## Lesson 8: Unknown Exponents

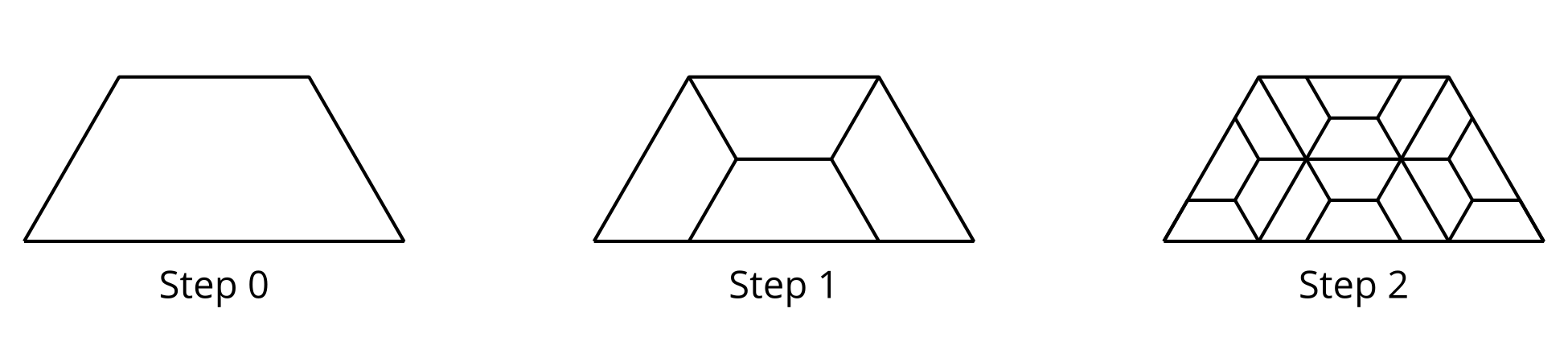
* Let’s find unknown exponents.

### 8.1: A Bunch of ’s

Solve each equation. Be prepared to explain your reasoning.

### 8.2: A Tessellated Trapezoid

Here is a pattern showing a trapezoid being successively decomposed into four similar trapezoids at each step.



1. If is the step number, how many of the smallest trapezoids are there when is 4? What about when is 10?
2. At a certain step, there are 262,144 smallest trapezoids.
   1. Write an equation to represent the relationship between and the number of trapezoids in that step.
   2. Explain to a partner how you might find the value of that step number.

### 8.3: Successive Splitting



In a lab, a colony of 100 bacteria is placed on a petri dish. The population triples every hour.

1. How would you estimate or find the population of bacteria in:
   1. 4 hours?
   2. 90 minutes?
   3. hour?
2. How would you estimate or find the number of hours it would take the population to grow to:
   1. 1,000 bacteria?
   2. double the initial population?

#### Are you ready for more?

A $1,000 investment increases in value by 5% each year. About how many years does it take for the value of the investment to double? Explain how you know.

### 8.4: Missing Values

Complete the tables.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | -1 | 0 |  | 1 |  |  | 5 |  |  |
|  |  |  |  |  |  |  | 4 | 16 |  | 256 | 1,024 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  | 1 |  |  | 5 | 125 | 625 | 3,125 |

Be prepared to explain how you found the missing values.

### Lesson 8 Summary

Sometimes we know the value of an exponential expression but we don’t know the exponent that produces that value.

For example, suppose the population of a town was 1 thousand. Since then, the population has doubled every decade and is currently at 32 thousand. How many decades has it been since the population was 1 thousand?

If we say that  is the number of decades since the population was 1 thousand, then , or just , represents the population, in thousands, after  decades. To answer the question, we need to find the exponent in . We can reason that since , it has been 5 decades since the population was 1 thousand people.

When did the town have 250 people? Assuming that the doubling started before the population was measured to be 1 thousand, we can write: or . We know that , so the exponent has a value of -2. The population was 250 two decades before it was 1,000.

But it may not always be so straightforward to calculate. For example, it is harder to tell the value of in or in . In upcoming lessons, we’ll learn more ways to find unknown exponents.



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