

Chemistry in the Environment— Experiment Summaries and Concepts



Physical and Chemical Properties of Soil—Effect on Soil Quality

Healthy soil provides structure and nutrients for plant growth and is also a vital component of the hydrologic (water) cycle. Explore how the physical and chemical properties of soil impact soil quality with this three-part investigation. Students perform settling tests to analyze the composition of soil and determine soil texture, “filter” organic dye solutions through soil to study the ability of soil to bind and store nutrients, and analyze the pH and nutrient levels in soil.

pH and the Alkalinity of Water—Buffer Capacity and Water Quality

Just as living cells contain natural buffer systems to control pH, many lakes, rivers, and streams are also naturally buffered due to the presence of dissolved minerals from soil and rocks. The purpose of this experiment is to analyze the buffering capacity or alkalinity of water by titration with a standard hydrochloric acid solution to a methyl orange endpoint. Alkalinity is expressed in terms of parts per million calcium carbonate.

How Hard Is Your Water?—Microscale Titration

As water flows through rocks and soil, it picks up minerals from the Earth’s surface. High levels of minerals such as calcium, magnesium, and iron ions create “hard water” and are often a nuisance. The purpose of this experiment is to analyze water hardness by microscale titration with EDTA. Water hardness levels are determined using a standard graph obtained by plotting the number of drops of EDTA versus water hardness for a set of standard solutions.



Air Pollution Investigation—Air Quality

How clean is the air you breathe? How does the air look, taste, smell or feel? Investigate the origin and types of air pollution with this three-part laboratory activity. Students measure the amount of particulate matter in air by “capturing” the particles on microscope slides, learn how combustion products contribute to air pollution and air quality, and examine the effects of acid rain on common building materials and living organisms.

Build a Solar Cell—Photovoltaic Effect and Photosynthesis

Update your curriculum today—build a dye-sensitized solar cell with your students! The solar cell consists of conductive glass plates containing titanium oxide (a semiconductor) at the anode, and graphite at the cathode. The titanium oxide is coated with a natural dye that absorbs visible light. Light striking the dye surface excites an electron, which enters the conduction band and travels through the external circuit, producing electricity from light.



Dissolved Oxygen Testing—Biochemical Oxygen Demand and Water Quality

Dissolved oxygen is one of the best indicators of water quality. Organize a cooperative class project to investigate the effects of environmental conditions on the amount of oxygen dissolved in water. Dissolved oxygen levels are measured in the laboratory using the Winkler method. Variables that may be studied include temperature, concentration of sodium chloride or dissolved nutrients, and biochemical oxygen demand.



Concepts

- Soil quality and soil texture
- Cation exchange capacity
- Acids, bases, and pH
- Nitrates and phosphates

- Acids, bases, and pH
- Alkalinity
- Buffers and buffer capacity
- Acid rain and water pollution

- Water hardness
- EDTA titration
- Chelates and complex ions
- Water softening

- Air pollution and air quality
- Particulates in air
- Combustion products
- Acid rain

- Solar energy
- Photovoltaic cell
- Photoelectric effect
- Semiconductors

- Dissolved oxygen
- Winkler method
- Biological oxygen demand
- Water quality