LESSON 1 ACTIVITY

Toxic Reactions

Chemical Equations

Name _____

Date _____ Period _____

Purpose

To interpret chemical equations involving toxins.

Materials

- Toxic Reactions cards

Part 1: Interpreting Chemical Equations

Chemical equation: $HCl(aq) + NaHCO_3(aq) \longrightarrow NaCl(aq) + H_2O(l) + CO_2(g)$

Interpretation: A solution of hydrochloric acid reacts with a solution of sodium bicarbonate to produce a solution of sodium chloride, water, and bubbles of carbon dioxide gas.

Fill in the table based on the equation and interpretation.

Symbol	What it represents
HCl	
(aq)	
+	
$NaHCO_3$	
$\longrightarrow$	

Symbol	What it represents
NaCl	
H_2O	
(l)	
CO_2	
(g)	

1. What are the reactants in this chemical reaction? What are the products?

2. What visible evidence do you have that $CO_2(g)$ was formed? That $NaCl(aq)$ was formed?

3. What does the chemical equation tell you that your observations do not?

4. Predict what you would observe if you heated the liquid until all the water was gone.

Part 2: Toxins

1. Work with your partner to sort the Toxic Reactions cards into four groups based on some pattern or similar features you discover. Describe the four groups.

2. What are some substances that toxins react with in the body?

3. What do the toxins that affect the eyes, nose, throat, and lungs have in common?

4. List the compounds that are the *products* of reactions that cause blood acidosis.

5. What do the substances that cause nerve damage have in common?

6. Identify the solids that result in kidney stones.

7. Making Sense Describe what information a chemical equation gives you.

A ***Toxin: Phosgene, $COCl_2$***

Use:
Biological weapon in World War I

Effect on body:
Damages eyes, nose, throat, and lungs

Chemical equation (in body):
$COCl_2(g) + H_2O(l) \longrightarrow 2HCl(aq) + CO_2(g)$

Interpretation:
Phosgene gas reacts with water from tears, saliva, or mucus to produce aqueous hydrochloric acid and carbon dioxide gas.

B ***Toxin: Formaldehyde, CH_2O***

Use:
In the production of plywood and carpeting

Effect on body:
Blood acidosis leading to coma

Chemical equation (in body):
$2CH_2O(aq) + O_2(g) \longrightarrow 2CH_2O_2(aq)$

Interpretation:
Aqueous formaldehyde reacts with oxygen gas to produce aqueous formic acid in the blood.

C ***Toxin: Thallium oxide, Tl_2O***

Use:
In the creation of clay pottery and ceramics

Effect on body:
Nerve damage

Chemical equation (in body):
$Tl_2O(s) + 2HCl(aq) \longrightarrow 2TlCl(aq) + H_2O(l)$

Interpretation:
Solid thallium (I) oxide reacts with aqueous hydrochloric acid (stomach acid) to form aqueous thallium (I) chloride and water.

D ***Toxin: Ammonia, NH_3***

Use:
Often found in household cleaning supplies

Effect on body:
Damages eyes, nose, throat, lungs

Chemical equation (in body):
$NH_3(g) + H_2O(l) \longrightarrow NH_4OH(aq)$

Interpretation:
Ammonia gas reacts with water (tears, saliva, mucus) to produce aqueous ammonium hydroxide.

E ***Toxin: Nitric oxide, NO***

Use:
Produced by automobile engines and lightning

Effect on body:
Damages eyes, nose, throat, lungs

Chemical equation (in body):
$4NO(g) + O_2(g) + 2H_2O(l) \longrightarrow 4HNO_2(aq)$

Interpretation:
Nitric oxide gas reacts with water (tears, saliva, mucus) and oxygen gas to produce aqueous nitrous acid.

F ***Toxin: Ethanol, C_2H_6O***

Use:
As automobile fuel; found in alcoholic beverages

Effect on body:
Blood acidosis leading to coma

Chemical equation (in body):
$C_2H_6O(aq) + O_2(g) \longrightarrow C_2H_4O_2(aq) + H_2O(l)$

Interpretation:
Aqueous ethanol reacts with oxygen gas to produce aqueous acetic acid and water in the blood.

G ***Toxin: Chlorine, Cl_2***

Use:
In water purification, disinfectants, and bleach

Effect on body:
Damages eyes, nose, throat, and lungs

Chemical equation (in body):
$Cl_2(g) + H_2O(l) \longrightarrow HOCl(aq) + HCl(aq)$

Interpretation:
Chlorine gas reacts with water (tears, saliva, mucus) to produce aqueous hypochlorous acid and aqueous hydrochloric acid.

