

Title: It's All Variable

Brief Overview:

This unit explores the concepts of algebra through three lessons. The first lesson develops understanding of balance and equality with the use of Cuisenaire Rods. In the second lesson students identify variables to use in mathematical sentences. In the final lesson the concepts of balance and variables are combined and students substitute values for variables to determine the values of equations.

NCTM Content Standard/National Science Education Standard:

Algebra

- Represent and analyze mathematical situations and structures using algebraic symbols;
- Represent the idea of a variable as an unknown quantity using a letter or a symbol.

Grade/Level:

Grade 3

Duration/Length:

Three Days (50 minutes each day)

Student Outcomes:

Students will:

- Express mathematical relationships using equations;
- Understand that quantities on both sides of an equation must be equal.

Materials and Resources:

- Functional balance
- 1 pound weight
- Bag containing objects of various weights (equal to, less than and greater than 1 pound)
- Crayons
- Cuisenaire Rods (1 set for each group of 3 or 4)
- Overhead Cuisenaire Rods
- Chart Paper
- Markers
- Equal to and Not Equal to Cards (TR1)
- Balance Worksheet (SR1)
- Transparency of Balance Worksheet (SR1)
- Combination Recording Sheet (SR2)
- Color Variable Chart for class display (TR3)
- Converting Word Sentences into Sentences with Variables Worksheet (SR3)
- Pattern Blocks
- Pattern Block Equations Extension Activity (SR4)

- Sticky Notes
- Lesson 3 Entrance Card (SR5)
- Variable Value Chart for class display (TR5)
- How Much is the Train Worth? Worksheet (SR6)
- Code Crackers Assessment Activity (SR7)
- There's Value in a Name Extension Activity (SR8)
- Summative Assessment (SR9)
- Summative Assessment Answer Key (TR7) and Rubric (TR8)

Development/Procedures:

Lesson 1

Preassessment/Launch –

- Display empty balance for the class. Ask students to explain why the balance looks the way it does. Students should respond by saying that the balance is equal, or even, because there is nothing on either side. Explain the term equal by displaying an equal sign in the middle of the balance using TR1 – Equal to and Not Equal to Cards.
- Show a specific weight (ex. 1 pound) and ask students to predict what will happen if the weight is placed on one side of the balance. Students should respond by saying the side of the balance with the weight will go down.
- Show an object from the bag that is obviously lighter than the 1-pound weight. Ask students to predict what will happen when the lighter object is placed on the other side of the balance. Students should respond by saying that the side of the balance with the weight will remain lower than the other side. Ask students why this happened. Students need to understand the concept that the weight was heavier than the object. Explain the term not equal by displaying a not-equal sign in the middle of the balance (TR1).
- Repeat above process with 2-3 more objects. Make sure that one of the objects is heavier than the 1-pound weight.

Teacher Facilitation –

- Explain to students that they will be exploring the concept of balance using Cuisenaire Rods using length as the measure instead of weight.
- Divide the class into groups of 3 or 4. Distribute Cuisenaire Rods and allow each group about 5 minutes to explore with the manipulatives.
- Distribute SR1 Student Balance sheet and SR 2 – Combination Recording Sheet to each group. Assign one recorder and a presenter for each group.
- Challenge students to create as many 2-rod trains that are equal to or balance one blue rod. Model an example if necessary (One light green and one dark green is equal to the length of one blue rod).
- Give students 15 minutes to create and record 2-rod combinations. Make sure each group has at least one correct combination before continuing.
- Have the presenter from each group demonstrate one example of a 2-rod combination using the overhead balance and Cuisenaire Rods. Each group needs to explain how they found their combination and how they know it is equal to a blue rod.
- Emphasize the concept of balance by using the term equal.
- Record 2-rod combinations on chart paper (save for Lesson 2). Refer to TR2-Combination Recording Sheet Answer Key. Record examples on chart paper using words, for example: light green + dark green = blue.

