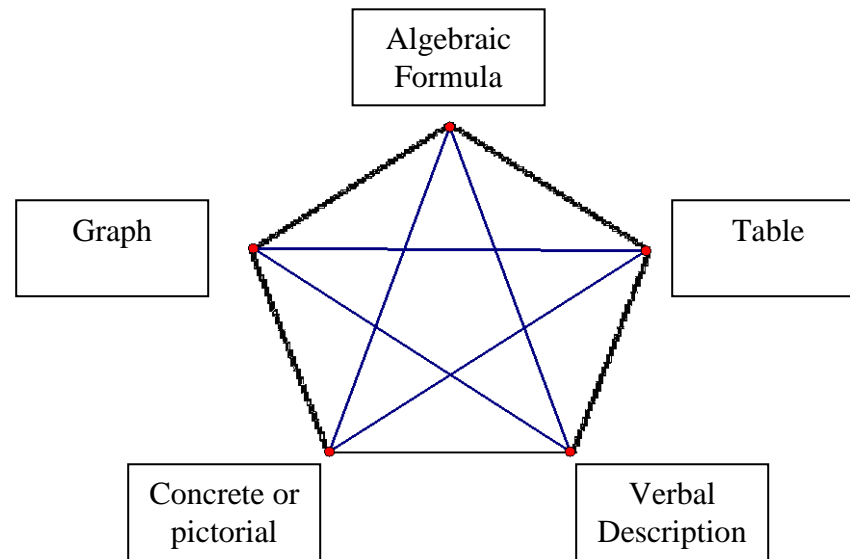


Overarching Goal:

- Students will discover patterns that lead to algebraic equations.

Lesson Objectives :

- Students will represent and solve a story problem using a variety of strategies (multiple representations).



SOL Objectives:

MTH.G6.23

MODEL AND SOLVE ALGEBRAIC EQUATIONS & USE TERMS APPROPRIATELY

The student will

- a) model and solve algebraic equations, using concrete materials;**
- b) solve one-step linear equations in one variable, involving whole number coefficients and positive rational solutions**

Prior Learning:

Exposure to multiple representations in problem solving (star). –concrete, pictorial, graph, table, symbolic, words

Prior experience to equations—

1. Observe and generalize patterns using input-output machine.
2. Connecting input-output machine pattern to a rule or function. (in words)
3. Translating rules to equations with variables.
4. Graphing ordered pairs from a table with input-output machine.
5. Penny Jar Problem—introduction to writing one equation.
6. Familiarity with Venn Diagram

Lesson Pacing:

Based on one 60 minute lesson

- | | |
|----|--|
| 13 | Present problem and check for student understanding of the problem |
| 25 | Student work time |
| 15 | Students share strategies |
| 7 | Students complete exit cards |

Lesson Overview:			
Lesson Flow	Teacher's Actions	Anticipated Student Responses	Remarks on Teaching
1. Present the problem.	<ul style="list-style-type: none"> The problem is distributed as a hand-out and read aloud to the students. 		
<p>Problem 1—Aleah's Problem</p> <p>Aleah has 180 dollars saved all in 10 dollar bills. She spends 10 dollars every Friday at Wal-Mart. Her younger brother has 110 dollars saved all in 5 dollar bills. He spends 5 dollars every Friday at Wal-Mart. One Friday they look into each others' wallets, the younger brother had more money in his wallet. When this happened, how many Friday's had it been since they started spending money?</p> <p>(Insert Graphic)</p>			
2. Comprehension of the problem.	<ul style="list-style-type: none"> Present an illustration and model to make the meaning of the problem easier to understand. Question students as I model. Who starts out with more money? After the first Friday who has more money? How many Friday's had passed when they noticed Aleah's brother had more money? 	<ul style="list-style-type: none"> To start Aleah has more money—she has \$180. After the first Friday Aleah still has more money—she has \$180. <p>STUDENT SOLUTION PATH'S</p> <p>Concrete/Pictoral:</p>	<ul style="list-style-type: none"> Materials available for students to use—graph paper (1/4 inch), graph chart paper, blank paper, paper money (\$10 bills and \$5); Chart paper for strategies to share with the group

Students will use a drawing or concrete materials to model the action in the problem. They will find that Aleah's brother will have more money on the 15th Friday.

Repeated Subtraction:

Some students may set up repeated subtraction.

