Altamonte Springs
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Name: _____
Date: _____

# Comparison of Water Quality Parameters

**High School Environmental Science | AP Module 2 | Regional Water Reclamation Facility**

## *NGSSS Big Idea: Standard 1—Nature of Science*

## *Benchmark Code & Description:*

**SC.912.N.1.1**—Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science, and do the following:

1. Pose questions about the natural world, (Articulate the purpose of the investigation and identify the relevant scientific concepts).
2. Conduct systematic observations, (Write procedures that are clear and replicable. Identify observables and examine relationships between test (independent) variable and outcome (dependent) variable. Employ appropriate methods for accurate and consistent observations conduct and record measurements at appropriate levels of precision. Follow safety guidelines).
3. Examine books and other sources of information to see what is already known,
4. Review what is known in light of empirical evidence, (Examine whether available empirical evidence can be interpreted in terms of existing knowledge and models, and if not, modify or develop new models).
5. Plan investigations (design and evaluate a scientific investigation).
6. Use tools to gather, analyze, and interpret data (this includes the use of measurement in metric and other systems, and also the generation and interpretation of graphical representations of data, including data tables and graphs), (Collect data or evidence in an organized way. Properly use instruments, equipment, and materials (e.g., scales, probeware, meter sticks, microscopes, computers) including set-up, calibration, technique, maintenance, and storage).
7. Pose answers, explanations, or descriptions of events,
8. Generate explanations that explicate or describe natural phenomena (inferences),
9. Use appropriate evidence and reasoning to justify these explanations to others,
10. Communicate results of scientific investigations, and
11. Evaluate the merits of the explanations produced by others.

## *NGSSS Big Idea: Standard 17—Interdependence*

## *Benchmark Code & Description:*

**SC.912.L.17.19**—Describe how human population size and resource use relate to envrionmental quality.

# LEARNING GOAL/OBJECTIVE

Students will be given a water sample from an unknown source and will infer from test results the source of water.

# PREREQUISITES

***Review:***

- Vocabulary List
- Water Quality Worksheet
- Applicable Textbook Sections

# VOCABULARY

See vocabulary sheet.

# HANDS-ON ACTIVITY

***Task(s):***

Students will use portable meters and probes like those used in the school laboratories to test water quality parameters.

***Provided Materials:***

- Clipboard and Pencil
- Sampling Worksheet
- Safety Glasses
- Gloves
- Lab Quest 2
- Conductivity Probe
- Optical Dissolved Oxygen Probe
- pH Sensor
- Temperature Probe
- Nitrate Ion-Selective Electrode

***Career Options:*** Engineer (BS Degree), Scientist (BS Degree), Operator (High School Diploma and Certification)

***Lesson Steps:***

1. Students will be split into 5 groups of 5 students.
2. Instructions will be given for tests/meters.
3. Students will rotate through 5 stations and record test results on the worksheet provided.
4. Based on information provided on the worksheet students will infer which water source they tested.
5. Using test results, students will determine the quality of each water source.
6. Students and staff will discuss the significance of the test results for each source.

**Physical Science**
**AP Environmental Water Quality Worksheet**

| Water Quality Parameters | Unit of Measure | Sample #_____ Results | Range for Water Sources | | |
|---|---|---|---|---|---|
| | | | Reclaimed Water | Potable Water | DI Water |
| Chlorine | mg/l | | 0.40-0.70 | 0.70-1.20 | ≈0.00 |
| Conductivity | µs/cm | | 450-600 | 280-300 | ≈0.00 |
| pH | | | 7.00-8.50 | 7.00-8.50 | Unstable |
| Dissolved Oxygen | mg/l | | 7.00-9.00 | 7.00-9.00 | 7.00-9.00 |
| Temperature | ° Celsius | | 20-30 | 20-30 | 20-30 |
| Turbidity | NTU | | 0.00-2.00 | 0.00-0.40 | 0.00-0.10 |
| Phosphorus | mg/l | | 2.00-4.00 | 0.50-1.00 | ≈0.00 |
| Nitrate | mg/l | | 6.00-9.00 | ≈0.00 | ≈0.00 |

**mg/l:** Milligrams per liter
**µs/cm:** Microsiemens per cm
**NTU:** Nephelometric Turbidity Units

## How These Parameters Affect Water Quality:

**Chlorine**—added in the form of Sodium Hypochlorite (bleach, NaOCl), chlorine is a powerful disinfectant used to neutralize bacteria and viruses. This test is important since potable water systems are required to have a chlorine residual.

**Conductivity**—a measure of the amount of electricity that can pass through water. Positive and negative ions in the water allow electricity to pass through it. Some of these ions are sodium (Na+), calcium (Ca+), chloride (Cl-), and sulfate ($SO_4^{2-}$).

**pH**—a measure of how acidic (pH <7) or how basic (pH>7) a solution is.

**Dissolved Oxygen**—amount of oxygen that living organisms can use to survive.

**Temperature**—affects dissolved oxygen and conductivity.

**Turbidity**—amount of suspended and organic matter in a solution can prevent light.

**Phosphorus**—essential nutrient, but too much causes excessive algal growth.

**Nitrate**—essential nutrient, but too much can cause excessive algal growth.

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# Regional Water Reclamation Facility AP Environmental Science Vocabulary List

**Activated Sludge**—small clumps of organisms that grow in wastewater. It's called "activated" because the particles are alive with microorganisms.

**Aeration**—combining air with a liquid.

**Aerobic**—to need oxygen.

**Alum (Aluminum Sulfate, Al2(So4)3)**—a coagulant used in water and wastewater treatment.

**Aerobic Digestion**—the process of stabilizing sludge.

**Anaerobic**—not needing oxygen.

**Biosolids**—solids that have been treated enough to become fertilizer.

**Clarifier**—a tank that lets the solids settle to the bottom.

**Coagulation**—destabilization of negatively charged particles.

**Colorimeter**—a meter that uses light to determine chemical concentrations. When light is passed through a sample some is absorbed and the meter measures the difference.

**Conductivity**—a measure of the amount of electricity that can pass through water.

**Disinfection**—the process of killing or disabling pathogenic organisms.

**Dissolved Oxygen (DO)**—a measure of the amount of oxygen that living organisms can use to survive. Usually measured in milligrams per liter (mg/l).

**Effluent**—treated wastewater ("reclaimed water") leaving the plant.

**Flocculation**—the action of polymers to bind particles into large clumps.

**Influent**—wastewater flowing into the wastewater treatment facility.

**Microbe/Microorganism**—microscopic organisms that can be either single-cell or multi-cell.

**MLSS (Mixed Liquor Suspended Solids)**—the mixture of solids and water in the aeration tank.

**Nutrients**—elements necessary for organisms to live and grow (including carbon, nitrogen, phosphorus).

**pH**—a measure of how acidic (pH < 7) or how basic (pH > 7) a solution is.

**Phosphorus**—one of six essential elements needed by all life forms to survive.

**Polymer**—a chemical compound used in wastewater to adjust particle charges

**Potable Water**—water that is safe for people to drink. This is the water that comes from homes.

**Preliminary Treatment**—the first treatment process that removes larger particles and heavier grit particles (sand, gravel, metal or glass).

**Reagent**—a chemical added to a system to bring about a change.

**Reclaimed Water**—treated wastewater that can be used for a beneficial purpose.

**Sand Filters**—filtration through sand.

**SCADA (Supervisory Control and Data Acquisition)**—computer system that monitors pumps, motors and plant processes.

**Secondary Treatment**—the third process in the treatment plant that includes the aeration tanks and secondary clarifiers. The wastewater is treated by microorganisms in the aeration tank then are removed (settle to the bottom) in the clarifier.

**Supernatant**—the usually clear liquid overlying material deposited by settling.

**Turbidity**—amount of suspended and organic matter in a solution.

**Wastewater**—water that has been used for purposes such as bathing, cooking, washing clothes, toilets, etc.

**Water Reclamation**—the physical, chemical and biological process of removing contaminants from wastewater to produce a reusable water source.