Student Application –

- Introduce the 2-rod Challenge Game to students.
- Directions for Game:

- Divide students into groups of three or four.
- The object of the game is to pick one rod that cannot be balanced with or matched to a 2-rod train.
- White rods cannot be used as the challenge rod.
- Player 1 chooses one challenge rod and challenges Player 2 to find a 2-rod train to balance it. Player 2 gets two chances to find a 2-rod combination.
- When a combination is found all the rods are placed aside and cannot be used for the remainder of the game. Player 2 then chooses a new challenge rod for Player 3.
- If a combination is not found by the second attempt, the challenge goes to the next player.
- Play continues until all rods are used, or when a player chooses a challenge rod that cannot be balanced, or matched.

Embedded Assessment –

- Observe each group making sure the game is being played correctly. Ask students to explain their thinking behind their choice of rods. After the game has been played, have students respond to the following questions in a math journal or on a piece of paper, 1) Explain to a friend how to play the 2-Rod Challenge Game and/or 2) explain a strategy that would help you win the game.

Reteaching/Extension –

- Reintroduce the concept of balance using snap cubes. Create a train to display to students. Have students use the snap cubes to create balanced trains using the same number of cubes as the display train. Provide examples of not balanced to help further their understanding.
- Challenge students to generate 3-rod trains to balance the blue rod. Students can also use the Shape Pan Balance at: <http://illuminations.nctm.org/mathlets/shapebalance/index.html>

Lesson 2

Preassessment-

- Distribute Cuisenaire Rods to each student and challenge them to create a 2-rod combination that balances or matches a blue (the same challenge from Lesson 1).

Launch-

- Display class recording chart with the 2-rod combinations from Lesson 1.
- Discuss with students how much time it took to write out the color words when recording the combinations. Ask students to think of a way to make recording the combinations easier and faster. Students may respond with abbreviations, or other short cuts.
- Elicit single letters for each color word. Record responses on chart paper. Students should encounter difficulty assigning single letters to colors that begin with the same letter, like dark and light green, and brown, blue, and black. Help students generate appropriate letters.

White- w

Red- r

Light Green – g

Purple – p

Yellow – y

Dark Green – d

Black – k

Brown – n

Blue- e

Orange - o

- Make the connection between letters and variables by explaining to students that in math single letters are called variables.

Teacher Facilitation-

- Display TR3-Color Variable Chart and distribute SR3-Converting Word Sentences into Sentences with Variables worksheet. Model how to convert a word combination sentence like (light green + dark green = blue) to a variable sentence ($g + d = e$).

Student Application-

- Students complete the remainder of the problems on the worksheet as teacher assesses progress.

Embedded Assessment-

- Assess student performance with SR3-Converting Word Sentences into Sentences with Variables worksheet. Provide feedback as necessary. Answers can be found on TR-4.

Reteaching/Extension-

- Pull students in a small group and have them write each variable on a sticky note. Have students manipulate the sticky notes to create the equations found during the lesson.
- Provide students with pattern blocks and SR4-Pattern Block Equation worksheet. Students will be creating their own variables for the pattern blocks for predetermined equations.

Lesson 3

Preassessment-

- Distribute SR5-Entrance Card. Challenge students to make a 2-rod train to balance/match a single brown rod. Students need to write a variable sentence using the Color Variable Chart from Lesson 2.

Launch –

- Review previous concepts of balance and variables with the students. Relate these 2 concepts to define the term, equation. Share the definition of equation with students. An equation is a mathematical sentence that uses an equal sign to show balance.
- Pose the questions, 1) Is $g + d = e$ an equation? 2) What would your parents say if you showed them an equation from yesterday, $g + d = e$? 3) Would they know what you were referring to? 4) Would they believe that $g + d$ really does equal e ? 5) How could you prove it?
- Share student responses.

Teacher Facilitation-

- Explain to students that there is a way to prove an equation with variables. To do this we assign values to variables.
- Display TR5-Variable Value Chart.
- Distribute SR6-How Much is the Train Worth?
- Model the first problem by showing students how to substitute values for variables and verify if the equation is true.

