level, but not much. One person reducing or recycling does make a difference. The impact, however, will be greater when many individuals reduce, reuse, and recycle.
Ask: In what ways can you reduce, reuse, and recycle, or be more careful about the demands you make on water?
 - When students have an idea about how they can give back to the environment, have them squeeze the water out of a wet sponge back into the container sharing their idea with the class. The water level will go up. It won’t go back to the original mark, however.
Ask: Why doesn’t the water level return to the original mark even after all the sponges are squeezed out? (Even by recycling resources, some of them will be used up.)
Why is it important to you to reduce, reuse, and recycle, and/or make careful demands on water?
What one thing have you learned about conserving water through the sponge demonstration? (Answers will vary, but should reflect an appreciation for the finiteness of many natural resources, the renewability of some, and the desirability of using natural resources wisely.)

INVESTIGATE YOUR OWN WATER USAGE

Students will estimate how much water they use during a week, then keep a journal for one week of when they use water and estimate how much for each use. Then have them compare to their earlier estimate.

Ask if they remembered to include every time they had a drink other than milk and included foods that require water in the preparation. Did they include their dishes being washed? Their clothes? Discuss why they probably underestimated the amount of water they used (there are a lot of hidden uses—we often take clean water for granted). From this discussion, begin the discussion of limited water. All of the water that will ever be on earth is here right now. How does knowing that change how we use water?

PERSONAL WATER USE WORKSHEET

Divide students into teams, or lead large-group discussion, to complete the Personal Water Use worksheet (page 34) and discuss results. Encourage students to estimate water used by their whole family for one month and to check their estimates against a utility bill. Brainstorm strategies to reduce the amount of water used in homes and at school. Devise a monitoring system to check efficacy of strategies.

POLLUTION - WHERE MIGHT POLLUTANTS ENTER THE WATER?

Have the students team up to investigate where the water comes from and goes to in their school. After they investigate, have each group draw a large diagram of how water flows through the school. The diagram should include anywhere there is a faucet or a drain (don’t forget the bathroom stools!). Ask the question again, “Where might pollutants enter the water?” and this time they should consider each of the drains they have discovered. Now look at the connections – what goes into their drain could eventually show up in their faucet or it could show up in the faucets “downstream.” Brainstorm what is “downstream” from them, and what is “upstream” from them.

CREATE A TERRARIUM

Terrarium building instructions can be found at: <http://extension.missouri.edu/explorepdf/agguides/hort/g06520.pdf> (Follow instructions for closed terrarium) and <http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-3162/F-6438web.pdf>

By creating a terrarium, students will observe how water is continuously cycled between the Earth and the atmosphere. In a terrarium, condensation appears as beads of water on the walls or ceiling (acting as the atmosphere) before falling onto the soil and plants. Discussions can be held on student observations, with references between the terrarium and different stages of the Earth’s water cycle.

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PERSONAL WATER USE

For this worksheet, you will calculate the amount of water you use in a 24 hour period of time. First, take a moment to estimate the amount you believe you use:

I think I use about _____ gallons/day and _____ gallons/week of water.

Activity	Times/day	Approximate gal./use	Total Water Used	
			Gallons/day	Gallons/week
Taking a bath		40 gallons		
Showering (5 min)		20 gallons		
Showering (15 min)		60 gallons		
Showering (30 min)		120 gallons		
Flushing toilet		1.5 gallons		
Washing face/hands		5 gallons		
Drink from tap		.25 gallons		
Brushing teeth (tap is off while brushing)		.25 gallons		
Brushing teeth (tap left on)		2 gallons		
Cooking		10 gallons		
Washing clothes		60 gallons		
Washing dishes by hand		30 gallons		
Automatic dishwasher		10 gallons		
Other				
Totals: (should include things that don't happen every week)				
Multiply weekly total by 52 for total annual water use.				

