Goal: Introduce concept of multiple representations. Create multiple representations of same relationship.

REPRESENTING MATHEMATICAL RELATIONSHIPS IN MULTIPLE WAYS

Lesson 1: Introducing multiple representations

Slide 1 Students work independently to complete #1-#5.

LESSON 1: OPENER 10 min

Think back to the Bike and Skateboard Problem you solved in Unit 1. An essential piece of information was the relationship between the **number of bikes** and the **number of wheels** on the bikes. Represent this relationship in each of the following ways. Note that the table already contains input values.

1. In an input-output table:

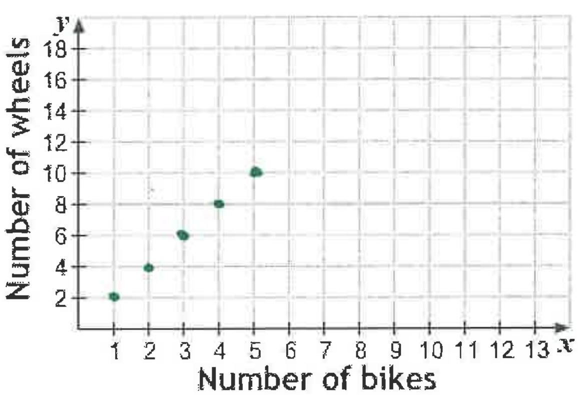
Number of bikes	Number of wheels
1	2
2	4
3	6
4	8
5	10

2. In a picture or diagram:

3. In words:

Each bike has 2 wheels. To find total wheels multiply the # of bikes by two.

4. In a graph:



5. In an algebraic rule:
(Hint: Use ***n*** to represent the number of bikes and ***w*** to represent the number of wheels.)

$w = 2n$

Do not debrief answers! It will be reviewed in core activity. As kids work take notes of strengths and trends of misconceptions

Slide 2: Review point for the day.

Goal: Students learn that mathematical relationships can be expressed in words, table, graph, algebraic rule

LESSON 1: CORE ACTIVITY

30 min

1. Compare the representations that you created in the Opener with those of your classmates. Then compare them with the representations shown in the animation. How are they similar? How are they different?

slide 3

→ Choose kids to share their diff representations.
For each one, show student work.
→ Ask: How does your representation show relationship b/w bikes & wheels?

slides 4 & 5: Don't use to teach. Use to check thinking after discussing the algebraic rule.
→ Hit the process b/w input & output

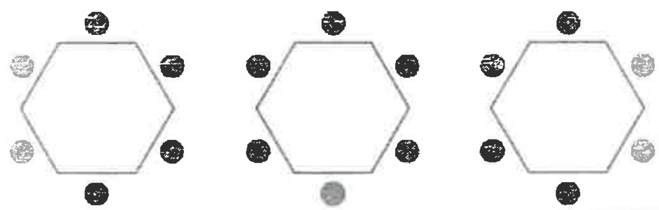
slide 6

2. Erlinda and Chris are working with a caterer to rent banquet tables for the ninth grade fall dance. The tables are hexagon shaped, and six chairs will be placed around each table. Erlinda and Chris want to determine how many tables they will need for whatever number of students plan to attend the dance.

A picture representation of the situation is shown below. Represent the relationship between the number of tables and the total number of people that can be seated as a table, as a graph, in words, and as an algebraic rule.

students read intro in partners & complete 2-4.

Picture or diagram

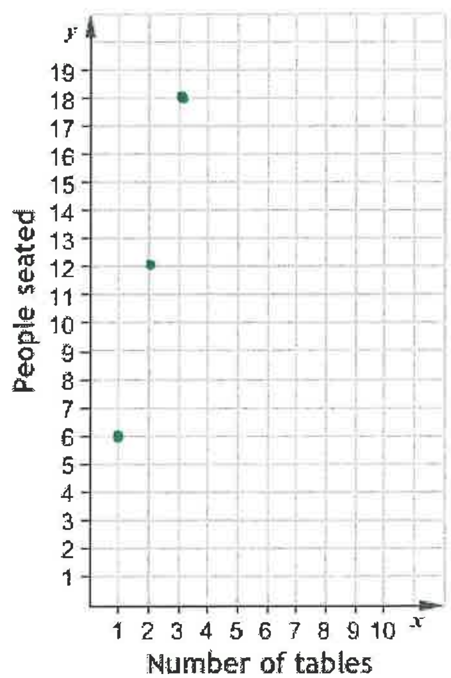


Table

Number of tables	Process	People seated
1	1·6	6
2	2·6	12
3	3·6	18

Words

Graph



Algebraic rule

Y=6X

3. Which representation do you think best illustrates the relationship between the number of tables and the number of people that can be seated? Explain your response.

Responses will vary → Require strong specific evidence

→ Hit that choice of representation should depend on what one wants to emphasize in the relationship.