Student Application-

- Students work in pairs, substituting values for variables and determining values of equations as teacher monitors progress. Answers can be found on TR-6.

Embedded Assessment-

- Distribute SR7-Code Crackers – Brief Constructed Response. This activity can be used as homework. Answers can be found on TR-7.

Reteaching/Extension-

- Build on the reteaching activity from Lesson 2. Instruct students to record number values from the Variable Value Chart onto sticky notes and practice substituting the values for the sticky note letters.
- Distribute SR8-There's Value in a Name worksheet. Instruct students to assign values to the letters of the alphabet and determine the value of different words.

Summative Assessment:

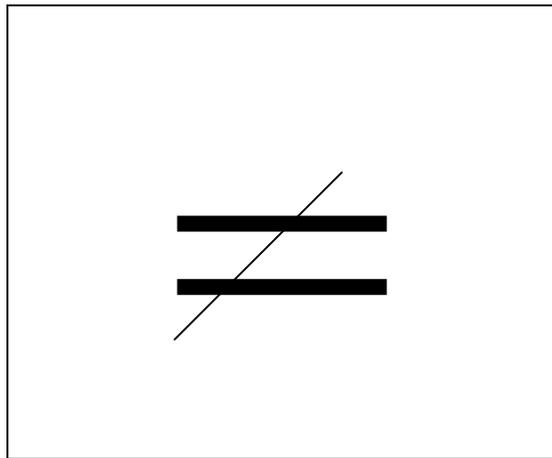
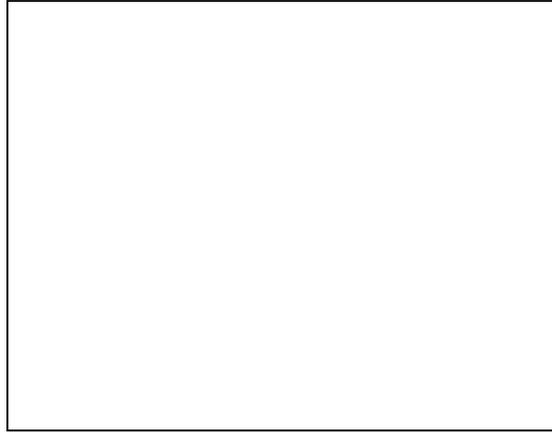
Students are to complete SR9-Assessment Activity. They will apply their knowledge of balance, variables, and substituting values by finding a 2-rod train to match an orange rod. They will use the Color Variable Chart and the Variable Value Chart to complete the activity. Students are asked to explain their thinking by describing how they determined their answers. Assess student performance using TR8-Answer Key and TR9-the BCR Rubric.

Authors:

