Unit 8

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Igloo

[Snow House]

Water, Water Everywhere

Overview:
In your tea, underneath the ground, on the South Pole... its unique physical properties make water one of the most amazing substances on earth! Arctic Transect 2004 team members will be following waterways within the Arctic Ocean watershed and monitoring water quality along the way. Explore the role water has played in lives of the Inuit. Activities flow through water-based themes that investigate watersheds and our current water usage.

Trail Reports:
Report 12 and 13

Chat Topic:
Water

Subject Areas:
Art
Language Arts
Math
Science
Social Studies

Skills:
- drawing
- comparing
- interpreting maps
- writing editorials
- experimenting
- observing
- mapping
- brainstorming
- researching
- discussing
- collecting data

National Standards:
Civics
Economics
English
Foreign Language
Geography
Health
Mathematics
Science
Technology
Visual Arts
World History

Concepts:

1. Water has played, and continues to play, an important role in the lives of the Inuit.
2. Water is a finite resource that possesses many unique qualities.
3. The health of an aquatic ecosystem can be assessed and monitored much like human health.
4. Water is a nonrenewable resource that should be preserved, protected and not polluted.

Table of Contents

Water, Water, Everywhere

The Role of Water. The vast waterways of Arctic Canada support a number of diverse plants and animals. Traditionally, as well as today, rivers, lakes and oceans were fundamental to the survival of the Inuit. Waterways supply the Inuit with food, shelter and clothing. For example, seals, an important food staple, are hunted on the ocean and caribou are often hunted by kayak on inland lakes and rivers. Water also sustains the lives of the Inuit by providing transportation routes.

The lakes and rivers of northern Canada supported a diverse population of wildlife. The healthy variety of fish proved to be a major food source for the Inuit. Char, salmon and tomcod were caught using many different methods. Angling equipment to catch fish through the ice consisted of hooks made out of bones that were split and fastened together at thirty-degree angles using line made from braided sinew. Fish were also speared with barbed points made from caribou antler or musk ox horns. In late summer stone weirs across rivers "herded" fish for harvesting.

Whalers arrived in the North and relied heavily on Inuit knowledge of ocean currents, safe harbors, and of course, the location of whales. During the fur trade the lakes and rivers of northern Canada were important transportation routes. The Hudson Bay Company and smaller trading operations wanted furs from the interior of Canada. They needed to transport furs from inland trappers to company posts on the bay. It is likely that important information from the Inuit about the local rivers and lakes; their location and navigable routes proved vital to the success of the Hudson Bay Company.

While water played an important role in Inuit life, it is water in solid form, as ice and snow, which often defines Inuit life. Remember, in northern Canada winter lasts for almost eight months. Therefore, the Inuit understood snow and many of its unique properties. It reflects light, absorbs heat, insulates, re-crystallizes and changes, all of which allowed the Inuit to live, travel and hunt with relative ease. Without the unique physical and chemical properties of snow, the lives of the Inuit would be drastically different.

The word "Igloo" means house. However, the term is most often associated with snow houses. One native Inuit said this about snow and Igloo building, "In looking for snow for you to make an igloo you would look for snow that is more PUKAJAAK (Snow that has fallen later, after the first of the autumn. This snow is crispy and will not hold together)..." Using a snow knife, the Inuit probed the pukajaak snow, looking for densely packed snow beneath it that could be cut into large blocks. Once a good snow source was found, a small igloo could be built in an hour.

Today water continues to be an important resource for the Inuit. However, the natural balance that existed between the people, land and water has been upset. Native rights and claims to the land were ignored as hydroelectric dams, mining, waste and other industrial activities exploited valuable water resources. Pollution, development and the disruption of natural river flowages have all altered the presence and quality of vital natural resources. In places like Baker Lake even the lake itself has become polluted.

Water. Water covers a little over two-thirds of the earth's surface. Ninety-seven percent of that water is contained in the 361,200,000,000,000,000,000 (361 quintillion) gallons of ocean sea water. Every living organism is mostly water too. For example, a tomato is made of 95% water whereas pizza is 49% and the human body 70%.

Water in the atmosphere acts as a natural insulator and helps regulate global temperature; in plants and animals it helps transport nutrients and remove waste. Water is vital to every component of our daily lives. Without water, life could not exist. Even though much of the earth is covered with water, only three percent can be considered fresh water. Only 0.003% of this supply is not highly polluted and this small percentage lies too far under the earth's surface to be extracted at an affordable cost or is locked up in glaciers, polar ice caps, atmosphere and soil (Miller).

That finite and quite small amount continually moves through the water cycle: water evaporates, falls as precipitation, flows into the ground or to rivers and lakes and then evaporates again. Lakes, rivers, reservoirs and ground water are able to replenish and purify themselves naturally; however, these mechanisms can be easily exhausted and contaminated.

People, like other living things, need a constant intake of clean water to keep their bodies functioning in a healthy way. Unlike all other living things, human water usage exceeds our basic requirements. We use it to wash, cook, play, manufacture, transport, generate power, grow crops and even treat sewage. A typical American uses more than 100 gallons of water per day with less than two percent going towards drinking and cooking (Steger and Bowermaster). Conversely, arid regions of the world survive on drastically smaller amounts. Regardless, as we use water we also tend to contaminate and pollute it. Therefore it is important to understand how much water we use and for what purpose.

