

# Make Sense of Problems and Persevere in Solving Them



Mathematically Proficient Students:

- Begin by explaining to themselves the meaning of the problem and looking for entry points to its solution.
- Plan a solution pathway rather than simply jumping into a solution attempt.
- Have ways to check their answers by solving the problem using a different strategy.
- Look to see if their answers make sense.
- Understand and compare/contrast strategies used by other students.

# Reason Abstractly and Quantitatively

Mathematically Proficient Students:

- Make sense of quantities and their relationships in problem situations.
- Can create a coherent representation of the problem.
- Use different properties of operations and quantities to calculate.

2 dimes + 4  
nickels = 6 coins

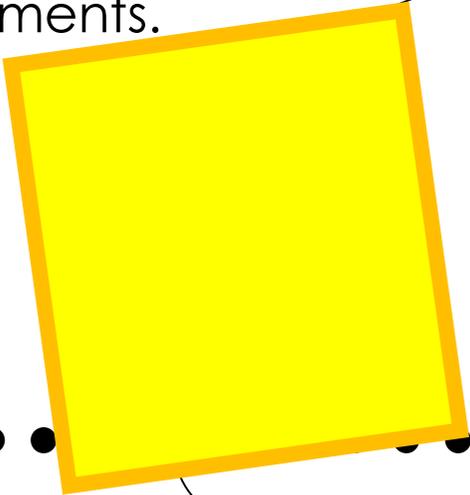
2 dimes + 4  
nickels = 40 cents

$$2 + 4 = 6$$

# Construct Viable Arguments and Critique the Reasoning of Others

Mathematically Proficient Students:

- Understand and use stated assumptions, definitions, and previously established results in constructing arguments.
- Can construct arguments using concrete referents such as objects, drawings, diagrams, and actions.
  - Arguments may be correct and make sense but are not necessarily generalized or made formal until later grades.
- Listen or read arguments of others and decide whether they make sense, and ask useful questions to clarify or improve arguments.



A square *can* be a rectangle because it is a four-sided flat shape with straight sides. It also has four right angles. Opposite sides are parallel and equal length.

# Model with Mathematics

## Mathematically Proficient Students:

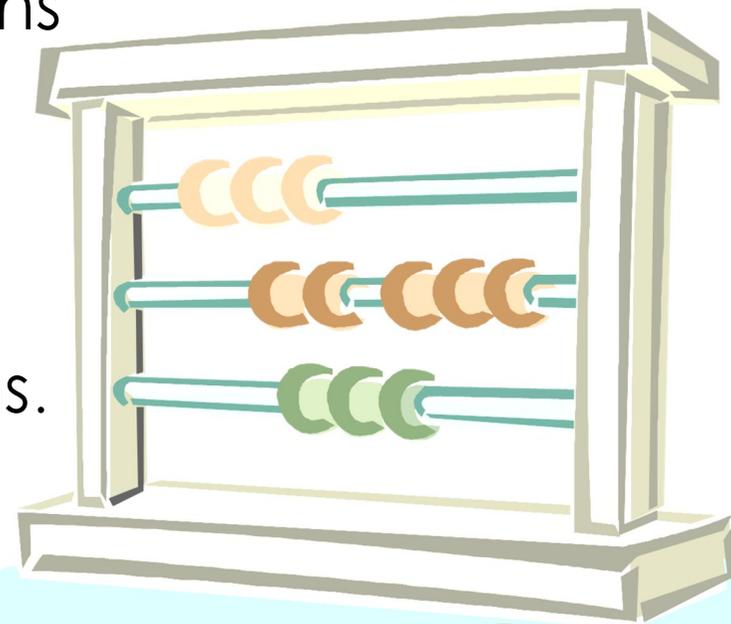
- Can apply mathematics they know to solve problems that arise in everyday life, society, and the workplace.
- In elementary grades, this might be as simple as writing an addition equation to describe a situation.
- Are able to identify important quantities in a practical situation and map their relationships using tools such as diagrams, two way tables, flowcharts or formulas.
- Routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.
- Analyze mathematical relationships to draw conclusions.



# Use Appropriate Tools Strategically

Mathematically Proficient Students:

- Consider the available tools when solving a mathematical problem and choose tools appropriate to the problem.
- Are familiar with tools appropriate for their grade level and make sound decisions about when each of the tools might be helpful, recognizing both the insight that can be gained but also their limitations.



# Attend to Precision

## Mathematically Proficient Students:

- Try to communicate precisely to other students.
- Use clear definitions in discussion with others and in their own reasoning.
- State the meaning of the symbols they choose, including the equal sign, consistently and appropriately.
- Are careful about specifying units and descriptors that correspond with the quantities of the problem.
- Calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context.
- Give carefully formulated explanations to each other.



# Look for and Make Use of Structure

Mathematically Proficient Students:

- Look for develop generalize and describe a pattern orally, symbolically, graphically, and in written form
- Apply and discuss properties.

$$3 \times 4 = 12$$

$$4 \times 3 = 12$$

when I switch the factors the products always come out the same way!

$$6 \times 3 = 18$$

$$3 \times 6 = 18$$

# Look for and Express Regularity in Repeated Reasoning

Mathematically Proficient Students:

- Notice if calculations are repeated and look both for general methods and for shortcuts.
- Maintain oversight of the process, while attending to the details.
- Continually evaluate the reasonableness of their intermediate results.
- Use repeated applications to generalize properties.

Wow!  
 $2 + 2 + 2$   
is the same  
as  
 $2 \times 3$