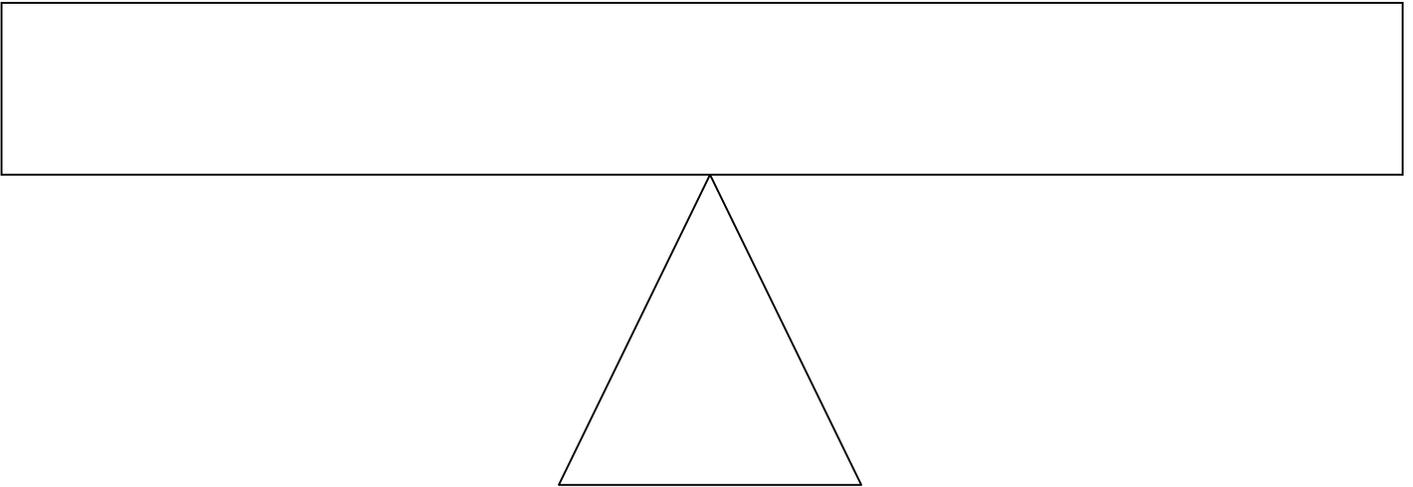
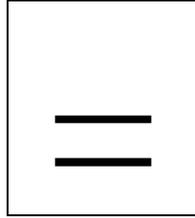
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Equal to and Not Equal to Cards



Balance



Names: _____

Date: _____

Combination Recording Sheet: Answer Key

Directions: Generate 2-rod trains that balance the blue rod. Write the color name on the blanks provided. Use the example to help you.

Example:

light Green + dark green = blue

dark Green + light green = blue

brown + white = blue

white + brown = blue

yellow + purple = blue

purple + yellow = blue

red + black = blue

black + red = blue

Color Variable Chart

white = w

red= r

light green= g

purple= p

yellow= y

dark green= d

black= k

brown= n

blue= e

orange= o



Name: _____

Date: _____

Converting Word Sentences into Sentences with Variables

1.) blue = dark green + light green

____ = _____ + _____

2.) blue = green + dark green

____ = _____ + _____

3.) blue = brown + white

____ = _____ + _____

4.) blue = white + brown

____ = _____ + _____

5.) blue = yellow + purple

____ = _____ + _____

6.) blue = purple + yellow

____ = _____ + _____

7.) blue = red + black

____ = _____ + _____

8.) blue = black + red

____ = _____ + _____



Name: _____

Date: _____

Converting Word Sentences into Sentences with Variables

1.) blue = dark green + light green

e = ___d___ + ___g___

2.) blue = green + dark green

e = ___g___ + ___d___

3.) blue = brown + white

e = ___n___ + ___w___

4.) blue = white + brown

e = ___w___ + ___n___

5.) blue = yellow + purple

e = ___y___ + ___p___

6.) blue = purple + yellow

e = ___p___ + ___y___

7.) blue = red + black

e = ___r___ + ___k___

8.) blue = black + red

e = ___k___ + ___r___



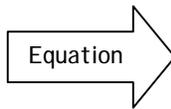
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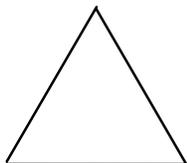
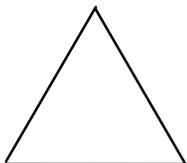
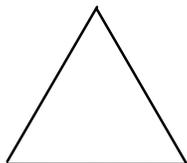
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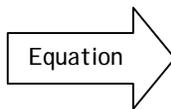
Pattern Block Equations

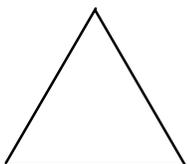
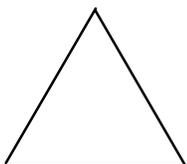
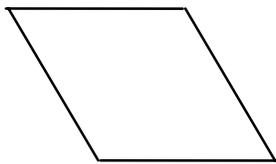
Directions:

1. Create the sentences using pattern blocks. Color the shapes on your paper to match the pattern blocks.
2. Create a different variable for each shape.
3. Write an equation using your variables.

