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18 - WATER QUALITY ANALYSIS

PURPOSE

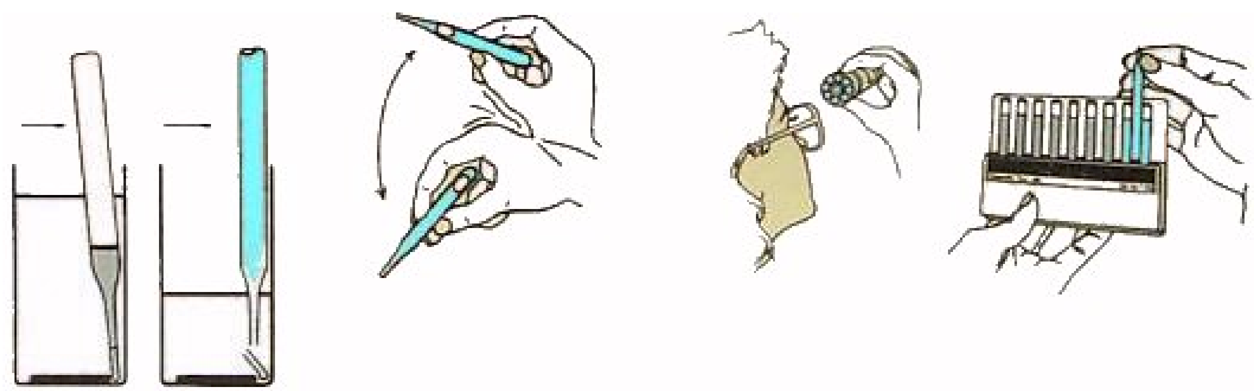
To measure dissolved solids in various samples of water to determine water quality

MATERIALS

- CHEMetrics water test kits in Vacu-vials
- water samples from various sources such as drainage ditches, farm ponds, rivers, wells, tap water, creeks, ocean, estuary
- distilled water as a control
- spectrophotometer - for optional turbidity test
- safety goggles

PROCEDURE

Use sterile technique to test the water samples according to kit directions. Read about the levels of these substances in water to make your judgement about the safety of the samples and their potential for pollution.



CHEMetric Vacu-vials

The units of measurement for water can be confusing. Milligrams per liter (mg/l) is the same as parts per million (ppm). Parts per thousand is percentage multiplied by 10.
To convert percentage to ppt, multiply the percent by 10. For example, a 2% solution is the same as 20 ppt.

ALKALINITY: Alkalinity is present in solutions with pH of 8-14. In natural processes, it is changed by aeration and reduced carbon dioxide. It may be added by industry as a buffering agent or to reduce corrosion. Elevated levels indicate industrial contamination.

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AMMONIA: Ammonia nitrogen is the product of microbiological activity. In natural waters, it is evidence of sanitary (fecal matter) pollution, industrial effluent or pesticide runoff. It is a source of nitrogen that contributes to excessive growth of algae and can be toxic to aquatic life.

CARBON DIOXIDE: Carbon dioxide is present in water as a dissolved gas. It is generated by animal respiration and decay of organic matter. It is used by aquatic plants for photosynthesis. Because of photosynthesis, daily CO_2 levels may exhibit a cycle opposite to dissolved oxygen levels. Surface water normally contains less than 10 ppm free carbon dioxide while ground water may easily exceed that concentration. When CO_2 dissolves in water, it forms weak carbonic acid, lowering the pH. Carbon dioxide is 200 times more soluble than oxygen, so a rise in carbon dioxide makes it more difficult for fish to use the limited amount of oxygen in the water.

CHLORIDE: The chloride ion is the most common ion found in sea water. When it occurs in fresh water, it may indicate salt water encroachment into the fresh water source or industrial waste. The U.S. Public Health service sets a maximum of 250 ppm on potable water.

CHLORINE: Chlorine is commonly used to kill disease producing bacteria. In municipal systems, if chlorine is present most bacteria will have been killed. A range of 0.1 to 0.4 milligrams per liter are usually maintained in drinking water. The presence of chlorine in concentrations above 0.5 ppm should be considered evidence of pollution from chlorine treated effluents.

CHROMIUM: Chromium may be present in water containing waste from industry such as the metal plating industry, manufacturing of paints, leather tanning or from air conditioning units where chromate compounds are added to control corrosion. It is considered to be toxic in amount over 0.5 ppm. Certain shellfish are capable of concentrating this element and thus endanger the health of the consumer - whether it be man or animal.

COPPER: Copper is a naturally occurring element in seawater, and is introduced into water to kill insects and fungus. The copper content of drinking water generally falls below 0.03 ppm and a copper content as high as 1.0 ppm will give water a bitter taste. High concentration of copper indicate industrial waste contamination, and are toxic to fish.

DISSOLVED OXYGEN: It is one of the most important characteristics of water quality. Aquatic plants produce oxygen through photosyntheses, and it enters the water from the air. Standards for oxygen vary but fresh water fish need concentrations of 4-5 mg/l. Salt water holds less oxygen than fresh water, when measured at the same temperature. The solubility of oxygen is inversely proportional to water temperature. Oxygen is essential to sustain life in marine ecosystems.

DISSOLVED SOLIDS: The U.S. Public Health Service recommends that the total solids of potable water be limited to 500 ppm. High solids content is also undesirable in industrial and agricultural usage.

