Grade 7 Mathematics

Appendix: Models for Computing Decimal Numbers

Appendix: Models for Computing Decimal Numbers

This appendix focuses on demonstrating computation with decimal numbers using base-10 blocks and number lines.

Base-10 Blocks

Base-10 blocks can be used to represent the operations of addition, subtraction, multiplication, and division of decimal numbers.

The model is based on viewing decimals as fractional equivalents. A fraction is viewed as a whole, cut into equivalent pieces. The whole is divided into tenths to represent $\frac{1}{10}$ or 0.1. The whole is divided into hundredths to represent $\frac{1}{100}$ or 0.01.

Students must have a fluent understanding of the numeric values of the model. If they lack this understanding, their attention will be focused on trying to make the model instead of learning to work with decimal numbers. Have students physically separate the blocks, or cut paper grids, to help them attach meaningful values to the representations. Spend time naming various combinations of blocks and creating representations of various decimal numbers to develop fluency.

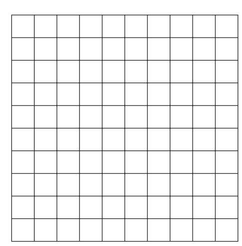
Base-10 grid paper serves as a two-dimensional representation of the base-10 blocks. (See BLM 5–8.10: Base-Ten Grid Paper.)

Note: It is important that students work flexibly with various representations to develop their understanding of operations with decimal numbers, rather than memorizing the steps without understanding their meaning.

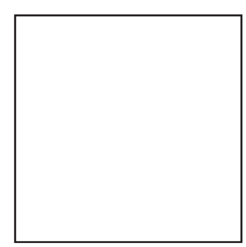
Representations*

If the flat represents a whole,

- its value is 1
- its dimensions are 1 unit by 1 unit
- it has an area of 1 unit^2



or



If the rod represents one-tenth of a whole,

- its value is 0.1
- its dimensions are 1 unit by 0.1 unit
- it has an area of 0.1 units^2

or

---

* For the purposes of this resource, models are represented without all individual blocks drawn.

If the small cube represents one-hundredth of a whole,

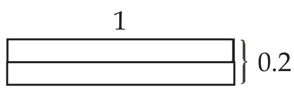
- its value is 0.01
- its dimensions are 0.1 unit by 0.1 unit
- it has an area of 0.01 units^2

Arranging the Blocks as Arrays or Area Models

0.2 units^2

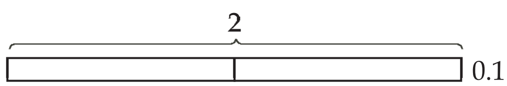
requires 2 tenths rods (or 20 hundredths cubes)

it may be arranged as 1×0.2



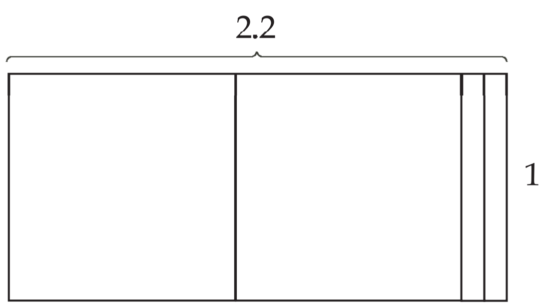
or

2×0.1



2.2 units^2

requires 2 flats and 2 rods (or 22 rods or 220 cubes)



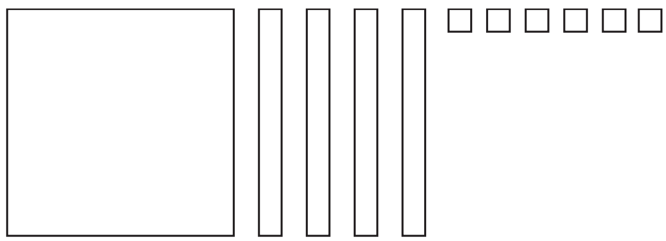
It is important to establish a convention of keeping the blocks organized, as it will help with developing future representations. This model is arranged as 2.2×1.

