Sunday Academy (2011-2012)

Mercury

Introduction:

Mercury is a very toxic element that is widely spread in the atmosphere, lithosphere, and surface water. It has traditionally been used to make products like thermometers, light bulbs, and mascaras. The largest human-caused source of mercury emission to the environment is coal-burning power plants in United States. The mercury eventually settles into water or onto land where it can be washed into water. Once deposited, some small aquatic organisms can change it into methylmercury (CH_3-Hg), a highly toxic form that builds up in fish and animals that eat fish. This is the main source of methylmercury exposure to humans when they eat them. High concentration of mercury content in human body may lead to some severe diseases, such as Mina Mata.

Red River of the North originates at the confluence of the Otter Tail and Bios de Sioux Rivers on the border between North Dakota and Minnesota and then flows about 394 miles northward into Manitoba, Canada. It is a major water source in the states of North Dakota and Minnesota. Unfortunately, the mercury pollution has been a public concern in the Red River and other lakes in North Dakota since 1990. In fact, the Red River pollution has threatened fishing industry in Lake Winnipeg, Canada. Due to its high toxicity, mercury is harmful even at a very low concentration (the maximum allowable level of mercury in drinking water is 2 ppb). Therefore, it's very important to reduce the mercury release and also detect the existence of mercury in local water sources.

Objectives:

- Students will test local water supplies for the presence of mercury
- Students will understand the basics of unit conversion
- Students will use unit conversion to solve basic applications

North Dakota State Standards:

9-10.2.2 Use appropriate safety equipment and precaution's during investigations
9-10.2.6 Design and conduct a guided investigation

Timeline:

11:00-11:30	Cultural Connection
11:30-11:40	Introduction/Pre Test
11:40-12:00	Power Point presentation
12:00-12:45	Lunch
12:45-1:15	Activity 1: Mercury Detection
1:15-1:45	Activity 2: Mercury Detection in Local Water Samples
1:45-2:15	Activity 3: Detection of Healthy Metal Ions
2:15-2:45	Activity 4: Measurement Conversions
2:45-3:30	Wrap up and Post Test

Materials:

Glass Stir rod (1/group)	250 mL Beaker (1/group)	Plastic droppers (4/group)
Test Tubes (6/group)	Test Tube Rack (1/group)	Sharpie Marker
Calculators		

**UND will bring all chemicals, waste bottles, and reaction plates

Activity 1: Mercury Detection

- Prepare all the needed chemicals (will be prepared previously by UND).
- In one clean, dry, and 6-well reaction plate, place 5-6 drops of the Hg $(NO_3)_2$ solution, followed by adding 4-5 drops of the KI solution. Stir with the stirring rod to mix the solution completely.
- Add about 4-5 drops of $Na_2S_2O_3$ to the same spot where the mixture of Hg $(NO_3)_2$ and KI. Finally add 10-15 drops of $CuSO_4$ and stir with the stirring rod. Observe the phenomenon change.
- Dispose the Hg^{2+} contained solution to a labeled waste contained. Wash all the plates.

chemicals	Concentration	notes
KI	1M	Dissolve 166 g KI in distilled water and diluted to1 L. It should be stored in brown-color bottle and better to be prepared freshly.
$CuSO_4$	20 g/L	Dissolve 31 g $CuSO_4.5H_2O$ in distilled water and dilute to 1 L.
$Na_2S_2O_3$	Statured solution	

Activity 2: Mercury Detection in Local Water Samples

- Prepare three real water samples. Each sample should be 1 liter. Sample 1 is the tap water. Sample 2 is the lake water. Sample three is the snow or rain water. The same experimental procedures as in activity 1 but changing $Hg(NO_3)_2$ to the real water samples.
- Compare the color change with activity 1 and observe whether precipitation is formed or not.

Activity 3: Detection of Healthy Metal Ions

CaC_{l2}:

- Prepare $CaCl_2$ solutions (will be prepared previously by UND).
- In one clean, dry, and 6-well reaction plate, place 5-6 drops of $CaCl_2$ solution, followed by adding 4-5 drops of KI solution. Stir with the stirring rod to mix the solution completely.
- Add about 4-5 drops of $Na_2S_2O_3$ to the same spot where the mixture of $Hg(NO_3)_2$ and KI. Finally add 10-15 drops of $CuSO_4$ and stir with the stirring rod. Observe the phenomenon change.
- The solution can be disposed down to sink directly. Wash all the plates.

