MIDDLE SCHOOL
DISCUSSION GUIDE

Into the Outdoors

DISCUSSION GUIDE

KNOW YOUR H_2O

Wisconsin Water Association
A section of AWWA

Educational Partner

Life Science

GRADE LEVELS
Middle School - Grades 6-8

ENDURING KNOWLEDGE
Students will know where and how people obtain safe drinking water while recognizing the various roles that professionals play in municipal water agencies in acquiring, treating and delivering safe water.

LEARNING TARGETS: After viewing the video, students will be able to:

1. Summarize how evaporation, condensation, and precipitation each play a role in the water cycle.
2. Give examples of surface and groundwater sources that provide drinking water, including aquifers, lakes, rivers, and streams.
3. Describe how water is disinfected to inactivate contaminants and filtered to remove bacteria, sediment, silt, and some types of pollution found in the water.
4. Explain that water quality is determined by testing the water and measuring for the amount of nitrates, metals, minerals, and microorganisms that may be present.
5. Tell how sand works as a natural filter, as found in nature.
6. Explain that water infrastructure is used to acquire, treat, distribute and store drinking water, and it includes treatment plants and equipment, wells, pumps, ground-level reservoirs, and water storage tanks.
7. Explain how certain disinfectants and chemicals are mixed into the water to ensure it is safe to drink.
8. Describe how people in rural areas who use groundwater get their water from wells and use water softeners to remove certain chemicals.
9. Give examples of careers in the drinking water profession that are involved in water treatment, testing, storage, infrastructure maintenance, planning and business such as engineers, plant operators, mechanics and electricians, maintenance workers, microbiologists and chemists, water meter technicians, customer service and accounting.
10. Describe challenges associated with distributing water to people, such as equipment failure, power outages, and leaks caused by extreme cold temperatures and pipe corrosion.

DISCUSSION GUIDE FOR THE VIDEO

TEACHER BACKGROUND

Did you know that three million people in the world die each year due to water related diseases? We would like to teach future generations about the source of clean water and how to provide it, and to make a positive impact on world health. Know Your H_2O teaches viewers about the water cycle and water sources, as well as how water is treated, tested, stored, and pumped. Viewers also explore careers and challenges associated with distributing safe drinking water to people.

Water Cycle and Sources

The water cycle is broken into three stages: evaporation, condensation, and precipitation. Evaporation occurs as the sun's energy heats the surface of lakes, rivers, plants, and soil, transforming water from a liquid to a gas known as water vapor. This gas rises into the sky and cools, forming water vapor particles. This process is called condensation. The water particles congregate together in clouds forming droplets, and as they become heavier, the droplets fall to the ground as precipitation.

Once on the ground, water can travel on the surface to lakes, rivers, streams, and oceans, or it can seep downward into the soil as groundwater. People collect groundwater by drilling wells into aquifers, which are underground layers of porous rock that have openings that liquids and gases can pass through. At a water treatment plant, water from a groundwater or surface water source, such as an aquifer or lake, passes through a filtration system. A disinfectant, such as chlorine, ozone gas, or ultraviolet light is added to the water to kill any bacteria and viruses present, and destroy harmful contaminants. Sometimes, fluoride is added as a preventative of dental cavities. After testing and the purification processes are complete, the water flows into a reservoir for storage, then is distributed through water mains to people for drinking and other daily activities.

TEACHER BACKGROUND *(continued)*

Science of Water

Water quality is determined using chemistry. Water is tested in a laboratory to make sure the levels of chemical concentration are within a safe drinking range. Minerals such as calcium and magnesium can be found in water, and they provide flavor to the tasteless liquid. Other inorganic compounds can be hazardous. If water contains high levels of substances such as nitrates and metals such as lead, it can be unsafe for humans to drink. Water is also tested for coliform and other microorganisms that may be present. These tests confirm the water is safe for people to drink.

Water Storage and Distribution

In many areas, infrastructure is used to store and distribute water. The distribution process begins when water is pumped from the ground or a treatment plant. It is then filtered and stored in a reservoir—either a ground level tank or a water tower. Water is then distributed to homes, schools, and businesses in an underground system of pipes. The pipes also connect to fire hydrants that provide pressurized water when opened. Ground-level water tanks use pumps to distribute water, and water towers use hydrostatic pressure, which is the water pressure exerted from the elevated column of water. Some people living in rural areas obtain water from private wells, and a water softener is often used to remove calcium carbonate, know as "hardness" from the water.

Challenges and Careers

Engineers, biologists and chemists, mechanics and electricians, heavy equipment operators, customer service specialists and accountants, information technology professionals, maintenance personnel, and plant operators work together to ensure the infrastructure is working properly and reliably. Utility employees provide direct service on water mains, fixing them when they break or corrode. Equipment failure can sometimes occur, so utility employees make sure electronics and mechanical components of the pumps work correctly and are repaired quickly when needed. Operators watch the whole water system to ensure all parts are working properly. People work in the laboratories to test the water and ensure it is safe. In addition, billing and financial professionals measure the water customer's use and bill them to cover the cost of producing and distributing the water.

VOCABULARY:

aquifer: an underground layer of rock with porous openings that liquids and gases can pass through

condensation: the process of changing a gas into a liquid

evaporation: changing a liquid into a gas

filter: porous device for removing unwanted substances from water.

H_2O: the chemical name for water; H represents hydrogen, and O is oxygen. Water is composed of two hydrogen atoms and one oxygen atom

infrastructure: structures, pipes and pumps through which water flows in a municipal water system

microorganism: a living thing such as bacteria that one cannot see without using a microscope

precipitation: water falling to the earth as hail, mist, rain, sleet, or snow

reservoir: a place where water is stored

water cycle: the continuous movement of water on, above, and below the Earth's surface; also known as the hydrologic cycle

water vapor: gaseous form of water

SPECIAL CONSIDERATIONS:

This activity is richest when completed in the classroom with discussion shared within the whole class. It may be helpful to create a guide sheet for notes with headings and questions to help guide students in picking out significant information.