4. Why might the choice of representation depend upon the question you are trying to answer?

Responses will vary → Require them to explain their answer.

Slides 7 & 8

→ These slides should only be used as a summary once you have discussed each question as a class. If used before discussion, they decrease rigor.

slide 9: Intro Problem

*work in partners

To debrief #1-#3 show student work & only discuss parts that kids demonstrated misconceptions on.

LESSON 1: CONSOLIDATION ACTIVITY 25 min

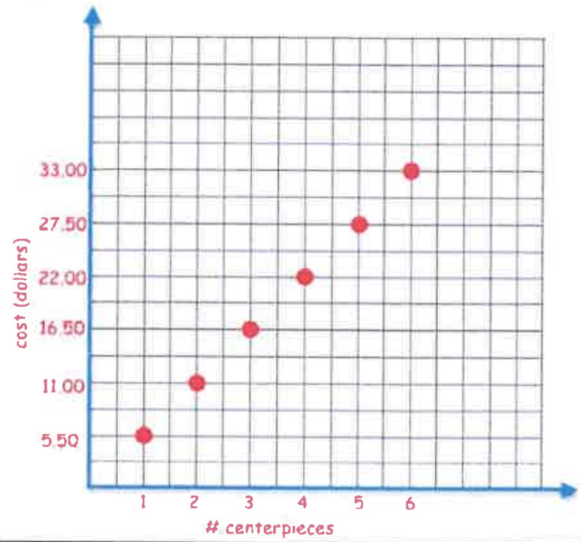
The dance committee is also responsible for other arrangements for the dance. Create tables, graphs, and algebraic rules for each of the situations described in questions 1-3. Include a process column in your tables to help you find and write the algebraic rules. Then, answer question 4. (Hint: Read through question 4, parts a-f, before making your tables and graphs.)

1. **Situation:** There will be a centerpiece on each table. A centerpiece costs $5.50. Represent the relationship between the number of centerpieces and the total cost for the centerpieces.

Table:

# centerpieces	Process	Cost
1	1 • $5.50	$5.50
2	2 • $5.50	$11.00
3	3 • $5.50	$16.50
4	4 • $5.50	$22.00
5	5 • $5.50	$27.50
6	6 • $5.50	$33.00

Graph:



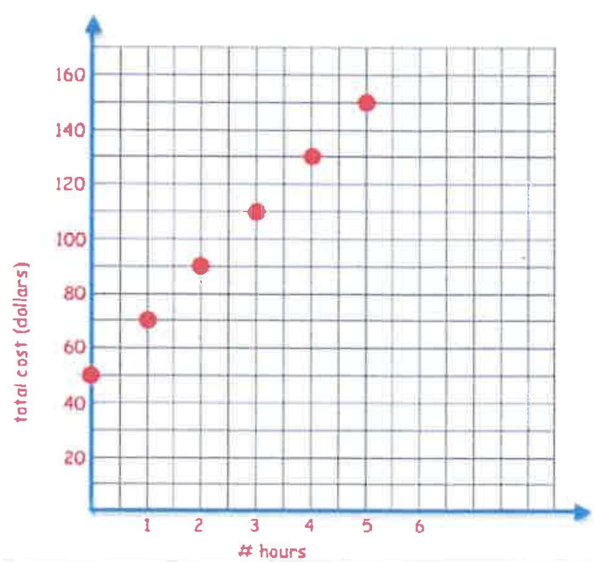
Algebraic rule:
# of centerpieces = x, cost = y ⇒ y = (5.50) x

2. **Situation:** A DJ will play music. The DJ charges $20 per hour plus a $50 appearance fee. Represent the relationship between the number of hours the DJ works and the total cost of hiring the DJ.

Table:

# hours	Process	total cost
0	0 + 50	$50
1	1(20) + 50	$70
2	2(20) + 50	$90
3	3(20) + 50	$110
4	4(20) + 50	$130
5	5(20) + 50	$150

Graph:



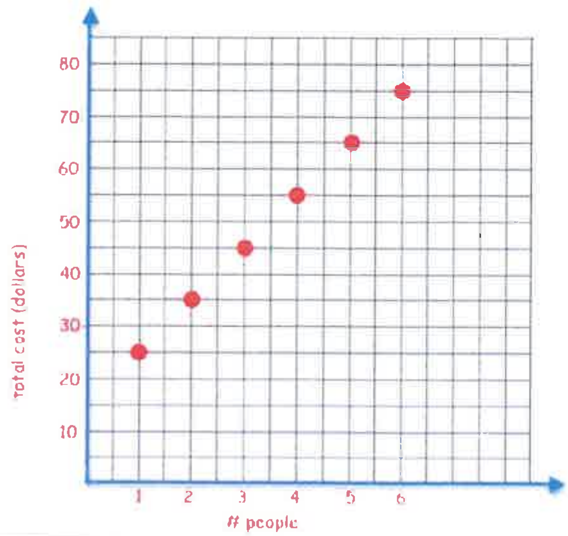
Algebraic rule:
hours = x, total cost = y ⇒ y = 20x + 50

3. **Situation:** Refreshments cost $10 per person, plus a $15 set-up charge. Represent the relationship between the number of people and the total cost for the refreshments.