Modelling Addition

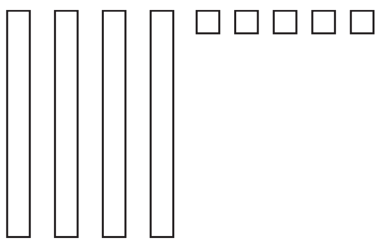
If you think it would be helpful, have students work on place value mats.

Model 1.46 + 0.45:

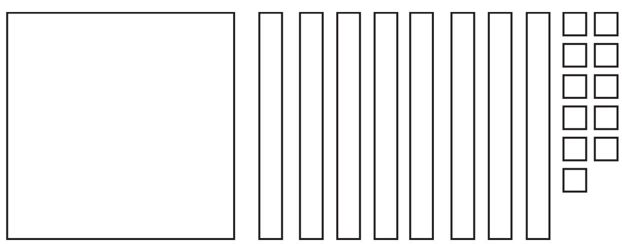
- Select the blocks to represent 1.46. (1 flat, 4 rods, 6 small cubes)



- Select the blocks to represent 0.45. (4 rods, 5 small cubes)

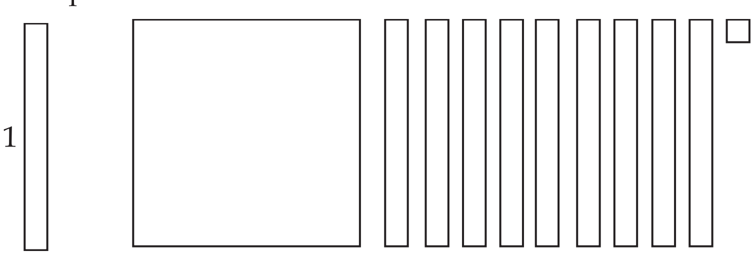


- Combine the blocks together.



- Group similar blocks where possible.

combine 10 □ to make 1



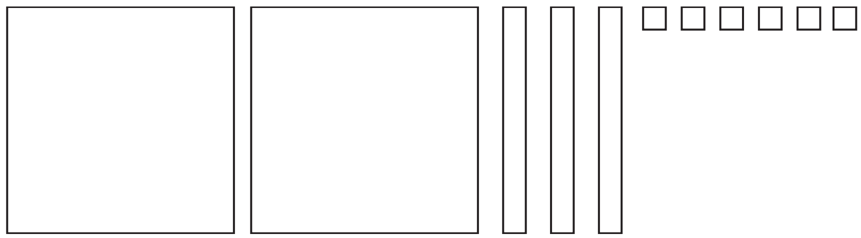
- Ten blocks of one value are exchanged for one block of the next larger value.
- The new quantity represents 1.91.

Modelling Subtraction

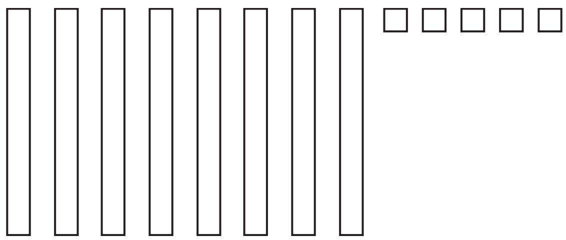
If you think it would be beneficial, have students work on place value mats.

Model 2.36 – 0.85:

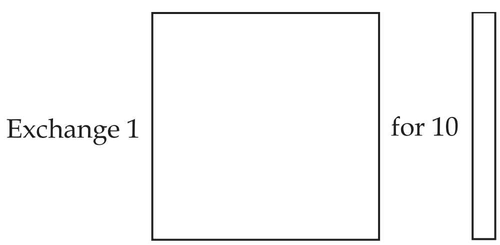
- Select the blocks to represent 2.36. (2 flats, 3 rods, 6 small cubes)