BEFORE VIEWING THE VIDEO:

Give each student a blank piece of paper. On one side, have them draw and label the water cycle. On the other, have the students draw and label two more diagrams—one of how people using groundwater obtain water and one showing how people using surface water get their water. The students will redraw these diagrams after watching the video, making modifications as needed.

VIEWING AND DISCUSSION GUIDE:

Water Cycle and Sources

1. Name and describe the three stages of the water cycle.
2. Another name for the water cycle is _____.
3. What is an aquifer?
4. Describe how water is processed using the following terms: filtration system, sand, chlorine, disinfection, fluoride, and reservoir.

Science of Water

1. List five things in water that can be harmful to humans if found at too high of levels:
2. What is water quality and why is it important?
3. What are microorganisms, and why do we test water for them?
4. Describe how Mother Nature filters water and why it works.

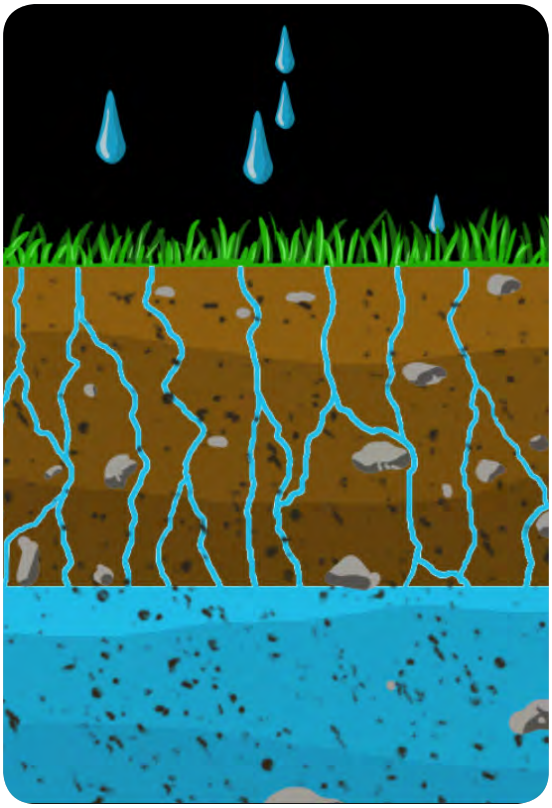
VIEWING AND DISCUSSION GUIDE continued:

Water Storage and Distribution

1. What is infrastructure as described in the video?
2. How do people get ground water?
3. Name the four parts of a water infrastructure.

Challenges and Careers

1. Describe two challenges that can occur in the water distribution process.
2. Name two careers associated with water distribution.



ADDITIONAL CONSIDERATIONS:

The online video "*Know Your H_2O*" is presented in four separate Parts. The instructor may want to stop the video after each of the four Parts to allow students time to take notes and write down their questions.

EVALUATION:

Students can be informally assessed from their notes taken while viewing the video and from their participation in class discussion.

After watching the video, students can also be instructed to draw diagrams of the water cycle, a surface water system and a groundwater system. For each of the diagrams, the students can write a three-to five-sentence paragraph explaining the process. This can serve as a formal assessment of the students' understanding of where and how people obtain fresh and safe drinking water.

EXTENDED LEARNING:

1. Instruct students to create a multimedia presentation about a career associated with water quality, treatment, distribution, or storage. Some careers include water quality specialists, engineers, operators, and customer representative.
2. Students can contact the local water utility and report to the class how water is tested, stored, and distributed in their community. They can also search online for information. www.drinktap.org is an excellent resource.
3. Have students work in small groups and research social issues that arose when safe drinking water was not present. They can then share their findings with their peers.

The following **Student Proficiency Standards** can be met by teaching KNOW YOUR H_2O:

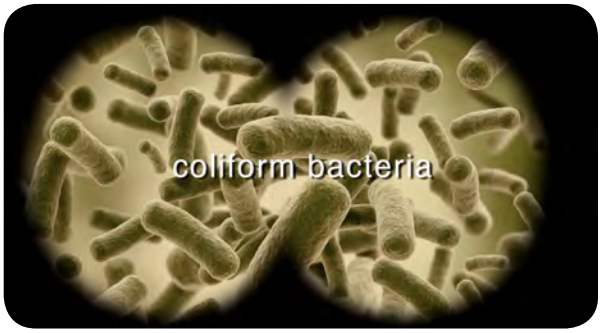
WISCONSIN MODEL ACADEMIC STANDARDS FOR SCIENCE, GRADE 8

Content Standard Science Standard E - Earth and Space Science

E.8.6 Describe through investigations the use of the earth's resources by humans in both past and current cultures, particularly how changes in the resources used for the past 100 years are the basis for efforts to conserve and recycle renewable and non-renewable resources

Content Standard Science Standard G - Science Applications

G.8.3 Illustrate the impact that science and technology have had, both good and bad, on careers, systems, society, environment, and quality of life



G.8.5 Investigate a specific local problem to which there has been a scientific or technological solution, including proposals for alternative courses of action, the choices that were made, reasons for the choices, any new problems created, and subsequent community satisfaction

Content Standard Science Standard H - Science in Personal and Social Perspectives

H.8.3 Understand the consequences of decisions affecting personal health and safety

NEXT GENERATION SCIENCE STANDARDS

Ecosystems: Interactions, Energy, and Dynamics

MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services

Earth's Systems

MS-ESS2-1 Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process

MS-ESS2-4 Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity

Earth and Human Activity

MS-ESS3-1 Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes