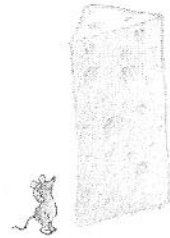


LESSON
7
CLASSWORK

Lethal Dose
Toxicity

Name DM Rae
Date _____ Period _____



Purpose

To calculate and compare the toxicity of various substances.

Part I: Determining Lethal Dose

Both aspirin and acetaminophen are common fever and pain relievers. However, too much of either can be toxic. Your job is to figure out how much of each is toxic to a child and to an adult. Assume that the lethal dose for rats applies to humans as well.

LD₅₀ is measured in milligrams of the substance per kilogram of body weight. Your first step is to convert measurements of body weight from pounds to kilograms.

1 kg = 2.2 lb

1. What is the mass of a 132 lb human in kilograms?

$132 \text{ lb} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} = 60 \text{ kg}$

2. How much does a 22 lb child weigh in kilograms?

$22 \text{ lb} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} = 10 \text{ kg}$

3. The LD₅₀ for acetaminophen is 2404 mg/kg (rat, oral).

- a. How many milligrams of acetaminophen would be a lethal dose for a 132 lb adult?

$60 \text{ kg} \times 2404 \text{ mg/kg} = 144240 \text{ mg} = 1.44 \times 10^5 \text{ mg}$

- b. How many 500 mg tablets of acetaminophen would be a lethal dose for a 132 lb adult?

$1.44 \times 10^5 \text{ mg} \times \frac{1 \text{ tab}}{500 \text{ mg}} = 288 \text{ tabs}$

- c. How many milligrams of acetaminophen would be a lethal dose for a 22 lb child?

$10 \text{ kg} \times 2404 \text{ mg/kg} = 24040 \text{ mg} = 2.40 \times 10^4 \text{ mg}$

- d. How many 500 mg tablets of acetaminophen would be a lethal dose for a 22 lb child?

$2.40 \times 10^4 \text{ mg} \times \frac{1 \text{ tab}}{500 \text{ mg}} = 48 \text{ tabs}$

4. The LD₅₀ for aspirin is 200 mg/kg (rat, oral).

- a. How many milligrams of aspirin would be a lethal dose for a 132 lb adult?

$60 \text{ kg} \times 200 \text{ mg/kg} = 12000 \text{ mg} = 1.20 \times 10^4 \text{ mg}$

- b. How many 500 mg tablets of aspirin would be a lethal dose for a 132 lb adult?

$1.20 \times 10^4 \text{ mg} \times \frac{1 \text{ tab}}{500 \text{ mg}} = 24 \text{ tabs}$

- c. How many milligrams of aspirin would be a lethal dose for a 22 lb child?

$10 \text{ kg} \times 200 \text{ mg/kg} = 2000 \text{ mg} = 2.00 \times 10^3 \text{ mg}$

- d. How many 500 mg tablets of aspirin would be a lethal dose for a 22 lb child?

$2.00 \times 10^3 \text{ mg} \times \frac{1 \text{ tab}}{500 \text{ mg}} = 4 \text{ tabs}!!!$

1 tablet
500 mg

5. Which is more toxic, acetaminophen or aspirin? How great is the difference in their toxicities? Explain.

aspirin = 24 tabs to kill an adult
vs 288 tabs

Part 2: Comparing Lethal Doses

Examine the table of lethal doses for various substances.

mcg = microgram
 $10^6 \mu\text{g} = 1\text{g}$

1. What substance in the table is the most toxic? Explain.

snake venom = $\frac{25 \mu\text{g}}{1 \text{ kg}} = \text{LD}_{50}$ = lowest dosage needed

2. Rank the substances in the table based on their lethal doses, with 1 being the most toxic.

- you must have them all the same units
- cannot compare μg to mg to g !!

3. Are any substances in the table good for you? Explain.

yes eg Fe tablets if you are anemic!

4. Are there any substances in the world that are not toxic? Explain.

- every substance has an LD_{50}
- some substances have very hi LD_{50}

5. **Making Sense** How does the size of a dose relate to the toxicity of a substance?