180	110
-10	-5
170	105
-10	-5
160	100
-10	-5
150	95
-10	-5
140	90

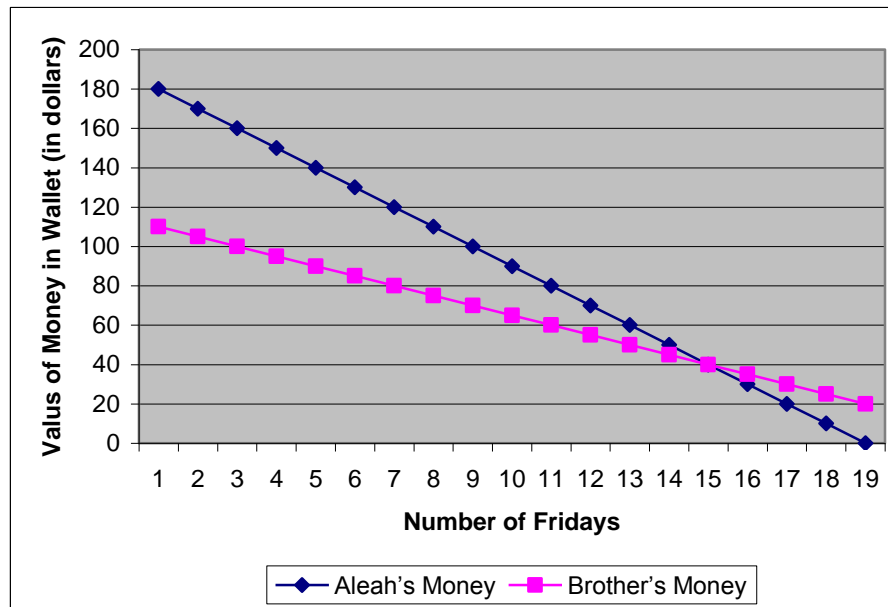
Table:

Number of Fridays	Aleah's Money	Brother's Money
Start	180	110
1	170	105
2	160	100
3	150	95
4	140	90
5	130	85
6	120	80
7	110	75

- Students work independently, in pairs or small groups to solve the problem.
- Students using this strategy may have trouble keeping track of the amounts or values. To troubleshoot I will ask them how they are recording their thinking. (Hopefully this will aid students in organizing their work into a table.)
- Teacher could ask the student how they are keeping track of how many Friday's have passed.
- Is there another way you could organize this information so it is easier to keep track?

8	100	70
9	90	65
10	80	60
11	70	55
12	60	50
13	50	45
14	40	40
15	30	35
16	20	30
17	10	25
18	0	20

Graph:



- There are probably many students who will think that the answer is only the 15th Friday, because they may stop their table there.

- Students can be asked if there is a faster way to do the problem without making the whole table?

- Can you write or a describe a rule about what is happening every Friday to Aleah's money? To her brother's money?

- Note: Guide students who are ready to write an algebraic equation to this point using reference to other times equations have been used in the classroom.

- Ask the student how many total 10 dollar bills she spends on the first

		<p>Words:</p> <p>Students will explain in words or writing how Aleah’s money and her brother’s money is changing each time.</p> <p>For Aleah’s money she starts with 180 dollars and each Friday she goes to Wal-Mart she spends 10 dollars.</p> <p>For her Brother’s money he starts with 110 dollars and each Friday he goes to Wal-Mart he spends 5 dollars.</p> <p>Symbolic:</p> <p>Students will write 2 equations that relate to both Aleah and her brother’s money.</p> <p>Aleah:</p> $m = 180 - 10d$ <p>Brother:</p> $m = 110 - 5d$	<p>Friday, on the second Friday, on the third Friday...what do you notice, is there a pattern?</p> <ul style="list-style-type: none"> • Restate the student thinking—on the first Friday you <u>spent 1 or 10 dollars</u>, by the second Friday you <u>spent 2 ten dollar bills or 20 dollars</u>. • How much money have they spent? • How much money do they have left in savings? • Can you write a rule for Aleah’s money? • What do the numbers and letters represent in your equation? Where do they come from? • How can you use your equations to help you answer this question?
3. Students present how they solved the problem			<ul style="list-style-type: none"> • Select 1 student or pair of students to explain their solution for each of the following possible representations (created

			<p>by students) and label with 5 star vocabulary:</p> <ol style="list-style-type: none"> 1. Concrete/Pictorial 2. Repeated Subtraction 3. Table 4. Graph 5. Words 6. Symbolic <ul style="list-style-type: none"> • Ask questions to check for understanding as students explain. (see attached Algebraic Connections Talk chart) • Allow students to ask other students questions about their thinking process/representation. • Let's compare 2 strategies...how are they alike, how are they different?
<p>5. Exit Ticket</p>	<ul style="list-style-type: none"> • Give students a piece of paper to write their closing thoughts. • Read to students: Compare and contrast sheet directions (see attachment) 	<ul style="list-style-type: none"> • Students will write about connections that they see in the different representations. 	