Nothing exists alone in nature. Every living and non-living thing is connected in a complex series of inter-relationships called the web of life. Each body of water (lake, ocean, aquifer, river, etc.) is a delicate system whose natural balance can easily be upset. If a chemical enters a river or lake, the water can tolerate, and even purify the pollutant, but only to a certain degree. Whether the smallest stream or the largest ocean, water will eventually become polluted or toxic. For example, the Cuyahoga River in Ohio was once so polluted with chemicals that it caught on fire. Worldwide water pollution has reached critical levels.

Some scientists argue that a safe and secure water supply may no longer exist. While our demands for water continue to increase, pollution, declining water tables and longer drought periods are further depleting the usable water supply. We return it to the environment, often to the same body of water it came from, but in poorer condition. Understanding how water use affects an entire watershed is the first step toward preserving the world's precious water resources.

Water Knowledge

Traditional Inuit life viewed interactions with rivers, lakes and oceans as opportunities for benefit as well as potentials for great danger. Waterways supplied sources of food for the Inuit. Knowledge about the behavior and properties of water, snow and ice was passed from generation to generation. Therefore Elders emphasized the importance of avoiding certain rapids and they shared information about dangerous ocean currents and shifting sea ice. They stressed how understanding the movement and flow of water was important for safety while traveling on rivers, lakes and oceans. Proper respect for, and knowledge about water was crucial to the survival of all life.

	ACTIVITIES
EXPERIENCE	**8-1. Water Concepts**..... 5 *Water was vital to the survival of the Inuit. Students investigate the close connection of water to every aspect of life by creating a water concept map.* Student Pages 21
EXPLORE	**8-2. Reading Rivers**..... 6 *While "coastal" Inuit spent most of their time on the oceans, many Inuit usually traveled on rivers to hunt caribou. Students learn how to "read" a river in order to avoid danger and then describe and evaluate a "danger" in their everyday lives.* Teacher Notes: Reading A River 22
EXPAND	**8-3. To The Editor** ..... 8 *Over the past few decades, several hydro-electric dams have been constructed across northern Canada. While these dams bring economic benefits, they also cause other kinds of damage. Students write a letter to an imaginary editor describing the effects of hydro-electric dams*.

Water Concepts

Background: The Inuit, as do many aboriginal groups, viewed things in nature not as individual and separate, but as part of an interconnected system. For example, water was not just a liquid necessary for survival, it was a vital component of a network whose ties stretched to traveling, migration of waterfowl and sea mammals, winter travel (snow and ice), safety (break up), food and much more. To fully understand the role of water in the lives of people it is first important to grasp the many interconnections that involve water.

Procedure:

1. Note to teachers: If you are new to concept mapping, read information and view samples in "Additional Resources."

2. Write the term "water" (or snow) on the board in front of your class. Ask students to brainstorm as many ideas about water as they possibly can. Reinforce the rule that brainstorming involves coming up with many ideas – no matter how far-fetched they may sound. Facilitate students' brainstorming, and as the list increases, try to group the ideas in separate categories (recreation, rivers, atmosphere, etc.).

3. Once the students have completed the "water" list, pass out Student Page 8-1. Instruct students to complete a concept map using all of their brainstormed ideas about water. Review the process of concept mapping with students if necessary.

4. Divide the class into small groups and ask each student to present their concept map to the other group members. Each student should explain how water relates to all the ideas they have brainstormed.

5. As a large group, discuss the interconnected nature of water in our lives as well as the lives of the Inuit.

Additional Resources:

http://users.edte.utwente.nl/lanzing/cm_home.htm **The Concept Mapping Homepage** – an amazing compilation of information on concept mapping, examples of concept maps and links to concept mapping software.

http://ga.water.usgs.gov/edu/helptopics.html **Water Science for Schools** – water science topics list is a site from the USGS that links to just about any kind of water information that you might need.

Activity Level:
Experience

Subject Areas:
Science
Social Studies
Language Arts

Objectives:
Students will...

- Increase their awareness of water.
- Explore the role water plays in the world.
- Illustrate the relationships that exist between water and life.

Time Consideration:
30 minutes

Materials:
- Copy of Student Page 8-1 "Water Concepts"
- Pen or pencil

Vocabulary:
Concept map, water

Assessment:
Upon completion of this activity students should...

- List words, pictures or concepts related to water.
- Complete Student Page 8-1 "Water Concepts".
- Discuss the many connections between water and life.

Reading Rivers

Background: Water in a river is moving, whereas lake water is relatively (emphasis on *relatively*) static. The volume of water, river width and gradient all affect current speed. *Volume flow of water* is the amount of flowing water and is sometimes expressed in cubic feet per second (cfs). The greater the volume flow of water; the faster it flows. Similarly, a steeper gradient will also increase water speed. As a river's flow increases (velocity and stage), discharge increases, as does a river's speed and power and the pressure that it exerts on objects in the river.

