



Leveraging Powerful Models to Promote Deep Learning

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MODELS ARE USED TO ...

Models are used to...

- help students **develop** new concepts or relationships.
- help students **make connections** between concepts and symbols.
- help teachers **assess** students' understanding.

MATHEMATICAL MODELS CAN ...

Mathematical models can...

- represent quantities
 - discrete
 - continuous
- show mathematical relationships
 - part-whole
 - relative position
 - comparison
 - equality
- illustrate operations or functions

DIFFERENT TYPES OF QUANTITIES ...

Different Types of Quantities

DISCRETE

collection of countable amounts
(counting, sharing)



CONTINUOUS

unbroken measurable amounts
(measuring, weighing, pouring)



Different Types of Quantities

DISCRETE

- “How many?”
- Requires counting
- Focuses on the attribute of number

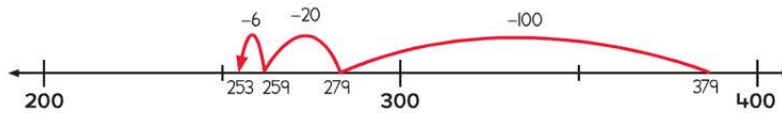
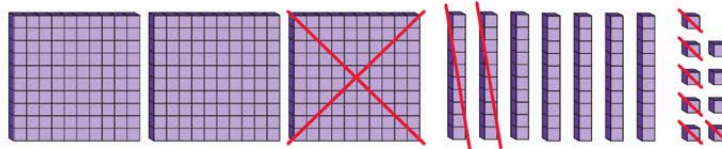
CONTINUOUS

- “How much?”
- Requires measuring
- Focuses on physical attributes (e.g. length, area, capacity, volume, mass, etc.)



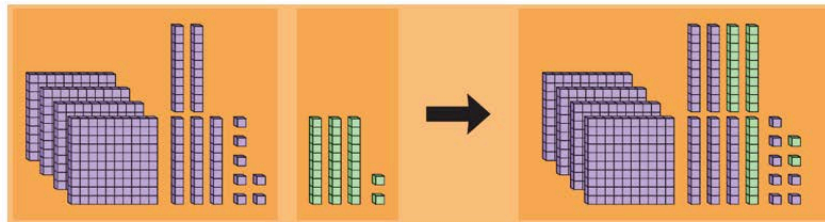
CONNECTING MODELS

How could you figure out the difference between these two prices?



A school play is being held in the gym.

Last week, 457 tickets were sold. Then an extra 32 tickets were sold yesterday. How could you figure out the total number of tickets that have been sold?



451	452	453	454	455	456	457	458	459	460
461	462	463	464	465	466	467	468	469	470
471	472	473	474	475	476	477	478	479	480
481	482	483	484	485	486	487	488	489	490
491	492	493	494	495	496	497	498	499	500



WHY SHOULD MULTIPLE MODELS BE USED?

Why should multiple models be used?

The linking of representations deepens concept development.

The ability to switch between multiple perspectives of a concept is fundamental to successful learning.

It assists in addressing the weaknesses inherent in all models.



Why should multiple models be used?

Different types of models provide **different perceptual features** and therefore serve different purposes.

Using only one (or a limited) model **hinders students' abilities to internalize and generalize** mathematical relationships.



MISCONCEPTIONS AND STUDENT DIFFICULTIES

Mathematical Models

Mathematical concepts do not come *from* the model.

Models are the testing ground for emerging ideas.

Models can be thought of as “tinker toys.”



When choosing models consider...

- How well the models represent the target knowledge
- If there are any issues with the model that may “interfere” with students’ understanding
- How engaging students find the model
- The types of questions to pose to scaffold students to “see” the key concept embedded in the materials



QUANTITY

1 - digit

QUANTITY

2 - digit

3 - digit

QUANTITY

4 - digit and higher

RELATIONSHIP

relative position

RELATIONSHIP

part - whole

RELATIONSHIP

comparison

OPERATION/FUNCTION

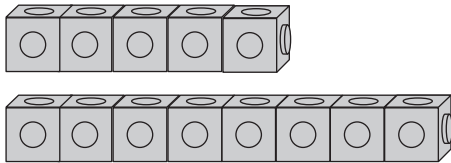
addition

OPERATION/FUNCTION

subtraction

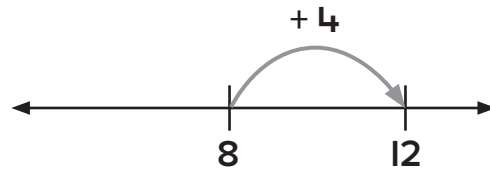
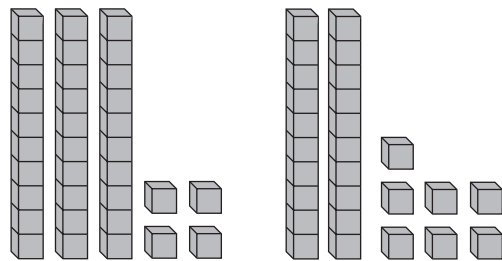
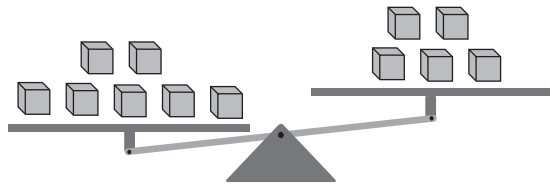
OPERATION/FUNCTION

