EXTEND

A: Toxicology Lab:
Primary Learning Outcomes
• Students will gain appreciation for the fact that life is dependent on an ongoing series of **chemical reactions**.
• Students will learn how government regulations protect our health.
• Students will learn that **toxic substances in our environment can affect all organisms.**
• Students will understand that we are surrounded by both **natural and manmade toxic substances** and be able to differentiate between the two.
• Students will be able to **define a "toxic substance**."
• Students will be able to define the "**science of toxicology**."
• Students will **analyze toxicological risks versus benefits with the understanding of basic toxicological principles**.
• Students will be able to **calculate chemical concentrations in water**.
• Students will **understand the dose-response principle**.

Secondary Learning Outcomes
• Students will obtain a **basic understanding of toxicology** that will provide them with more knowledge about choices they make in their everyday lives.

Procedures:.
Step 1: Duration ~10 minutes Activity/Discussion Ask students what a chemical is and to name some things made of chemicals. List the responses on the board. After generating a list, go through the list with students and identify listings as: synthetic (manmade), natural, toxic, nontoxic, good, or bad. Relay the fact that all substances are made of chemicals. This is an important concept that many students do not fully appreciate. This is an important first step in understanding the science of toxicology. Option: You may choose to bring in examples of items for them to classify at the beginning instead of listing things made of chemicals on the board. In this exercise you could have them group the items into the above categories as well as things made of chemicals and things not made of chemicals. Naturally many students will place items such as food and clothing into the 'not made of chemicals' category and this will help you address the misconception, stated above, that is possessed by many students.

Step 2: Duration ~10 minutes Reading/Lecture/Discussion Have students read the introduction to toxicology handout or provide this information in a lecture style. This will provide the background information for discussions, demonstrations, and lab activities.

Step 3: Duration ~10 minutes Dose Demonstration This is a demonstration to relay the importance of the amount of dose. Fill three 400mL beakers about ¾ full with water. Place one drop of food coloring in the first beaker, five in the second, and fifteen in the last beaker. Stir each beaker and discuss the change in color as a response to increased dose (amount of food color) in each beaker. Use white paper as a backdrop for easy visualization. The human body is about 75% water, thus the beakers represent the

amount of water in a human. Explain how some chemicals, like caffeine, are able to distribute throughout the body, just like the food coloring they witnessed in the water.

Step 4: Duration ~5 minutes Size Demonstration Fill one 400mL and one 100mL beaker about ¾ full with water. The large beaker represents an adult and a child is represented by the small beaker. Put the same amount of food coloring in each beaker (1 or 2 drops). The small beaker will be darker than the larger one. Use white paper as a backdrop for easy visualization. This is a demonstration on the importance of size or weight of the organism/human. Children may be more severely affected than an adult by the same dose. For example, a child who drinks one caffeinated soft drink will likely have a greater response than an adult who drinks the same amount.

Step 5: Duration ~55 minutes Lab Activity—Day 1 This activity will allow students to become toxicologists in your laboratory and determine the effects of various chemicals on the germination of radish seeds. They will construct a dos-eresponse curve for the effect of their chosen chemical on the germination of radish seeds. Radish seeds are used in this experiment because of their rapid time to germination (1-3 days). For solid chemicals, make a saturated solution in about 50mL of water.

Background:

Everything in the environment is made of **chemicals**. Both naturally occurring and man-made (synthetic) substances are chemical in nature. People and other animals are exposed to chemicals by ingesting them, inhaling them, or absorbing them through their skin or mucosa. Protection from harmful chemicals can only occur by blocking these routes of exposure. Students often have many misconceptions about chemicals. When asked what a chemical is, rather than providing a definition (any substance that has a defined molecular composition), they tend to give examples of synthetic, toxic chemicals like pesticides. **It is important to begin with an exercise asking students to name some things made of chemicals**. This will help you gauge the understanding of your students. Often, they do not realize that all natural substances are also made of chemicals

Source: Toxicology Lesson with plant seeds: Microsoft Word - Introduction to Toxicology Lesson Plan.doc (uga.edu)

B. Lethal Dose Toxicity Calculations

C. Podcast Assignment – Sam Kean's The Disappearing Spoon
"The Life-Saving Rat Poison"

D. Research 3 famous people/celebrities/historical figures that died from a toxin related death. List their name, provide a picture (include the resource), and describe how their death relates to toxicology.



D. Read about recent findings in milkweed plants purchased in stores. If you're interested in pollinators and especially Monarch butterflies, take a closer look at what's happening! Milkweed plants and pesticides

E. National Library of Medicine Toxicology Courses:

a. Free Principles of Toxicology Course
b. Free Principles of Genetic Toxicology
c. Free Pathophysiology Course
d. **Free Applied Systems Toxicology Course**
e. **Free Biochemistry and Molecular Genetics Course**
f. **Free Regulatory Toxicology Course**

F. Opportunities for formative assessment:

The periodic table - classification of elements (video) | Khan Academy