Discrete Math

for

Grade 5

Alison Tisdell

Northern Elementary School, Grade 5

Alison_Tisdell@bemidji.k12.mn.us

Erin Brooks

Northern Elementary School, Grade 5

Erin_Brooks@bemidji.k12.mn.us

Executive Summary:

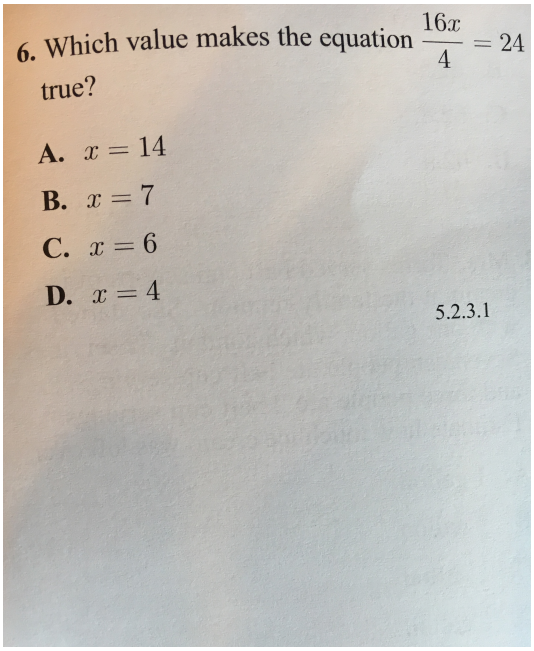
Unit Goal: Students will work with a variety of manipulatives and in numerous situations to practice, explore, and understand many different examples of patterns. Students will know what a variable is and how it represents an unknown. Students will begin to build up their algebraic thinking skills by exploring unknown weights of various shapes using an electronic balance tool. Some of these lessons may take a different amount of time, or would be better used as interventions rather than whole group activities, depending on the level of your students.

Teaching Strategies: Students will work as an individual, in small groups and as a class to discover and explore how patterns and variables are used in the world around us.

Minnesota Standards-Algebra

5.2.11 and 5.2.1.2 Recognize and represent patterns of change: use patterns, tables, graphs and rules to solve real-world and mathematical problems.

Students will be able to solve the following MCA math problems:



6. Which value makes the equation $\frac{16x}{4} = 24$ true?

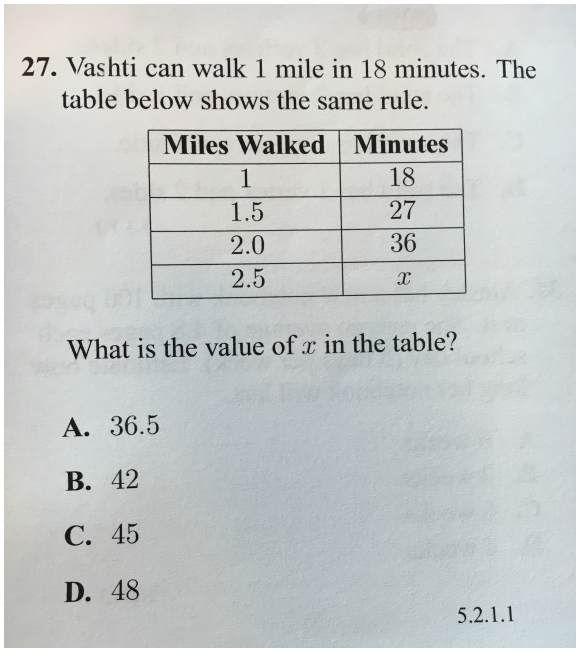
A. $x = 14$

B. $x = 7$

C. $x = 6$

D. $x = 4$

5.2.3.1



27. Vashti can walk 1 mile in 18 minutes. The table below shows the same rule.

Miles Walked	Minutes
1	18
1.5	27
2.0	36
2.5	x

What is the value of x in the table?

A. 36.5

B. 42

C. 45

D. 48

5.2.1.1

Table of Contents

Pre-test and Posttest are from Minnesota Mathematics 5th grade MCA-III Book Published by American Book Company.

1. Solve the following expression using $a = 4$.

$$3a - 2$$

A. 14
B. 10
C. 16
D. 12

2. Solve the following expression using $y = 3$.

$$8y \div 3$$

A. 8
B. 21
C. 24
D. 72

3. Use the order of operations to solve the following expression:

$$8 \times 2 - 3$$

A. 8
B. 1
C. 37
D. 13

4. Solve the following expression using $x = 2$ and $y = 5$.

$$3x + 4y - 1$$

A. 25
B. 9
C. 22
D. 6

5. Use order of operations to solve the following expression:

$$(10 + 5) \div 5 - 2$$

A. 9
B. 5
C. 1
D. 7

6. What is the value of the expression below, when $x = 2$?

$$75 \times x - 8$$

A. 67
B. 59
C. 142
D. 81

7. What is the value of the expression below, when $k = 2$?

$$102 \div k + 7$$

A. 58
B. 51
C. 109
D. 37

8. Use the order of operations to solve the following expression:

$$2(3 \times 6) - 4$$

A. 14
B. 36
C. 32
D. 28

9. Solve using $a = 3$, $b = 2$, and $c = 5$.

$$2c + (6 \times b) - a$$

A. 22
B. 15
C. 18
D. 19

10. Solve using $d = 5$, $z = 6$, and $w = 4$.

$$(8 \times z) + d - w$$

A. 49
B. 48
C. 47
D. 57

11. Which property of mathematics is demonstrated by the expression below?

$(3+11)+12=3+(11+12)$

A. associative property of multiplication

B. associative property of addition

C. distributive property

D. commutative property of addition

12. Which property of mathematics is demonstrated by the expression below?

$114 \times 236 = 236 \times 114$

A. associative property of multiplication

B. associative property of addition

C. distributive property

D. commutative property of multiplication

13. Which property of mathematics is demonstrated by the expression below?

$7(5+8)=(7\times5)+(7\times8)$

A. associative property of multiplication

B. associative property of addition

C. distributive property

D. commutative property of addition

14. Which mathematical expression below is an example of the commutative property of addition?

A. $6 \times 5 = 5 \times 6$

B. $(6+5)+3=6+(5+3)$

C. $17+15=15+17$

D. $6(5+2)=(6\times5)+(6\times2)$

15. What is the volume of a rectangular prism that is 10 cm long, 3 cm wide, and 5 cm high? $(V = lwh)$

A. 18 cubic cm

B. 150 cubic cm

C. 180 cubic cm

D. 35 cubic cm

16. What is the area of a sidewalk measuring 42 feet long and 3 feet wide? $(A = lw)$

A. 18 square feet

B. 150 square feet

C. 180 square feet

D. 126 square feet

17. When using the order of operations phrase "Please My Dear Aunt Sally", which of the following is true?

A. Always add before multiplying.

B. First do the work in the parentheses, then do the multiplication and division.

C. Always do the work in the parentheses first, then add and subtract.

D. First add and subtract, then do the work inside the parentheses.

18. Solve: $12(22-18)+2(40+1)-8$

A. 124

B. 49

C. 122

D. 130

Activity 1: What Comes Nex_?