Equation 

						
_____		_____		_____		

Equation 

					
_____		_____		_____	

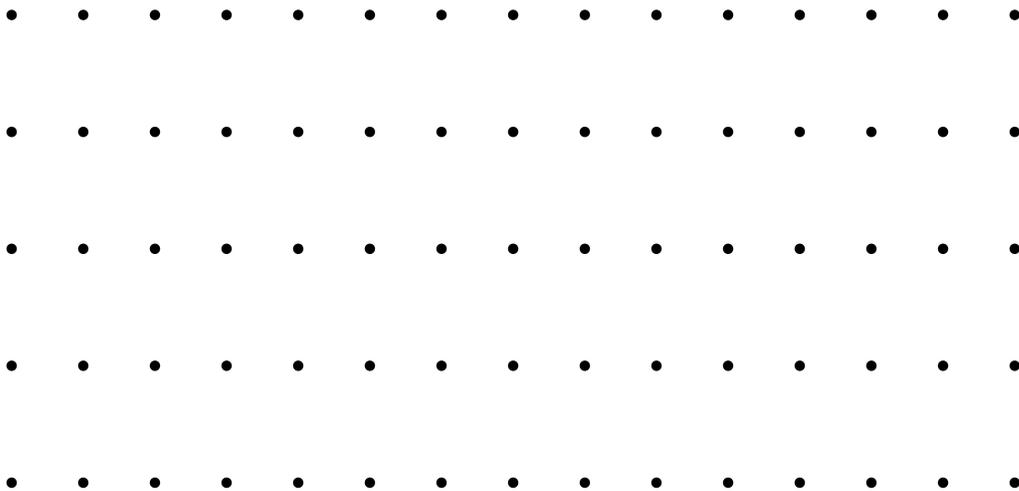
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Date: _____

Entrance Card



Challenge: Create a 2-rod train that balances/matches a single brown rod. Illustrate your work by drawing your 2-rod train balancing the brown rod on the dot paper below. Next, label your drawing by writing a sentence using the variables that we used yesterday.



$$\underline{\hspace{2cm}} = \underline{\hspace{2cm}} + \underline{\hspace{2cm}}$$

