

INVESTIGATING WATER QUALITY

An educational resource for understanding the issues of water quality. This package is part of the WE Walk for Water campaign.

LESSON PACKAGE FOR GRADES 9-12

AN INITIATIVE OF



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Dear Educator,

Welcome to the WE Movement. We are so glad you've joined us in our mission to inspire, educate and empower students to find their place in the world. Throughout the last two decades, educators have stood by us. With over 12,000 schools thriving in WE Schools, we are delivering impressive results in academic engagement, life skills and civic engagement. Through the WE Schools program of experiential service-learning, students engage in collaborative learning and independent reflection. As a result, your students will become more engaged in local and global issues.

Our partnerships with Brita supports our commitment to making the world a better place as they make better water. Brita is making an investment in helping to bring clean water to those who need it. Millions of people around the world don't live near a reliable, clean water source or have access to sanitary washing facilities, leaving them at risk of illness from waterborne diseases. Brita's Filter for Good campaign is working toward bringing clean water and sanitation to those who need it the most.

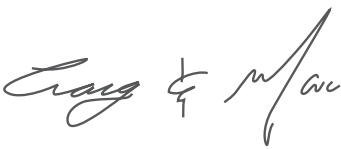
Brita and WE Schools have partnered to give teachers and students the tools to investigate water quality in their communities. Students will gain a greater appreciation for the accessibility of safe, clean water and learn about the effects of consuming unsafe water. Together, we're empowering students with knowledge to better understand the importance of clean water and encouraging them to explore the current issues concerning water.

This package was created to help you bring discussions about clean water issues into your classroom. It is designed to guide students through experiments using the scientific method so that they can find solutions to local water issues as they better understand water issues that exist around the world.

This is an exciting time to be an educator. Together, we have the power to reignite the fundamental purpose of education: moving students to want to learn, and preparing them with the life skills to better the world and forge their own paths to success.

Thank you for having the heart and passion to bring WE into your classroom. We are honoured and encouraged to work with such a dedicated and enthusiastic group.

We are stronger together,



Craig and Marc Kielburger
Co-Founders, WE



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Essential Question:

Why is water a basic need for survival and how can we ensure that it is safe for consumption?

WE Schools

WE Schools is a unique, step-by-step program that challenges young people to identify the local and global issues that spark their passion and empowers them with the tools to take action. Educators and students work together to learn about the world and to take action to create meaningful change. Delivered in 12,300 schools and groups across North America and the UK, the program provides educators and students with curriculum, educational resources and a full calendar of campaign ideas.

What is Experiential Learning?

Experiential service-learning is based on a structured academic foundation that goes beyond volunteering and community service. It's a practice that engages teachers and students with their communities in a structured way and allows students to meet their learning objectives while addressing their community's needs.

The Four Steps of WE Schools

1.

INVESTIGATE AND LEARN

Students explore topics related to a real-world challenge or opportunity.

2.

ACTION PLAN

Students develop a plan to implement their service-learning project, including one **local** and one **global** action.

3.

TAKE ACTION

Students implement their action plan.



4.

REPORT AND CELEBRATE

Students present the results of their service-learning initiatives.

Setting Students Up For Success: In school, the workplace and in life.

WE Schools Introduction: www.WE.org/we-at-school/we-schools/

Living WE is about improving our lives and our world by reaching out to others. It involves focusing less on “me” and more on “we”—our communities, our country and our world.

Social Emotional Learning: The WE Learning Framework is grounded in social emotional learning principles, helping students develop the skills to manage their emotions, resolve conflict and make responsible decisions.

Global Mindset is the ability to operate comfortably across borders, cultures and languages. The WE Schools program promotes global mindedness and cultural competency amongst student populations during their formative years.

Active Citizenship: Students act on their growing knowledge by connecting with others in their communities, thereby generating interest, further research and engagement in local and national causes.