H ***Toxin: Mercury sulfide, HgS***

Use:
As a red paint pigment

Effect on body:
Nerve damage

Chemical equation (in body):
$HgS(s) + 2HCl(aq) \longrightarrow HgCl_2(s) + H_2S(aq)$

Interpretation:
Solid mercury (II) sulfide reacts with aqueous hydrochloric acid (stomach acid) to produce solid mercury (II) chloride and aqueous hydrogen sulfide.

I

Toxin: Ethylene glycol, $C_2H_6O_2$

Use:
As antifreeze in automobiles

Effect on body:
Blood acidosis leading to coma

Chemical equation (in body):
$$C_2H_6O_2(aq) + O_2(g) \longrightarrow C_2H_4O_3(aq) + H_2O(l)$$

Interpretation:
Aqueous ethylene glycol reacts with oxygen gas to produce aqueous glycolic acid and water in the blood.

J

Toxin: Lead carbonate, $PbCO_3$

Use:
In house paint until 1978

Effect on body:
Nerve damage

Chemical equation (in body):
$$PbCO_3(s) + 2HCl(aq) \longrightarrow PbCl_2(aq) + H_2CO_3(aq)$$

Interpretation:
Solid lead (II) carbonate reacts with aqueous hydrochloric acid (stomach acid) to produce aqueous lead (II) chloride and carbonic acid.

K

Toxin: Sodium oxalate, $Na_2C_2O_4$

Use:
In certain foods: chocolate, peanuts, spinach, beets, rhubarb, berries

Effect on body:
Kidney stones

Chemical equation (in body):
$$Na_2C_2O_4(aq) + CaCl_2(aq) \longrightarrow CaC_2O_4(s) + 2NaCl(aq)$$

Interpretation:
Aqueous sodium oxalate reacts with aqueous calcium chloride to produce solid calcium oxalate and aqueous sodium chloride.

L

Toxin: Lead, Pb

Use:
Formerly in household paint, toys, plumbing, and car bodies

Effect on body:
Nerve damage

Chemical equation (in body):
$$Pb(s) + 2HCl(aq) \longrightarrow PbCl_2(aq) + H_2(g)$$

Interpretation:
Solid lead reacts with aqueous hydrochloric acid (stomach acid) to produce aqueous lead (II) chloride and hydrogen gas.

M ***Toxin: Arsenic, As***

Use:
In agricultural insecticides; found in contaminated groundwater

Effect on body:
Nerve damage

Chemical equation (in body):
$2As(s) + 6HCl(aq) \longrightarrow 2AsCl_3(aq) + 3H_2(g)$

Interpretation:
Solid arsenic reacts with aqueous hydrochloric acid (stomach acid) to produce aqueous arsenic trichloride and hydrogen gas.

N ***Toxin: Oxalic acid, $C_2H_2O_4$***

Use:
Natural ingredient of many plants and foods, including black pepper, parsley, and rhubarb

Effect on body:
Kidney stones

Chemical equation (in body):
$C_2H_2O_4(aq) + CaCl_2(aq) \longrightarrow CaC_2O_4(s) + 2HCl(aq)$

Interpretation:
Aqueous oxalic acid reacts with aqueous calcium chloride to produce solid calcium oxalate and aqueous hydrochloric acid.

O ***Toxin: Methanol, CH_4O***

Use:
As a fuel in dragsters, sprint cars, and model airplanes

Effect on body:
Blood acidosis leading to coma

Chemical equation (in body):
$CH_4O(aq) + O_2(g) \longrightarrow CH_2O_2(aq) + H_2O(l)$

Interpretation:
Aqueous methanol reacts with oxygen to produce aqueous formic acid and water in the blood.

P ***Toxin: Sodium phosphate, Na_3PO_4***

Use:
As a cleaning agent, degreaser, and laxative

Effect on body:
Kidney stones

Chemical equation (in body):
$2Na_3PO_4(aq) + 3CaCl_2(aq) \longrightarrow Ca_3(PO_4)_2(s) + 6NaCl(aq)$

Interpretation:
Aqueous sodium phosphate reacts with aqueous calcium chloride to produce solid calcium phosphate and aqueous sodium chloride.

Toxic Reactions Patterns

Group	Toxin type	Effect on body	Reacts with	Produces
1				
2				
3				
4				