Variable Value Chart

w= 1

r= 2

g= 3

p= 4

y= 5

d= 6

k= 7

n= 8

e= 9

o= 10



Name: _____

Date: _____

How Much is the Train Worth?
Variables with Values

1.) blue = dark green + light green
 e = _d_ + _g_
 _____ = _____ + _____

2.) blue = light green + dark green
 e = _g_ + _d_
 _____ = _____ + _____

3.) blue = brown + white
 e = _n_ + _w_
 _____ = _____ + _____

4.) blue = white + brown
 e = _w_ + _n_
 _____ = _____ + _____

5.) blue = yellow + purple
 e = _y_ + _p_
 _____ = _____ + _____

6.) blue = purple + yellow
 a. _e_ = _p_ + _y_
 b. _____ = _____ + _____

7.) blue = red + black
 a. _e_ = _r_ + _k_
 b. _____ = _____ + _____

8.) blue = black + red
 e = _k_ + _r_
 _____ = _____ + _____



Name: _____

Date: _____

How Much is the Train Worth?
Variables with Values

- 1.) blue = dark green + light green

$$\underline{\text{e}} = \underline{\text{d}} + \underline{\text{g}}$$

$$\underline{9} = \underline{6} + \underline{3}$$

- 2.) blue = light green + dark green

$$\underline{\text{e}} = \underline{\text{g}} + \underline{\text{d}}$$

$$\underline{9} = \underline{3} + \underline{6}$$

- 3.) blue = brown + white

$$\underline{\text{e}} = \underline{\text{n}} + \underline{\text{w}}$$

$$\underline{9} = \underline{8} + \underline{1}$$

- 4.) blue = white + brown

$$\underline{\text{e}} = \underline{\text{w}} + \underline{\text{n}}$$

$$\underline{9} = \underline{1} + \underline{8}$$

- 5.) blue = yellow + purple

$$\underline{\text{e}} = \underline{\text{y}} + \underline{\text{p}}$$

$$\underline{9} = \underline{5} + \underline{4}$$

- 6.) blue = purple + yellow

$$\underline{\text{e}} = \underline{\text{p}} + \underline{\text{y}}$$

$$\underline{9} = \underline{4} + \underline{5}$$

- 7.) blue = red + black

$$\underline{\text{e}} = \underline{\text{r}} + \underline{\text{k}}$$

$$\underline{9} = \underline{2} + \underline{7}$$

- 8.) blue = black + red

$$\underline{\text{e}} = \underline{\text{k}} + \underline{\text{r}}$$

$$\underline{9} = \underline{7} + \underline{2}$$



Code:

A-26	B-25	C-24	D-23	E-22	F-21	G-20
H-19	I-18	J-17	K-16	L-15	M-14	N-13
O-12	P-11	Q-10	R-9	S-8	T-7	U-6
V-5	W-4	X-3	Y-2	Z1		

Part A

Question?

Using the code above find the value of the word "math".

Part B

Use what you know about variables and equations to explain why your answer is correct. Use number and/or words in your explanation.

Code:

A-26	B-25	C-24	D-23	E-22	F-21	G-20
H-19	I-18	J-17	K-16	L-15	M-14	N-13
O-12	P-11	Q-10	R-9	S-8	T-7	U-6
V-5	W-4	X-3	Y-2	Z1		

Part A

Question?

Using the code above find the value of the word "math".

$$\begin{array}{r} 14 \\ 26 \\ 7 \\ + 19 \\ \hline 66 \end{array}$$

The value of the word "math" is 66.

Part B

Use what you know about variables and equations to explain why your answer is correct. Use number and/or words in your explanation.

I know my answer is correct because m is 14, a is 26, t is 7, and h is 19.

Therefore, when I added $14 + 26 + 7 + 19$ I got the sum, or value, of 66.

Name: _____

Date: _____

There's Value in a Name

Directions: Assign a value to each letter of the alphabet below. Find the value of your name. You must write out your equation.

1.) What is the equation you used to find the value of your name:

2.) What equation would you use to find the value of the word "elementary"?

3.) What is the value of the word "elementary"?