Reflection is a key component of our experiential service-learning model. Our reflection activities direct students' attention to new interpretations of events and provide a lens through which service can be studied and interpreted.

INVESTIGATING WATER QUALITY IN THE ELEMENTARY CLASSROOM

■ RATIONALE

Investigating Water Quality is a package of lessons designed to introduce the concepts that water is necessary for survival, is a basic human right and that there is a water crisis we need to know about, understand the causes of and address. Progressing through the four steps of WE Schools: Investigate and Learn, Action Planning, Take Action and Report and Celebrate with reflection activities incorporated throughout, students experience the full cycle of service learning. Lessons focus on water quality for human consumption—locally, nationally and globally—allows students to conduct experiments using the scientific method and encourages them to develop a deeper appreciation for the accessibility of safe water. Students will also learn about the effects of consuming unsafe water and about the current water crisis.

Consisting of a series of lessons, assessments for/as/of learning suggestions and blackline masters—all established within the WE Learning Framework—this package will introduce students to the concept of investigating water quality to ensure that it is safe to consume and encourage them to explore the current issues in the water crisis.

Brita and WE's Partnership

Brita is an international water filtration company dedicated to helping Canadians take simple, small steps toward making positive change that have big impact. Brita is committed to “Filter for Good,” a campaign highlighting Brita’s dedication to making clean, healthy water accessible locally and globally. Brita is passionate about providing better water for a better world through helping create water that is better in health, taste, value and sustainability.

Together, we’re working to increase the accessibility of clean water at home and around the world.

■ RECOMMENDED ASSESSMENT OF LEARNING

You know your students best, their learning styles and preferences, skill levels and knowledge. You also are best positioned to anticipate their differentiated needs that will make this lesson package successful in your classroom. In this lesson the teaching strategies focus on creating a scientific experiment. Students are required to use research and critical thinking to develop a hypothesis and analyze the results that come from the experiment. Please take a moment to make any accommodations or modifications that will allow each student in your class to be a successful learner.

Core Skill Sets

Look for these icons at the top of each lesson. The icons identify the most relevant core skills being developed. Learn more about the WE Learning Framework at www.WE.org/we-schools/program/learning-framework/.



CRITICAL THINKING



RESEARCH AND WRITING



INFORMATION LITERACY



ARGUMENT FORMATION



LEADERSHIP SKILLS



ORGANIZATION



ACTION PLANNING



REFLECTION

WE WALK FOR WATER

INVESTIGATING WATER QUALITY

THEME: WE Walk for Water

SUBJECT(S): Science, Geography

GRADE LEVEL: Grades 9 to 12

LESSON PACKAGE OVERVIEW:

The Investigating Water Quality lesson package introduces the concepts that 1) water is necessary for survival and is a basic human right, and 2) there is a water crisis.

The lesson package focuses on the quality of the water consumed by humans (locally, nationally and globally) and allow students to develop a deeper appreciation for "safe" water. These lessons will develop students' understanding about water contamination, their ability to assess the quality of water prior to consumption, and their knowledge of how water can be made safer.

Students will also learn about the impact of consuming unsafe water and how this contributes toward the water crisis.

ESSENTIAL QUESTION:

- Why is water a basic need for survival and how can we ensure that it is safe for consumption?

LEARNING GOALS:

Students will:

- Develop an understanding about water as a human right.
- Investigate causes and impact of water pollution.
- Raise awareness about the water crisis occurring globally.
- Use scientific inquiry to test the physical characteristics of water.
- Explore ways to take action as global citizens.

