Investigating Water Quality

Learning Activity and Project Guide

Activity One

Chemical Reactions and the Standard Curve

Lead is a dangerous heavy metal that can be found in drinking water supply . It is one of the most common contaminants tested for on drinking water quality test strips. But when we drop a strip into water what is happening? This activity helps us understand the chemistry of testing water quality

Materials:

- Lead nitrate ($Pb(NO_3)_2$) solution
- Potassium iodide (KI) solution
- Distilled water
- Glassware (test tubes or small beakers)
- Pipettes
- Graduated cylinders
- Scale

Procedure:

1. Prepare the Lead Standards:
    - Create a series of lead nitrate solutions with concentrations of 0 ppm (control), 10 ppm, 20 ppm, 30 ppm, 40 ppm, and 50 ppm.
    - Label each test tube or beaker with the respective concentration.
2. Prepare KI Solution:
    - Prepare a 0.1 M KI solution. This will serve as the reagent to react with lead ions.
3. Add KI to Lead Solutions:
    - To each test tube containing different concentrations of lead nitrate, add 5 mL of the KI solution
    - Upon mixing, lead iodide (PbI_2) will form a yellow precipitate according to the following reaction:

$$Pb^{2+}(aq) + 2I^{-}(aq) \rightarrow PbI_2(s)$$

Observe and Record Precipitate Formation:

1. As you add KI, observe the formation of the yellow PbI_2 precipitate. Higher concentrations of lead will result in more precipitate and more intense yellow color.
2. Rank the intensity of the yellow color or precipitate amount.
3. Record the observations for each concentration.

Create a Standard Curve:

1. Plot the visual observations against the known lead concentrations. For example, you could assign a numerical value to the amount or intensity of precipitate (on a scale from 1 to 10), where 1 is no visible precipitate (0 ppm) and 10 is the most precipitate (highest concentration).
2. The x-axis will represent lead concentration (in ppm), and the y-axis will represent the visual intensity/amount of precipitate.

This will give you a "standard curve" which can be used for qualitative or semi-quantitative analysis.

Water Quality Project

Testing water samples

Individual Collection Procedure:

- Fill collection bottle with water from sample site
- Record the latitude and longitude of the sample site
- Record any observations about the site:
  - Describe the location of where the water was collected including the water source and surrounding landscape; is there a source of nearby runoff, is it near agricultural fields, is a road nearby?
  - Describe the water; is it clear, is there algae or other visible substance, is there a particular smell?
  - Describe what the water is used for; is it used for fishing, swimming, drinking or some other use?

Observation	Begin by having students share out their sample site observations either whole group or in small groups depending on class size. Conduct Background Research: • What causes contaminants such as lead, copper, zinc and nitrates to end up in a water sample? • What effect do these contaminants have on the human body?
Question	From the observations, generate questions surrounding the safety of the water based on observations, background research and its uses. • Is this water safe for drinking based on its...smell, appearance, ect. • Does the quality of this water affect any wildlife? • Does the quality of this water affect the nearby plants?
Hypothesis	Students generate an idea or question that they can **TEST** For example: • The smell of this water means it contains sulfur • Water found near factories will contain more heavy metals

Experiment	**Step one:** • Use water quality test strips to test sample • Follow instructions on bottle **Step Two:** • Analyze nutrient levels (nitrate and nitrite) • Make a determination if the levels are acceptable or too high. **Step Three:** • Analyze heavy metal content ◦ Lead, nickel, copper, zinc • Make a determination if the levels are acceptable or too high. **Step four:** • Record latitude and longitude of sample location. • Record type of sample (tap, lake, river) • Record nutrient determination

Results and Analysis	**Results analysis:**
	• Make a water quality map
	  ◦ Create a digital or paper map of the region noting the location of each sample.
	  ◦ Create a key that will demonstrate the nutrient level and heavy metal content.
	
	Analyze the relationship between the location of each sample and water quality results.
	• What is nearby? Agriculture fields, industry, traffic, ect…
	• What is the local geology? Any limestone?

Science Communication Options	**Make a model:** • Map of water sample locations and results to demonstrate which locations are at high risk. Identify sources of pollution • Explain that water in certain areas are prone to contamination using your model **Give an Elevator Talk:** • What solution do you propose for the cleaning of the water source? Emphasize the “so what” of it all.

Lab Sheet

Sample Site Observations

Sample Location (latitude and longitude):

Type of water sample (tap, well, river, lake, runoff, ect):

Describe the surrounding landscape:

Describe the appearance of the water:

What is this water used for?

Background Research - *use additional paper if needed*

What causes contaminants such as lead, copper, zinc and nitrates to end up in a water sample?

What effect do these contaminants have on the human body?

Questions and Ideas

From the observations, generate questions surrounding the safety of your water sample based on observations, background research and its uses.

Data Collection	
Target Contaminant	Level (acceptable/high)
Lead	
Copper	
Zinc	
Iron	
Nitrates	
Nitrites	