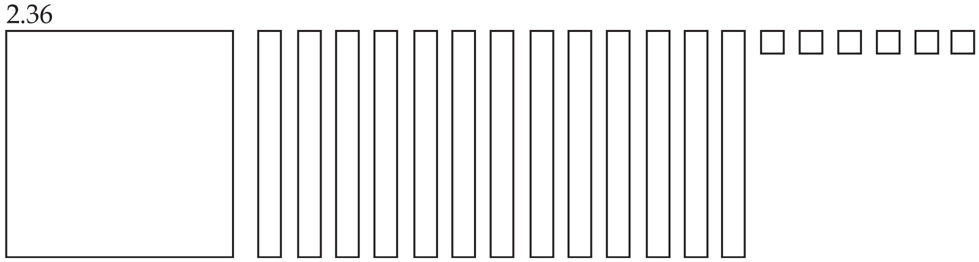
- If possible, remove blocks that represent 0.85. (8 rods, 5 small cubes)



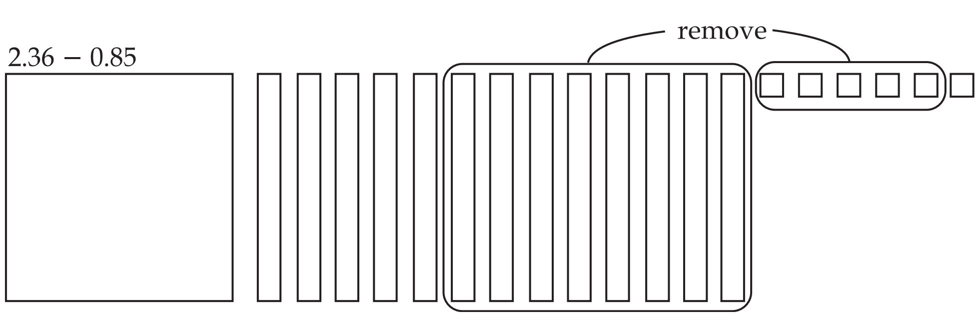
- If there are insufficient similar blocks to allow removal of the required amount, exchange one block of the next largest value for 10 of the required blocks.



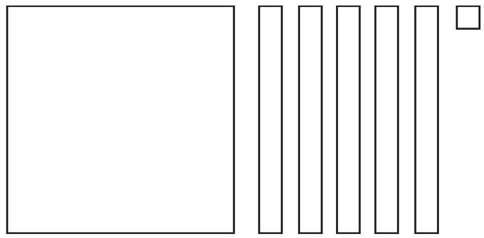
2.36



2.36 − 0.85



- The new quantity represents 1.51.



Modelling Multiplication

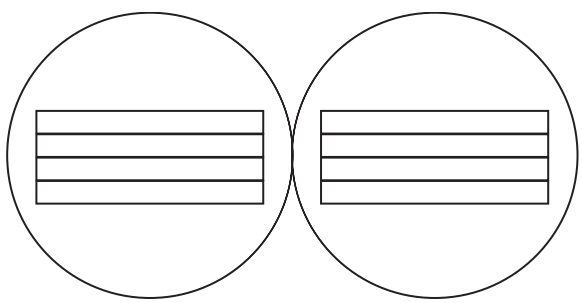
Base-10 blocks can be used to represent both the active understanding of multiplication as a specific number of groups of a specific size, or the non-active array representation of a quantity.

When the blocks are arranged as a rectangle, the rectangle may be rotated, and the quantity does not change. This is a verification of the commutative property of multiplication. The orientation of the array has no affect on the result, but in some places a convention has been established of representing the first number horizontally and the second vertically.

The array also serves as a model for area. It represents the area covered by a rectangle with a length of the multiplicand and a width of the multiplier, or vice versa.

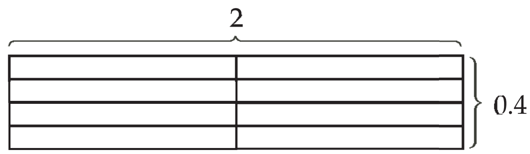
Model 2 × 0.4 using active understanding:

- Understand the statement as 2 groups of 0.4.
- Select blocks to represent 1 group of 4 tenths.
- Select a second group of 4 tenths.
- Combine the two groups.
- The new quantity represents 0.8.