http://illuminations.nctm.org/LessonDetail.aspx?id=L286

Minnesota Standards-Algebra

5.2.11 and 5.2.1.2 Recognize and represent patterns of change: use patterns, tables, graphs and rules to solve real-world and mathematical problems.

Launch:

Tell the class that they will see a list of names to think about. At the top of a blank SMART Notebook page write ANN in uppercase letters in red. Explain that your friend teaches at a different school and this is the name of the first person in her class. Below this name, write Brad in blue and say that this is the name of the second student in her class. Then write CAROL in red, and Darius in green stating they are the third and fourth students on her class list; note the capitalization. Then ask, "Can you tell me the name of the next person on this list?" Let the students brainstorm responses.

Students may notice only the gender pattern and therefore argue that the next name might be Yolanda and that any female name fits. They could also choose Roberto, since the pattern could be three, four, five, six, and seven letters. Other choices are possible, depending on the attributes identified by the students. Tell them that numerous reasonable solutions are possible, provided that students can identify and justify a rule for the pattern.

Explore:

Animal Parade Activity Sheet

It is best if students work by themselves or at the most, in pairs on this part to allow for varied creative responses. Ask each student to cut out the rectangles that contain animal pictures and to place the pictures in order to form a pattern or sequence with an invented "rule."

Have each student cut out the large, rectangular strips and tape or glue them together to form a long strip. Students then attach their "animal parades" to the strips, with the first animal of their pattern on 1, and so on. Next, each student cuts out the blank rectangle, draws a fifth animal in the pattern, and attaches it to the strip. Ask each student to write a short explanation of the pattern and its rule.

Corrals

Ask students how they would sort a deck of playing cards, say, five times, using a different rule each time. Students can work in groups of two or three to sort out their decks of playing cards. Encourage them to consider different ways of sorting things on the basis of invented "rules." As a class, share the groups' sorting rules.

Corrals Activity Sheet

Individually, students should cut out each of the numbered horses. Have the students then sort them into two separate groups and place them in the two corrals.

Share:

Animal Parade

When students complete their "parades," they display the strips. Begin a discussion about the various patterns: "Do we all have the same pattern?" "Why not?" "How many people do you think used the same rule?" Have the class try to predict the rules that certain parades seem to follow. Ask students to point out their parades, display their rules, and explain them to the class. Emphasize that many solutions are possible.

Corral

Once students have completed this activity, have them compare with a partner. Ask students to justify their reasoning to their partner. Partners can verify the other's rule and make sure all of the horses are placed correctly.

Summarize:

Students will learn to identify attributes that determine a pattern. Students will be able to extend a pattern and justify the extension both orally and in writing. Students will view patterns from several perspectives and identify similarities and differences among items or objects. Students will examine collections of objects from different perspectives and use elementary number theory to formulate opinions.

Animal Parade

NAME _____

Directions:

- Using the shapes on the next page, cut out each of the rectangles containing animals.
- Place the pictures in order to form a pattern or sequence using a "rule" you choose.
- Cut out the strip of numbers. Tape them together so they form one long strip with the numbers 1 to 5.
- Tape or glue the animals to the strip. Put your first animal on number 1, your second animal on number 2, and so on. Repeat for all of your animals.
- Cut out the blank rectangle and draw your own animal. Attach it to the strip, too.
- Below, describe your pattern and explain your reason for choosing the fifth animal.

My pattern is:

_____

_____

I chose the fifth animal because:

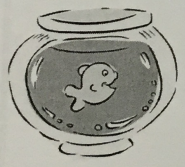
_____

_____

Hyena

Lizard

Dog



Fish

1

2

3

5

4

Tape or glue this part
to the back of box 3.