WORD BANK

Contaminant—a polluting or poisonous substance that makes something impure

Crisis—a time of intense difficulty or danger

Need—requirement for something because it is essential or very important rather than just desirable

Pollution—the presence in or introduction into the environment of a substance which has harmful and poisonous effects

Survival—the state or fact of continuing to live or exist, typically in spite of an accident, ordeal or difficult circumstances

MATERIALS AND RESOURCES

- Chart paper and markers
- Computer with Internet access
- Projector
- Blackline Master 1 – Water Changes Everything Questions
- Blackline Master 2 – Rubric/Table for Awareness Video
- Blackline Master 3 – Differences and Similarities in Types of Water
- Blackline Master 4 – Experimental Report
- Blackline Master 5 – Research Table – Physical and Chemical Characteristics
- Blackline Master 6 – Water Quality Overview
- Blackline Master 7 – S.M.A.R.T. Goals Template
- Blackline Master 8 – Water Treatment Diagram

LESSON 1:

Water to Survive



SUGGESTED TIME:

75 minutes

Investigate and Learn

1. Share the question "How many ways does water contribute to our daily lives?" Ask students to brainstorm and record ideas in small groups.
2. As the groups share their ideas with the class, create a table that categorizes each area of water use into specific categories such as Body/Self, Home, Food/Farm, Community and Global.

Body/Self	Home	Food/Farmers	Community	Global
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3. Ask students to reflect on the summary table created by the teacher. Ask students, "Do we need water to survive and why?" Using the table, ask students to discuss why water is needed for survival and are there areas where water is needed more than others.
4. Ask students, "If we believe water is needed for survival, what is the current state of the world's water?"
5. Distribute **Blackline Master 1: Water Changes Everything Questions** and tell students to think about the answers while they watch "Water Changes Everything" www.youtube.com/watch?v=BCHhwvQqyg (3:23).
 - a. What is the water crisis?
 - b. Where is the water crisis happening? Is it isolated to specific areas or spread out over the world?
 - c. Who does it affect and what is the impact of the crisis?
 - d. How does contaminated water affect humans?
 - e. Is there a solution to the water crisis?
6. Share the United Nations quote, "The human right to water includes sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses."

As a class, explore "safe" as a factor. What makes water safe for personal and domestic use? Why does water need to be safe? What is the impact of unsafe water on a community? Why did the UN choose this as a factor?
7. Assign one factor (safe, sufficient, affordable, acceptable and physically accessible) to different groups. Ask students to think consider a factor that contributes to the right of water for each human. Why do they believe the UN focused on these five factors as contributors toward water as a right? Why is

that factor important for human water consumption? Write or draw the ideas on chart paper and share the discussion and ideas with the class. Each person in the group must contribute in the presentation to the class.

8. Show students the website "United Nations, International Decade for Action 'Water for Life' 2005-2015" (www.un.org/waterforlifedecade/human_right_to_water.shtml). As a class, read through the statements for the five factors "safe, sufficient, affordable, acceptable and physically accessible." Tell students that each of these factors contributes toward the type of water that should be available to each human.
9. **Exit Ticket:** In pairs, ask students to choose one factor. Have a discussion about what would happen to the quality of water if the factor did not meet the required standards. For example: Water is unsafe to drink because it has been contaminated. What happens?



EXTENSION: The United Nations website refers to the International Decade for Action, which ended in 2015. Has the water crisis been solved or is it an ongoing issue? Write a short reflection that explains your opinion.

LESSON 2:

What is Water Contamination?



SUGGESTED TIME:

- (A) 75 minutes
(B) 45 minutes

EDUCATOR'S NOTE: Collect five to six jars of water from local water source (pond, river, beach, garden hose and lake. Label each jar of water). Ensure the jar is clear and that contaminants are visible.

1. In groups, ask students to analyze (look, smell) the contents of one of the jars that have been contaminated by natural and external forces. Ask students to list the types of contaminants in the jar that are visible and invisible. Ask students, "What is something undesirable present in the water, and how can you tell? For example, is a twig desirable or undesirable? Would you want to consume water with contaminants? Provide a rationale."
2. In groups, ask students to define the word "contamination." Remind students that contamination is the action state of making or being impure by polluting or poisoning.
3. Share the video "Water Contaminants" www.youtube.com/watch?v=pYXsN8yao0g (1:30).
4. As a class, categorize types of pollutants that can contaminate water using the list created in the first activity. Explore and discuss why the pollutant was placed in a certain category and provide a rationale.

