

Grade 9: HOW CLEAN IS YOUR WATER?

Students conduct an experiment to identify microscopic organisms in water samples and learn how related environmental practitioners apply similar skills and knowledge to monitor water quality.

CURRICULUM CONNECTIONS

Related Outcomes

This lesson will contribute to the student's ability to

- identify questions arising from practical problems and issues to investigate;
- design an experiment and identify specific variables;
- identify and describe science- and technology-based careers related to microbiology;
- describe and apply classification systems and nomenclature used in the sciences;
- identify and evaluate the potential applications of findings.

Related Coursework

This lesson works well in classes studying

- biodiversity and microbial taxonomy;
- environmental studies;
- microbial contamination of water;
- public health and safety issues facing Aboriginal communities;
- careers related to hydrogeology, engineering, geology, microbiology, water pollution, and public health and safety.

PREPARATION

Learning Objectives

During this lesson, students will

- observe, identify, and classify types of microscopic organisms present in treated and untreated water samples by accurately using a microscope and a microscopic organisms identification key;
- draw conclusions about water quality based on their experiment results and describe their findings in a laboratory report;
- practise proper use of laboratory equipment and safe laboratory techniques;
- discuss types of Traditional Ecological Knowledge used to assess water quality;
- explore the occupations of water treatment plant operator and hydrogeologist, and explain how each occupation might apply similar skills and knowledge in the workplace.

Total Time 70 minutes, including group presentations.

Material Required

- Copies of the profiles for water treatment plant operator and hydrogeologist from EnviroCareers section of the Aboriginal EnviroCareers website/CD-ROM (reviewed prior to class by students)
- Light Microscope (one for each pair of students)
- Glass slides with depression (two per microscope)
- Glass cover slips (two per microscope)
- Two beakers (per pair of students), one labelled as UNTREATED, containing untreated water, the other labelled as TREATED, containing treated water from the community's water treatment plant, i.e. tap water
- Microorganism identification key (one transparency and one copy per student)
- One eyedropper or small plastic pipette per beaker also labelled as TREATED or UNTREATED
- Laboratory apron, goggles, and gloves (per student)
- Paper and pencil
- Overhead projector



10 minutes



1. **Introduction: Identifying Measures Of Water Quality** (Brainstorming)
 - 1.1 Brainstorm: "If you were lost in the bush, how would you tell if water was safe for drinking, fishing or swimming?" Record the students' responses.
 - 1.2 Conclude brainstorming
 - a. "Indicators such as (examples of student responses) represent Traditional Ecological Knowledge (TEK) used by Elders and others who interact closely with the environment to distinguish between safe and contaminated water."
 - b. "Environmental practitioners like water treatment plant operators and hydrogeologists also use this type of information to test water quality in our community."
 - 1.3 Ask students to think of questions water treatment plant operators and hydrogeologists might try to answer when testing water. For example, water treatment plant operators might try to determine the amount of solids suspended in the water.

50 minutes

2. **Main Activity: Identifying and Classifying Microorganisms** (*Experiment*)
 - 2.1 Introduce the main activity: "In partners, you will conduct an experiment to test and compare the quality of treated and untreated water from our community. Specifically, you'll compare water quality based on the types of microscopic organisms such as algae and protozoa present in each type of water."
 - 2.2 Introduce the role of microscopic organisms in the water system
 - a. "Every organism in the ecosystem has a specific role and place in a hierarchy. Microorganisms have their own roles, in that some eat food from polluted water and others from cleaner water. That is why they're called indicators."
 - b. Display a microorganism identification key using the overhead projector. Review each type of organism the students will be looking for.
 - 2.3 Demonstrate the experiment procedure
 - a. "Use an eyedropper to remove one drop of the water from the treated water beaker and transfer it to a glass slide."
 - b. "Use another clean eyedropper to remove one drop of water from the untreated water beaker, and transfer it to a glass slide."
 - c. "Cover the slide with the cover slip and carefully transfer it to the stage of the microscope."
 - d. "Focus the material, using first the 10x lens of the



To find a microorganism identification key, try

- Electron Microscopy Gallery, Education Site, Dennis Kunkel Microscopy Ltd. website: www.denniskunkel.com
- anthology for teacher-based key: An Introduction to the Aquatic Insects of North America, Houghton Mifflin Co., 1970.
- Internet search using key words: microscope electron images.

1.2.a For example, TEK indicators might include water colour, presence or lack of different types of fish, smell, clarity, and amount of sediment.

1.2.b Briefly describe the occupations water treatment plant operator and hydrogeologist.

1.3 Water quality is a growing concern in many communities. Testing and monitoring the community's reservoirs and other water sources help decrease the development of harmful diseases like those caused by *E. coli* bacterium. Laboratories must follow the guidelines set out by the federal and provincial/territorial governments when testing water.

2.2.a Students will investigate the microbiological indicators of water quality. Indicators are microscopic organisms whose presence indicates the presence or absence of certain pathogens or disease causing agents like bacteria and viruses.

Specifically, students will be looking for indicators often referred to as "nuisance organisms." "Nuisance organisms" refer to a diverse group



10 minutes

- microscope.”
- e. “Increase the magnification of the lens, if necessary.”
 - f. “Using the microorganism identification key, compare what is seen in the microscope to the key, and identify the organism accordingly.”
- 2.4 Direct students to
- a. Record the names of each organism they identify and the type(s) of water in which each grows.
 - b. Draw conclusions about the quality of each water sample.
3. **Closure and Evaluation: Drawing Conclusions and Exploring Careers** (Discussion and Report)
- 3.1 Ask students to share their conclusions in a class discussion.
 - 3.2 Distribute the profiles for the occupations water treatment plant operator and hydrogeologist. Discuss the role and job duties of each occupation.
 - 3.3 Assign the laboratory report for homework (or provide additional class time). Instruct students to include
 - a. Rationale for conducting the experiment.
 - b. Materials and procedures used.
 - c. Results with graphic representation of the species.
 - d. Conclusion.
 - e. Explanation of how a water treatment plant operator or a hydrogeologist might use a similar experiment in their job.

of organisms such as algae and protozoa that may harbour pathogens.

While “nuisance organisms” are not pathogenic themselves, they can protect pathogens from being disinfected by the chlorine used in the water treatment process, thus indicating unsafe water.

2.2.b Give each pair of students a microorganism identification key to assist in identifying the types of organisms found (see attached key).

2.3.a, b Stress the fact that pipettes or eyedroppers should not be mixed to eliminate cross-contamination.

Process 2.3.f Draw students’ attention to the names of each organism on the key, and the places where each organism can be found, e.g., polluted water or clean water.

2.4.a Students need to record both pieces of information.

Evaluation Considerations
Use a standard Laboratory Experiment rubric to evaluate students’ performances during the experiment.

Also evaluate students’ abilities to

- identify organisms from the microorganism identification key accurately;
- anticipate questions to investigate related to water-quality testing;
- describe potential applications of their testing process and findings in a related career.

SUGGESTIONS FOR ADAPTATION

- This experiment can be adapted to Grade 10 as part of a unit on the dynamics of the ecosystem. Students would study a single water sample to investigate microbial indicators of water quality rather than comparing two distinctly different samples.