

DMT COMPANION

Insight 20 · 2026 · for teachers, coaches, principals, and families



RETHINKING POWERS OF TEN

How to Use This

This Companion accompanies the DMT Insight on powers of ten, for teachers, coaches, principals, and families. Work through the guiding questions before the Insight or the video, and again afterward. One useful move is to ask what happens to the quantity when a number is multiplied by ten, not what happens to the digits. Ask: What unit does each digit count now? How many times as large is the quantity?

Guiding Questions

ANSWER THESE BEFORE THE INSIGHT, AND AGAIN AFTER

1. **Build and Rename Units.** Can students compose 10 ones into 1 ten, 10 tens into 1 hundred, and partition them back? Can they rename 340 as 34 tens and as 340 ones?
2. **Compare Related Quantities.** In 34, 340, and 3,400, how many times as large is each, and what unit does the 3 count? What is its value?
3. **Connect Representations.** Do base-ten units, the number line, and the place-value chart show the same $\times 10$ relationship, or do students treat them as separate tricks?
4. **Extend Across the Unit of One.** How are the units related in 100, 10, 1, 0.1, and 0.01? Can students describe the $\times 10$ relationship in both directions?

Before and After: A Change in Quantity, Not a Rule for Digits

Ask what happens when 34 is multiplied by ten, and many students say add a zero. The answer is correct, but the explanation hides the mathematics. Compare the before and after to focus students on what changed in the quantity rather than on a rule about digits.

Before: a rule about digits

$$34 \times 10 = 340$$

"just add a zero"

After: a change in quantity

$$34 \times 10 = 340$$

3: tens $\rightarrow$ hundreds (30 $\rightarrow$ 300)

4: ones $\rightarrow$ tens (4 $\rightarrow$ 40)

the quantity is 10 times as large

Figure 1. Before, multiplying by ten is a rule that appends a zero. After, the quantity is ten times as large, and each digit counts a unit ten times as large.

The takeaway: adding a zero gets the right answer for whole numbers but explains nothing. The quantity became ten times as large: the 3 now counts hundreds, and the 4 now counts tens.

Worked Examples

Each example pairs a model students should reason with and the language that keeps attention on units, quantity, and the $\times 10$ relationship.

Example 1 • Build and rename units.

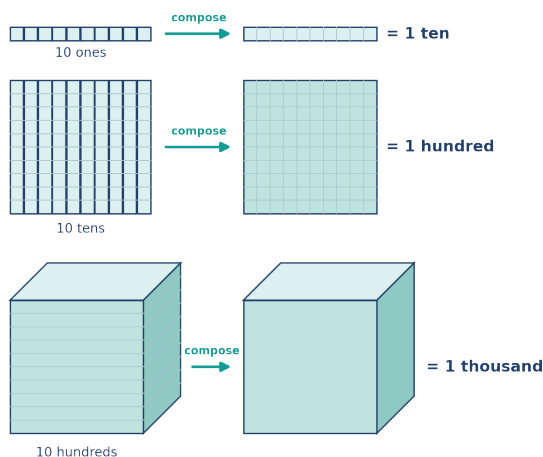


Figure 2. Ten of one unit compose one of the next: ten ones make a ten, ten tens make a hundred, ten hundreds make a thousand.

Powers of ten begin with composing units. Ten of one unit compose one of the next larger unit, and any unit can be partitioned back into ten of the next smaller one. A student who can rename 340 as 34 tens and as 340 ones is reasoning about units, not digits.

- How many ones make a ten? How many tens make a hundred?
- Compose ten of one unit to make one of the next larger unit.
- 340 is 3 hundreds and 4 tens, and also 34 tens, and also 340 ones.
- What changed in each representation? What stayed the same? The units changed; the quantity stayed the same.

Example 2 • Compare 34, 340, and 3,400

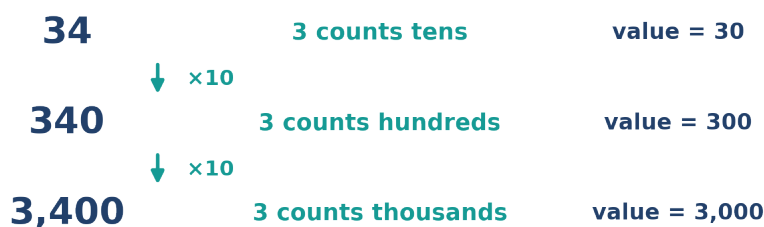


Figure 3. The digits 3 and 4 stay the same; each quantity is ten times the previous one, so the 3 counts a larger unit each time.

Comparing related quantities separates the digit, the unit, and the quantity. The digits do not change from 34 to 340 to 3,400. What changes is the unit each digit counts, and so the size of the quantity.

- How many times as large is 340 as 34? How many times as large is 3,400 as 340?

- What unit does the 3 count in each number? What is its value?
- From 34 to 340 is ten times as large, not ten more.
- How do you know without using the rule “add a zero”?