As a class categorize the pollutants:

- Detergents, fertilizers and pet waste
 - Automotive products
 - Yard waste and litter
 - Erosion
 - Litter such as cigarette butts
 - Garbage
 - Recreation – water sports
5. Share the video "Water Pollution Effects and the Ways to Reduce It" www.youtube.com/watch?v=KqZihghcMJA (3:40) and explore other contaminants discussed in the video. Add these to the table of water pollutants.
 6. Using the above categories of pollutants, ask groups to create a short awareness video that can be presented to other students in their school about the types of pollutants in water. Explore how these pollutants arrive into the water source, the impact on the water source and how to reduce these pollutants.

RECOMMENDED ASSESSMENT AS LEARNING: Provide students with a rubric to assess the information provided in the student awareness videos. Ask students to peer-mark the videos by assessing the quality of information in the video. (Blackline Master 2: Rubric/Table for Awareness Video)

7. Have groups present their videos to the class and school.

RECOMMENDED ASSESSMENT AS LEARNING: Ask students to write a short reflection on "how a water source becomes unfit for consumption and use."

Part B- Water Treatment and Filtration



SUGGESTED TIME:

75 minutes

EDUCATOR'S NOTE: Prior to the class, pour equal amounts of tasting water (filter, tap and bottle) for each member of your class (for example, if you have thirty students, you will have ten samples each of filtered, tap and bottled water). These may be provided in clean beakers, glasses or paper cups. Have these on trays ready for a blind taste test by students. Number each of the glasses and keep a record of the type of water in each glass.

1. In groups of three to four students, research the differences in treatment of filtered, tap or bottled water. In groups list the differences and share with the class. Ask students to explore types of impurities that can be found in filtered, tap and bottled water. Does the treatment of the water remove all impurities prior to consumption?
2. Distribute **Blackline Master 3: Differences and Similarities in Types of Water**. As each group presents their research, have students complete the chart to tap, filtered and bottled water.

List of Websites for Reference

- Brita Water Contamination (brita.ca/water-filtration-process/water-quality-contamination/)
 - Toronto Water Treatment (www1.toronto.ca/wps/portal/contentonly?vgnextoid=baa807ceb6f8e310VgnVCM10000071d60f89RCRD)
 - Canadian Bottled Water Association (www.cbwa.ca/)
3. Using a think-pair-share strategy, ask students: Do you prefer tap, filtered or bottled water? Why do you prefer this type of water? What physical characteristics draw you toward that type of water? Create a class poll of student answers and list all the preconceived notions stated by students (for example: bottled water is healthier because it has less impurities).

4. Distribute **Blackline Master 4: Experimental Report**. As a class, conduct a simple experiment.

EDUCATOR'S NOTE: Review classroom procedures for experiments and the scientific method. Based on your class and the differentiated needs, you may want to extend the explanations and expectations.

- Does each person in the world have the same systems to clean their water?

RECOMMENDED ASSESSMENT FOR LEARNING: If we turned on our taps at home or at school and the water was brown, what has occurred? Discuss with a partner. Write or draw a short reflection about the consequences of contaminated water.