FIELD TRIP TO A BODY OF WATER

Schedule a field trip to a lake or other water body within the local watershed. Remind students to dress appropriately and to bring notebooks to record observations. Divide students into small groups or pairs, instruct them to draw plants/animals they see and to answer the following questions:

1. What types of vegetation do you see? Does vegetation type change in relation to distance from water body?
2. What type of soil is observed? Does soil type change in relation to proximity to water?
3. What wildlife (aquatic and/or land-based) is observed, either directly (via viewing) or indirectly (via tracks, nests, feces, etc.)? Does any wildlife seem absent?
4. Do you note any signs of erosion or other pollution?

Upon return, compare notes and discuss health and vibrancy of the local watershed. Assign a 1-2 page reflection piece.

SHARE LAKE EXPERIENCES

Lead students in sharing experiences they've had at Iowa lakes. Which lakes were visited? What kinds of activities occurred (fishing, skiing, swimming, hiking, etc.)? What was the quality of the water and surrounding land? If they saw any problems, what do they think caused them, and how could they be remedied? Discussion could also include other water forms, such as rivers, wetlands, or streams.

RIVER WRITING

Write an essay about a river, creek or lake that you've spent some time around. Pick a day or an event that you remember. Describe it using all of your senses, so that another person will understand how it looked, felt and smelled to you. It doesn't have to be a good experience. If you are writing about a bad experience, talk about what happened and how it made you feel.

Interview some older people in your community about a river, creek or lake that they knew as a younger person. Ask them to describe it to you. You might want to share your essay with them.

STORM DRAINS AND NPS POLLUTION

This exercise demonstrates what a storm drain may collect and how water from storm drains can impact water quality and health of watersheds.

Materials needed

- Aquarium
- Rectangular box
- Watering can
- Spray bottle
- Water
- Green food coloring (to represent pesticides/fertilizer)
- Vegetable oil (to represent motor oil)
- Soil (to represent silt)
- Grass clippings, twigs, cafeteria waste, and trash

Preparation

Fill aquarium half full of water. Cut hole in bottom of box and place on top of aquarium. The box represents the storm drain and the aquarium is the water body in the storm drain's watershed.

Procedure

1. Discuss storm drain systems and purpose of storm drains. Discuss where water goes after entering a storm drain. Have students list things that might find their way down a storm drain.
2. Assign a group of students to each pollutant. Discuss each pollutant, including its use or origin and how it could enter the storm drain.
3. Have each group place their pollutant into the "storm drain." Use watering can to produce rain to wash pollutants into waterway.
4. Discuss the following questions:
How does each pollutant damage the waterway, local watershed, and watersheds downstream?
Do the people responsible for the pollutant want to hurt the watershed? Why do they do what they do? How can this type of pollution be reduced?
5. After adding all of the pollutants, examine contents of the waterway. Discuss how it has changed and how viewing this change makes the students feel.

DEFINING SOIL EROSION

Students research and then use words and pictures to describe in detail the following:

- Erosion
- Sedimentation
- Soil
- Three types of erosion
- Three forces that cause different forms of erosion
- Three negative effects of erosion on the environment

WAYS TO HOLD SOIL IN PLACE

Plantings: Plants with lots of roots help to hold soil in place. Grasses, shrubs and trees can all hold soil in place. Conservation farmers may plant cover crops in their fields to hold soil in place after the corn and soybeans have been harvested.

Structures: We can build structures that hold soil in place. These may be retaining walls or terraces in farmers' fields. In cities and towns, you might see them in yards.

Residue: Conservation farmers keep residue in their fields to reduce erosion and increase biological activity. In cities, you will see gardens with mulch (leaves or wood chips) covering the soil.

See if you can find examples in your schoolyard or neighborhood, or on farms in the countryside.

SILT AND SEDIMENTATION

Students will investigate the sediment load in local water sources. It is most effective to collect the water samples after a rain if at all possible.

Preparation

As a class, discuss and decide how to get consistent results from sampling methods. Discuss the variables that must be controlled in order to have results that can be compared fairly (e.g., same size and shape of containers, same volume). Determine the volume of water to be collected, and collect similarly sized and shaped clear containers.