Water is also "lazy" and wants to flow downhill continuously until an obstacle forces it in a different direction. Water generally seeks the easiest descent - the steepest, clearest route within the river bed. However, a river's current is affected by many variables that often makes choosing a safe paddling route difficult. Reading a river involves recognizing obstacles and evaluating water flow so that an appropriate course can be chosen. Inuit knowledge about reading rivers, dangerous rapids and safe passage routes is important information passed down from Elders.

Procedure: see page 7

Activity Level:
Explore

Subject Areas:
Science
Social Studies
Language Arts

Objectives:
Students will...

- Observe physical changes in a natural area.
- Predict safe canoe travel routes.
- Interpret clues from the natural environment.

Time Consideration:
45 minutes

Materials:
- Teacher Notes 8-2 "Reading a River"

Vocabulary:
Volume, current, discharge, flow

Assessment:
Upon completion of this activity students should...

- List basic components of interpreting water movement.
- Investigate possibly dangerous situations encountered in daily life.
- Counsel peers about local landscape and important safety considerations.

Additional Resources:

http://nationalgeographic.com/geographyaction/rivers/
Rivers2001 – an excellent site with lessons and diagrams about rivers!

http://sites.state.pa.us/PA_Exec/Fish_Boat/mj2001/rivrread.htm **River Reading Basics** – a few pages of easy-to-read background information about interpreting whitewater.

http://www.gorp.com/gorp/publishers/menasha/pad_tech.htm **Paddling Technique: Reading Water and Basic Strokes** – a short description of river reading with discussions about the formation of rapids and

Reading Rivers - Continued

Procedure:

1. Draw a river on the board, illustrating the obstacles that might be present in a river and how the current might look in relation to those particular objects. Use Teacher Notes 8-2 for guidelines and "Rivers 2001" from the "Additional Resources."

2. Discuss the role of water in the lives of the Inuit and how safety while canoeing meant interpreting dangers in the water and natural landscape then choosing appropriate routes.

3. Ask students to pick an element of their daily lives (riding a bus, walking to school, taking a taxi ride, hunting, camping, etc.) that might be potentially dangerous. Once they have selected an activity, instruct students to write a paragraph and/or draw a picture describing the danger. Next ask students to list the specific clues they would use to choose an appropriate route or course of action.

4. Ask students to explain their "advice" about avoiding danger to the rest of the class (similar to how an Inuit Elder might pass on information).

5. As a group, discuss the role of interpreting clues in the environment as well as the oral tradition of passing information.

To the Editor

Background: The water that enters Hudson Bay comes from one of the largest watersheds in the world. One-third of all Canadian Rivers empty into the Hudson Bay. These waters sustain fish, plant, animal and human populations. However, the health of these natural systems depends largely on the quality of the water. Over the past few decades northern Canada has been witness to the construction of many new hydro-electric dams. Other industries, like mining and logging, soon followed, often without the full or knowledgeable consent of the Native people who hold claim to the land.

While these new industries bring economic development and new resources to remote communities, they can also destroy much of the regional environment. The construction of hydro-electric dams alters seasonal water levels and results in unstable winter ice, early break up of ice, freezing of animals' water exit routes and large amounts of floating debris. As plants decompose underwater, areas flooded by the dams produce unusually high (and toxic to people) levels of heavy metals. Finally the physical construction of dams and diversion projects negatively affects land and animals in the area.

Procedure: see page 9

Activity Level:
Expand

Subject Areas:
Language Arts
Social Studies
Science

Objectives:
Students will...

- Understand the natural, cultural and economic effects of hydroelectric dams.
- Research issues related to the effects of hydro-electric dams.
- Formulate an opinion about the consequence of hydro-electric dams.

Time Consideration:
30 minutes; 1–2 hours additional research time required

Materials:
- Access to research materials

Vocabulary:
Hydro-electric dam, watershed

Assessment:
Upon completion of this activity students should...

- Conduct research about hydro-electric dams.
- List at least 3 of the effects of water in the lives of the Inuit.
- Write a clear and concise letter to an editor.

Additional Resources:

http://www.dams.org/links.htm **General Information on Dams** – a long list of links that covers every aspect of dam construction, location, impact and more. Site also includes water information.

http://www.mapinc.org/resource/ **Map, Inc Writer's Resource** – clear and concise tips on writing letters to an editor. Site also includes sample letters.

To The Editor - Continued

Procedure:

1. Familiarize yourself with issues related to hydro-electric dams. See "Additional Resources" for links to help you find more information.

2. Introduce students to concepts associated with hydro-electric dams.

3. Assign each person in a group one of the following: salmon, caribou, business person, Inuit Elder, Inuit youth, polar bear, hydro-electric dam worker, hydro-electric dam engineer, hydro-electric power user, commercial fisher, sport fisher, fur trapper, winter recreation participant, highway developer or any other person, plant or animal.

4. Ask students to research their particular subjects and how they are affected by hydro-electric dams (construction, use, etc.) in northern Canada, or around the world.

5. Each student should write a letter to the editor of an imaginary (or real) paper detailing the issue and how it affects their topic on behalf (or from the perspective) of their particular animal or person.