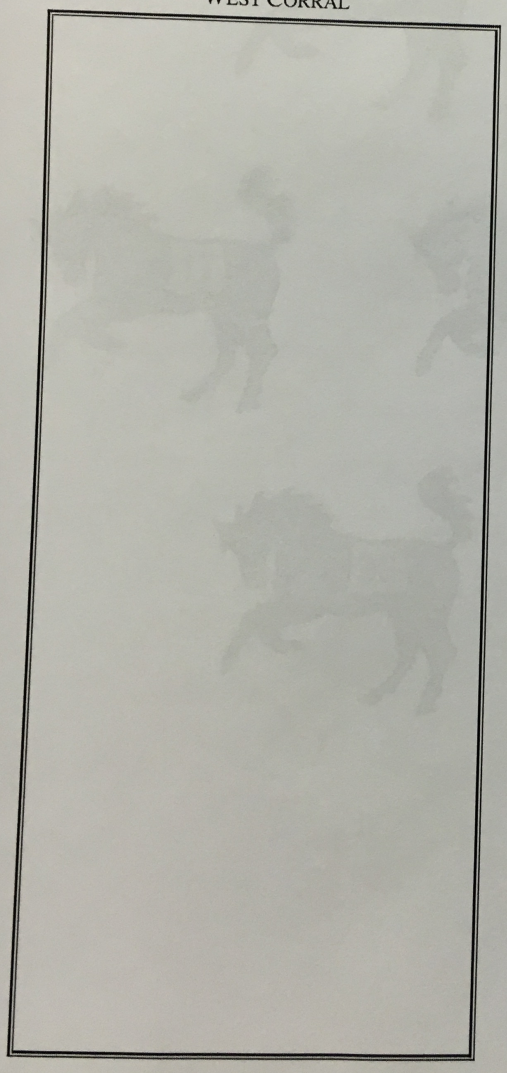
Corrals

NAME _____

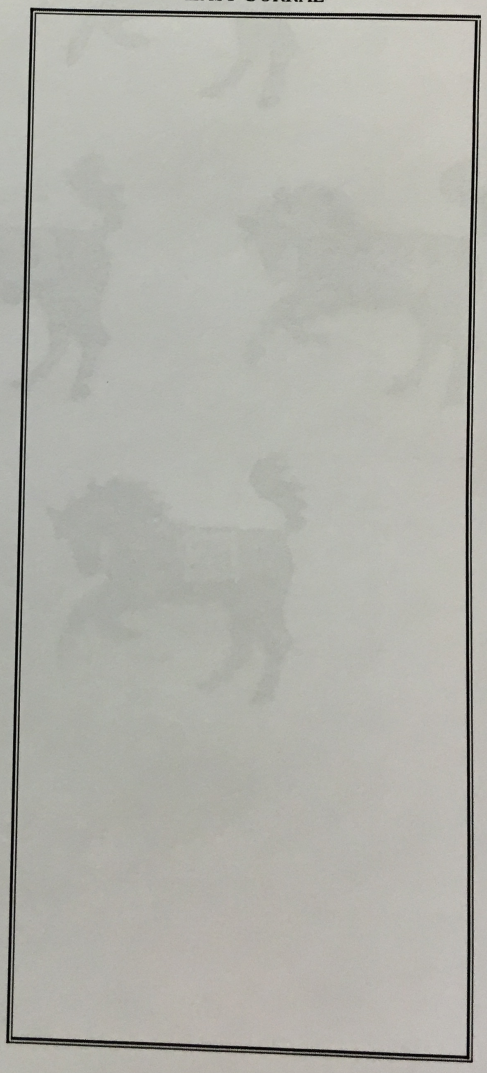
Directions

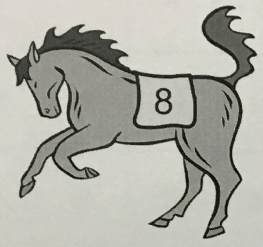
- Cut out each of the numbered horses (found on the following page).
- Decide how you want to sort the horses into two separate corrals.
- Place each of the horses into the corrals you have chosen.

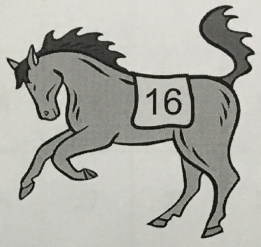
WEST CORRAL

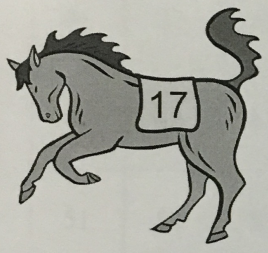


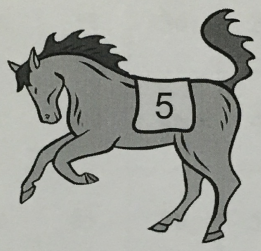
EAST CORRAL

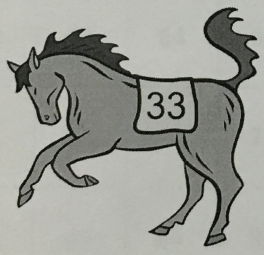












Activity 2: A Tale of Two Stories

http://illuminations.nctm.org/LessonDetail.aspx?id=U102

Minnesota Standards-Algebra

5.2.11 and 5.2.1.2 Recognize and represent patterns of change: use patterns, tables, graphs and rules to solve real-world and mathematical problems.

Lesson 1: Pigging Out

Launch:

Ask students to decide what each would use – straw, wood, brick, or a combination of two or all three – to build a house for themselves. Have each child record this decision by marking his or her initials in the region on the Venn diagram on the Pigging Out activity sheet.

On the classroom floor, form three large intersection loops of yarn to match the Venn Diagram on the activity sheet. Have each child stand inside the loop or loops that he or she believes represents the preference stated above. Discuss the preferences of the class as a whole.

Explore:

Put a copy of the "Pigging Out" Venn Diagram under the Elmo camera and tabulate the classes results by putting each child's initials in the appropriate place.

Each child should then compare the location marked on the page with the place he or she was standing in the yarn circles. Discuss what it means to have a child in each of the seven regions. Where would a child stand who chooses none of the three materials? (Outside the three circles.)

For an experience involving estimation and graphing, ask students to recall that the wolf "huffed and puffed" a number of times in the story. Have each student cut, fold, and tape the house pattern on the Pigging Out Activity Sheet.

Ask the students to estimate how far they can blow the house across the floor. Have groups of four record estimates and then conduct the experiment. What would happen if these houses were made with different materials such as construction paper, newspaper, or interlocking blocks?

To reinforce measurement and map skills have students create a map within the boundary on the second page of the Pigging Out Activity Sheet. Next they mark with an “sh,” “wh,” and “bh” – for straw house, wood house, and brick house, respectively – where they think the pigs in the story built their houses. They should also indicate with a “w” where they think the wolf might have lived. Identify a standard unit of measure, such as a centimeter cube, with which to measure distances on the map.

Share:

Have pairs of students compare their measurements and their maps to explore similarities and differences. For example, two students with similar looking maps would have similar distances between houses, but it is possible that two students with similar distances between houses may have very different looking maps. Ask pairs of children to sit back-to-back and have on child describe his or her map while the other student attempts to draw it next to his or her map on the second page of the Pigging Out Activity Sheet. Have students answer the questions on the activity sheet and discuss their results with the class.

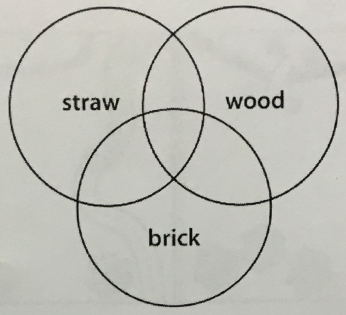
Summarize:

Students will be developing reasoning skills through the use of Venn Diagrams. They will be able to identify similarities and differences, draw and interpret a simple map and measure distances using concrete objects. Students will be able to tell us where the intersection and the union of each of the circles is by the end of this lesson.