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CALCIUM, MAGNESIUM AND HARDNESS: The U.S. Public Health Service sets a limit of 200 ppm. for calcium, and 150 ppm for magnesium. Water with a total hardness from 0-60 ppm is considered soft; from 60-120 ppm medium; from 120-180 ppm hard; and over 180 ppm very hard. Calcium and magnesium are dissolved in water as it passes over rock and soil containing large amount of these minerals. From a domestic standpoint, hard water is less desirable because it consumes excessive quantities of soap, forming curds and depositing a film on hair, fabrics and glassware.

IRON: Most natural waters contain some iron oxides. For domestic uses, the concentration should not exceed 0.2 ppm. High Iron concentrations (1mg/l) in water indicate industrial contamination, will give water a bitter taste and will leave a reddish stain.

NITRATE: Nitrogen is essential for plant growth and is a component of fertilizers. But the presence of excessive amounts in water supply presents a major pollution problem. Nitrogen compounds may enter water as nitrates or be converted to nitrates from agricultural fertilizers, sewage discharge from waste treatment facilities or septic tanks, drainage from livestock areas and farm manure. Nitrates in large amounts can cause methemoglobinemia (blue babies), a fatal disorder for infants less than six months of age. The U.S. Public Health Service limits drinking water to 10 ppm nitrates.

NITRITE: While nitrites are present in natural water, they should be at lower levels than nitrate, because it is easily converted by bacteria to other forms of nitrogen. Excess nitrites can form nitrous acid at low pH levels. This is a health concern because nitrous acid can react with organic compounds to form nitrosamines, known carcinogens. High levels indicate decomposing organic matter, or discharge from industry or waste treatment facilities.

PHOSPHATE: Phosphorus is an important nutrient for aquatic plants, and is naturally occurring in rocks. It is used to manufacture pharmaceuticals and detergents. The amount found in water is generally not more than 0.1 ppm unless the water is polluted from agricultural drainage or detergents. When excess phosphorus is present in marine systems, eutrophication takes place. This creates a favorable environment for the increase in algae and weed nuisances. When algae cells die, oxygen is used in the decomposition and fish die due to lack of oxygen. Rapid decomposition of dense algae scum cause foul odors and hydrogen sulfide gas. High concentrations indicate fertilizer runoff, discharge from industry or waste treatment facilities.

SULFIDE : Sulfides may occur due to bacteria decomposing organic matter, particularly under anaerobic conditions. This process is common in bottom sediments in estuaries and further reduces oxygen levels. Sulfide excesses are evidence of industrial discharge from pulp mills and sewage treatment facilities. It can also be an indication of acid rain. Sulfides give water a musty odor and at high concentration, the unpleasant smell of rotten eggs. It is toxic to aquatic organisms. Hydrogen sulfide is a respiratory depressant in humans and fish.

TURBIDITY : Turbidity is a state of reduced transmission of light through water caused primarily by the presence of suspended matter - either organic or inorganic. Increased turbidity results in a decrease in biomass due to the decrease in potential photosynthesis.

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18 - DATA CHART

PARAMETERS	sample one	sample two	sample three	sample four	sample five
AMMONIA					
ALKALINITY					
CARBON DIOXIDE					
CHLORIDE					
CHLORINE					
CHROMIUM					
COPPER					
DISSOLVED OXYGEN					
DISSOLVED SOLIDS					
Ca, Mg, and HARDNESS					
IRON					
NITRATE					
NITRITE					
PHOSPHATE					
SULFIDE					
TURBIDITY					

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TURBIDITY BAR GRAPH

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CONCLUSION

As part of a formal lab report, discuss each water sample in terms of its potability, risks to humans and wildlife and overall quality. State in which samples pollutants were identified and what type of pollutants caused the quality to drop. If the lab was set up as a blind test, determine the source or location from which each sample was taken.

How to write a formal lab report:

Step 1 - The Title Page: The title should be centered on the paper. The course name should be centered and written two spaces below the title. The date is centered two spaces below the course name. Your first name, followed by the name of your lab partners, should be in the lower right-hand corner. Typed papers with computer spell-checking make the best presentation. However, if that is not available, use black pen and make sure that your handwriting is neat. Proof read and correct minor spelling errors. Major errors may warrant recopying the page.

Step 2 - Purpose Statement: State the purpose of the lab or the hypothesis to be tested.

Step 3 - Materials and Procedure: The materials are listed separately. A diagram of the lab equipment should be included if applicable to the experiment. Use a short paragraph, written in third person past tense, to describe the methods used to determine the data. The paragraph should be general rather than step by step instructions.

Step 4 - Data: Present the data is some organized manner - a graph, map or table. Every entry must be clearly labeled. Graphs must be titled and axes labeled. All calculations and formulas should be presented in an organized format, with corrects units of measurements.

Step 5 - Analysis and Questions: Use separate paragraphs to summarize what the data for each sample is showing, identify causes and effects, use comparison and contrast, and evaluate what you have observed

Step 6 - Conclusion: Use a second paragraph to restate the purpose if the lab was a skill or observation-type lab. For an experimental lab, give your final result or answer to the question. What were you suppose to discover from this activity? How could you apply what you have learned? Could this information be useful in predicting results for similar circumstances?

Include any possible sources of error, either in the procedure or in your techniques, especially if you did not obtain the expected results. Would your results be reproducible for others? Do not “fix” the data to meet your expectations. Finish with a summary statement - a final answer.