3-5
Role of Math Games in Building Computational Fluency

Presented by:

Ariel Dlugasch, Annie Read, Bari Baron, Shirley Shum

Big Ideas in Mathematics

- A ***Big Idea*** is a statement of an idea that is central to the learning of mathematics, one that links numerous mathematical understandings into a coherent whole.

- Our math games are designed to develop skills reinforcing the big ideas in mathematics.

Essential Big Ideas in Operations
(Addition, Subtraction, Multiplication and Division)

- Place Determines Value
- Place Value Patterns
- Commutative Property of Addition and Multiplication
- Associative Property of Addition and Multiplication
- Distributive Property of Multiplication
- Unitizing
- Proportional Reasoning
- Relationship Between Partitive and Quotative Division
- Relationship Between Multiplication and Division

Place Determines Value

- The idea that a numeral can represent ones or tens or hundreds, etc. depending on where it is placed.

$$28+21 = (20 + 8) + (20 + 1)$$

Place Value Patterns

- Because multiplication is commutative, an interesting thing happens when we multiply by the base (10).

$$4 \times 10 = 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4$$

or

$$4 \times 10 = 10 \times 4$$

Commutative Property of Addition and Multiplication

- Numbers can be added or multiplied in any order and the sum/product will stay the same.

$$5 + 3 = 3 + 5$$

or

$$4 \times 5 = 5 \times 4$$

Associative Property of Addition and Multiplication

- When working with addition or multiplication, numbers can be grouped in a variety of ways and the sum or product stays the same.

$$50 + (30 + 20) = (50 + 30) + 20$$

or

$$(5 \times 3) \times 20 = 5 \times (3 \times 20)$$

Distributive Property Of Multiplication

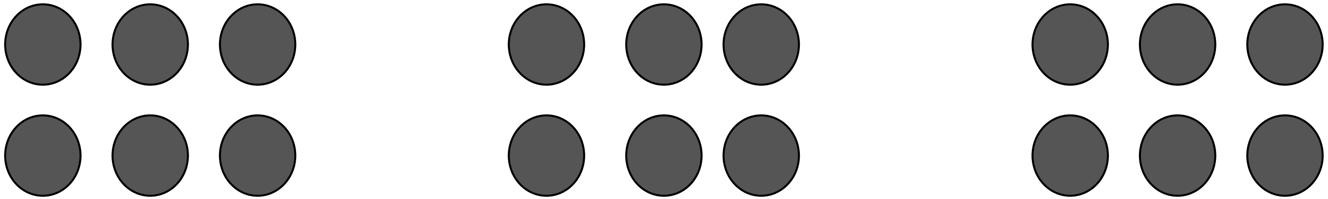
- Knowing that factors can be broken apart and distributed to make partial products, which can then be added together to produce the product of the original factors.

Over Addition		***Over Subtraction***
45 x 20 = (40 + 5) x 20	*or*	*198 x 12 = (200-2) x 12*
45 x 20 = (40 x 20) + (5 x 20)		*198 x 12 = (200 x 12) - (2 x 12)*
45 x 20 = 800 + 100		*198 x 12 = 2,400 - 24*
45 x 20 = 900		*198 x 12 = 2, 376*

Unitizing

- Thinking of a group as a unit.

3 x 6 = 3 groups of 6



6 is now seen as a unit instead of 6 individual things

Proportional Reasoning

- Proportional reasoning is one of the hallmarks of genuine multiplicative thinking.

If 4 tires are needed for 1 car, 8 are needed for 2 and 24 are needed for 6.

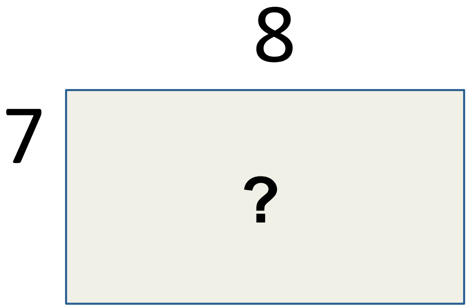
Cars	**1**	**2**	**6**
Tires	**4**	**8**	**24**

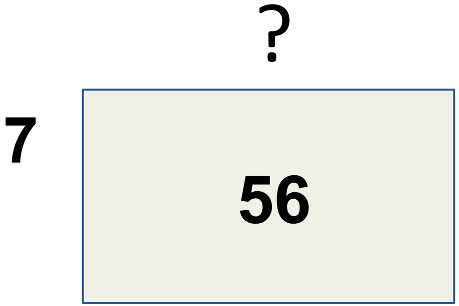
Relationship Between Partitive and Quotative Division

Partitive Division	Quotative Division
The goal is to figure out how many are in a predetermined number of groups. The number of groups is known but the but the amount in each group is unknown. *There are 35 children going on a field trip. The teacher wants to fit them in 7 groups. How many students will be in each group?*	The goal is to determine how many groups can be made from a total number of objects. The amount in each group is known but the total number of groups is unknown. *There are 35 children going on a field trip. The teacher wants there to be 5 children in each group. How many groups will there be?*

Relationship Between Multiplication and Division

- The factors when multiplied produce the product; thus the product when divided by a factor produces the other factor.