Procedure

1. Have students collect the water samples in the containers from a variety of local water sources such as streams, lakes, rivers and ditches (the best time to collect samples is following a rainy period). Be sure that students identify the location sampled and collect water from the water body itself, not from bottom material.
2. After students bring samples to school, have them gently shake each jar and compare the color and clarity of the samples. Ask students to rank the water samples based on how much sediment each contains.
3. After the particles settle overnight, students compare the amount of sedimentation to their predictions.
4. Discuss the area water bodies that seem to be receiving the most eroded soil particles. As the class discusses, have students share their ideas why those particular water bodies may contain the most sedimentation and ideas for reducing the amount of sediment.

EROSION OBSERVATION

Have students make observations of their own neighborhoods looking for signs of erosion. Students should answer the following questions and share their answers via presentation, report, etc.

What is the example of erosion happening around your neighborhood or local area?

What agent or force is causing the erosion to happen?

Where is the eroded material going?

What can be done to reduce the amount of erosion?

Can you think of another example of erosion and describe it?

AGRICULTURAL SOIL PRACTICES FIELD TRIP

Take a class trip to look for area examples of agricultural soil management practices that affect the land both positively and negatively. Discuss what was most commonly seen.

FARMING SOIL MANAGEMENT PRACTICES

Materials needed

Aluminum roasting pans:

2 for teacher demonstration, 2 for each group of 4-5 students

Soil, sod, dry plant material

Scissors

Preparation

Prepare two demonstration pans by cutting a V-notch 2-4 cm deep in a short side of each pan. If students are to bring their own materials for their demonstrations, carry out activity through #3. Conduct remaining activity on another day.

Discuss the soil management practices that can be used to reduce farming runoff. After discussing the practice of establishing cover crops to reduce erosion, solicit suggestions of ways to model the procedure using the set of teacher demonstration pans. (One way to carry out the procedure is to fill both pans with soil, cover one with sod cut from grass, elevate one end, pour water simultaneously over both pans and collect the runoff in a cup at the notched spout.)

Discuss variables in the experiment and how to control them. Students may suggest that the pans must be tilted equally, equal amounts of water must be poured on both pans, water must be poured from the same height, and water should be poured at the same rate of flow.

Procedure

1. Conduct the experiment with the demonstration pans as noted above. Explain that the pan with turf represents a field with cover crops, while the other represents a bare (tilled) field. Discuss results by comparing the amount and clarity of the water that flows off of each pan.

2. Divide the class into groups of 4-5 students. Distribute two pans to each group and have them cut a 2-4 cm V-notch in a short side of each pan for water spout.
3. Once everyone understands how to control for variables, have each group choose one soil management practice to model using their pans. Groups should discuss their plans with the teacher before actually conducting their tests. Practices that are easiest to model include terracing, plant residue cover, contour farming, and establishing a buffer area. Small pieces of sod will be needed to model crops and plantings.
4. After the groups prepare their models, have them conduct their experiment in front of the whole class. Once all experiments have been observed, discuss the following:
 - Which pans showed the most erosion? The least?
 - Why do farmers need to understand this problem?
 - If you were a farmer, what factors would you consider when deciding which practices to use?

DON'T TREAT MOTHER EARTH LIKE DIRT

Students will determine what it means to "treat" someone like "dirt" (e.g. disrespectful, uncaring, as if it didn't matter). Students will then brainstorm activities they have observed people doing in the natural world around them that they believe harms the natural environment. While working cooperatively in groups, the students will create pictures and write short paragraphs illustrating and describing the behavior and ways to accomplish the same behavior without harming the environment.

Materials needed

Art supplies (crayons, scissors, glue, construction paper)

Magazines from various topics for real-life "photos"

Large index cards

Pencils

Procedure

1. Watch the video "Reclaiming Stewardship."
2. After placing the students in cooperative groups, ask the students to help make a list of activities people do that seem harmful to the world that they live in. As responses are given, record them down on the blackboard or overhead transparency for the whole class to view. Using large index cards, students will use cut out photos from magazines and/or draw pictures to illustrate the stated harmful behaviors visually. Each group's cards will be collected and redistributed so that each group gets another group's pictures.
3. Ask the groups to analyze each of the cards they've received, directing them to discuss such things as:
 - What is happening?
 - What specifically is being harmed?
 - How does it affect others?
 - Does it seem to be appropriate or inappropriate behavior? Why?
 - Is the person doing it having fun?
 - What are alternative forms of the same behavior that would be less harmful to the environment?Each group will report to the rest of the class, displaying

the picture card and discussing their feeling concerning the harmful activity and their possible recommendation(s) for less harmful behaviors. After each group has had a turn to lead the discussion, the illustrative cards could be posted in the classroom science center as a reminder of the harmful way(s) people could behave in the environment.