Student Work Samples

Lesson Modification Ideas

- Plan lesson over two 60 minute sessions, with the first hour session is the intro and work time. For students who finish the initial problem early, have them work on a related problem (from *Navigating Through Algebra*) or solve the same problem with different values, or add in a third person to the scenario. The second hour session would be student sharing and discussion focused on connecting representations. Students write a description justifying their strategy. Students complete Venn Diagram (exit card), and then share Venn comparisons with a partner or as a group.

Lesson Extensions (Now and Then)

- Pose the questions “How much money is left in the savings?” and “How much money did they spend?”
- Create a spreadsheet of data and graph. Show to whole class using LCD projector and/or Smartboard. Ask students to see if there is more than one correct answer to this problem. If students came up with more than one answer as a class, then ask them to locate all the answers groups found on the graph.

Attachments

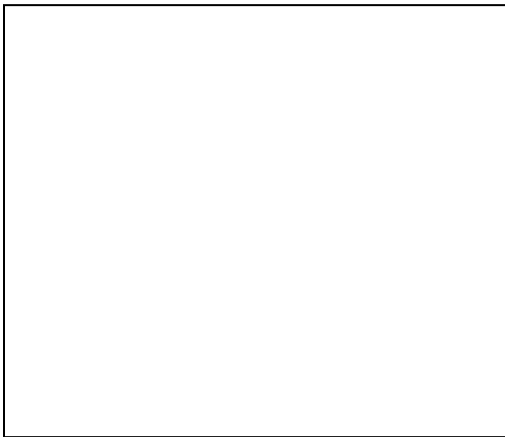
- I. Student problem sheet
- II. \$5 bills
- III. \$10 bills
- IV. Algebraic Connections Talk – Questions Table
- V. Student Exit Card

Aleah's Problem

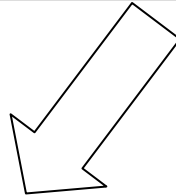
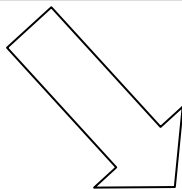
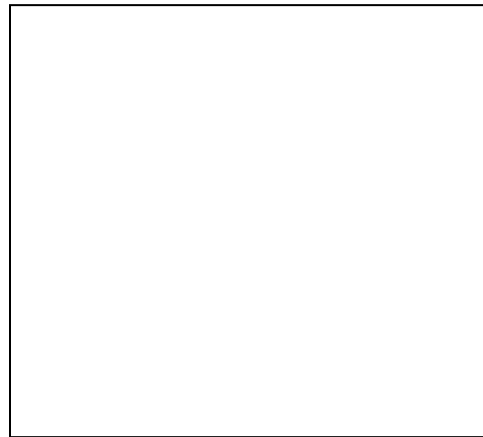
Aleah and her younger brother have been given money to put into their savings account from their parents. Aleah has 180 dollars saved all in 10 dollar bills. Her younger brother has 110 dollars saved all in 5 dollar bills. Every Friday, Aleah's parents let her and her younger go with them to Wal-Mart and spend some of the savings money. Aleah spends 10 dollars every Friday, while her little brother spends 5 dollars every Friday.

One Friday they look into each others' wallets, the younger brother had more money in his wallet than Aleah did. When this happened, how many Friday's had it been since they started spending money?

Aleah's Savings



Little Brother's Savings



Use the space below to figure out how many Fridays it took for Aleah's little brother to have more money in his savings than Aleah had in hers. Be sure to use some of the methods that we have talked about already this year (Graphs, Tables, Drawings, etc.)

Attachment III



Algebraic Connection Talk



DOING AND UNDOING



How is this number in the sequence related to the one that came before?
What if I start at the end?
Which process reverses the one I'm using?
Can I decompose this number or expression into helpful components?



Building Rules to Represent Functions



Is there a rule or relationship here?
How does the rule work and how is it helpful?
Why does the rule work the way it does?
How are things changing?
Is there information here that lets me predict what's going to happen?
Does my rule work for all cases?
What steps am I doing over and over?
Can I write down a mechanical rule that will do this job once and for all?
How can I describe the steps without using specific inputs?
When I do the same thing with different numbers, what still holds true? What changes?
Now that I have an equation, how do the numbers (parameters) in the equation related to the problem context?