Now, let's play some games with a partner!

- Use the big ideas sheet to play some games on your child's grade level.
- Write down games that fall under specific big ideas.
- Some games may cross over to more than one big idea and more than one game will support each big idea.

Essential Big Ideas in Fractions, Decimals and Percents

- Fractions are relations - the size or amount of the whole matters
- Fractions may represent division with a quotient less than one.
- With unit fractions, the greater the denominator, the smaller the piece is
- Pieces don't have to be congruent to be equivalent
- For equivalence, the ratio must be kept constant
- To compare, add or subtract fractions, a common whole is needed.

Fractions are relations - the size or amount of the whole matters

- A ratio of part to whole (3 parts out of 4) or a rate (3 sandwiches for 4 people). When comparing fractions, the whole must remain constant.

Ex. $\frac{3}{5}$ can be more than $\frac{4}{5}$ if we are talking about $\frac{3}{5}$ of 15 vs. $\frac{4}{5}$ of 10.

Fractions may represent division with a quotient less than one.

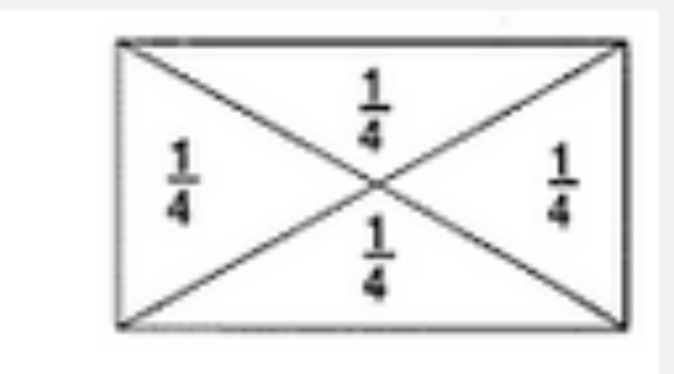
- Multiplication and division are related to fractions: 3 subs shared among 5 children results in each child getting $\frac{1}{5}$ of each sub. Because there are three subs, everyone gets $3 \times \frac{1}{5} = \frac{3}{5}$.

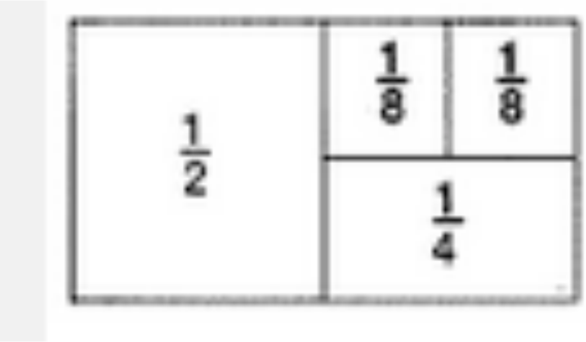
With unit fractions, the greater the denominator, the smaller the piece is

- When eight people share a pizza, each piece is smaller than when seven people share it, therefore 1/7 is greater than ⅛.

Pieces don’t have to be congruent to be equivalent

- Fractions may look different but may still be the same amount.

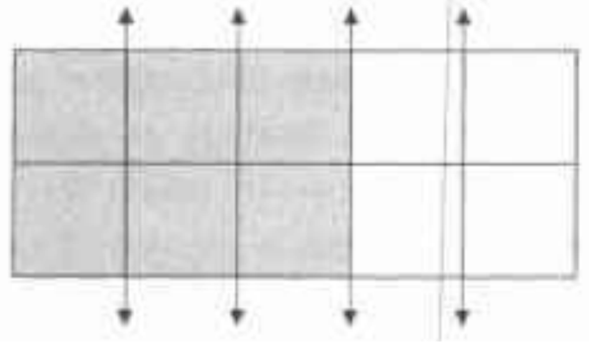




For equivalence, the ratio must be kept constant

- 3 subs shared among 5 people is the same as 6 subs shared among 10 people. If you double the number of people, you better double the number of subs!

$3/5 = 6/10$



To compare, add or subtract fractions, a common whole is needed

Common wholes make is possible to compare, add or subtract fractions.

Ex. If 12 cans of dog food costs $15 and 20 cans of dog food costs $23, you can not find out what is the better buy without finding a common whole.

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What is computational fluency?

The three main components of computational fluency are:

- Efficiency
- Accuracy
- Flexibility

-Ann Dowker Research

What is efficiency?

In efficient strategy use, the student…

- Does not get bogged down in too many steps or lose track of the logic of the strategy
- Uses a strategy that can be easily carried out
- Is able to keep track of sub-problems
- Makes use of intermediate results to solve the

What is accuracy?

Accuracy depends on many aspects of the problem-solving process:

- Careful recording
- Knowledge of number facts
- Knowledge of other important number relationships

What is flexibility?

- Requires the knowledge of more than one approach to solving a particular kind of problem
- Enables the student to choose an appropriate strategy for the problem at hand
- Enables the student to shift strategies in the problem-solving situation if a more efficient strategy becomes apparent
- Allows the student to use one method to solve a problem and another method to double-check the results.