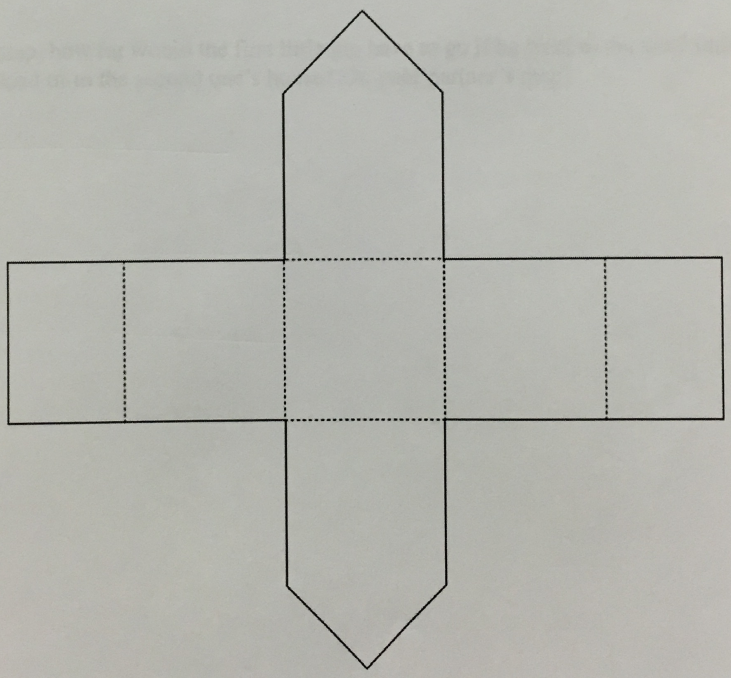
Pigging Out

NAME _____

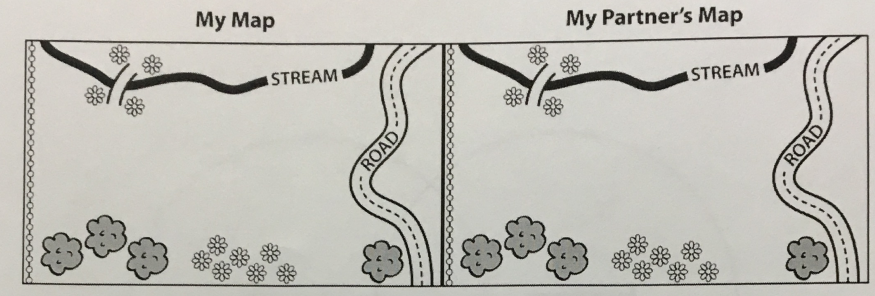
The following Venn Diagram shows house-building materials. Choose your favorite of the three house-building materials and put your initials in the region that shows your choice.



Clip and fold the artwork below to form your "house."



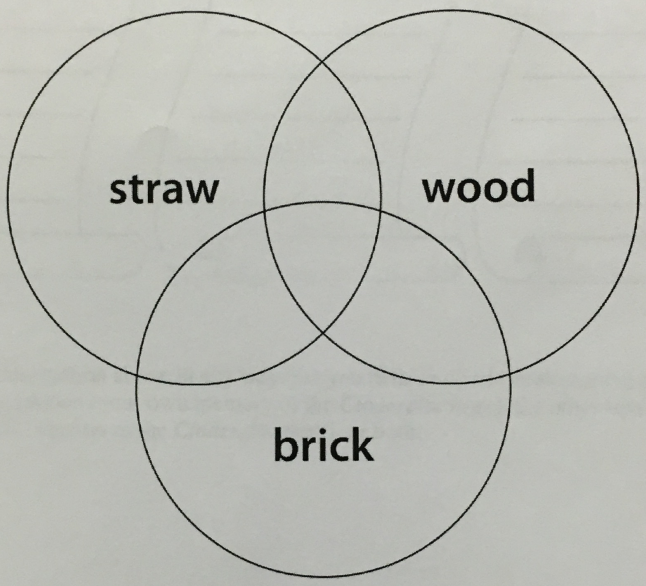
Where Should I Build My House?



1. On your map, who built a house closest to the wolf? On your partner's map?

2. On your map, how far would the first little pig have to go if he went to the third little pig's house instead of to the second one's house? On your partner's map?

Pigging Out: Venn Diagram



Activity 2: A Tale of Two Stories

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Minnesota Standards-Algebra

5.2.11 and 5.2.1.2 Recognize and represent patterns of change: use patterns, tables, graphs and rules to solve real-world and mathematical problems.

Lesson 2: If the Shoe Fits….

Launch:

Engage students in a discussion of characteristics that are typical of fairy tales by asking them to name a fairy tale and explain why they think it is one. Compare this explanation with that of another fairy tale that they name. Focus on students' abilities to generalize by encouraging such statements as "beginnings and endings are predictable," "Stories take place 'once upon a time,'" and "good usually wins over evil." Inform students that they will be exploring characters, objects, and events for the fairy tale of Cinderella.

Group students into teams of three or four. Give each group a large sheet of paper and a marker. Challenge groups to generate a list of everything they remember about the Cinderella story. Allow three to five minutes for students to generate ten to fifteen ideas.

Explore:

After generating this list and writing it on their large paper, give each group a copy of the If the Shoe Fits….. activity sheet.

Have students sort the items on their list into the groups listed on the first section of the activity sheet – Characters, Objects, and Events.

Examples might include the Prince, the magic wand, and running away at midnight. For those groups that have only one or two items in a category, allow student to expand their list to include at least four or five.

Read aloud the Grimm brothers' version of the Cinderella story. During this reading, have students check off items that appear in any of the three categories and add new items to the lists using a marker of a different color. Ask students to compare and contrast this version and their remembrances.

To create visual representations to communicate the similarities and differences in the versions of the story, challenge students to organize their lists on the second section of the If the Shoe Fits… activity sheet so that it is easy to identify those items found only in the Grimm brothers' version, those only in their original lists, and those in both. Observe the format in which students organize the data they generate.

Share:

Have selected groups present their results to the entire class to show various ways of representing the information.

Give each group a different multicultural version of the Cinderella story to read. Have group members compare it with both the Grimm brothers' version and their own. Ask groups to explain how their multicultural version is more like either the Grimm brothers' version or their own recollections of the fairy tale. Students can record their responses in the third section of the activity sheet. Students will compare their version of the story with another students recording their results on a Venn Diagram. This will allow them to continue practicing the intersection and union of Venn Diagrams.

