Order of Magnitude (OM)

- The OM is the power of ten that is "closest" to the value you are estimating
  - Always written as a whole number power of 10
    - i.e. 10^{13} kg
  - They give us a general idea about the magnitude (size) of a value, but are just estimates

OM ranges of measurements

- Online: OM Ranges for Mass, Time, Distance, and Energy

- You should be aware/know the min and max of each of these ranges.
- Hint: knowing the size of an atom and proton tends to come in handy ☺

Order of Magnitude (OM)

- If an approximate (or known) value can be determined, an Order of Magnitude can be calculated
- OM values are only used to determine rough estimates

- But HOW?? Let's use the following example…

Population of Washington State

- According to the Census Bureau, the population of Washington in 2011 was 6,830,080 people.
- The population growth rate between 2010 and 2011 was +1.6%/year
- Based on this information, what, approximately, is the state's population right now?

Population of Washington State

- Step 1: Assumptions?

- Step 2: If those assumptions are accurate, determine the population (2011 population + 1.6% = 2012 population...it's now 2016)

- Step 3: can we consider this an exact number?

Since we cannot assume our calculation is an exact answer:

- Step 1: $z = Log(VALUE)$

- Step 2: round **z** to nearest whole number

- Step 3: $$OM = 10^z$$

- So... $z = \log(7,050,391) = 6.848 \approx 7$
    - **OM = 10^7 people in the state of WA**

Using OM in ratios—comparisons

- For example,
- **How much larger than the population of Washington (state) is the US population? The World's population?**

- Use the 2012 population of WA (6.897 million people) and the information from THIS WEBSITE to determine this answer.

Population Ratio:

- WA Population: OM = ?
- World population: OM = ?

$$\frac{WORLDpopulation}{WApopulation} = \frac{10^{10}}{10^7} = 10^3$$

- The population of the world is on the order of 10^3 times larger than the population of WA

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Activity: Heartbeats

1. In your journal, Record 3 trials of the number of heartbeats (for yourself) that occur in 60.0 seconds.
2. Calculate the average number of heartbeats per minute.
3. Calculate the number of heartbeats per lifetime you would predict using your data. Show your work using the factor-label method

   (beats·minute^{-1} → beats·lifetime^{-1})...you'll need about 4 factors to get there
4. Convert each of your separate factors into OM, then re-do the calculation to heartbeats per lifetime.
5. Determine the OM of your original answer (from #3) and compare this to the OM from #4

Sample question—like on WA and worksheet
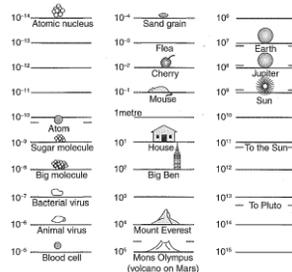
- How much larger is an atom than an atomic nucleus?

- How much larger is Mount Everest than a house?

- How much larger is the Earth than an atomic nucleus?

Activity: pt. 2—Landscaping Dilemma

- Fred's Landscaping has been hired to seed a field the size of a football field completely with grass seed (the field's owner doesn't like sod for some reason).
- Fred wants to purchase the right number of bags of grass (they are 3 lb. bags) so that he doesn't have extra.
- **How many bags of grass seed should he purchase?**

Landscaping Dilemma—Journal entry 9/18/17

- How many bags should Fred purchase?
- How confident are you?
- What could have happened that would have affected your results?