Applications of Arithmetic with Powers of 10

Let's use powers of 10 to help us make calculations with large and small numbers.

12.1 What Information Do You Need?

What information would you need to answer these questions?

1. Which is taller, the Burj Khalifa or a stack of the money it cost to build the Burj Khalifa?

2. Which has more mass, the Burj Khalifa or the mass of pennies it cost to build the Burj Khalifa?

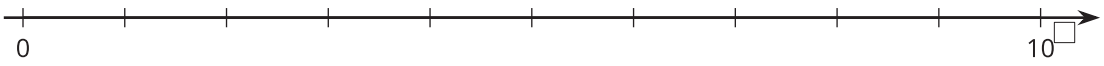
12.2 That's a Tall Stack of Cash

In 2010, the Burj Khalifa became the tallest building in the world. It was very expensive to build.

1. Which is taller, the Burj Khalifa or a stack of the money it cost to build the Burj Khalifa? Ask your teacher for the information you need to be able to answer this question, and record the information here.

2. Answer the question "Which is taller, the Burj Khalifa or a stack of the money it cost to build the Burj Khalifa?" and explain or show your reasoning.

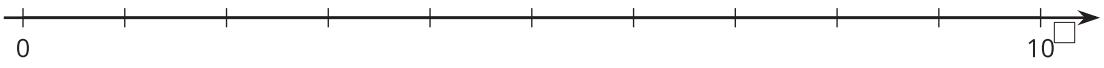
3. Decide what power of 10 to use to label the rightmost tick mark of the number line so that both the height of the stack of money and the height of the Burj Khalifa can be plotted on the same number line. Label the tick marks, and plot and label both values.



4. Which has more mass, the Burj Khalifa or the mass of the pennies it cost to build the Burj Khalifa? Ask your teacher for the information you need to be able to answer this question and record the information here.

5. Answer the question "Which has more mass, the Burj Khalifa or the mass of the pennies it cost to build the Burj Khalifa?" and explain or show your reasoning.

6. Decide what power of 10 to use to label the rightmost tick mark of the number line so that both the mass of the Burj Khalifa and the mass of the pennies it cost to build the Burj Khalifa can be plotted on the same number line. Label the tick marks and plot and label both values.

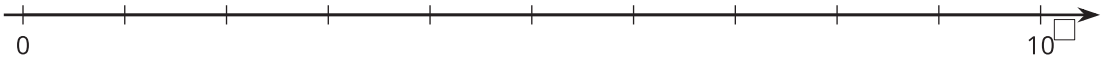


12.3 Meter Sticks to the Moon

1. How many meter sticks does it take to equal the mass of the Moon? Ask your teacher for the information you need to be able to answer this question, and record the information here.

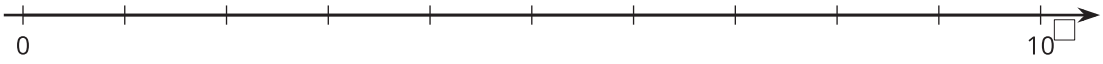
2. Answer the question "How many meter sticks does it take to equal the mass of the Moon?" and explain or show your reasoning.

3. Label the number line and plot your answer for the number of meter sticks.



4. If you took all the meter sticks from the last question and lined them up end to end, would they reach the Moon? Would they reach beyond the Moon? If yes, how many times farther will they reach? Explain your reasoning.

5. One light year is approximately 10^{16} meters. How many light years away would the meter sticks reach? Label the number line, and plot your answer.



Are you ready for more?

Here is a problem that will take multiple steps to solve. You may not know all the facts you need to solve the problem. That is okay. Take a guess at reasonable answers to anything you don't know. Your final answer will be an estimate.

If everyone alive on Earth right now stood very close together, how much area would they take up?

Lesson 12 Summary

Powers of 10 can be helpful for making calculations with large or small numbers. For example, in 2014, the United States had 318,586,495 people who used the equivalent of 2,203,799,778,107 kilograms of oil in energy.

The amount of energy used per person is the total energy divided by the total number of people. We can use powers of 10 to estimate the total energy as $2 \cdot 10^{12}$ and the population as $3 \cdot 10^8$. So the amount of energy per person in the U.S. is roughly $(2 \cdot 10^{12}) \div (3 \cdot 10^8)$. That is the equivalent of $\frac{2}{3} \cdot 10^4$ kilograms of oil in energy. That's a lot of energy—the equivalent of almost 7,000 kilograms of oil per person!

In general, when we want to perform arithmetic with very large or very small quantities, estimating with powers of 10 and using exponent rules can help simplify the process. If we wanted to find the exact quotient of 2,203,799,778,107 by 318,586,495, then using powers of 10 would not simplify the calculation.