A____ B____ C____ D____ E____ F____

G____ H____ I____ J____ K____ L____

M____ N____ O____ P____ Q____ R____

S____ T____ U____ V____ W____ X____

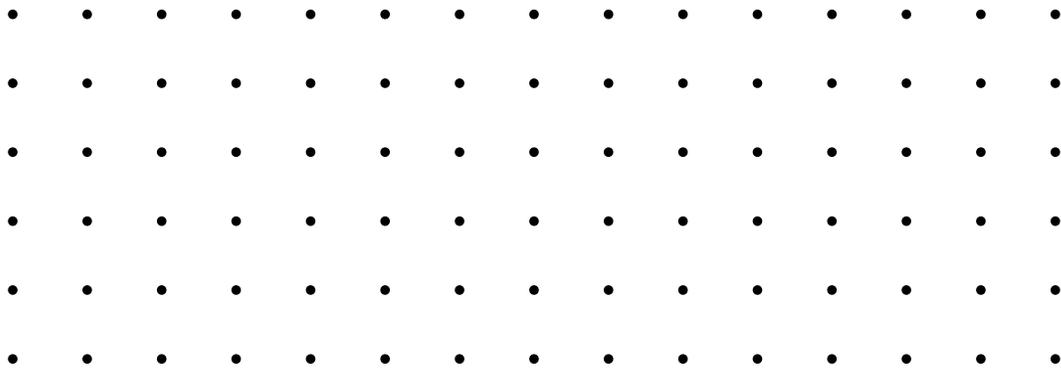
Y____ Z____

Name: _____

Date: _____

Assessment Activity

1. Create a 2-rod train to balance the orange rod. Trace and color your 2-rod train below.



2. Write an equation for your 2-rod train using the class variable chart.

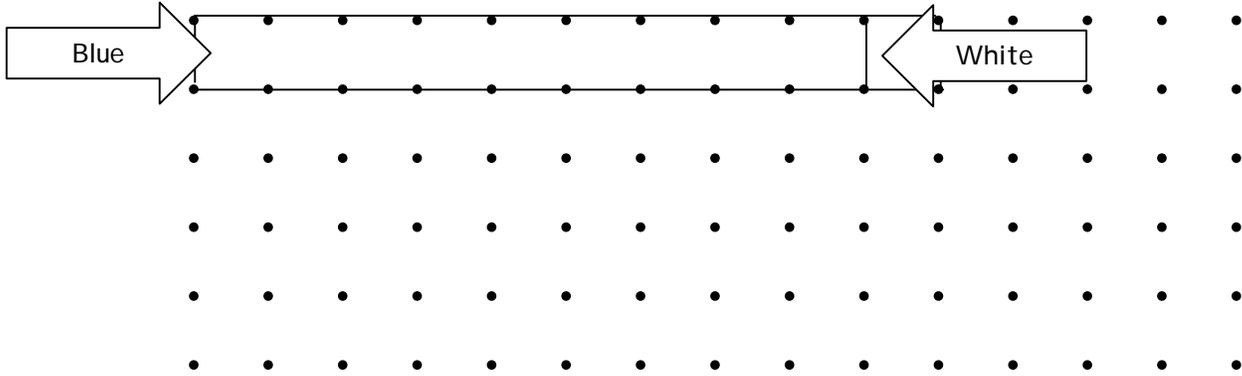
3. Determine the value of your 2-rod train using the class value chart.

4. Use what you know about equations and variables to explain how you got your answer to number 3. Use numbers, pictures or words in your answer.

Name: _____ Date: _____

Summative Assessment - Sample Response

1. Create a 2-rod train to balance the orange rod. Trace and color your 2-rod train below.



2. Write an equation for your 2-rod train using the class variable chart.

$$\underline{e + w = 0}$$

3. Determine the value of your 2-rod train using the class value chart.

$$\underline{9 + 1 = 10}$$

4. Use what you know about equations and variables to explain how you got your answer to number 3. Use numbers, pictures or words in your answer.

First, I looked at my equation, $e + w = 0$. Next, I assigned values to the variables using the chart. ($e = 9$, and $w = 1$) Then, I added $9 + 1$ and that equaled 10. So, O equals 10.

**MSA Brief Constructed Response “Kid Speak”
Mathematics Rubric
Grades 1 through 8**

Score	
2	<p>My answer shows I completely understood the problem and how to solve it:</p> <ul style="list-style-type: none">• I used a very good, complete strategy to correctly solve the problem.• I used my best math vocabulary to clearly explain what I did to solve the problem. My explanation was complete, well organized and logical.• I applied what I know about math to correctly solve the problem.• I used numbers, words, symbols or pictures (or a combination of them) to show how I solved the problem.
1	<p>My answer shows I understood most of the problem and how to solve it:</p> <ul style="list-style-type: none">• I used a strategy to find a solution that was partly correct.• I used some math vocabulary and most of my reasons were correct to explain how I solved the problem. My explanation needed to be more complete, well organized or logical.• I partly applied what I know about math to solve the problem.• I tried to use numbers, words, symbols or pictures (or a combination of them) to show how I got my answer, but these may not have been completely correct.
0	<p>My answer shows I didn't understand the problem and how to solve it:</p> <ul style="list-style-type: none">• I wasn't able to use a good strategy to solve the problem.• My strategy wasn't related to what was asked.• I didn't apply what I know about math to solve the problem.• I left the answer blank.