 **Purpose**: It is the purpose of this \_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_-based lab to introduce students to the \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_\_\_\_\_ in \_\_\_\_\_\_\_\_ using a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Scenario: THE CASE OF THE DROWNED \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

The body of a \_\_\_\_\_\_\_\_\_ local \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ was found dumped alongside a country road a few \_\_\_\_\_\_\_\_\_\_\_ outside of Dalian, China. The man's hair and clothing were completely wet, and the coroner estimated that the man had died within an hour of when the body was found. An \_\_\_\_\_\_\_\_\_\_ revealed large \_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_\_ in the man's lungs, and the cause of death was listed as \_\_\_\_\_\_\_\_\_\_\_\_\_.

In view of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the police have labeled this death a \_\_\_\_\_\_\_\_\_\_\_\_. Primary suspicion falls on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_'s three adult children; a socialite daughter, a rancher son, and another son who is a mining engineer. All of the adult children would inherit \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ from their father, and all were known to have recently argued with him.

Knowing where the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ took place will help the police to possibly narrow their list of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. There are only three bodies of \_\_\_\_\_\_\_\_ within a one-hour radius of where the businessman's corpse was found. They are the swimming pool at the local country club; a large stock \_\_\_\_\_\_\_\_\_ on one son's ranch, and a mine-waste settling \_\_\_\_\_\_\_\_\_\_\_.

A chemical analysis of the \_\_\_\_\_\_ from the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_'s lungs reflected abnormally high \_\_\_\_\_\_\_\_\_\_\_\_\_\_s of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_s. It is hoped that \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_ from the three possible \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ sites will pinpoint exactly where the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ was drowned and thus provides a clue regarding his murderer.

**Materials Needed:**

Spectronic 20 or similar \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Cuvettes; graduated cylinders; Erlenmeyer flasks; beakers

ammonium molybdate \_\_\_\_\_\_\_\_\_\_\_\_; stannous chloride \_\_\_\_\_\_\_\_\_\_\_\_

stock 20 ppm \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ solution; distilled or deionized water

5 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ standards (1-5 pmm) to be prepared by students

**Safety, handling, and Disposal:** It is recommended that students read the M.S.D.S.s of all chemicals used in this lab experiment. As always, the use of safety goggles is required, as is the compliance with standard laboratory safety rules. Dispose of used \_\_\_\_\_\_\_\_\_\_\_s according to local ordinances.

**Procedure:**

In this experiment, we will analyze a series of water samples for their \_\_\_\_\_\_\_\_\_\_\_\_ content. Detergents are among the greatest contributors to \_\_\_\_\_\_\_\_\_\_ content in rivers and lakes because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-containing compounds are used in detergent formulation as \_\_\_\_\_\_ softeners. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is not toxic to animals or plants. In fact, it is a plant nutrient, which stimulates the growth of aquatic weeds and algae. This may cause lakes and rivers to become clogged and overrun with plants (eutrophication).

The principle of this method involves the formation of molybdophosphoric acid, which is reduced to the intensely colored complex, molybdenum blue. This analytical method is extremely sensitive and is \_\_\_\_\_\_\_\_ down to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_s below 0.1 ppm (mg) phosphorus per liter.

**Apparatus:**

The Spectronic 20 spectrophotometer will be employed in the measurement of color intensity of the blue solution. A wavelength of 650 nm will be used in these analyses.

**Reagents used:**

 Ammonium molybdate reagent

 Stannous chloride reagent

 Stock 20.0 ppm phosphate solution

**Procedure:**

Note: Glassware should be washed thoroughly with hot water followed by a rinsing with distilled water. DO NOT use phosphate-containing detergents to clean equipment for this experiment.

Prepare the following standard phosphate solutions:

a. 1.0 ppm standard: Place 2.00 ml of 20.0 ppm phosphate solution in a 100 ml graduated cylinder and dilute to 40 ml with distilled water.

b. 2.0 ppm standard: Place 4.00 ml of 20.0 ppm phosphate solution in a 100 ml graduated cylinder and dilute to 40 ml with distilled water.

c. 3.0 ppm standard: Place 6.00 ml of 20.0 ppm phosphate solution in a 100 ml graduated cylinder and dilute to 40 ml with distilled water.

d. 4.0 ppm standard: Place 8.00 ml of 20.0 ppm phosphate solution in a 100 ml graduated cylinder and dilute to 40 ml with distilled water.

e. 5.0 ppm standard: Place 10.00 ml of 20.0 ppm phosphate solution in a 100 ml graduated cylinder and dilute to 40 ml with distilled water.

f. Blank: Set aside 25 ml of distilled water, which will be treated with the color-developing reagent to serve as a blank.

These five standard solutions and the blank should now be treated according to the following "color development" procedure. After measuring the absorbance of these solutions, make a plot of absorbance (Y-axis) versus concentration (x-axis).

**Color development in sample:**

This procedure is used for the five standard solutions and for any river, lake, or sewage water samples, which are to be analyzed for phosphate. In this case, the samples represent the water from the victimâs lungs and the three samples from the water sources, which are the potential drowning sites.

Place 25 ml of the water sample to be analyzed in an Erlenmeyer flask.

Put 1.00 ml (using a pipet) of ammonium molybdate solution into the flask and swirl to mix.

Add 2 drops of stannous chloride solution to the flask and mix by swirling.

If phosphate is present, a blue color will develop to a maximum intensity in 5 minutes. NOTE: The time period is somewhat critical. Measurements should be taken anywhere from 5 to 15 minutes after addition of stannous chloride.

While you are waiting for the blue color to develop, set the wavelength to 650 nm on the spectrophotometer. Use the blank solution to set it to read zero absorbance. Using 650 nm wavelength measure the absorbance (after 5-15 minutes development) of the blue sample\*.

**Preparation of standards plot:**

Use the absorbance values of the five phosphate standards and make a plot of absorbance (y-axis) versus the concentration of the standard (x-axis). Draw a best-fit line through the data points and use this plot to interpret the results of the crime samples.

\* Should one of your samples produce a very dark blue color which cannot be read with the spectrophotometer, dilute the original water sample 100 fold. This is accomplished by placing 1.0 ml of the water sample in a 100 ml graduated cylinder and then adding enough distilled water to bring the volume up to 100 ml. Now, this diluted sample may be analyzed according to the directions for color development above.

Remember that the concentration, which you ultimately obtain from this sample, will have to be multiplied by 100 because of the 100-fold dilution.

**Question:** After analyzing the 4 crime-related water samples, determine which drowning location is the best match to the sample from the victim’s lungs.

**Suggested reading:**

Standard methods for the examination of Water and Wastewater. American Public Health Association. 1985 or current edition.

**quantitative analysis** suspects

**phosphate** pond

**spectrophotometer concentration**

crime scene **analysis**

businessman **reagent**

wealthy **reliable**

**kilometers water**

autopsy homicide

drowning

quantities

circumstances

substantial fortunes