Abstracting from Computation



How is this calculating situation like/unlike that one?
How can I predict what's going to happen without doing all the calculations?
What are my operation shortcut options for getting from here to there?
When I do the same thing with different numbers, what still holds true? What changes?
What are other ways to write that expression that will bring out hidden meaning?
How can I write the expression in terms of things I care about?
How does this expression behave like that one?

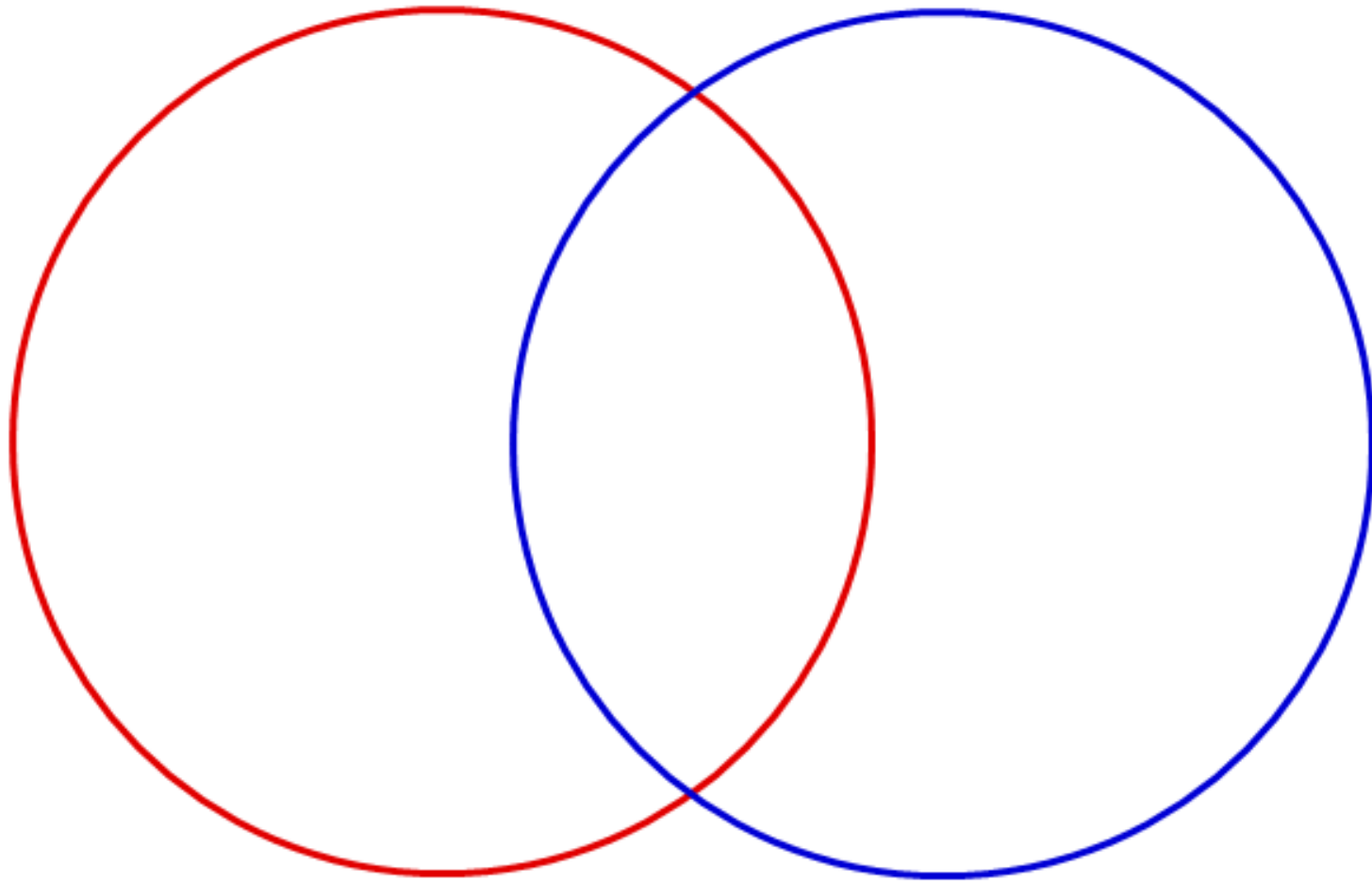
Attachment V

Compare and Contrast your way of solving Aleah's Problem
with a different method that you have seen used today.

What is unique about both of the methods?

What is similar about them?

Fill out this Venn Diagram with your ideas.



Your Way of Solving Aleah's Problem

Another Way of Solving Aleah's Problem