6. Encourage students to read their letters to the rest of the class.

Wow! It's Water

Water can easily be considered one of the most amazing substances in the world. Unlike any other compound known, it exists as a solid, liquid or gas within the normal parameters of our environment. Water has other unique physical properties as well. It is clear, colorless, odorless and tasteless and is a universal solvent. The molecular structure (two parts hydrogen and one part oxygen) is a relatively simple form that exhibits many complex characteristics. Coupled with other forces, water in the form of rain, ice and floods can destroy land forms within minutes or over the course of centuries.

The world's streams and waterways form ties between upland runoff areas and major waterways. As rain, snow and other precipitation falls to the ground it collects as gravity pulls it downhill. Flowing water is steered by topography, geomorphology and the presence of wetlands. Water is naturally detained in wetlands where it can recharge ground water before flowing into streams, rivers, lakes and oceans. At anytime during this process, water can evaporate, only to condense and fall to the ground as precipitation somewhere else. The water cycle continually moves water through our environment.

	ACTIVITIES
EXPERIENCE	**8-4: Water Magic**..... 11 *The physical and chemical properties of water make it one of the most unique compounds on earth. Students watch in awe as you dazzle them with water "tricks."* Teacher Notes: Water Magic..... 23
EXPLORE	**8-5: What Is My Watershed?** ..... 12 *A watershed is a catch basin that guides all the precipitation and runoff into a specific water system. Students use topographic maps to map and describe watersheds.* Student Pages 26
EXPAND	**8-6: Water Managers**..... 13 *Students develop an imaginary water front plot. Each group represents a particular interest group and must eventually balance individual needs with the quality of the watershed.*

Water Magic

Background. The physical and chemical properties of water make it one of the most unique compounds on earth. It is one of the few substances that can exist as a solid, liquid and gas within the natural parameters of our environment. As it changes states (and temperature) its density changes as well. Ice is less dense than water and water vapor is less dense than either ice or water. Water density also changes as temperature changes. Molecules of water naturally attract one another. Cohesion between water molecules is responsible for surface tension and capillary action. Water often acts like a magnet. It will attach (form hydrogen bonds) to substances like sugar and dissolve them. Oil and fat do not attach to water and therefore will not dissolve. As water evaporates, it cools. As it freezes, it expands.

Procedure:

1. Explain to students that before becoming a teacher you were once a famous magician. Today you would like to show the group a few magic tricks. Depending on the abilities of the group you may want to have students help with the experiments.

2. Use Teacher Notes 8-4 to demonstrate some of the unique properties of water. Emphasize your role as a magician. (Ask for help from members of the audience.)

3. After each "trick," ask students to summarize what they saw. Relate student observations to the physical behavior of water. Use students' thoughts to help explain what is happening and why.

Additional Resources:

http://wwwga.usgs.gov/edu/waterproperties.html **USGS Water Science for Schools** – a nicely presented web page describing the properties of water. Lots of links and search capabilities, too!

http://www.uni.edu/~iowawet/H2OProperties.html **Water Properties** - a site with good pictures of water cohesion, capillary action and more with helpful links.

http://www.topozone.com **Topo Zone** – download and use topographic maps for regions throughout the United States

Activity Level:
Experience

Subject Areas:
Science
Art

Objectives:
Students will...

- Identify properties of solids, liquids and gases.
- Observe water related experiments.
- Understand many of the unique properties of water.

Time Consideration:
30 minutes

Materials:

- Teacher Notes 8-4 "Water Magic"
- Water
- Sugar
- Ice cubes
- Eye dropper
- Hot plate
- Tea pot
- Bowl
- Penny
- String
- Paper towel
- Clear glass or jar

Vocabulary:
Solid, liquid, gas, molecule, cohesion, capillary action

Assessment:
Upon completion of this activity students should...

- Define terms that relate to the physical properties of water.
- Observe water tricks.
- Summarize experiment results.

What Is My Watershed?

Background: A watershed is a catch basin that guides all the precipitation and runoff into a specific water system. Outlined by geological high points (mountains, plateaus, etc.), water flows downhill to large bodies of water like creeks, streams, rivers, reservoirs, lakes and oceans. Perhaps the single most important thing to remember about watersheds is that they are not single units but are actually connected systems that combine with other watersheds as they flow downstream. It is important to understand that what affects a watershed in one place eventually affects other sites downstream. As water travels through a watershed, damage from pollution and other toxins increases as water continues downstream.

Procedure:

1. Obtain topographic maps (one for each group) of your local region, a larger area, or even a country. Introduce the term *watershed* and use a map to define the properties of watersheds (Topographic maps can be downloaded using a link from "Additional Resources.")

2. Divide students into groups. Make sure all groups are familiar with topographic map symbols and features like contour lines, roads, water and other colors and shapes. Pass out a map and Student Page 8-5 to each student.

3. Have students use their maps to answer the questions on Student Page 8-5. Once completed, ask students to redefine a watershed and discuss how the everyday actions of people might affect the water flowing through a particular watershed or how that particular watershed has changed over time.