5. Tell students that the purpose of this experiment is to identify if there is a difference in taste or odour between tap, bottled and filtered water.
6. Ask students to individually create a hypothesis about which type of water tastes and smells the purest or is the least contaminated. Record response in the experiment report.
7. Conduct the experiment.
- a. Give each student a numbered glass. Ask students to smell and taste the water.
 - b. Ask students to write down any characteristics they notice about the water sample's smell and taste.
 - c. Have them make a prediction. Is the sample tap, filtered or bottled water?
8. Draw a diagram of the experiment. Ensure that you label the diagram.
9. As a whole class, create a tally of the amount of students who thought their water was tap, filtered or bottled. Students may create a bar graph to represent the results.
10. Reveal the type(s) of water.
11. Have students reflect on their hypothesis and findings to create their conclusions. From the results, what are the differences between tap, bottled and filtered water?
12. Show students the diagram. Distribute **Blackline Master 8: Water Treatment Diagram** of the Water Treatment Process. Share with the students the video "Water and You: The Treatment Process" www.youtube.com/watch?v=KMP9-4911U4 (4:19). Ask students to list the processes of the water treatment system. Discuss, how does the treatment make the water safe for human consumption?
13. Divide the students into five groups and ask them to discuss and answer one of the following questions. Share the discussion and ideas with the class.
- What would happen if the water that came out of the tap was contaminated?
 - What happens to the water we drink from the time the water leaves the treatment facility, is stored and comes out from our taps?
 - How safe is our drinking water?
 - What can we do to ensure that our drinking water is clean and safe?

LESSON 3:

Testing Water Quality



SUGGESTED TIME:

75 to 90 minutes

EDUCATOR'S NOTE: Students will be conducting an experiment to test the quality of water from a range of accessible sources that students regularly drink from or are in contact with.

Types of Water Sources:

- a. Tap water
- b. Bottled water
- c. Filtered tap water
- d. Pond or river water
- e. Yard water (garden hose)

1. Ask students to create and conduct an experiment that tests the quality of water from local sources.

Students will need to complete the experimental report with the following components:

- a. Purpose of the experiment
- b. Relevant research
- c. Experimental hypothesis
- d. Diagram with labels
- e. Materials and methods of the experiment
- f. Results
- g. Analysis of the results
- h. Conclusions

(Blackline Master 3: Differences and Similarities in Types of Water)

2. Ask students to think about the purpose of testing water quality: Why is it an important process? Remind students that the purpose of the experiment is to test the quality of tap water and to compare the water quality to that of bottled, filtered, yard and local source (pond, river) water.
3. Remind students that they will need to research the appropriate range of chemical and physical indicators that demonstrate that the water is "fit for consumption."
4. Share the videos about Walkerton's water contamination Issues in 2000 as part of student research (www.cbc.ca/news/canada/inside-walkerton-canada-s-worst-ever-e-coli-contamination-1.887200).

Provide students with a table to fill in the physical and chemical characteristics they will be testing the water

against. (Blackline Master 5: Research Table – Physical and Chemical Characteristics)

5. Using the research, ask students in pairs to develop a hypothesis that is a reasonable assumed explanation that creates the basis for the scientific experiment.

Example: Bottled water is the best type of water to be consumed because the quality of water is controlled. OR, filtered water is the best type of water to be consumed because it is treated through both the government treatment system and the filter on your jug. Students are able to refer to the table created in the previous lesson, which outlines the differences between filtered, tap and bottled water. (Blackline Master 3: Differences and Similarities in Types of Water)

6. Conduct the experiment.
 - a. The experiment will be conducted in stations. Each station will have a water testing kit with the materials and instructions to effectively test each chemical indicator (pH, dissolved oxygen, chlorine, copper, nitrates and phosphates).
 - b. Create groups of three students. Allocate groups a type of water to test. Some groups may conduct the experiment on the same type of water. Each group will conduct all of the water quality tests on a type of water. The water quality will be compared to that of the research collected by students and the water quality overview sheet (Blackline Master 6: Water Quality Overview).

Materials and Resources

- Water quality kits (1 per station to test specific chemical indicators)
- Tap, bottled, filtered and pond/river/yard water
- Experimental Report sheet to record results
- Water Quality Overview sheet to compare results
- Beakers

Procedure

- Each group will be allocated one type of water.
 - Groups will conduct tests for pH, dissolved oxygen, chlorine, nitrates and phosphates, and record the results of the experiments.
 - Each water kit provides specific materials and instructions to conduct the tests.
7. Ask students to compare the results of their water sample to that of the Water Quality Overview sheet. What are the differences in the chemical and physical indicators? Record these differences.
 8. Each group will present their results and students will record the results of each water quality test on the Experimental Report (Blackline Master 4: Experimental Report).
 9. Students will analyze the results collected and answer the following questions using the Water Quality Overview sheet as the basis for the comparative study:
 - a. What are the differences in chemical indicators between

tap water and the indicators on the Water Quality Overview sheet?

