



# 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                                                                                                                                                             |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $(10^n)^m = 10^{n \cdot m}$ | $(10^2)^3 = \underline{(10 \cdot 10)} \cdot \underline{(10 \cdot 10)} \cdot \underline{(10 \cdot 10)} = 10^6$<br><br>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,  $(10^6)^{11} = 10^{(6 \cdot 11)} = 10^{66}$ .