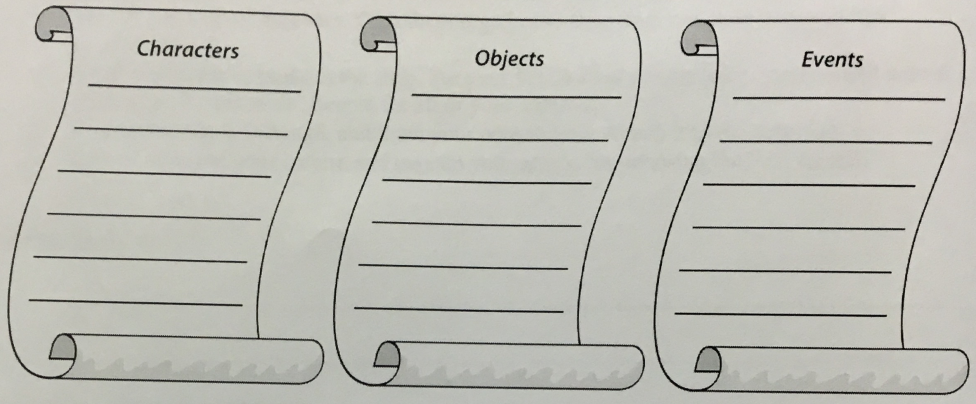
Summarize:

Students will be able to generate data through brainstorming. Students will be able to identify similarities and differences using attributes to classify and sort information.

If the Shoe Fits....

NAME _____

1. Sort the items from your group's brainstormed list into the three categories below.



2. Organize the information above in any way that you believe clearly indicates the elements that are in only one version (your own memory of the *Cinderella* story), the other version (the Grimm Brothers' version of the *Cinderella* story), or both.

3. Explain how the multicultural version you read in class is more like either the Grimm Brothers' version or your own remembrances of the fairy tale.

Activity 3: Patterns That Grow

http://illuminations.nctm.org/LessonDetail.aspx?id=L302

Minnesota Standards-Algebra

5.2.11 and 5.2.1.2 Recognize and represent patterns of change: use patterns, tables, graphs and rules to solve real-world and mathematical problems.

Lesson 1: What's Next?

Launch:

Using pattern blocks, make a pattern with at least three repeats of the pattern core (for example, square, trapezoid, hexagon, square, trapezoid, hexagon, square, trapezoid, hexagon).

Then ask a volunteer to read the pattern. Repeat with other patterns and other volunteers.

Explore:

Place the students in pairs and give each pair several pattern blocks. (If you don't have pattern blocks, you can give the students paper shapes.) Ask each student to make a pattern with at least three repeats. Call on volunteers to read their patterns and ask if anyone else has a similar pattern.

Share:

Encourage several students to read their patterns using both descriptive language (square, square, triangle) and generic pattern cores (AAB).

Next have each student make a new pattern with three repeats, trade patterns with their partner and extend the pattern they were given. If students are having difficulty, encourage them to read the patterns aloud using both descriptions (red, blue) and generic pattern cores (AB).

Some questions to go over:

- Here are two patterns (for example, triangle, triangle, square and square, square, triangle).
- How are they alike? How are they different?
- How can you tell where a pattern core begins and ends?
- If you wanted to extend your friend's pattern, how would you decide which shapes to use?
- Suppose you want to make an AB pattern with pattern blocks. How could you do that? Who could do it a different way?

- How would you make an ABB pattern with pattern blocks? How is it like an AB pattern? How is it different from an AB pattern?
- (Repeat the second shape in the pattern core; the same two shapes are used; the second shape is repeated before beginning again.)
- How would you explain to a friend how to find out what is missing in a pattern?

Extend:

As a challenge, make a pattern and ask the students to hide their eyes while you remove one shape from it. (Doing this successfully requires interpolation, a higher-order thinking skill.) Then have them open their eyes and determine what was removed. Call on students to place the shape that they think was removed back in the pattern and then read the pattern aloud to verify their answer. Repeat this several times. Next ask the students to make a pattern with pattern blocks, leave out on shape, and then show it to their partners to see if the partner can determine the missing piece.

Summarize:

Students will be able to create and read a linear pattern. Students will be able to extend a given linear pattern and identify the missing element in a linear pattern.

Activity 4: Patterns That Grow

http://illuminations.nctm.org/LessonDetail.aspx?id=L302

Minnesota Standards-Algebra

5.2.11 and 5.2.1.2 Recognize and represent patterns of change: use patterns, tables, graphs and rules to solve real-world and mathematical problems.

Lesson 2: Patterns on Charts

Launch:

Ask a volunteer to enter 2, +, 2, =, =, =, = into the online calculator and to describe what he or she sees on the calculator display. Ask another student to describe what happened on the online hundred chart.

Explore:

Place the students in pairs and give each pair one copy of the Hundreds Chart and some crayons. Have the students circle the patterns they find on their paper hundred chart. When the groups have located several patterns, call on volunteers to describe patterns they found. Encourage the students to find skip-counting patterns for 2's, 5's, and 10's (preparing for multiplication) and the pattern of odd and even numbers. Also encourage them to notice patterns in the tens and ones places.

For independent practice, give students copies of the Multiplication Chart and ask them to color any number patterns that they notice.

Share:

After students have found several patterns, call on volunteers to read one of their patterns. Then ask what other patterns the students found. You may wish to have the students record some of the patterns at the bottom of their charts.

Leading Questions (if needed)

- Listen to this pattern (3,6,9,12). Can you find it on the multiplication chart?
- What three numbers will come next when you extend this pattern? (15,18,21)
- Tell about one pattern that you found on the hundred chart.
- How would you describe it to a friend?
- Did anyone find another pattern? How would you describe that pattern to a friend?
- How would you use a calculator to generate the pattern 1, 12, 23, 34….?
- Suppose that you wanted to find a pattern of even numbers. Where would you look?
- How would you tell a younger student to find a pattern on a hundreds chart?

Summarize:

Students will be able to find and record patterns on hundreds and multiplication charts. Students will be able to analyze patterns on hundreds and multiplication charts and use a calculator to generate patterns.

Multiplication Chart

NAME _____

×	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

Hundreds Chart

NAME _____

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Activity 4: Patterns That Grow

http://illuminations.nctm.org/LessonDetail.aspx?id=L302

Minnesota Standards-Algebra

5.2.11 and 5.2.1.2 Recognize and represent patterns of change: use patterns, tables, graphs and rules to solve real-world and mathematical problems.

