Lesson 13: Multiplying, Dividing, and Estimating with Scientific Notation

Let's multiply and divide with scientific notation to answer questions about animals, careers, and planets.

13.1: True or False: Equations

Is each equation true or false? Explain your reasoning.

1. $4 \times 10^5 \times 4 \times 10^4 = 4 \times 10^{20}$

2. $\frac{7 \times 10^6}{2 \times 10^4} = (7 \div 2) \times 10^{(6-4)}$

3. $8.4 \times 10^3 \times 2 = (8.4 \times 2) \times 10^{(3 \times 2)}$

13.2: Biomass

Use the table to answer questions about different creatures on the planet. Be prepared to explain your reasoning.

creature	number	mass of one individual (kg)
humans	7.5×10^{9}	6.2×10^{1}
cows	1.3×10^{9}	4×10^{2}
sheep	1.75×10^{9}	6×10^{1}
chickens	2.4×10^{10}	2×10^{0}
ants	5×10^{16}	3×10^{-6}
blue whales	4.7×10^{3}	1.9×10^{5}
Antarctic krill	7.8×10^{14}	4.86×10^{-4}
zooplankton	1×10^{20}	5×10^{-8}
bacteria	5×10^{30}	1×10^{-12}

1. Which creature is least numerous? Estimate how many times more ants there are.

2. Which creature is the least massive? Estimate how many times more massive a human is.

3. Which is more massive, the total mass of all the humans or the total mass of all the ants? About how many times more massive is it?

4. Which is more massive, the total mass of all the krill or the total mass of all the blue whales? About how many times more massive is it?

13.3: Info Gap: Distances in the Solar System

Your teacher will give you either a problem card or a data card. Do not show or read your card to your partner.

If your teacher gives you the *problem card*:

1. Silently read your card and think about what information you need to answer the question.
2. Ask your partner for the specific information that you need.
3. Explain to your partner how you are using the information to solve the problem.
4. Solve the problem and explain your reasoning to your partner.

If your teacher gives you the *data card*:

1. Silently read the information on your card.
2. Ask your partner "What specific information do you need?" and wait for your partner to *ask* for information. *Only* give information that is on your card. (Do not figure out anything for your partner!)
3. Before telling your partner the information, ask "Why do you need that information?"
4. After your partner solves the problem, ask them to explain their reasoning and listen to their explanation.

Pause here so your teacher can review your work. Ask your teacher for a new set of cards and repeat the activity, trading roles with your partner.

13.4: Professions in the United States

Use the table to answer questions about professions in the United States as of 2012.

profession	number	typical annual salary (U.S. dollars)
architect	1.074×10^5	7.3×10^4
artist	5.14×10^4	4.4×10^4
programmer	1.36×10^6	8.85×10^4
doctor	6.9×10^5	1.87×10^5
engineer	6.17×10^5	8.6×10^4
firefighter	3.07×10^5	4.5×10^4
military—enlisted	1.16×10^6	4.38×10^4
military—officer	2.5×10^5	1×10^5
nurse	3.45×10^6	6.03×10^4
police officer	7.8×10^5	5.7×10^4
college professor	1.27×10^6	6.9×10^4
retail sales	4.67×10^6	2.14×10^4
truck driver	1.7×10^6	3.82×10^4

Answer the following questions about professions in the United States. Express each answer in scientific notation.

1. Estimate how many times more nurses there are than doctors.

2. Estimate how much money all doctors make put together.

3. Estimate how much money all police officers make put together.

4. Who makes more money, all enlisted military put together or all military officers put together? Estimate how many times more.

Lesson 13 Summary

Multiplying numbers in scientific notation extends what we do when we multiply regular decimal numbers. For example, one way to find $(80)(60)$ is to view 80 as 8 tens and to view 60 as 6 tens. The product $(80)(60)$ is 48 hundreds or 4,800. Using scientific notation, we can write this calculation as

$$(8 \times 10^1)(6 \times 10^1) = 48 \times 10^2.$$

To express the product in scientific notation, we would rewrite it as 4.8×10^3.

Calculating using scientific notation is especially useful when dealing with very large or very small numbers. For example, there are about 39 million or 3.9×10^7 residents in California. Each Californian uses about 180 gallons of water a day. To find how many gallons of water Californians use in a day, we can find the product $(180)(3.9 \times 10^7) = 702 \times 10^7$, which is equal to 7.02×10^9. That's about 7 billion gallons of water each day!

Comparing very large or very small numbers by estimation also becomes easier with scientific notation. For example, how many ants are there for every human? There are 5×10^{16} ants and 7×10^9 humans. To find the number of ants per human, look at $\frac{5 \times 10^{16}}{7 \times 10^9}$. Rewriting the numerator to have the number 50 instead of 5, we get $\frac{50 \times 10^{15}}{7 \times 10^9}$. This gives us $\frac{50}{7} \times 10^6$. Since $\frac{50}{7}$ is roughly equal to 7, there are about 7×10^6 or 7 million ants per person!