CHEMICAL HAZARD AWARENESS MODULE

A curriculum for chemistry teachers

INTRODUCTION

The *Chemical Hazard Awareness Module* teaches students how to assess and compare the hazards of different chemicals commonly used in classroom laboratories. Students will use hazard data to assign chemicals a hazard level, and they will decide which of the following reactions uses the safest chemicals:

REACTION 1:

$Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$

REACTION 2:

$CuSO_4 + K_2CO_3 \rightarrow CuCO_3 + K_2SO_4$

REACTION 3:

$CaCl_2 + Na_2CO_3 \rightarrow CaCO_3 + 2NaCl$

This module is designed to complement a laboratory exercise you currently use. It pairs well with Beyond Benign's *Reactions Lab* exercise (www.beyondbenign.org/K12educations/highschool.html). In the *Reactions Lab*, students identify types of chemical reactions and distinguish between those that use safer, less hazardous chemicals and those that are more dangerous.

CHEMISTRY CONCEPTS

Nomenclature, double displacement reactions, environmental health and safety

PREREQUISITIES

It helps if students have a basic understanding of Safety Data Sheets (SDSs). We recommend MoDRN's *How to Read an SDS for Chemistry Classrooms* module (modrn.yale.edu/teachers-modules).

TEACHER'S GUIDE

beyondbenign green chemistry education

DEPARTMENT OF ECOLOGY State of Washington

SUGGESTED BACKGROUND READING FOR STUDENTS

How Toxic is Toxic?
www.acs.org/content/acs/en/education/resources/highschool/chemmatters/past-issues.html

Natural vs. Synthetic Chemicals is a gray matter
blogs.scientificamerican.com/guest-blog/natural-vs-synthetic-chemicals-is-a-gray-matter

When It Comes To Chemicals, How Safe Is "Safe"?
ewg.org/enviroblog/2013/06/when-it-comes-chemicals-how-safe-safe

Chemicals of Concern
safecosmetics.org/get-the-facts/chemicals-of-concern

Banned in Europe, Safe in the US
ensia.com/features/banned-in-europe-safe-in-the-u-s

INSTRUCTIONS

1. Introduce students to the resources they'll use to gather data about chemical hazards:
   - **Globally Harmonized Safety Data Sheets (SDSs)**
   - **King County, Washington's LHWMP School Chemical List**
     www.hazwastehelp.org/educators/chemlist.aspx
     Approximately 1,000 chemicals cataloged and characterized by physical hazard, health hazard, environmental hazard, lowest grade allowed, storage category, common experiment usage, and disposal method.