Discuss what it means to respect each other. What are the behaviors that show respect? Link that to the Earth. What are the behaviors that show respect for the Earth? Draw on all earlier lessons.

WASTE NOT

Have students draw "Waste/No Waste" pictures showing themselves "wasting" and "not wasting." Have students fold pieces of white paper in half and on one side draw a picture showing how they might use water. On the other half, students can draw a picture of how they can save that resource.

The students will demonstrate an understanding of water conservation by 1) Drawing an accurate picture of using and conserving water; 2) Writing a poem about one or more ways water can be reused, reduced, and recycled.

RESILIENCE THINKING

Have students look up the word "resilience" and record definitions. Discuss what they think the word "resilience" means as used in the video.

"The ability to recover from or adjust easily to change or misfortune."

"The ability of systems to absorb change and still persist."

Investigate an occurrence of a change or misfortune the students can remember. Track what changes took place, and how the system recovered from it. (The floods in Iowa or the Dust Bowl would make excellent topics.)

Have the students look for examples of what changed before and after the event in terms of diversity and adaptability. For example, before the Dust Bowl, farmers began planting less diverse crops. As diversity decreases, the system becomes less able to adapt to change.

CREATING YOUR PREFERRED FUTURE

What do you think is important to your future? How will food be grown? What kind of shelter will you live in? What kind of energy will be used? How will you travel? What will cities look like? What will the countryside look like?

Make a PowerPoint presentation, a drawing or a collage to represent this future. What will it take to have that future? Will this future have more or less resilient systems than the present? Discuss this in terms of the two basic concepts—diversity and adaptability.

COMMON GOOD

Materials needed

A River Ran Wild by Lynne Cherry

Definition: common good (noun): Resources shared for the collective benefit of the whole group of people.

Read the definition to students. Talk about what a resource is (anything you use). Give a few examples of common good in your classroom (shared books, tables). What happens when someone messes up a space that is shared by all? Read *A River Ran Wild* and answer the following questions, either on a worksheet or collectively in class.

1. Many people, from early Indians to European settlers, came to the river. Give at least three benefits of living by the river.

2. People lived by clean rivers for about 400 years before the Industrial Revolution. Then the rivers were greatly polluted in the next 150 years. Name at least three things that were done that damaged the rivers.
3. Through the efforts of Marion Stoddart and many other people the Nashua River was restored. Name at least three things that were done to help this river. Talk about how, by working together, the people cleaned up and restored the river as a common good. See if there are examples in your community or watershed where people have worked together to restore a common good.

BIODIVERSITY PYRAMID

Teacher Preparation: Draw two biodiversity pyramids on marker board or large sheets of paper. Label the tiers as shown at right.

Materials needed

Biodiversity Pyramid illustration
Large sheets of paper or board
Drawing materials