- b. Compare the measured tap, bottled and filtered water. Which type of water is closest to the results of the overview sheet? What type of water is the most pure with the least contaminants for regular consumption?
- c. How contaminated is the pond/river water and can it be consumed by humans? Explain your answer with evidence.

10. Ask students to reflect on the hypothesis created. Draw a conclusion based on the results you collected from the experiment and the analysis questions. Which type of water has the best quality?

LESSON 4:

WE Walk for Water



SUGGESTED TIME:

120-150 minutes + Take Action Initiative

Action Planning

EDUCATOR'S NOTE: Students have had the opportunity to learn about the impact of water pollution on local communities and the process of treatment and measurement of water quality. This lesson will allow students to look outside their community to understand the impact of water pollution on communities who do not have the infrastructure to move water for supply nor treat their water supply.

1. Ask students to think about what they have learned in the campaign lessons. In small groups discuss the following questions to reflect on their learnings:
 - Is water pollution and contamination a local, national or global issue? Does it affect our local communities or is it only seen in developing countries?
 - Why is it important to understand the process of water treatment before consumption?
 - What is the global water crisis and is there a solution?
 - What role can you play to raise awareness or contribute to the solution?
2. Share with students the work occurring in the WE Villages to help communities who are living through the water crisis (www.we.org/we-villages/water/).

In pairs, ask students to read through the page and think about the following questions:

 - a. Which countries have been impacted by the global water crisis?
 - b. How is the global water crisis affecting the health, education, food security and livelihood (income) of the communities?
 - c. Is there an effective solution to ease the crisis? Is it long or short term?
 - d. How is WE Villages helping create a sustainable solution?
3. Tell students to keep in mind all they have learned throughout the course of the lessons and ask them the following questions:
 - a. What are the goals of the WE Walk for Water campaign?
 - b. Why is it important to address the global water crisis?

- c. What role can your participation in the WE Walk for Water campaign have on the global water crisis?

4. As a class, in small groups or individually, ask students to think about how they can contribute to the WE Walk for Water campaign and make a difference. Ask students to choose the action that they are most passionate about.

Example Actions:

- Raising awareness in schools about the global water crisis.
- Helping local communities understand the importance of safe and fresh water for all Canadian and global communities.
- Writing a letter to federal or provincial parliament about the Boil Water Advisories in Northern Canada.

5. Once the action has been selected by the individual student/ small group or class, ask students to think about the overall goal for the action. Instruct students to use **Blackline Master 7: S.M.A.R.T. Goals** to set goals for the action and discuss how each goal will be measured.

Types of evidence:

- Photographs and visual aids
- Surveys and questionnaires
- Website and Twitter posts
- Oral and written feedback

6. Create an actionable timeline with roles and responsibilities allocated for each student. Review the timelines and roles and provide guidance for the students to ensure that their set goals are achievable. Involve parents in the actions.

Take Action

1. Before interacting on social media, review classroom and school guidelines on using social media.
2. Before interacting with members of the wider community, review classroom guidelines on etiquette and respect.
3. Ensure students are actively participating and collecting data throughout the take-action section.

Report and Celebrate

1. Share your learning process and the actions you took with students from your class and from another class/school. Challenge them to apply their actions to influence the global water crisis.

2. Here's how:

- Post your milestone moments online to show the world your influence with #WEWalkforWater or focus on writing posts with tricks and tips to help others live more sustainably.
- Invite a friend, family member or local business to take the WE pledge. Offer to feature their progress with #WEWalkforWater in your posts on Facebook, Twitter, WE Day App or wherever you like to share good news stories.