Lesson 3: Growing Patterns

Launch:

To begin the lesson recite, “The House that Jack Built” by Mother Goose. Then ask the students to tell what happened in the story.

Next explain that students will be exploring patterns that grow according to a rule. Display the “bowling pin” pattern which is a “counting-on” pattern.

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. . .

. . . .

Then ask, “What will come next in this pattern?” When students give the correct answer, ask them to explain how they got that answer. Repeat with several more rows. Then ask the students to state the rule that they would sue to add more figures to the pattern. Encourage alternate expressions of the rule.

Next display the pattern below, and ask students what they might call the pattern (a T pattern).

. . . . .

.

. . . .

. .

. .

Then repeat the steps used in the counting-on pattern above with the new pattern below. (The next figures will contain 13, 17, and 21 dots). Ask several students to state the rule that they would use to add more figures to the pattern. (Each time, two dots are added to each part of the previous figure.) Then ask them to add more rows to the table below.

Figure	Dots
1	1
2	5
3	9

Explore:

Next introduce the students to Pascals's triangle by opening Exploring Pascal's Triangle. Ask for volunteers to name any patterns that they see. (You may wish to print out copies of the triangle and provide calculators for the students to use.) Partners should take turns answering questions at the site.

Share:

To conclude the lesson have the students make patterns that grow and exchange them with a friend to extend. At the end of the class, ask for volunteers to share their growing patterns and their rules.

Summarize:

Students will be able to create and describe growing patterns. Students will be able to analyze how growing patterns are created. Students will be able to find number patterns in Pascal's triangle.

- How many dots are in the first figure of the T growing pattern?
- How many dots will be in the fourth figure? In the fifth? How do you know? What is the rule? How would you demonstrate that you have found the rule?
- Make a "corner pattern" by making a right angle with three dots then one with five dots, then one with seven dots. What will come next in the growing pattern? Then what? How do you know? Have you seen this pattern before?
- What was the rule for one of the patterns that you made? Did anyone else make a different pattern with that rule?
- Here is a row from Pascal's triangle (1 4 6 4 1). What would be the row after that? How do you know? What is the sum of this row? What is the sum of the first four rows? Do you notice a pattern in the sum of the rows? (Each row's sum is double the previous sum.)
- Do you notice any patterns in the triangle?

Activity 4: Patterns That Grow

http://illuminations.nctm.org/LessonDetail.aspx?id=L302

Minnesota Standards-Algebra

5.2.11 and 5.2.1.2 Recognize and represent patterns of change: use patterns, tables, graphs and rules to solve real-world and mathematical problems.

Lesson 4: Exploring Other Number Patterns

Launch:

Give each student several pattern blocks and call on volunteers to make patterns cores with blocks in at least two different shapes (for example, square, square, trapezoid, hexagon). Then ask them to identify the pattern core. Ask each student to make a copy of the pattern core.

Explore:

Now place the student sin groups of six and ask them to make the pattern using all six repeats. Then record on a table the number of shapes that they used in all. (An example of how four repeats of the sample pattern would be recorded is shown on the table below.)

Ask what the entries would be if there were eight or ten people. Encourage the students to skip count to find the answers.

Number of Shapes (located within the cells of the table)

Repeats of the Pattern Core (1, 2, 3, 4, 5, or 6)

Shape	1	2	3	4	5	6
Triangle					0	
Hexagon					4	
Square					8	
Rhombus					0	
Trapezoid					4	

Then ask what the entries would be if there were eight or ten people. Encourage students to skip count to find the answers.

Next display the pattern 1, 1, 2, 3, 5, 8, 13, 21. Tell the students that this special pattern is named after a man who lived in Italy many years ago, and that the Fibonacci pattern is different from those they have studied before. Ask the children to speculate on the rule for this pattern (each pair of numbers is added to get the next number in the series) and what the next 3

numbers in it will be (34,55,89). Ask the students to make a list of the first ten Fibonacci numbers, and then record the difference between each pair of numbers. (The differences will be 0, 1, 2, 3, 5, 8, 13, and so on.)

Share:

Have the students compare and share their results.

Summarize:

Students will analyze patterns and record numeric patterns. Students will use a table to record and analyze patterns.

- If the pattern core is triangle, square, trapezoid, trapezoid, how many squares and how many trapezoids would you use in five repeats of the pattern? How many triangles would you use in six repeats? (5 squares, 10 trapezoids, 6 triangles).
- What would come next in this pattern? 0, 4, 8, 12, 16 How do you know?
- My pattern is 1, 4, 7, 10. What are the next five numbers in my pattern? What is the rule for my pattern? How would you make a table to show that?
- What would the pattern be if you started at five and added two each time?
- Here is how the Fibonacci pattern begins: 1, 1, 2, 3, 5, 8. What comes next? Then what? How do you know? Can you state the rule in words?

Multiplication Chart

NAME _____

×	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

Activity 4: Patterns That Grow

http://illuminations.nctm.org/LessonDetail.aspx?id=L302

Minnesota Standards-Algebra

5.2.11 and 5.2.1.2 Recognize and represent patterns of change: use patterns, tables, graphs and rules to solve real-world and mathematical problems.

Lesson 5: Looking Back and Moving Forward

Launch:

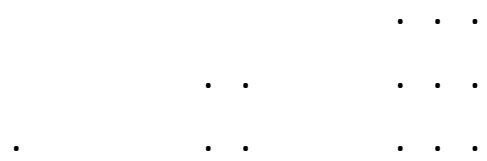
Students work in small groups at four different centers to review the concepts learned in each of the four lessons in this unit. You may wish to print out the directions for each station. Students might be assigned to rotate among the stations in groups of four to six.

Station 1

Work in pairs to create and record pattern block patterns on paper. When you have a pattern, record it by tracing the pattern blocks. Write a description of the pattern on you piece of paper.

Station 2

Look at the growing pattern below and draw the next two figures.



Then create a growing pattern and exchange it with a friend. Ask someone in your group to add two more repeats. Keep a copy of your pattern to give to your teacher.

Station 3

Circle the 6, 7, and 8 multiplication tables on a copy of the multiplication chart using different colored crayons for each table. Read each of the tables to another member of your group. Record each of the patterns at the bottom of, or the reverse side of your multiplication chart.