Procedure

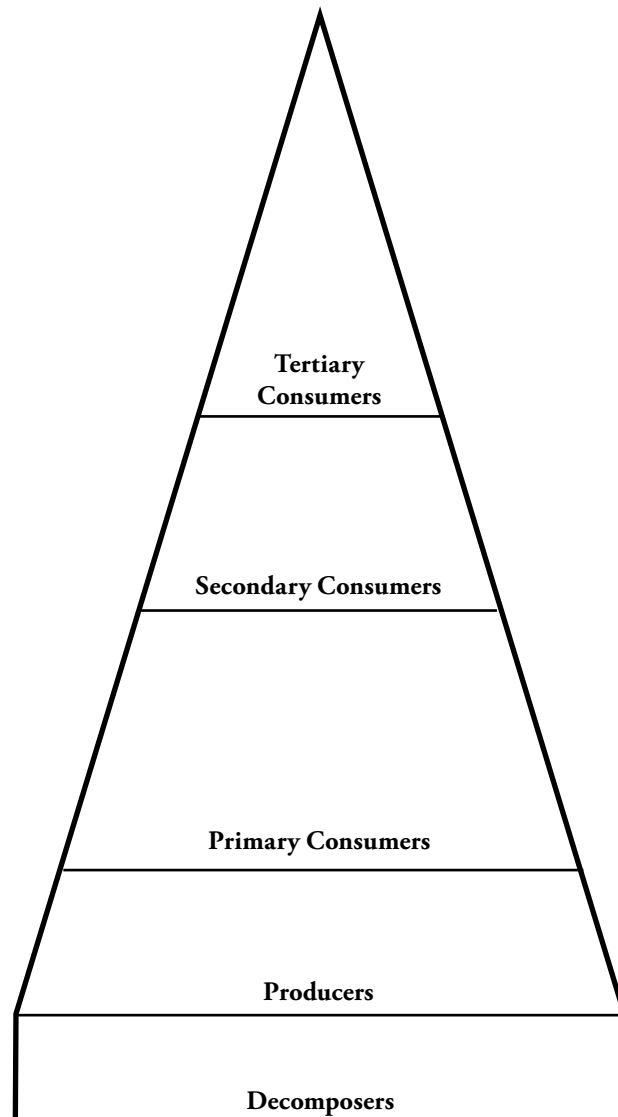
1. Present and discuss the biodiversity pyramid, trophic levels, and the concept of food webs. Have students name two to three organisms to write in each tier.
2. Divide students into two groups. One group will construct a biodiversity pyramid representing present day Iowa and the other representing the state before it was settled.
3. Students research animals that live(d) in or use(d) wetlands. (Groups can be subdivided to research mammals, reptiles, amphibians, insects, etc.) Assist each group in identifying three to five animals per student.
4. Each student provides drawings or pictures and writes a short summary (less than a page) on assigned animals, including where the animal belongs(ed) in the biodiversity pyramid, how it fits into the food web, populations, food sources, and duration of stay in Iowa wetlands.
5. Each group constructs the assigned biodiversity pyramid.
6. Groups present their pyramid to the rest of the class by having each student in the group present their written summary.

Group discussion: Compare and contrast the pyramids, noting which animals continue to thrive, no longer live (or live in the wild) in Iowa, are endangered, have been reintroduced, size of populations, etc. Include the following questions:

Are there tiers in the pyramid that have noticeably fewer species today?

Do you think there are fewer species of animals in Iowa now than in the past?

How do introduced species affect native animals?
What is the effect of the loss of large predators in Iowa?
How has the draining of wetlands affected animal populations?



BENEFITS OF WETLANDS

PLANT FILTERS

Materials needed

Celery stalks with leaves
Beakers or jars
Food coloring

Procedure

1. Add coloring to beaker of water, and explain it represents pollutants (review different types of pollutants at this time).
2. Ask students to imagine the water is flowing through a wetland and the celery represents different wetland plants (review different types).
3. Cut off bottom half-inch of celery stalks and place in beakers. Over time (next few days) the colored water will travel up the capillaries, showing how the plants “drink up” the pollutants.
4. Discuss the process and ask students the following questions: How do wetland plants help purify water? Why is the water remaining still “polluted?” Where does the water go after uptake into the plant? What happens to the pollutants? Why not just dump our waste into wetlands? How does this experiment relate to croplands with wetlands?

SOIL FILTERS

Students gain perspective of how prairies and wetlands filter and purify water through their soil.