$ZnCl_2$:

- Prepare $ZnCl_2$ solutions (will be prepared previously by UND).
- In one clean, dry, and 6-well reaction plates, place 5-6 drops of $ZnCl_2$ solution, followed by adding 4-5 drops of KI solution. Stir with the stirring rod to mix the solution completely.
- Add about 4-5 drops of $Na_2S_2O_3$ to the same spot where the mixture of $Hg(NO_3)_2$ and KI. Finally add 10-15 drops of $CuSO_4$ and stir with the stirring rod. Observe the phenomenon change.
  The solution can be disposed down to sink directly. Wash all the plates.

Activity 4: Unit Conversion Activity

Suppose you are filling your swimming pool. You are asked to add the chemicals to the pool. The directions given to you say that you should add 1 mL per pint of water. The problem is the chemical is in liter jugs and your pool holds 25,000 gallons of water.

We often use ratios and proportions to help us convert from one unit of measurement to another. In order to do so, it is important to be familiar with some basic units of measurements. Below are some equivalent measurements that we will use later on.

12 in = 1 ft	5280 ft = 1 mile	2 cups = 1 pt	16 oz = 1 lb
3 ft = 1 yd	2000 lbs = 1 ton	2 pts = 1 qt	4 qts = 1 gal
16 oz = 1 pt			

Make sure that you are also familiar with some common metric prefixes. *Kilo* means 1000 times as much. For example, a kilometer (km) equals 1000 meters, and a kilogram (kg) equals 1000 grams. *Centi* means 100 times as small. For example, 100 centimeters equals one meter, or, stated another way, one centimeter equals 1/100 of a meter. *Milli* means 1000 times as small. For example, 1000 millimeters equals one meter, or, stated another way, one millimeter equals 1/1000 of a meter.

To convert from one unit of measurement to another, multiply by a unit conversion factor so that the unwanted unit will cancel out, and you'll be left with the desired unit. For example, let's convert 4 feet to inches. We can use the unit conversion factor 12 inches / 1 foot. That fraction is really equivalent to 1, so we're allowed to multiply by it. We can multiply (4 feet / 1) times (12 inches / 1 foot). The units of feet cancel, since they appear in the numerator and denominator of the product. The units of inches remain, and multiplying across gives us an answer of 48 inches.

There are some examples on the next page for you to work on before we come back to solve the swimming pool problem!

$$\frac{1 \text{ dollar}}{4 \text{ quarters}} = 1 \qquad \frac{1 \text{ dollar}}{10 \text{ dimes}} = 1 \qquad \frac{1 \text{ dollar}}{20 \text{ nickels}} = 1 \qquad \frac{1 \text{ dollar}}{100 \text{ pennies}} = 1$$

$$\frac{12 \text{ nickels}}{} \times \frac{\text{dimes}}{\text{nickels}} = \frac{\text{dimes}}{}$$

$$\frac{7 \text{ nickels}}{} \times \frac{\text{pennies}}{\text{nickels}} = \frac{\text{pennies}}{}$$

$$\frac{3 \text{ dollars}}{} \times \frac{\text{nickels}}{\text{dollars}} = \frac{\text{nickels}}{}$$

$$\frac{15 \text{ nickels}}{} \times \frac{\text{quarters}}{\text{nickels}} = \frac{\text{quarters}}{}$$

$$\frac{5 \text{ dollars}}{} \times \frac{\quad}{\quad} = \frac{\text{quarters}}{}$$

$$\frac{325 \text{ pennies}}{} \times \frac{\quad}{\quad} = \frac{\text{nickels}}{}$$

1. 1.6 m into mm

2. 36 g into kg
3. 470. mi into km

4. 1.43 kg/L into g/mL

5. 86 inches into m

6. 30 feet per second into miles per hour

7. 18 mm into m

8. Levoxyl is a drug used to treat hypothyroidism. If a patient takes one 75 µg tablet per day, how many milligrams of Levoxyl are in their 1 month (30 day) supply?

9. So now: Suppose you are filling your swimming pool. You are asked to add the chemicals to the pool. The directions given to you say that you should add 1 mL per pint of water. The problem is the chemical is in liter jugs and your pool holds 25,000 gallons of water. The answer is?