Station 4

Make a pattern with the pattern blocks and record in a table how many of each block would be used in two, three, four, and five repeats. Trade your table with a partner and ask them to make other patterns that the table could be used to describe. Record your table on a piece of paper to be given to your teacher.

Explore:

Students might be assigned to rotate among the stations in groups of four to six.

Share:

Have the students discuss what new patterns or knowledge they have discovered after working in the different stations.

Summarize:

Students will be able to create, extend, analyze, describe, and record linear patterns with shapes. Students will be able to describe and analyze patterns in a chart. Students will be able to create, extend, analyze, describe, and record number patterns.

Activity 5: Chairs Around the Table

http://illuminations.nctm.org/LessonDetail.aspx?id=L627

Minnesota Standards-Algebra

5.2.11 and 5.2.1.2 Recognize and represent patterns of change: use patterns, tables, graphs and rules to solve real-world and mathematical problems.

Launch:

Present the following situation to students:

There's a new restaurant in town named, "The Good Stuff" and it has 24 square tables. One chair is placed on each side of a table. How many customers can be seated at this restaurant? Show an arrangement of one table with four chairs on the white board. When all students understand how the chairs are placed ask, "If there were 24 tables in a room, how many chairs would be needed?" Some students may realize that 24 x 4 = 96. If not, work with the class to complete a table as follows:

Tables	Chairs
1	4
2	8
3	12
4	16
5	20

From this table, students should realize that the number of chairs is equal to four times the number of tables. Alternatively, they might recognize that each time a table is added, four chairs are added. If there are some students who use each approach, this is a good opportunity to reinforce the connection between multiplication and repeated addition. Ask students to explain their observations.

Explore:

After the original problem has been solved, explain to students that the restaurant needs some additional help. Pose the following problem.

"The Good Stuff" has a problem. For large groups, they must push some of the tables together to make a longer table. As before, they place one chair on each side of the table. How many tables would be needed for a group of 18 people? Again show students an example of the situation. Explain that for just one square table four chairs are needed, but when two tables are pushed together, six chairs are needed.

Ask, “How many chairs would be needed if three square tables were pushed together? What about four tables? Five? How would you determine the number of chairs needed for any number of tables?

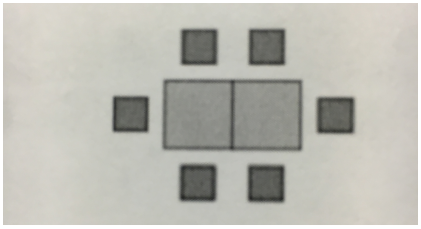
At this point, divide students into groups. Allow them to explore various arrangements of tables and chairs using pattern blocks. As students work, they should keep an organized record of their data. Before they begin to explore, you may wish to discuss how a table or chart could be used to keep their data organized. Allow students to investigate the relationship between tables and chairs, and circulate as they explore. Make sure every group is working toward finding a general relationship between the number of chairs and the number of tables.

After the exploration, conduct a class discussion to reveal the relationship between chairs and tables. Ask, “If you know the number of tables, how can you determine the number of chairs?” Keep a record of the student’s suggestions on the overhead. Continue discussing until the class reaches an agreement on which relationships are correct.

As students suggest answers using words, convert their answers to algebraic expressions using variables. If a student says, “You find the number of chairs by multiplying the number of tables by 2, and then adding 2,” then you might write either of the following on the board:

Chairs + 2 x tables + 2 or $c = (2 \times t) + 2$

Students may suggest several correct rules for determining the number of chairs. One student may realize that there are two chairs on the sides of each table, as well as an additional chair on each end, leading to the rule $c = (2 \times t) + 2$. This is shown in the first diagram below. Another student may realize that there are three chairs around each end table, and there are two chairs on the sides of each middle table, leading to the rule $c = 3 \times 2 + 2 \times (t - 2)$. This is shown in the second diagram below.



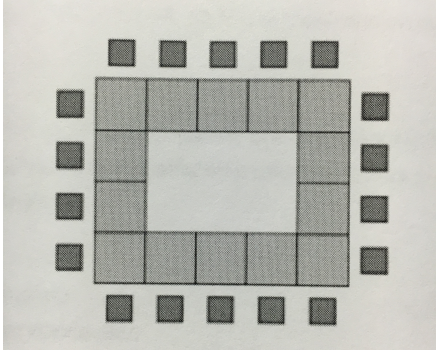
Once students have discovered acceptable relationships, they should use them to determine the number of chairs when the number of tables is known and vice versa. Ask the following two questions:

How many chairs would be needed for 24 tables?

How many tables would “The Good Stuff” have to push together for a group of 18 people?

Finally allow students to consider arrangements in which square tables are connected to form the outside border of a rectangle. Pose the following problem to students:

Customers at “The Good Stuff” like that tables can be combined for larger groups, but they don’t like that tables are only arranged end to end to form a long chain. One patron suggests that tables should instead be arranged in a rectangular pattern with chairs placed around the outside.



Ask, “How many chairs would you need when tables are arranged in rectangular patterns like this?”

Let students explore various relationships that allow the number of chairs to be determined. If students are familiar with perimeter then they may realize that the number of chairs is dependent on two variables, namely length and width. The arrangement above can be thought of as a rectangle with length 5 and width 4, so then the total number of chairs could be determined by 2(5) + 2(4) = 18.

If the number of chairs in the length and width of the arrangement are represented by m and n, these three approaches lead to the following symbolic rules, respectively:

$C = 2m + 2n$

$C = 8 + 2(m-2) + 2(n-2)$

$C = T + 4$

Note that the last of these symbolic rules indicates that he number of tables is four less than the number of chairs. But the number of tables is given by $t = 2m + 2n = 4$.

Share:

A whole-class discussion is important after this exploration. It is important that ll students are exposed to other students’ strategies.

Summarize:

Students will be able to identify and extend a linear pattern involving the number of chairs that can be placed around a series of square tables. Describe linear patterns using words or symbols.

Activity 6: The Variable Machine

http://illuminations.nctm.org/LessonDetail.aspx?id=L291

Minnesota Standards-Algebra

5.2.11 and 5.2.1.2 Recognize and represent patterns of change: use patterns, tables, graphs and rules to solve real-world and mathematical problems.

Launch:

You may wish to group your students in pairs to carry out the activity. Tell the students that they are going to create a variable machine to discover the value of words. On the three-centimeter-wide strip of lined notebook paper, have them write the letters of the alphabet in order down the left side of the paper.

