

LESSON
1
ACTIVITY

Toxic Reactions

Chemical Equations

Name _____

Date _____ Period _____



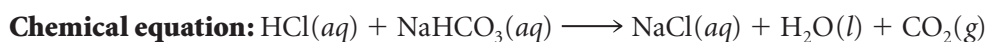
Purpose

To interpret chemical equations involving toxins.

Materials

- Toxic Reactions cards

Part I: Interpreting Chemical Equations



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	
→	

Symbol	What it represents
NaCl	
H ₂ O	
(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 CO₂(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.

TOXIC REACTIONS CARDS

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):

$$\text{COCl}_2(g) + \text{H}_2\text{O}(l) \longrightarrow 2\text{HCl}(aq) + \text{CO}_2(g)$$

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):

$$2\text{CH}_2\text{O}(aq) + \text{O}_2(g) \longrightarrow 2\text{CH}_2\text{O}_2(aq)$$

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):

$$\text{Tl}_2\text{O}(s) + 2\text{HCl}(aq) \longrightarrow 2\text{TlCl}(aq) + \text{H}_2\text{O}(l)$$

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):

$$\text{NH}_3(g) + \text{H}_2\text{O}(l) \longrightarrow \text{NH}_4\text{OH}(aq)$$

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):
$$4\text{NO}(g) + \text{O}_2(g) + 2\text{H}_2\text{O}(l) \longrightarrow 4\text{HNO}_2(aq)$$

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

F **Toxin:**
Ethanol, C₂H₆O

Use:
As automobile fuel; found in
alcoholic beverages

Effect on body:
Blood acidosis leading to coma

Chemical equation (in body):
$$\text{C}_2\text{H}_6\text{O}(aq) + \text{O}_2(g) \longrightarrow \text{C}_2\text{H}_4\text{O}_2(aq) + \text{H}_2\text{O}(l)$$

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

G **Toxin:**
Chlorine, Cl₂

Use:
In water purification, disinfectants,
and bleach

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

Chemical equation (in body):
$$\text{Cl}_2(g) + \text{H}_2\text{O}(l) \longrightarrow \text{HOCl}(aq) + \text{HCl}(aq)$$

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

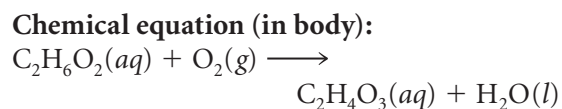
Chemical equation (in body):
$$\text{HgS}(s) + 2\text{HCl}(aq) \longrightarrow \text{HgCl}_2(s) + \text{H}_2\text{S}(aq)$$

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

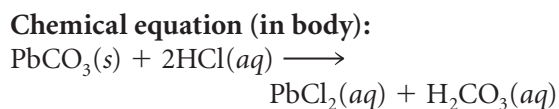


Interpretation:
Aqueous ethylene glycol reacts with oxygen gas to produce aqueous glycolic acid and water in the blood.

J **Toxin:**
Lead carbonate, $PbCO_3$

Use:
In house paint until 1978

Effect on body:
Nerve damage

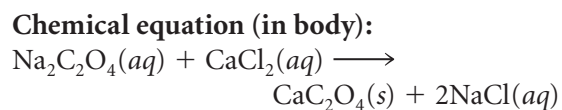


Interpretation:
Solid lead (II) carbonate reacts with aqueous hydrochloric acid (stomach acid) to produce aqueous lead (II) chloride and carbonic acid.

K **Toxin:**
Sodium oxalate, $Na_2C_2O_4$

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

Effect on body:
Kidney stones

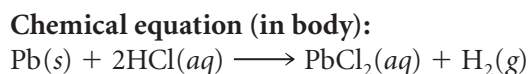


Interpretation:
Aqueous sodium oxalate reacts with aqueous calcium chloride to produce solid calcium oxalate and aqueous sodium chloride.

L **Toxin:**
Lead, Pb

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

Effect on body:
Nerve damage

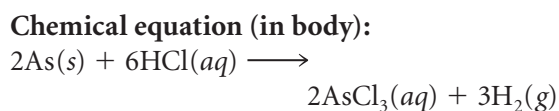


Interpretation:
Solid lead reacts with aqueous hydrochloric acid (stomach acid) to produce aqueous lead (II) chloride and hydrogen gas.

M **Toxin:**
Arsenic, As

Use:
In agricultural insecticides; found in contaminated groundwater

Effect on body:
Nerve damage

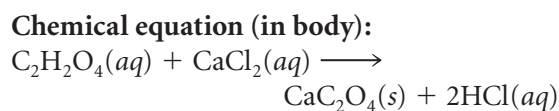


Interpretation:
Solid arsenic reacts with aqueous hydrochloric acid (stomach acid) to produce aqueous arsenic trichloride and hydrogen gas.

N **Toxin:**
Oxalic acid, C₂H₂O₄

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

Effect on body:
Kidney stones

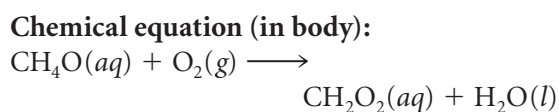


Interpretation:
Aqueous oxalic acid reacts with aqueous calcium chloride to produce solid calcium oxalate and aqueous hydrochloric acid.

O **Toxin:**
Methanol, CH₄O

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

Effect on body:
Blood acidosis leading to coma

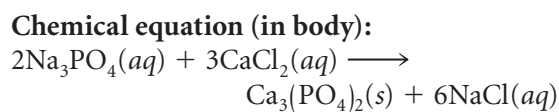


Interpretation:
Aqueous methanol reacts with oxygen to produce aqueous formic acid and water in the blood.

P **Toxin:**
Sodium phosphate, Na₃PO₄

Use:
As a cleaning agent, degreaser, and laxative

Effect on body:
Kidney stones



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				