2. Have students complete the Student Worksheet using the resources listed above.

Rxn #:	Chemical name:	Data Source:	Physical Hazard:	Health Hazard:	Environmental Hazard:	Hazard Level:
1	Lead (II) Nitrate	HCS List Data	May intensify fire; oxidizer	Causes serious eye damage, Harmful if inhaled, Harmful if swallowed, May cause damage to organs through prolonged or repeated exposure, May damage fertility or the unborn child	Very toxic to aquatic life Very toxic to aquatic life with long lasting effects	**High**
		SDS Data & H-Statements	H272	H302, H332, H318, H350, H360, H373 *High acute and chronic human health toxicity, including carcinogenicity, reproductive and developmental hazards;* LD50 (intravenous, rat) – 93 mg/kg; LD50 (intraperitoneal, mouse) – 74 mg/kg; IARC Group 2A: Probably carcinogenic to humans	H400, H410 *Very high acute and chronic aquatic toxicity;* LC50 (fish, 96 hr) – 1.5 mg/l; LC50 (fish, 96 hr) – 0.4-1.3 mg/l; EC50 (daphnia, 48 hr) – 0.5-2.0 mg/l	
	Potassium Iodide	HCS List Data	None	Causes serious eye irritation, Causes skin irritation Harmful if swallowed, May damage fertility or the unborn child	None	**Medium**
		SDS Data & H-Statements		H302, H315, H319 *Medium,* LD50 (oral, mouse) 1,000 mg/kg	*Medium,* LC50 (fish, 96 hr) 2,190 mg/l; EC50 (daphnia, 24 hr) 2.7 mg/l	
2	Copper (II) Sulfate	HCS List Data	None	Causes serious eye irritation Causes skin irritation Harmful if swallowed	Very toxic to aquatic life Very toxic to aquatic life with long lasting effects	**High**
		SDS Data & H-Statements		H302, H315, H319, *Medium;* LD50 (oral, rat) – 482 mg/kg; LD50 (intraperitoneal, rat) – 20 mg/kg; LD50 (subc, rat) – 43 mg/kg; LD50 (intravenous, rat) – 48.9 mg/kg	H410 *High;* LC50 (fish, 96 hr) – 1-2.5 mg/l; EC50 (daphnia, 48 hr) – 0.024 mg/l	
	Potassium Carbonate	HCS List Data	None	Causes serious eye irritation, Causes skin irritation Harmful if swallowed	None	**Medium**
		SDS Data & H-Statements		H302, H315, H319, H335, LD50 (oral, rat) – 1,870 mg/kg – Moderate toxicity	LC50 (fish, 96 hr) < 510 mg/l – Low toxicity	
3	Calcium chloride	HCS List Data	None	Causes serious eye irritation	None	**Low**
		SDS Data & H-Statements		H319 *Low toxicity,* LD50 (oral, rat) – 2,301 mg/kg	*Low toxicity,* LC50 (fish, 96 hr) – 10,650 mg/l; EC50 (daphnia, 48 hr) – 2,400 mg/l	
	Sodium carbonate	HCS List Data	None	Causes serious eye irritation	None	**Low**
		SDS Data & H-Statements		H319 *Low toxicity;* LD50 (oral, rat) – 4,090 mg/kg; LC50 (inh, rat, 2 hr) – 5,750 mg/l	*Low toxicity;* LC50 (fish, 96 hr) – 300 mg/l; EC50 (daphnia, 48 hr) – 265 mg/l	

Rxn #:	Chemical name:	Data Source:	Physical Hazard:	Health Hazard:	Environmental Hazard:	Hazard Level:
1	Lead (II) Iodide	HCS List Data		Harmful if inhaled, Harmful if swallowed, May cause damage to organs through prolonged or repeated exposure, May damage fertility or the unborn child	Very toxic to aquatic life Very toxic to aquatic life with long lasting effects	High
		SDS Data & H-Statements		High, H302, H332, H350, H360, H373, IARC Group 2A Carcinogen	High, H400, H410	
	Potassium Nitrate	HCS List Data	May intensify fire; oxidizer	Causes serious eye irritation, Causes skin irritation May cause respiratory irritation	None	High
		SDS Data & H-Statements	H272	High, IARC Group 2A Carcinogen, LD50 (oral, rat) 3,750 mg/kg	High, H402, H412	
2	Copper (II) Carbonate	HCS List Data		Causes serious eye irritation, Causes skin irritation Harmful if swallowed, May cause respiratory irritation	High Very toxic to aquatic life, Very toxic to aquatic life with long lasting effects	High
		SDS Data & H-Statements		Medium H302, H315, H319, H335, LD50 (oral, rat) 1,350 mg/kg	None	
	Potassium Sulfate	HCS List Data		Causes serious eye damage	None	Low
		SDS Data & H-Statements		Low LD50 (oral, rat) 6,600 mg/kg	LC50 (fish, 96 hr) 680 mg/l	
3	Calcium Carbonate	HCS List Data		Causes serious eye irritation Causes skin irritation	None	Low
		SDS Data & H-Statements		Low LD50 (oral, rat) 6,450 mg/kg		
	Sodium Chloride	HCS List Data		Causes serious eye irritation	None	Low
		SDS Data & H-Statements		Low LD50 (oral, rat) 3,550 mg/kg; LC50 (inh, rat, 1 hr) 42,000 mg/m3; LD50 (dermal, rabbit) 10,000 mg/kg	LC50 (fish, 96 hr) 5,840 mg/l; LC50 (daphnia, 48 hr) 1,661 mg/l	