Additional Resources:

http://www.epa.gov/surf/ **Surf Your Watershed** – an EPA website designed to help locate, find and share information about watersheds. Get maps, find links, and everything else watershed related.

http://edcwww.cr.usgs.gov/Webglis/glisbin/finder_main.pl?dataset_name=MAPS_LARGE **USGS Map Finder** – find and order 7.5 minute (size and scale) paper topographical maps.

Activity Level:
Explore

Subject Areas:
Science
Social Studies

Objectives:
Students will...

- Understand how watersheds catch and channel water.
- Interpret topographic maps to find watershed boundaries.
- Evaluate the impact of cities and urban development on watershed quality.

Time Consideration:
45 minutes

Materials:

- Student Page 8-5 "What is my Watershed?"
- Topographic maps (one for each group)
- Colored pencils, crayons or markers

Vocabulary:
Watershed, downstream, runoff, topographic map

Assessment:
Upon completion of this activity students should...

- Outline a watershed on a topographic map.
- Complete Student Page 8-5.
- Discuss how watersheds are impacted by people and development.

Water Managers

Background: Patterns of water consumption vary from watershed to watershed. However, world water usage has increased dramatically over the past 200 years. As a result, the quality (both physical and chemical) of water in most watersheds has deteriorated. Many experts believe that all drinking water in the United States is contaminated. Water pollution and over-consumption are serious environmental problems that have local and global implications.

Watersheds become contaminated in several ways. Most often human activities are to blame. Some contamination is the result of natural processes that have been unnaturally accelerated like soil erosion. Other damage is caused through a series of interactions. As an area is developed many natural buffers are removed and chemicals and other pollutants wash, unchecked, into rivers, lakes and ground water. Point (a specific location) and nonpoint (broad areas) source pollution overload natural balances of nutrient levels and other chemicals in water. Agriculture, home and industry use of water all contribute to the degradation of water quality and the watersheds themselves.

Procedure: see page 14

Activity Level:
Expand

Subject Areas:
Science
Social Studies
Language Arts

Objectives:
Students will...

- Identify factors that affect watershed quality.
- Interpret the needs of a typical waterfront development.
- Analyze the consequences of waterfront development and conservation.

Time Consideration:
1 hour

Materials:

- Teacher Notes 8-6 "Water Managers"
- 8 1/2 x 11 inch sheets of paper
- Markers, crayons and pencils
- Newspapers and magazines
- Other materials as needed

Vocabulary:
Watershed, contamination, nonpoint source, point source, erosion

Assessment:
Upon completion of this activity students should...

- List factors that affect the quality of water in a watershed.
- Plan the development of a particular waterfront plot.
- Debate the positive and negative effects of waterfront development on watershed quality.

Additional Resources:

http://www.worldwater.org **The World's Water: Information on the World's Freshwater Resources** – a site providing current water information, data and links about global freshwater problems and solutions.

http://www.ctic.purdue.edu/kyw/kyw.html **Know Your Watershed** - a watershed information network. This site contains very useful guidelines for creating a watershed management plan.

Water Managers - Continued

Procedure:

1. Draw an imaginary river or lake on the board or a large sheet of butcher paper. This will serve as the backdrop for the activity. Be creative and decorate your river if time permits.

2. Inform students that they are going to be given a section of waterfront property (a piece of paper) that needs to be developed. Students will be able to develop the property in any way they see fit as long as it aligns with their particular interest. See Teacher Notes 8-6.

3. Divide the class into groups and assign each group (or individual) a particular interest. Choose from the list on Teacher Notes 8-6 or make up others more related to your specific area.

4. Pass out a piece of paper to each group. Explain to students that this is their section of waterfront property. Instruct each student to draw and develop their waterfront plot with pictures and descriptions. Encourage them to be creative! The more ideas (power plants, lawnmowers, construction) the students portray on their plots, the more exciting and involved the discussion will become, as conflicts will surely arise.

5. Once completed, add each piece of paper to the large river or lake so all can see them. Ask students to present their land and waterfront usage plan to the rest of the class. Make sure that students save their comments until all the plans have been presented.

6. As a group, discuss the benefits and costs of each proposal. For example, farming produces food, provides jobs through seasonal employment and has high economic value. However, agricultural practices also use pesticides that may damage people and the environment, provide a natural source for soil erosion, and sometimes drain wetlands due to the need for irrigation.

7. Give the students extra time to work in their groups and determine what they believe to be the best possible land use plan under these circumstances. End the activity with an emphasis on solutions rather than problems.

EXPERIENCE

Watch the water cycle first hand! Find a clear glass jar with a lid and fill it 1/3 with water. Screw the cap on tightly and set it on a windowsill in the sun. Eventually water will evaporate and then condense on the sides of the jar.

Write a paragraph or short story about an experience with water (swimming, canoe trip, day at the beach). Next, re-write the story, and this time the same experience will occur in polluted or contaminated water. Ask students to describe a few of the changes that they might notice, feel, smell or taste.

