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Unit 7, Lesson 15

Adding and Subtracting with Scientific Notation

Let's add and subtract using scientific notation to answer questions about animals and the solar system.

15.1 Number Talk: Non-zero Digits

Mentally decide how many non-zero digits each number will have.

$(3 \times 10^9)(2 \times 10^7)$

$(3 \times 10^9) \div (2 \times 10^7)$

$3 \times 10^9 + 2 \times 10^7$

$3 \times 10^9 - 2 \times 10^7$

15.2 Measuring the Planets

Diego, Kiran, and Clare were wondering:

"If Neptune and Saturn were side by side, would they be wider than Jupiter?"

1. They try to add the diameters, 4.7×10^4 km and 1.2×10^5 km. Here are the ways they approached the problem. Do you agree with any of them? Explain your reasoning.
   a. Diego says, "When we add the distances, we will get $4.7 + 1.2 = 5.9$. The exponent will be 9. So the two planets are 5.9×10^9 km side by side."

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b. Kiran wrote 4.7×10^4 as 47,000 and 1.2×10^5 as 120,000 and added them:

$$\begin{array}{r} 120{,}000 \\ +47{,}000 \\ \hline 167{,}000 \end{array}$$

c. Clare says, "I think you can't add unless they are the same power of 10." She adds 4.7×10^4 km and 12×10^4 to get 16.7×10^4.

2. Jupiter has a diameter of 1.43×10^5. Which is wider, Neptune and Saturn put side by side, or Jupiter?

15.3 A Celestial Dance

object	diameter (km)	distance from the Sun (km)
Sun	1.392×10^6	0×10^0
Mercury	4.878×10^3	5.79×10^7
Venus	1.21×10^4	1.08×10^8
Earth	1.28×10^4	1.47×10^8
Mars	6.785×10^3	2.28×10^8
Jupiter	1.428×10^5	7.79×10^8

1. When you add the distances of Mercury, Venus, Earth, and Mars from the Sun, would you reach as far as Jupiter?

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2. Add all the diameters of all the planets except the Sun. Which is wider, all of these objects side by side, or the Sun? Draw a picture that is close to scale.

Are you ready for more?

The emcee at a carnival is ready to give away a cash prize! The winning contestant could win anywhere from \$1 to \$100. The emcee only has 7 envelopes and she wants to make sure she distributes the 100 \$1 bills among the 7 envelopes so that no matter what the contestant wins, she can pay the winner with the envelopes without redistributing the bills. For example, it’s possible to divide 6 \$1 bills among 3 envelopes to get any amount from \$1 to \$6 by putting \$1 in the first envelope, \$2 in the second envelope, and \$3 in the third envelope (Go ahead and check. Can you make \$4? \$5? \$6?).

How should the emcee divide up the 100 \$1 bills among the 7 envelopes so that she can give away any amount of money, from \$1 to \$100, just by handing out the right envelopes?

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15.4 Old McDonald's Massive Farm

Use the table to answer questions about different life forms on the planet.

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. On a farm there was a cow. And on the farm there were 2 sheep. There were also 3 chickens. What is the total mass of the 1 cow, the 2 sheep, the 3 chickens, and the 1 farmer on the farm?

2. Make a conjecture about how many ants might be on the farm. If you added all these ants into the previous question, how would that affect your answer for the total mass of all the animals?

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3. What is the total mass of a human, a blue whale, and 6 ants all together?

4. Which is greater, the number of bacteria, or the number of all the other animals in the table put together?

Lesson 15 Summary

When we add decimal numbers, we need to pay close attention to place value. For example, when we calculate $13.25 + 6.7$, we need to make sure to add hundredths to hundredths (5 and 0), tenths to tenths (2 and 7), ones to ones (3 and 6), and tens to tens (1 and 0). The result is 19.95.

We need to take the same care when we add or subtract numbers in scientific notation. For example, suppose we want to find how much further the Earth is from the Sun than Mercury. The Earth is about 1.5×10^8 km from the Sun, while Mercury is about 5.8×10^7 km. In order to find

$$1.5 \times 10^8 - 5.8 \times 10^7$$

we can rewrite this as

$$1.5 \times 10^8 - 0.58 \times 10^8$$

Now that both numbers are written in terms of 10^8, we can subtract 0.58 from 1.5 to find

$$0.92 \times 10^8$$

Rewriting this in scientific notation, the Earth is

$$9.2 \times 10^7$$

km further from the Sun than Mercury.