Model 2 × 0.4 using non-active understanding:

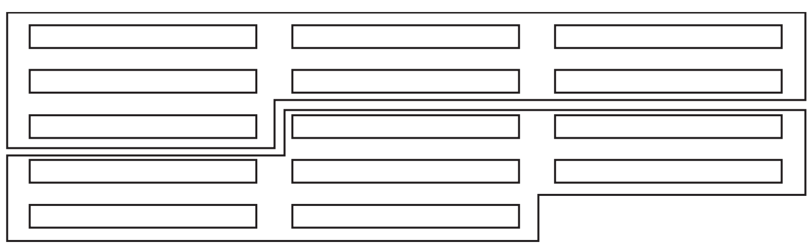
- Arrange the blocks into a rectangle, with one dimension having a linear measure of 2 units and the other dimension having a linear measure of 0.4.
- The arrangement requires 8 rods and represents 0.8.
- Rotating this model represents the commutative property of multiplication.



Modelling Division

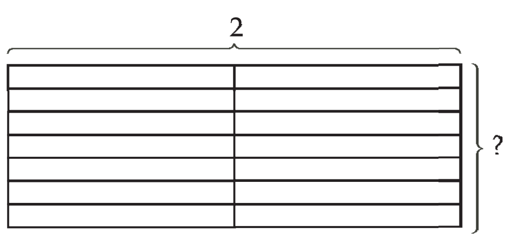
Model 1.4 ÷ 2 using active understanding:

- Understand the statement as either how many groups of 2 are in 1.4 or how many will be in each group if 1.4 is shared between 2 groups.
- Select base-10 blocks to represent 1.4.
- Divide the blocks into 2 groups.
- The quotient is 0.7.



Model 1.4 ÷ 2 using non-active understanding:

- Represent the divisor (1.4) as a rectangle with the length of one side equal to the dividend (2).
- The length of the other side will be the quotient.

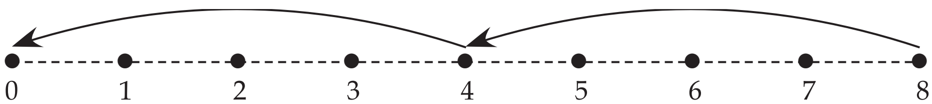


Number Lines

Modelling Division

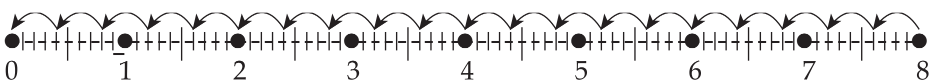
$8 \div 4 = 2$

Begin at 8, and jump back to 0, putting 4 steps in each jump. It takes 2 jumps to reach 0.



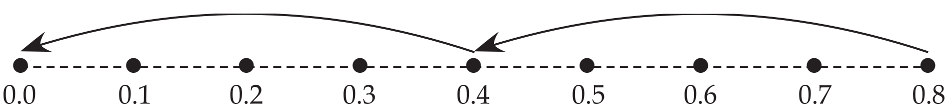
$8 \div 0.4 = 20$

As 0.4 is less than 0.5 of a jump, there are more than 2 jumps of 0.4 in each 1, so there are more than 16 jumps in 8. This is a good place to discuss estimating strategies and the concept that the result of a number divided by less than 1 will always be larger than the original number.



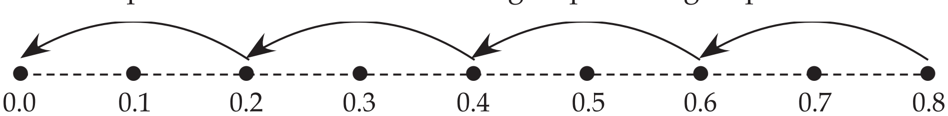
$0.8 \div 0.4 = 2$

Change the values on the line to tenths. Jumping back by 0.4 requires 2 jumps.



$0.8 \div 4 = 0.2$

Take the 0.8 spaces and divide them into 4 groups. Each group contains 0.2.



NOTES