Unit 7, Lesson 3

Powers of Powers of 10

Let's look at powers of powers of 10.

3.1 Big Cube

What is the volume of a giant cube that measures 10,000 km on each side? Be prepared to explain your reasoning.

3.2 Raising Powers of 10 to Another Power

1. a. Complete the table to explore patterns in the exponents when raising a power of 10 to a power. You may skip a single box in the table, but if you do, be prepared to explain why you skipped it.

expression	expanded	single power of 10
$(10^3)^2$	$(10 \cdot 10 \cdot 10)(10 \cdot 10 \cdot 10)$	10^6
$(10^2)^5$	$(10 \cdot 10)(10 \cdot 10)(10 \cdot 10)(10 \cdot 10)(10 \cdot 10)$	
	$(10 \cdot 10 \cdot 10)(10 \cdot 10 \cdot 10)(10 \cdot 10 \cdot 10)(10 \cdot 10 \cdot 10)$	
$(10^4)^2$		
$(10^8)^{11}$		

   b. If you chose to skip one entry in the table, which entry did you skip? Why?

2. Use the patterns you found in the table to rewrite $(10^n)^m$ as an equivalent expression with a single exponent, like $10^{\square}$.

3. If you took the amount of oil consumed in 2 months in 2013 worldwide, you could make a cube of oil that measures 10^3 meters on each side. How many cubic meters of oil is this? Do you think this would be enough to fill a pond, a lake, or an ocean?

Are you ready for more?

$2^{12} = 4{,}096$. How many other whole numbers can you raise to a power and get 4,096? Explain or show your reasoning.

Lesson 3 Summary

In this lesson, we developed a rule for raising a power of 10 to another power: Taking a power of 10 and raising it to another power is the same as multiplying the exponents.

Rule	Example showing how it works
$(10^n)^m = 10^{n \cdot m}$	$(10^2)^3 = \underline{(10 \cdot 10)} \cdot \underline{(10 \cdot 10)} \cdot \underline{(10 \cdot 10)} = 10^6$ three groups of two factors that are ten = six factors that are ten

To understand this, take 10^2 and raise it to the power of 3. We know that 10^2 has two factors that are 10. Raising 10^2 to the power of 3 means that there are three groups of two factors that are 10, for a total of 6 factors that are 10, or 10^6.

This works for any power of 10 raised to another power. For example, $(10^6)^{11} = 10^{(6 \cdot 11)} = 10^{66}$.