3. Ask students to create a video, blog, written or visual reflection, or public service announcement to understand the deeper impact of the take-action section and to consider how they can ensure their initiative has lasting influence.

REFLECTION QUESTIONS

- How will we ensure that the initiatives started will continue?
- How can we support the initiative spreading to other communities, as needed?
- How will we continue to seek feedback from others about additional ways to make change in our communities?
- How can you share your knowledge about environmental school certificate programs with others, so it broadens their ability to take action and make change?

4. Ask students to reflect further to understand the outcomes of the take-action section:

- Do schools have a duty/responsibility to teach students about the global water crisis and actively engage all students in learning and understanding that the water crisis affects local, national and international communities?

Blackline Master 1:

Water Changes Everything Questions

What is the water crisis?

Where is the water crisis happening? Is it isolated to specific areas or spread out over the world?

Who does it affect and what is the impact of the crisis?

How does contaminated water affect humans?

Is there a solution to the water crisis?

Blackline Master 2: Rubric/Table for Awareness Video

1 of 2

Types of Pollutants	How do pollutants arrive into the source?	Impact of the pollutant?	How to reduce the pollutant?
Detergents, Fertilizers and Pet Waste			
Automotive Products			
Yard Waste and Litter			
Erosion			

Blackline Master 2: Rubric/Table for Awareness Video

2 of 2

Types of Pollutants	How do pollutants arrive into the source?	Impact of the pollutant?	How to reduce the pollutant?
Litter			
Garbage			
Recreation (Cause)			

Blackline Master 3: Differences and Similarities in Types of Water

	Tap	Bottled	Filtered
Similarities			
Differences			

Blackline Master 4: Experimental Report

1 of 2

Purpose

Hypothesis

Research

Diagram (with labels)

Blackline Master 4: Experimental Report

2 of 2

Results

Analysis

Conclusion

Blackline Master 5:

Research Table – Physical and Chemical Characteristics

1 of 2

Chemical Characteristics	Research	Results of the experiment
pH		
Dissolved Oxygen		
Chlorine		
Nitrates		
Phosphates		
Copper		

Blackline Master 5: Research Table – Physical and Chemical Characteristics

2 of 2

Physical Characteristics	Research	Results of the experiment
Odour		
Look		
Temperature		

Blackline Master 6:

Water Quality Overview

Chemical Characteristics	Research
pH	Water with pH less than 5 or greater than 9 is harmful for aquatic life. • Below pH 4.5, few fish and invertebrates can survive. • pH can be influenced by soil leaching, industrial pollution, and acid rain.
Dissolved Oxygen	As dissolved oxygen levels in water drop below 5.0 mg/l, aquatic life is put under stress. The lower the concentration, the greater the stress. Oxygen levels that remain below 1-2 mg/l for a few hours can result in large fish kills.
Chlorine	Water with more than 250 mg/l chloride is considered not drinkable. • Chlorides can enter water from road salt, soil leaching, and industrial and animal wastes.
Copper	If the level of copper in less than 10 percent of the tap water samples collected by a water system is less than 1,300 micrograms per litre (or 1,300 parts per billion).
Nitrates	High readings indicate pollution from fertilizer, sewage, industrial waste or detergents, and may accelerate the eutrophication process. • Federal law requires that nitrate levels in public water supplies be less than 10 mg/l of nitrate-nitrogen or 45 mg nitrate; 1 mg/L of nitrite-nitrogen.
Phosphates	Readings higher than 0.3 mg/l phosphate indicate pollution from fertilizer, sewage, industrial waste or detergents, and may accelerate the eutrophication process. • Waste water is 5 to 30 mg/l phosphate. • Drinking water must have less than 0.5 mg/l phosphate, according to federal law.

Blackline Master 7: S.M.A.R.T. Goals

Specific	Measurable
Agreed Upon	Realistic
Time Specific	

Blackline Master 8: Water Treatment Diagram

