

# Lethal Dose Toxicity

Name \_\_\_\_\_

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.

LD<sub>50</sub> 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.

$$1 \text{ kg} = 2.2 \text{ lb}$$

1. What is the mass of a 132 lb human in kilograms?
2. How much does a 22 lb child weigh in kilograms?
3. The LD<sub>50</sub> for acetaminophen is 2404 mg/kg (rat, oral).
  - a. How many milligrams of acetaminophen would be a lethal dose for a 132 lb adult?
  - b. How many 500 mg tablets of acetaminophen would be a lethal dose for a 132 lb adult?
  - c. How many milligrams of acetaminophen would be a lethal dose for a 22 lb child?
  - d. How many 500 mg tablets of acetaminophen would be a lethal dose for a 22 lb child?
4. The LD<sub>50</sub> for aspirin is 200 mg/kg (rat, oral).
  - a. How many milligrams of aspirin would be a lethal dose for a 132 lb adult?
  - b. How many 500 mg tablets of aspirin would be a lethal dose for a 132 lb adult?
  - c. How many milligrams of aspirin would be a lethal dose for a 22 lb child?
  - d. How many 500 mg tablets of aspirin would be a lethal dose for a 22 lb child?

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

## Part 2: Comparing Lethal Doses

Examine the table of lethal doses for various substances.

1. What substance in the table is the most toxic? Explain.
2. Rank the substances in the table based on their lethal doses, with 1 being the most toxic.
3. Are any substances in the table good for you? Explain.
4. Are there any substances in the world that are not toxic? Explain.
5. **Making Sense** How does the size of a dose relate to the toxicity of a substance?
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.

## LETHAL DOSES

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

\*LC<sub>50</sub> refers to the lethal concentration of an inhaled substance.