Materials needed

1 gallon-size plastic jug with small holes poked in bottom and a section cut out on top opposite of handle
Pan or basin
Large clear beaker
Smaller clear beaker
Soil samples (gravel, sand, clay, loam, humus)
Coffee filter

Procedure

1. Discuss importance of clean water. “How is tap water cleaned?” Use coffee filter as visual aid to represent filtration processes. “What is nature’s way to clean water?” Mention plants and previous activity if completed. Discuss different layers of soils in our ground and how water is filtered as it seeps through those layers to make its way to groundwater sources.
2. Create a natural filter by layering soils in jug, so that each is at least 1 inch thick.
3. Create a slurry with water and soil in clear beaker. Have students make observations on its appearance. Pour small amount into smaller beaker and set aside.
4. Hold jug above pan or basin and pour remaining dirty water into jug via cutout. Watch the water work its way through the layers of soil and drip out the bottom holes.
5. Pour collected basin water into clear beaker. Observe its appearance. Compare with reserved slurry water.
6. Review filtering benefits of wetlands.

HIGH SCHOOL ACTIVITIES

CONDUCT A WATER SURVEY

Work as a class to create a water use survey. Discuss why and how surveys are created. Determine what information the survey will examine and who will be surveyed. Decide how responses will be collected, analyzed and presented. Then complete the project.

GLOBAL CHANGES IN WATER CYCLE

Investigate scientific knowledge on changing patterns in the hydrologic cycle. Present current research findings and expert opinions on the topic. Share information in the form of a written report, media presentation or poster.

IOWA'S IMPAIRED WATERS

Go to http://www.iowadnr.gov/Portals/idnr/uploads/watermonitoring/impairedwaters/Impaired_Waters2012map.pdf for a map of impaired waters in Iowa; and

<http://www.igsb.uiowa.edu/wqm/beaches/beachmapstate.htm> for a listing of state beach recommendations.

How are water bodies and beaches within the local watershed rated? If impaired, how can these waters and beaches be improved? What obstacles might be encountered on the “road to recovery” for impaired waters?

SOIL FUNCTIONS

Divide the class into five groups. Assign one of the five soil functions to each group to research and prepare a 5-10 minute persuasive argument as to why their assigned function is the most important function that soil performs. After arguments have been presented, discuss what stood out as the most valid points of importance. What points were most surprising?

Healthy soil discussion questions

1. Do you have a personal responsibility to keep our soils healthy? If not, whose responsibility is it?
2. Do you think our local environment is healthy? What parts of our environment do you think we could study to try and find the answer? (Clues to the health of an environment can be found in its air, water, plant and animal ecosystems, and soil. Highlight the fact that although all of these factors are very important to a healthy planet, soil pollution heavily influences the health of every other part of the environment.)
3. Make a list on the board of ways unhealthy soil affects plants, animals and humans.

HUMAN CONNECTION TO HEALTHY SOIL

1. Separate students into groups of 5-8. Explain that each group will present a persuasive argument about the cause-and-effect relationship between humans and soil health. Students will develop a hypothesis, conduct an investigation to discover the facts and then inspire others to act.
2. Instruct each group to choose a specific human action that could lead to soil contamination. Each group decides what the primary effect of that action will be and writes a hypothesis (e.g., human actions such as poor waste management, deforestation or the use of pesticides can lead to effects such as soil erosion, animal and plant extinction and food shortages).
3. Groups then do investigative research and determine effects, both locally and globally, of the chosen human action.
4. Students present their findings through a PowerPoint presentation. The presentation should include the facts that were uncovered from the research regarding local and global effects and also recommended local and global action plans. Additionally, students should present their answers to the following questions:
If your plans are enacted, what do you hope will happen? What challenges do you see in persuading others to take action?
5. Take a class poll to find out which group had the most compelling argument for action. Discuss what was most persuasive about each presentation.

AGRICULTURAL SOIL MANAGEMENT PRACTICES

Have students research best soil management practices for agriculture, including investigating fields in their local area for the use of such practices. Written submission by students should include whether these practices are, or are not, currently being used by local farmers and to what extent, potential reasons why they are not being used more frequently or by all, and suggestions for increasing the usage of such practices.

WHAT SHOULD WE DO?

Have students write an opinion paper which includes the following topics:

Have soil erosion and destruction problems occurred only in the last 100 years?

Is it something we need to be concerned about?