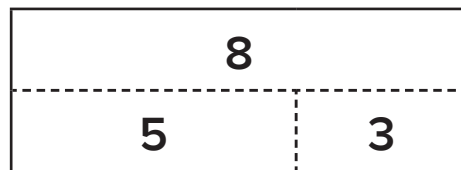
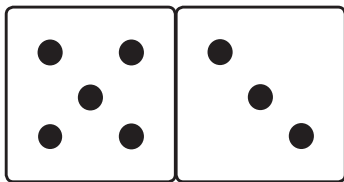
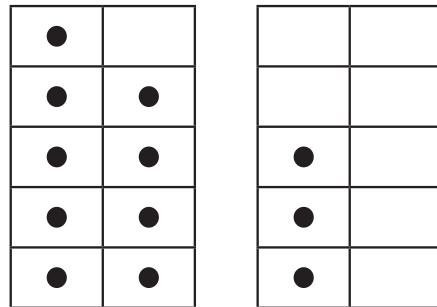
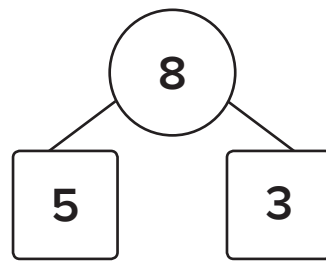
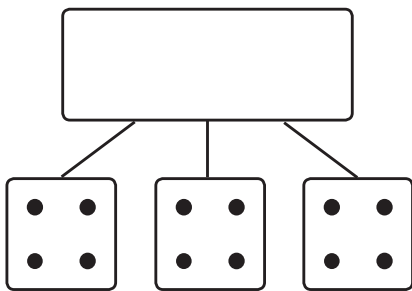
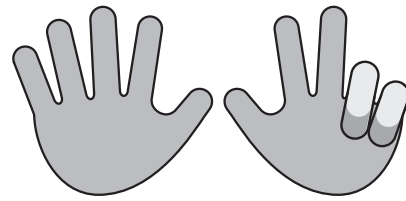
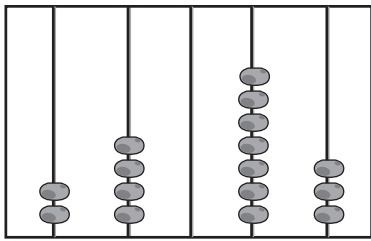
multiplication

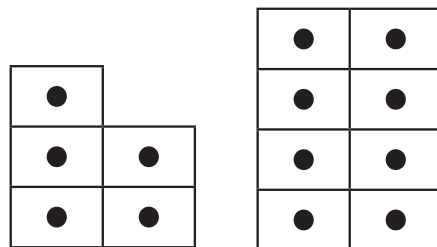
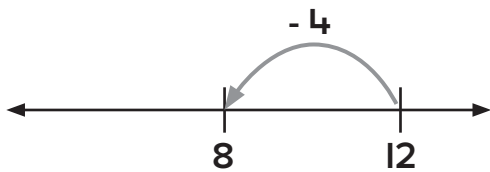
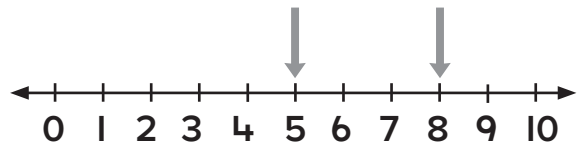
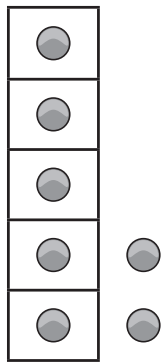
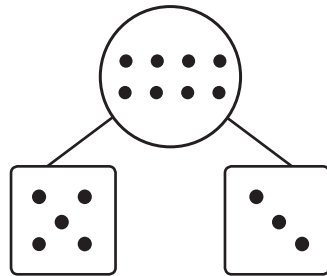
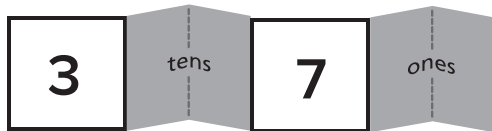
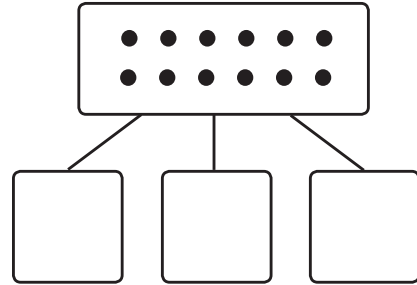
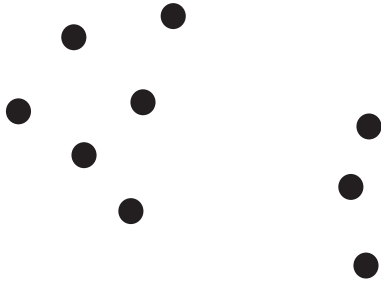


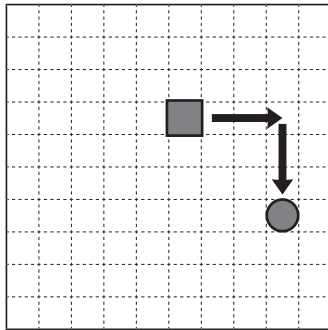
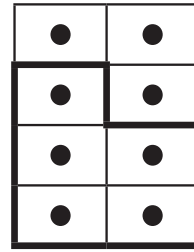
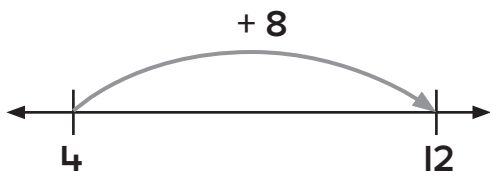
OPERATION/FUNCTION

division









Th	H	T	O
1	4	7	3