Demonstrate the amount of water on the earth with the following:

1. Take a large container (10 cups) and fill it full of water.
2. Pour 1/3 of a cup of water into another container - this represents the world's freshwater, while the large container represents the world's saltwater.
3. Take the small container (freshwater) and pour about 2/3 of that into an ice-cube tray. The tray represents water that is frozen in glaciers and polar ice caps. At this time, there should be approximately 1/9 of a cup of water left – this is unfrozen fresh water.
4. Scoop out 1 teaspoon of water from the small container. This represents all surface water on the earth. The water still in the container is groundwater.
5. From the teaspoon, take an eyedropper full of water. Place three small drops onto the table. This represents all the water in the Great Lakes.

EXPLORE

Ask students to **monitor their water usage**. Conduct simple experiments to find out how much water they use (brushing teeth, taking showers, doing dishes, etc.). Create a worksheet to help students to track their water usage throughout a one-week period. Use research to discuss water conservation issues.

Have the students **research a story about watersheds and write a short essay about how watersheds relate to wildlife habitats**, why they are important to people and what they could do to protect, conserve or restore a watershed. Have each student read their essay aloud for the class and encourage questions and discussion.

Arrange a (real or virtual) tour of a wastewater treatment plant. Ask students to write a paragraph summarizing the role wastewater treatment plays in keeping the world's water resources clean and healthy. Brainstorm possible water treatment strategies as well as preventative methods.

EXPAND

Pick a local waterway (lake, river, pond, etc.) and research how the land has been used along its shore. As a class, create a management plan that addresses local needs for water as well as issues that relate to sustaining or improving water quality.

Compare and contrast water with another molecule. Write a paragraph describing water's unique properties and how those characteristics are similar to, or different from, other molecules. Emphasize how water's properties change as a solid, liquid or gas.

Clean water campaign. Develop a poster or advertisement that promotes the positive effects (or negative repercussions) of clean water. Present the ad campaign to group, class, school or community.

Additional Resources: see page 16

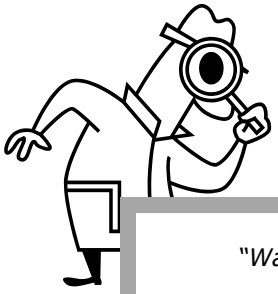
Extensions - Continued

Additional Resources

http://www.fi.edu/fellows/fellow8/dec98/watercycle/jigsaw.htm **The Water Cycle Interactive Jigsaw Puzzle** - just like the name implies this page is a water cycle jigsaw puzzle.

http://www.k12science.org/curriculum/drainproj/ **Down the Drain** – an Internet-based collaborative project that allows students to share information about water usage with other students from around the world. Site provides comprehensive reference materials and links.

http://www.geobop.com/World/Facts/Geography/Water/ **Water World Facts and Statistics** – a fun website with water pictures and facts.



The Science of

Water Quality

"Water is the driver of Nature."
- Leonardo da Vinci

Summary:
Students become water doctors as they analyze aquatic ecosystems. They must use a variety of tools and observations to help assess the health of an aquatic ecosystem.

Background:
Aquatic ecosystems are a lot like people. They are complex systems that exhibit many unique characteristics. Water is similar to our blood as it is a medium for transporting gases and nutrients and contains the many producers, consumers and decomposers that inhabit aquatic systems. In a river, the main driving force is current which powers river processes while moving nutrients and organisms through the system (much like the human heart). The current also dictates erosion, deposition, bottom type and the presence of aquatic organisms. Water moves in lakes as well. Differences in temperature and density cause bottom and surface water to "turn over" and exchange vital nutrients. Rivers and lakes are affected by temperature but can operate under a wider range than a person's narrow requirements.

Background and Procedure continued page 18

Additional Resources:

http://www.crcwater.org/wqmanual.html **Water Quality Monitoring - A How-to Guide** – quick and easy information on sampling techniques, chemical and biological tests plus much more. A good place for helping you design water quality testing activities.

http://www.ai.org/dnr/soilcons/riverwatch/vsm/manual.html **Hoosier Riverwatch** - training manual for monitoring water quality. PDF files contain information on conducting chemical tests, macro invertebrate analysis, data analysis and action suggestions.

Field Manual for Water Quality Monitoring 9th edition, by Bill Stapp and Mark Mitchell - background information on water quality monitoring, heavy metal testing, macro invertebrates, land use practices, a case study of the Rouge River Project, computer networking, international rivers and cross cultural partnerships.

Activity Level:
Experience
Explore
Expand

Subject Areas:
Science

Objectives:
Students will...

- Analyze physical, chemical and biological components of an aquatic ecosystem.
- Use monitoring tools to assess water quality.
- Predict the health of an aquatic ecosystem.

Time Consideration:
45 minutes; 2-3 hours additional water research time required

Materials:
- Student Page 8-7a "Water Lab Results"
- Student Page 8-7b "The Prognosis"
- Water quality monitoring equipment
- Pencil or pen

Vocabulary:
Producer, consumer, decomposer, current, turn over

Assessment:
Upon completion of this activity students should...

- List several components of aquatic ecosystems.
- Employ various data collecting measures.
- Give an accurate assessment of water quality.

Background - continued

Just as people need to receive regular physicals to maintain a healthy body, rivers and lakes can benefit from regular check-ups as well. They both can experience imbalances and diseases that affect the life inhabiting them. Testing the temperature, velocity, pH, dissolved oxygen and biological content of rivers on a regular basis allows "water doctors" to assess the water's current state of health, but also alerts them to any conditions that could become a problem.

