Kilograms (kg), grams (g), milligrams (mg), and micrograms (µg)

Definition

A gram (g) is a metric unit for a small amount of mass or weight. It's equal to the weight of one cubic centimeter (or one milliliter) of water.

A kilogram (kg) is 1,000 grams. A kg has the same weight as one liter of water.

A milligram (mg) is one thousandth of a gram. There are one thousand mg in a g, and one million mg in a kg.

A microgram (µg, ug, or Ug) is one millionth of a gram. There are one million µg in a g, and one billion µg in a kg.

Uses

In environmental science, these units are frequently used in relation to each other, because even a tiny amount of contamination in a large amount of soil, water, or air can be harmful.

Soil contamination is often measured in mg or µg of contaminant per kg of soil sampled. Water contamination is measured in mg or µg of contaminant per liter of water. Air contamination is measured in mg or µg of contaminant per cubic meter of air.

Because there are one million mg in a kg, the ratio mg/kg is sometimes expressed as "parts per million (ppm)." Similarly, µg/kg sometimes appears as "parts per billion (ppb)."

Examples

- A kg weighs about 2.2 pounds.
- There are about 28 g in 1 ounce.
- A 2-L bottle of soda/pop weighs 2 kg. A major league baseball bat weighs about 1 kg.
- A dollar bill, a small paper clip, and a packet of artificial sweetener each weigh about 1 g.
- Medical pills are often described in mg, but you shouldn't use that as a way of understanding how big a mg is: A "200-mg" tablet of ibuprofen contains 200 mg of the drug, but it also contains fillers and coatings to help the drug release slowly. A whole 200-mg pill weighs much more than 200 mg.
- One mg is almost too small to see. One grain of fine table sugar or salt might be about one mg. One µg is definitely too small to see without a microscope.

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Note: The discussion and activities below focus on grams and kilograms. If your group is more interested in milligrams and micrograms, first do the activity below. Then, use the 1,000-to-1 relationship between kg and g to imagine the *same* relationship between g and mg, or mg and µg.

Launch the Discussion

Remind or tell the group why you're talking about these units (it came up at a meeting, it's a key to understanding something the group has identified as a priority, etc.) Ask the group:

Kilograms: What's an example of a kilogram? Which of these do you think is closer to a kilogram? (Read the list and have participants vote, but don't give an answer until they have had a chance to guess.)

- A deck of cards? (about 1/10 of a kilogram)
- A baseball bat? (about 1kg)
- A gallon of water? (3.8 kg)
- A cinder block? (12 -14 kg)

Grams: What's an example of a gram? Which do you think is closest to a gram? (Read the list and have participants vote, but don't give an answer until they have had a chance to guess.)

- A drop of water? (0.05 g)
- A piece of copier paper? (about 4.5 g)
- A packet of artificial sweetener? (about 1 g)
- A tablespoon of sugar? (about 12 g)

Fact Sheet

Pass out the Fact Sheet. Review key points. Discuss with the group how it connects to their work. If the group is focused on mg and µg, have participants make statements like, "There are as many milligrams in a packet of sweetener as there are packets of sweetener in a baseball bat."

Activities

Bring in a digital bathroom scale (for kg) and/or a sensitive digital kitchen scale (for grams). Bring in objects of various weights and invite participants to guess the weight in kilograms/grams, and then weigh the objects to verify. Invite people to guess and check with objects in the room or in their pockets: Books, keys, wallets, water bottles, etc. For a special challenge, have participants guess which one is closest to 1 g or 1 kg.