What do you feel should be done in our country regarding soil conservation and why?

COMMON GOOD

Rivers are shared spaces. Explore the concept of “Common Good” by listing at least three changes in a nearby river, then determine how those changes affected the population downstream. Discuss reasons why a decision that is good for one group might negatively affect another.

THE LAND ETHIC

Once the students have researched and discussed the effects of change in the river on human populations, ask them to consider the rest of the beings that depend on the river. Brainstorm a list of other beings, and then revisit the changes that have occurred in the river and how these have affected life other than humans.

Have the students (in groups or in guided discussion) create a plan for making better decisions about a river close to them. Is any part of their plan a reality now? Is there any part they can act upon to create change?

WHY SHOULD WE CARE ABOUT BIODIVERSITY?

Biodiversity in Iowa is largely attributed to our wetlands.

Hold a class discussion evaluating the following statements:

1. It is important to conserve the diversity of life for medical and economic reasons.
2. Biodiversity helps maintain ecological processes that help support life on earth; therefore we should protect it.
3. Our lives would not be as rich if we lost species such as fireflies, leopard frogs, Blanding's Turtle, or red-tailed hawks.
4. All species have a right to exist.
5. It is imperative that we preserve the environment and resources for future generations.
6. Diversity of life is important for inspiring poets, writers, and artists, and for sparking curiosity and imagination.

Students research biodiversity in Iowa and choose one of the preceding statements to write a 1-2 page opinion paper.

WETLANDS HARD AT WORK

Wetlands provide numerous ecosystem services. Referring to the video “Incredible Wetlands,” discuss the many jobs wetlands perform on the landscape. Guide students in researching these jobs.

Students present their findings in one of the following ways:

1. Create a series of “Wetlands Hard at Work” trading cards, with each card representing a different ecosystem service that wetlands provide.
2. Design a series of memes that illustrate the jobs that wetlands do.
3. Design a hotel-style brochure or advertisement inviting migratory birds to stop at your wetland; be sure to promote all the “amenities” and services that would be of interest to waterfowl!
4. Write an original haiku or other poetry describing how wetlands work and the services they provide.
5. Plan a lesson to teach younger students about the jobs wetlands do. Use props to explain the different jobs—sponge, toy house, filter, picture of a restaurant, etc.

The list below contains just a few Iowa prairies and wetlands—there are many more all over the state to be explored. Please contact your local County Conservation Board for locations near you or visit www.iowaprairienetwork.org.