Procedure:

1. Locate a local waterway and determine suitability for student testing. Arrange necessary permission slips and address safety concerns. Familiarize yourself with water quality assessment forms.

2. Obtain water quality monitoring kits (from school or local natural resource office) or devise your own measuring systems. Use information from the "Additional Resources" to determine correct and accurate testing methods and equipment. Choose appropriate tests for your grade level. Review and practice testing procedures before leaving.

3. Travel to a local body of water and conduct experiments. Set clear and concise safety guidelines.

4. Divide students into groups and complete Student Page 8-7a.

5. Upon return to the classroom, complete Student Page 8-7b to evaluate the health of the aquatic system tested.

6. Discuss results and possible causes of contamination.

Water Quality

Background: "If you could tomorrow morning make water clean in the world, you would have done, in one fell swoop, the best thing you could have done for improving human health by improving environmental quality." - William C. Clark

A safe and secure water supply may no longer exist. While our demands for water continue to increase, pollution, declining water tables and longer drought periods are further depleting the usable water supply. We use water everyday at our homes and at work in many circumstances that we tend to take for granted. Water passes through our homes, helps cook our food, bathes us, washes our clothes, waters our lawns and carries away the many by-products of our everyday lives. We return it to the environment, often to the same body of water it came from, but in poorer condition. Understanding how people's water uses affects an entire watershed is the first step towards preserving our precious water resources.

Procedure:

1. Access the Online Classroom at PolarHusky.com

2. Add your own opinion or thoughts to the discussion boards. Think about and answer the following questions:

   a. Give examples of how you use water in your daily, weekly and monthly lives.

   b. What are some examples of water pollution? Do any of these directly or indirectly affect you?

   c. Is water pollution a serious environmental problem? Why or why not?

3. Participate in the chat on "Water" during week 12 and 13 of Arctic Transect 2004 – Check in the chat section of the website http://www.PolarHusky.com for exact schedule.

Questions for the Team!

Water plays a vital role in the Arctic Transect expedition. The rivers and lakes of the Hudson Bay watershed provide Arctic Transect team members with important travel routes. Winter travel on snow and ice would be impossible without the contributions of the water cycle. Drinking water is obtained by melting snow or ice.

Use this simple worksheet to send questions to team members on the trail:

- Email your questions to questions@PolarHusky.com
- Check out your answers in the Question and Answer section of the website: http://www.PolarHusky.com

Here are some questions other folks have asked:

1. How do you get water to drink when everything else is frozen?
2. Do the dogs eat snow?
3. What rivers or lakes are you traveling near?

Now it is your turn!

1.

2.

3.

Water Concepts

Name_____

Your Concept Map:

Reading a River

The first step in interpreting how water is affected by objects in a river is to understand how water works. Water wants to flow in a straight line down the steepest, straightest channel. Therefore, as a river bends the water tends to be faster and deeper near the outside of the bend. Water moves slower near the bottom because of friction with the riverbed and faster near the surface where there is less friction. Friction also causes water to bend and move in irregular paths as it comes in contact with different objects.

1. Upstream "V"s. As water flows into an object, like a rock, it collects on the upstream side for an instant then flares out and past the object forming an upstream V. The point of the V indicates the presence of an obstacle. The V may be caused by an obstacle above the water or below the surface of the water. Whichever the case, avoid all upstream "V"s.

2. Downstream "V"s. Deeper channels are created between obstacles as the water bounces off the rocks and flows around them. The lines of current meet in the channel as a downstream V. Choosing a route through a downstream V will be the safest and one that most paddlers choose because it appears as a smooth chute through a rapid. Examine the "V"s carefully because even the best route can be choked by a rock that will alter what appears to be the "best".

3. Strainers. Trees or branches that have fallen into a river are called strainers. **Strainers are dangerous. Avoid them at all costs.** A canoe caught in a strainer will, more often than not, tip over. Paddlers will be forced underwater and trapped in branches as water presses against them, making escape almost impossible. Most strainers are on the sides of rivers and are easily avoided.

4. Riffles. Water flowing over shallow areas creates disturbances in the surface called riffles. Riffles denote shallow water - stay away.

5. Eddies. A rock or turn in the river will force water to flow around it creating an eddy. An eddy is an area immediately downstream of an obstacle in a river where the current is relatively calm or may actually flow upstream. It results from water filling the void from behind the obstacle as the main currents flow past. Eddies are good places to rest while running rapids because they are generally calm. If half of your canoe is in the eddy and the other half in the main current, eddies can sometimes twist your canoe unexpectedly.

5. Horizon line. The appearance of a horizon line, where only the top of the scenery downstream is evident, is clear evidence of a dam or natural ledge. Other signs are increased noise from falling water and spray or mist from the impact of the drop. Proceed with caution and be prepared to stop and get out!

6. Pillow. In slower current, a rock just under the surface will create a disturbance just down stream of it, often in the form of a tightly curling wave. The rock becomes an obstacle called a pillow because of the smooth sheen of water covering it - similar, at times, to an upstream V.