- the higher the dose the closer to the LD_{50} you get

6. **If You Finish Early** How many tablets of vitamin A would be lethal for a 140 lb human? Assume that each tablet contains 3.0 mg of retinal.

$$140 \text{ lb} \times \frac{1 \text{ kg}}{2.2 \text{ lb}} \times \frac{2000 \text{ mg}}{1 \text{ kg}} \times \frac{1 \text{ tab}}{3.0 \text{ mg}} = 93333 \text{ tablets}$$

cannot have

X 93333.3333333333 >

$$1 \mu\text{g} = 1 \times 10^{-3} \text{ mg} = 1 \times 10^{-6} \text{ g}$$

$$\text{OR } 1000000 \mu\text{g} = 1000 \text{ mg} = 1 \text{ g}$$

repeating because we use tools that have finite

~~*~~ to compare they must be in the same units !! ~~*~~

LETHAL DOSES

Common name	Toxin	Lethal doses	Description	Toxic response
5 aspirin	acetylsalicylic acid, $C_9H_8O_4$	LD ₅₀ 200 mg/kg (rat, oral)	odorless white crystal	gastric distress, confusion, psychosis, stupor, tinnitis, hyperventilation
0 table salt	sodium chloride NaCl	LD ₅₀ 3 g/kg (rat, oral) 12,357 mg/kg (human, oral) <i>30000 mg/kg</i>	white cubic crystal	eye irritant, elevated blood pressure
2 castor beans	ricin protein molecules, molecular mass 63,000 amu	LD ₅₀ 30 mcg/kg (human, oral) LD ₅₀ 3.0 mcg/kg (human intravenous) <i>0.030 mg/kg</i>	small, shiny black seeds with white spots	vomiting, diarrhea, internal bleeding, kidney and liver failure; death within minutes if injected
7 bleach (fumes)	chlorine Cl ₂	LD ₅₀ 850 mg/kg (rat, oral) *LC ₅₀ 1,300 mg/m ³	greenish gas or amber liquid, pungent odor	corrosive to eyes, skin, respiratory tract; nausea, vomiting, pulmonary edema
5 lorchel mushroom	gyromitrin C ₄ H ₈ N ₂ O	LD ₅₀ 200 mg/kg (rat, oral)	reddish mushroom	nausea, vomiting, severe liver damage, coma, convulsions
3 arsenic	arsenic (III) oxide As ₂ O ₃	LD ₅₀ 15 mg/kg (rat, oral)	gray, metallic crystals	acute—irritates eyes, skin, respiratory tract, nausea chronic—convulsions, tissue lesions, hemorrhage, kidney impairment
11 sugar	glucose C ₆ H ₁₂ O ₆	LD ₅₀ 30 g/kg (rat, oral) <i>30000 mg/kg!</i>	sweet white powder	lethargy, gastrointestinal distress; if diabetic—heart disease, blindness, nerve damage, kidney damage
* iron tablets	iron sulfate FeSO ₄	~5 adult tablets for a 3-year-old	grayish white powder	nausea, vomiting, diarrhea, black stool, liver damage, coma
6 lead	lead Pb	lowest published dose 450 mg/kg (human, oral)	bluish or silvery solid	acute—headache, joint pain chronic—anemia, kidney disease, birth defects
1 snake venom	α-bungarotoxin C ₃₃₈ H ₅₂₉ N ₉₇ O ₁₀₅ S ₁₁	LD ₅₀ 25.0 mcg/kg (rat, intramuscular) <i>0.025 mg/kg</i>	large protein molecule	paralysis, suffocation, loss of consciousness, seizures, hemorrhaging into tissues
4 soft drink	caffeine C ₈ H ₁₀ N ₄ O ₂	LD ₅₀ 140 mg/kg (dog, oral)	odorless white crystals	renal failure, nausea, psychosis, hemorrhage, rapid pulse, convulsions
10 alcohol	ethanol C ₂ H ₆ O	LD ₅₀ 7,060 mg/kg (rat, oral)	colorless liquid, pleasant odor	nausea, headache, vomiting, seizure, dizziness, loss of consciousness
8 vitamin A	retinol C ₂₀ H ₃₀ O	LD ₅₀ 2,000 mg/kg (rat, oral)	yellow crystals, orange solid	convulsions, unconsciousness, reproductive toxin

can't compare

*LC₅₀ refers to the lethal concentration of an inhaled substance.

I think I'm right but check me