

## Order of Magnitude

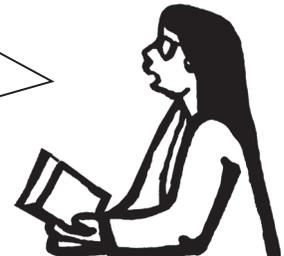
“Order of magnitude” is a term often used in environmental work. It is a quick, general way to communicate the size or quantity of something. There are a few ways the term is used:

### Estimating or Generalizing

When guessing the size of a number, people may not be able to be very specific, but they can guess whether it's closer to 1, 10, 100, or 1,000, etc. (or 0.1, 0.01, 0.001, etc.) This “ballpark” estimate helps start a conversation, even without precise numbers.

**Example:** The regulator knows background levels are generally between 6-14 ppm. They're rarely as low as 1 ppm or as high as 100 ppm.

In this part of the state, background levels of arsenic in the soil are on the order of magnitude of 10 ppm.



### Comparing

When comparing two numbers quickly, the exact comparison might not be as important as the order of magnitude comparison. Health effects from contamination don't change much with a small increase in contamination. Usually it takes an order of magnitude increase or decrease in contamination to cause a significant change in health effects.

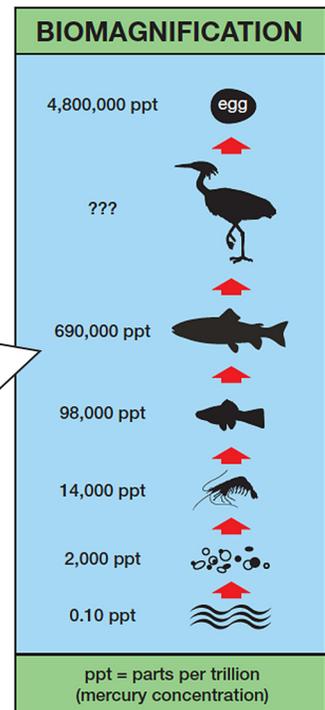
**Example:** The screening level for a contaminant is 2 mg/kg. Some test results show 3 mg/kg. The risk assessor knows screening levels are generally set by order of magnitude.



Contamination is a little over the screening level, but not by much; they're on the same order of magnitude. We'll do more testing, but there's no reason to panic.

**Example:** Mercury contamination becomes more concentrated as it goes up the food chain.

Mercury levels may be less than a part per trillion in the river, but it's 7 orders of magnitude higher in a crane's egg.



Source: Source: U.S. Department of the Interior, U.S. Geological Survey, Center for Coastal Geology

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### Launch the Discussion

Remind or tell the group why you're covering this topic (it came up at a previous meeting, it's a key to understanding something the group has identified as a priority, etc.) Ask the group: Has anyone heard the phrase "order of magnitude" before? What do you think it is?

Fact Sheet

Pass out the Fact Sheet. Review key points. Discuss with the group how it connects to their work.

### Activities

**Activity 1:** Ask the group to compare familiar things by order of magnitude. Make sure people say what aspect is being compared: Length? Area? Volume? Weight? Expense? Prompt with the comparisons below (don't give an answer until participants have had a chance to guess.)

- Height of an adult, and height of a toddler? (same order of magnitude)
- Amount of water in a tablespoon, and amount of water in a gallon? (two)
- Time in an hour, and time in a year? (four)
- Weight of a bicycle, and weight of a car? (two)
- Weight of a person, and weight of an elephant? (two)

Then, ask participants to come up with their own order of magnitude comparisons.

**Activity 2:** Find a common small object, like a post-it note or a dollar bill. Have the group figure out big it would be if it were one or two orders of magnitude larger. Mark how big it would be on the floor.