7. Hole. Fast, deep water can drop sharply over an extremely large obstacle into a depression known as a hole (also known as a hydraulic or reversal). The volume is not great enough to flow over the ledge or rock and continue downriver so it gets trapped in the depression below the rock, re-circulates upstream and continues to roll around within the deep hole. A large hole with very strong upstream current is called a keeper because it will hold boats in it.

Water Magic

Choose from the following experiments to demonstrate some of water's unique physical properties.

1. **Into Thin Air.** Take some ice cubes and place them in a pot on a hot plate. Allow the ice cubes to melt into water and then boil into water vapor. Discuss how water exists as a solid, liquid and gas in our natural environment.

2. **Disappearing Act.** Fill a clear glass jar with water. Stir in a teaspoon of sugar. Discuss how water acts as a universal solvent.

3. **Tightrope Walk.** Soak a string in water. Ask a student to hold the string at a slight angle. Using an eyedropper, add a drop of water to the string. Discuss cohesion and how water molecules like to cling together.

4. **All Aboard.** Fill an eyedropper with water. Place a penny on the table and carefully place a drop of water on the penny. Repeat the process counting each drop. Discuss cohesion and how water molecules like to cling together.

5. **Walk on Water.** Fill a bowl with water and gently place a paper clip on the surface of the water. Keep adding paper clips until the surface tension breaks. Discuss surface tension of water.

6. **Up and Up.** Fill a bowl with water. Take a piece of paper towel and carefully place one edge in the water. Watch as water rises up the paper. Discuss capillary action.

What Is My Watershed?

Group Name_____

Use a topographic map to complete the following tasks and questions.

1. Using a colored pencil or marker, trace the rivers and lakes of one watershed on your map.
2. Using another color, outline the ridges and other highpoints that define your watershed.
3. Is this watershed part of a larger watershed?

4. Draw arrows that indicate the direction that water is traveling in your watershed.
5. Name three rivers or lakes that are part of this watershed.

6. Where does this watershed empty?

7. How many cities are intersected by rivers or lakes?

8. Are there any dams or other man-made objects that affect this watershed?

9. Describe the land surrounding this watershed.

10. How do actions from people affect the quality of water in this watershed?

Water Managers

Use this information to create management areas and facilitate debate.

Possible interest groups:

- Summer Resident – wants a nice quiet cabin with close access to water
- Subsistence Hunter – uses fish to feed family and small dog team, traps along water front as well
- Farmer - wants to use the land to raise food and livestock
- Gas Station - plans to build a service and pumping station to serve growing community
- Parks Department - plans to build a park and swim beach
- Highway Department - wants to connect two sections of town with a bridge
- Sewage Treatment Plant – needs to expand facilities to meet city needs
- Paper Factory - sees ideal location for producing and shipping paper products
- Hydro-electric Company - wants to utilize water resources for energy
- Fishing Guide - wants to build a bait shop, dock and boat landing

Once the students have completed their development, have them place their plot (piece of paper) on the river (tape them up on board or poster). Allow them to explain their development by answering various questions. As the students answer, formulate other relevant questions in order to facilitate a good discussion about each land use.

- What was your special interest group?

- Where was your plot of land located on the map?

- Did construction occur on your site? Explain what was done and why.

- What effects might your land use have on other people and the environment?

Water Lab Results

Name:

Water Patient's Name:

Doctor's Name:

Nearest City:

Current Weather Conditions:

– Now, record your findings to the questions below on a separate sheet!

Physical Properties

I. **General Appearance**: Describe the color and smell of the water. Note any erosion, garbage, animal signs and other observations.

II. **Temperature:** Measure ___ Air ___ Surface ___ Bottom

III. **Velocity (moving water):** Throw a small stick or leaf in the water and time how long it takes to travel 10 feet.

10 feet/_____ sec. = _____ feet/sec.

IV. **Turbidity:** Describe the clarity of the water. How clear is it? Can you see the bottom? What is the turbidity reading?

V. **Bottom:** Describe the bottom type.

Chemical Properties

I. Dissolved Oxygen
II. Biological Oxygen Demand
III. pH
IV. Nitrates
V. Phosphates

Biological Properties

I. **Plants:**
Algae? Floating-leaved plants? Submerged plants? Emergent plants?

II. **Invertebrates:**
- Name and/or draw each species found.
- Record number of each species found.

III. **Vertebrates:**
- Name and/or draw each species found.
- Record number of each species found.

The Prognosis

1. Using your data sheet and the "Water Research Chart" decide whether each test listed below showed good or poor results. Place an "X" in the appropriate box. In the last row, total the number of "X"s from each column.

River Tests	Good	Poor (Danger reading)	Uncertain/ Not applicable
General Appearance			
Temperature			
Turbidity			
Dissolved Oxygen			
pH			
Nitrates (opt.)			
Invertebrate Diversity			
Total			

2. List three conclusions about the current state of the river's health (examples: dissolved oxygen level is good for trout growth, pH level is 7.5— good, invertebrate diversity is low, etc.):

1.

2.

3.

3. Rate the health of the river on a scale from 1 to 10 (circle your answer). Be prepared to explain your choice.

1 2 3 4 5 6 7 8 9 10

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