Example 3 • Connect representations

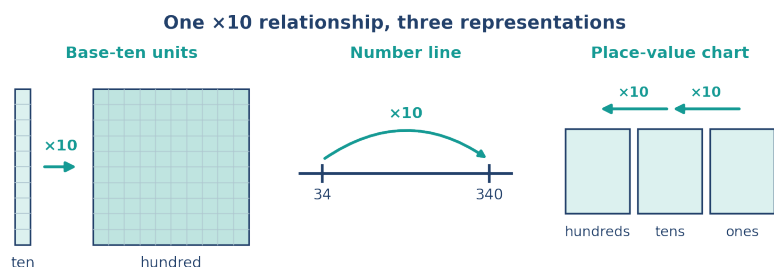


Figure 4. Base-ten units, the number line, and the place-value chart all show the same $\times 10$ step.

Representations earn their place when they reveal the same structure. Base-ten units, the number line, and the place-value chart should each reveal the same $\times 10$ relationship, not three separate tricks to memorize.

- Where is the $\times 10$ step in the base-ten units? On the number line? In the chart?
- Do these show the same relationship, or different ones?
- Symbols record the structure students have already reasoned about.

Example 4 • Extend across the unit of one.

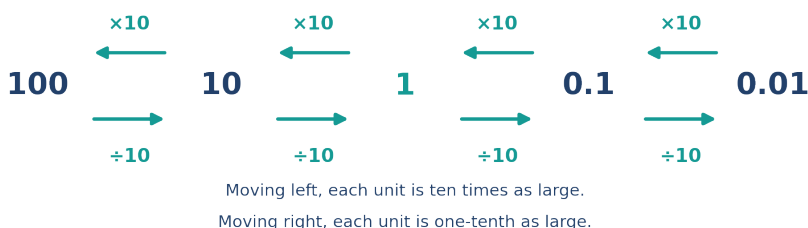


Figure 5. The unit of one anchors the system. Moving left, each unit is ten times as large; moving right, each unit is one-tenth as large.

The same $\times 10$ structure continues past the unit of one. Iterating left builds tens, hundreds, and thousands; partitioning right builds tenths and hundredths. Anchoring the system on the unit of one connects whole-number place value to decimals.

- How is each quantity related to the one beside it? What unit is being counted at each position?
- Moving right, each unit is one-tenth the size of the previous unit; moving left, each unit is ten times the size.
- The unit of one is the anchor, not the decimal point.

The Language Shift

Wording can hide the mathematics or point at it. Keep this by the board.

Instead of	Say	Mathematical idea
Add a zero.	The quantity is ten times as large.	The $\times 10$ relationship
The digits move one place left.	Each digit now counts a unit ten times as large.	Digit, unit, and quantity

Instead of	Say	Mathematical idea
34 to 340 adds ten.	34 to 340 is ten times as large.	Multiplicative, not additive
Move the decimal.	The quantity is one-tenth as large, and each digit now counts a unit one-tenth the size.	Extending across the unit of one
Increase the place value.	Compose ten of one unit to make one of the next larger unit.	Composing and partitioning units

What to Look For in a Classroom

- *Students explaining that multiplying by ten makes the quantity ten times as large, not that it adds a zero.*
- *Students telling what unit a digit counts in 34, 340, and 3,400, and what its value is.*
- *Students composing ten of one unit into one of the next, and partitioning back.*
- *Students extending the pattern past the unit of one into tenths and hundredths.*
- *Students describing multiplicative relationships rather than saying “the digits move,” “add a zero,” or “plus ten.”*
- *Student work that shows how the quantity changed, not only the final answer.*

Evidence of Developing $\times 10$ Structure

These behaviors provide evidence that students are developing an understanding of the $\times 10$ structure. They also connect to unitizing, magnitude, position and value, and equivalence across the Place Value MLP.

Developmental understanding	What it looks like when it is emerging
Build and Rename Units	Composes ten of one unit into the next larger unit and partitions back; renames a quantity in unit terms, such as 340 as 34 tens.
Compare Related Quantities	Given 34, 340, and 3,400, says how many times as large each is and what unit each digit counts.
Connect Representations	Sees the same $\times 10$ relationship across base-ten units, the number line, and the place-value chart.
Extend Across the Unit of One	Continues the $\times 10$ structure past one into tenths and hundredths, anchored on the unit of one.

DMTI TAKEAWAY

Powers of ten are not rules for moving digits or adding zeros. They describe relationships among units and quantities in our base-ten system. When students can compose and partition units, rename quantities, and explain how adjacent units are related, the $\times 10$ structure becomes something they can reason with, not just a rule to remember.

Where to Go Next

Read the full research overview and watch the accompanying video on the DMT Insights page at mathsuccess.io/dmtinsights. This issue's newsletter includes a one-page version for families and staff meetings. For more classroom materials, visit mathsuccess.io.