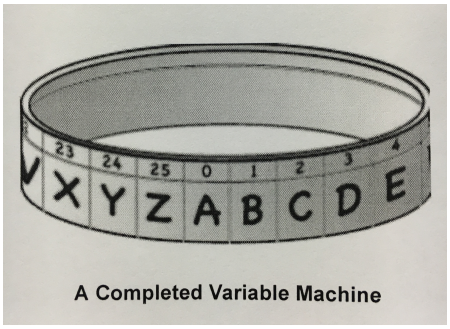
Down the right side of the five-centimeter strip of notebook paper, have them write the numbers from 0 to 25. They should then attach the ends of the number strip together with a piece of tape; wrap the letter strip around the number wheel, matching the letters to the corresponding numbers:

A to 0

B to 1

C to 2 and so on…..

And tape the ends of the letter strips together as shown below:



A Completed Variable Machine

Explore:

Have the students find the value of the first and last names, using their variable machines.

Ask the following questions:

Which name has the higher value? What is the difference in the values of your first and last names? Next have them find the values of various words.

What is the three-letter word with the greatest value? Are the greatest values always associated with words that contain the most letters? Challenge students to find words of more than ten letters whose values are less than the values of words having only three letters: whose values are equal to 25, 36, or 100. Do most of the words you checked have a value that is even or odd?

Extended Idea:

Realign the number strips to let A equal 7, as shown in the figure below. Doing so changes the assigned values. The number strips can be altered also by writing different values, such as decimal or fractional numbers, on different strips.

Share:

Students share results or fun names and words they have created. They can brainstorm what how we can use variables in other ways to represent unknowns.

Summarize:

Students will explore the idea of variable as a symbol that can stand for any member of a set of numbers. Students will use substitute numbers for variables (letters) to discover unknown values.

Cracking the Code

NAME _____

Use your Variable Machine to answer the questions which follow.

1. What is the value of your last name? _____ What is the value of your first name? _____

   What is the difference of these two values? _____

2. What is the value of each of these words?

   a. variable _____

   b. machine _____

   c. algebra _____

   d. mathematics _____

3. Find three different words whose values are each equal to 25. Record the words below.

   What do you notice about the number of letters in each of these words?

4. Find three different words whose values are each equal to 36. Record the words below.

   What do you notice about the number of letters in each of these words?

5. Find three different words whose values are each equal to 100. Record the words below.

   What do you notice about the number of letters in each of these words?

6. Do most of the words you found have a value that is even or odd? Do you think there is a reason for this?

Activity 7: Stability In Numbers

http://illuminations.nctm.org/LessonDetail.aspx?id=1813

Minnesota Standards-Algebra

1.2.11 and 5.2.1.2 Recognize and represent patterns of change: use patterns, tables, graphs and rules to solve real-world and mathematical problems.

Launch:

Ask students what an addition sentence/equation looks like. Students should notice there are two addends, the addition symbol, the equal symbol, and a sum.

Introduce the on-line Pan Balance-Number Tool to the students.

Put 4 onto the left pan by typing in the red space above the pan. Ask students, "What happens? Why?" Now put 9 onto the blue right pan by typing in the space above the pan. "What happens? Why?"

Explore:

What number sentences can you create using the number 12?

Review the commutative property of addition, namely 3 + 9 has the same sum as 9 + 3.

Give them time to explore and create as many equations as they can. Discuss as a class before putting them in partners and giving them the Addition Equations Activity Sheet.

Share:

Discuss with the class the possible solutions and how the methods they used to get their answers. Ask the students what the largest number of numbers you can use to balance with 12? What is the smallest number of numbers?

Summarize:

Students will create and solve addition equations using an electronic balance tool. They will investigate the equivalence of 2 numeric expressions.

Addition Equations

NAME _____

Use the Pan Balance – Numbers Tool to complete the following activities. Work with a partner.

1. What addition equations can you create using the number 20? Use the electronic tool to create at least five different equations, and record them below.

2. What addition equations can you create using the number 33? Use the electronic tool to create at least five different equations, and record them below.

3. Put 7 + 8 in the left pan. Put something onto the right pan that will make it balance. Then find something else that will balance with 7 + 8. How many answers can you find?

4. Put 10 + 9 in the left pan. Put something onto the right pan that will make it balance. Then find something else that will balance with 10 + 9. How many answers can you find?

5. Choose one person to create a problem similar to 3 or 4 above. The other person in the pair should solve the problem. Record the problem and solutions below.

Activity 8: Pan Balance-Shapes

http://illuminations.nctm.org/LessonDetail.aspx?id=3531

Minnesota Standards-Algebra

1.2.11 and 5.2.1.2 Recognize and represent patterns of change: use patterns, tables, graphs and rules to solve real-world and mathematical problems.

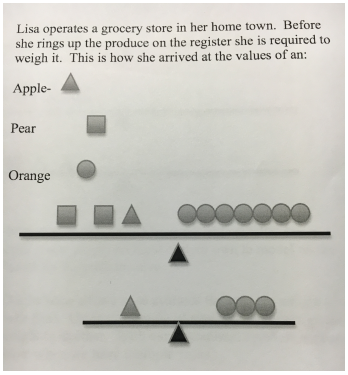
Launch:

Begin by telling the class they will be using a computer program to explore a balance tool called a pan balance using shapes of unknown weight.

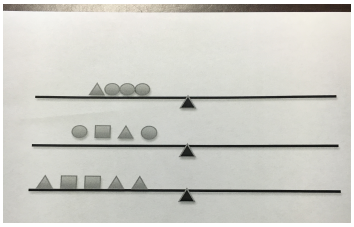
Explore:

Tell the class their job is to find the weight of each shape in one of six built-in sets. Try to find equivalent sets of shapes by placing shapes on each side of the balance. When you think you know any of the weights you can check your guess. Once the students have had time to discover the different weights pose this problem to them:

Amber works at a grocery store in her home town. Before she rings up the produce on the register she is required to weight it. This is how she arrived at the values of an:



Pair up with someone and figure out the equality of the square and then complete the following table together:



Share:

With the whole group discuss the results of the table. Have each group supply an input of their own to model on the board for the class to solve.

Summarize:

Our balance allows us to evaluate the value in weight of each fruit. Using the weight of one allows us to assign the weight to another. With our operational symbols we can solve when we have multiple fruits.