Allamakee & Clayton Counties

Effigy Mounds National Monument, Marquette

Buena Vista County

Browns' Prairie, north of Storm Lake

Black Hawk County

Cedar Hills Sand Prairie State Preserve

Bremer County

Sweet Marsh Wildlife Area

Buchanan County

Patton Prairie

Rowley Fen

Butler County

Wolter's Prairie Preserve, Clarksville

Cedar County

Rochester Cemetery, Rochester

Cerro Gordo County

Hoffman Prairie and Ventura Marsh, Clear Lake

Dickinson County

Cayler Prairie State Preserve

Freda Haffner Kettlehole State Preserve

Yager Slough

Dubuque County

Kauffman Prairie, Dubuque

Upper Mississippi River National Wildlife & Fish Refuge

Emmet County

Anderson Prairie State Preserve

Four Mile Lake Wetland Complex

Fayette County

Becky's Fen

Gray-Hart Preserve

Floyd County

Fossil and Prairie State Preserve, Rockford

Restoration Marsh

Franklin County

Blackmun Prairie, Ackley

Howard County

Crossman Prairie

Hayden Prairie State Preserve

Jasper County

Neal Smith National Wildlife Refuge

Johnson County

Finkbine Prairie at University of Iowa Finkbine Golf Course

Williams Prairie

Kossuth County

Union Slough National Wildlife Refuge

Linn County

Behrens Ponds and Woodland State Preserve

Louisa County

Port Louisa National Wildlife Refuge

Marshall County

Marietta Sand Prairie State Preserve

Mills County

Folsom Point Preserve

Muscatine County

Greiner Family Nature Preserve

Palo Alto County

Lost Island Lake Prairie Wetland Nature Center

Pocahontas County

Kalsow Prairie

Plymouth County

Five Ridge Prairie

Knapp Prairie

Loess Hills-Broken Kettle Grasslands

Story County

Ames High School Prairie

Doolittle Prairie

Hendrickson Marsh

Warren County

Medora Prairie

Rolling Thunder Prairie

Webster County

Root Cellar Prairie, Brushy Creek State Recreation Area

Woodbury County

Sioux City Prairie, Sioux City

6TH-8TH GRADE

Biodiversity. By Dorothy Hinshaw Patent. Stresses the importance of protecting the planet's rich gene pool for the survival of all species.

Clean Water. By Karen Barss. Discusses the problems of maintaining a clean water supply and relates this to pollution, depletion of resources, and other environmental concerns.

A Drop Of Water: A Book of Science and Wonder. By Walter Wick. Shows the different forms of water in detailed photographs; explains water's properties.

Drought. By Christopher Lampton. Investigates the causes and effects of drought, giving the history of some of the most severe droughts in the U.S. and elsewhere.

Our Endangered Planet: Rivers & Lakes. By Mary Hoff and Mary M. Rodgers. Explains the way rivers and lakes work together and how we have harmed them. It tells stories of success in reviving dying rivers and lakes and of failure to preserve our fresh water.

Rivers: Make It Work! By Andrew Haslam and Barbara Taylor. Explains where rivers come from, why people settle near them and how rivers form valleys and underground caves. Discusses how rivers create energy and why it's important to control flooding.

Water: A Resource in Crisis. By Eileen Lucas. Discusses the quality and quantity of water on a global scale and includes discussions of resources, the ways we use water, pollution, making water safe, and taking care of our water.

HIGH SCHOOL AND BEYOND

Food and Water: Threats, Shortages and Solutions. By Bernard S. Cayne (Editor), Jenny E. Tesar. Discusses the importance of having an adequate supply of food and water and the effects of pursuing this need through various forms of storage and farming methods.

Last Oasis: Facing Water Scarcity. By Sandra Postel, Linda Starke (Editor). The worldwide water crisis, according to this book, is due to water's ready availability, low cost, people's overuse and lack of respect. Solutions are offered for restoring and sustaining this essential lifeline.

Resilience Thinking. By Brian Walker and David Salt. Sustaining ecosystems and people in a changing world.

Rising Tide: The Great Mississippi Flood of 1927 and How It Changed America. By John M. Barry. While tracing the history of the nation's most destructive natural disaster, this book explains how human decisions helped cause the flood and how the policies created to deal with the disaster changed the culture of the Mississippi Delta.

Tapped Out: The Coming World Crisis in Water and What We Can Do About It. By Paul Simon. Discusses increasing global population and a water supply that cannot increase; faced with this crisis, what can the average citizen do?

Water: A Natural History. By Alice Outwater. Takes us on a 500 year journey to recover a lost knowledge—how the land cleans its own water, how natural ecologically interacting systems can create healthy waterways.

Water: Almost Enough for Everyone. By Stephanie Ocko. Through case studies, anecdotes, facts, and theoretical explanations, this book provides a look at the social and environmental implications of severe droughts, their causes, and some possible solutions.

Water Rocks! is a statewide youth water education campaign that fosters the interplay of knowledge, caring and engagement among Iowa's youth. Through a combination of STEM (science, technology, engineering and mathematics) and the arts, Water Rocks! challenges and inspires Iowans towards a greater appreciation of our water resources. Water Rocks! is based on campus at Iowa State University.

HANDS-ON LEARNING



GETTING OUTSIDE



GEOCACHING



TECHNOLOGY



SCIENCE



SCHOOL VISITS



ART & MUSIC



GET INFORMED. GET INVOLVED.



Water Rocks! Partners

Iowa State University Extension and Outreach
 Iowa Department of Natural Resources (USEPA Section 319)
 Leopold Center for Sustainable Agriculture
 Iowa Water Center
 Iowa Learning Farms