Table:

# People	Process	Total Cost
1	1(10) + 15	$25
2	2(10) + 15	$35
3	3(10) + 15	$45
4	4(10) + 15	$55
5	5(10) + 15	$65
6	6(10) + 15	$75

Graph:



Algebraic rule:
people = x, total cost = y ⇒ y = 10x + 15

spend majority of discussion on these questions.

4. Use the tables, graphs, and algebraic rules you created to help you answer the following questions. Tell which representation you used and why, and describe how you found the answer.

- Extend graph or table
- rule is ALWAYS helpful!

a. How much will 10 centerpieces cost? What about 20 centerpieces?
10 centerpieces will cost $55, and 20 centerpieces will cost $110
Representation used and why: Responses will vary.

b. How many centerpieces can the committee buy for $88?
The committee can buy 16 centerpieces
Representation used and why: Responses will vary.

c. How much will the DJ charge for playing 3 hours? How much will the DJ charge for playing only 2 hours?
The DJ will charge $110 for 3 hours, and $90 for 2 hours
Representation used and why: Responses will vary.

d. The committee has budgeted a maximum of $130 for the DJ. How many hours of DJ services will that amount provide?
$130 will provide 4 hours of DJ services
Representation used and why: Responses will vary.

e. The committee is estimating that 60 to 120 people will attend the dance. How much will refreshments cost for that number of people?
Refreshments will cost between $615 and $1,215
Representation used and why: Responses will vary.

f. If the committee wants to keep refreshment costs under $1000, what is the maximum number of people who can attend the dance (assuming they all want refreshments)?
*requires rounding
$1000 will buy refreshments for 98 people
Representation used and why: Responses will vary.

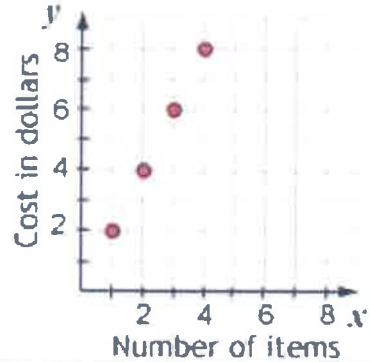
LESSON 1: HOMEWORK

Notes or additional instructions based on whole-class discussion of homework assignment:

* Kids should do all homework

1. Some, but not all, of the representations in each set model the situation described. Answer the questions for each problem.

a.

Situation	Algebraic Rule	Table	Graph
A store is having a sale. Every item in the store costs \$2, and you get to subtract \$1 from your total bill.	$y = 2x - 1$	see table below	

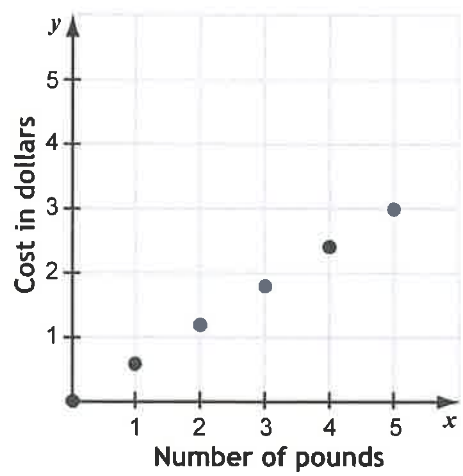
Number of items x	Cost in dollars y
1	1
2	3
6	11

Does the algebraic rule match the situation? YES / NO Explanation: Explanations will vary.

Does the table match the situation? YES / NO Explanation: Explanations will vary.

Does the graph match the situation? YES / NO Explanation: Each y is equal to 2x. There is no subtraction of \$1 from the total bill.

b.

Situation	Algebraic Rule	Table	Graph
Bananas sell for \$0.60 per pound.	$y = 0.60x$	see table below	

Number of pounds x	Cost in dollars y
2	\$1.60
5	\$4.00
6	\$4.80

Does the algebraic rule match the situation? YES / NO Explanation: Explanations will vary.

Does the table match the situation? YES / NO Explanation: Each y value is not equal to its corresponding x value multiplied by 0.6.

Does the graph match the situation? YES / NO Explanation: Explanations will vary.

2. Whenever water comes into contact with heated underground rocks, geothermal energy is generated. The underground temperature of the rocks depends on the rocks' depth below the surface. The temperature, ***t***, in degrees Celsius is estimated by the following algebraic rule:

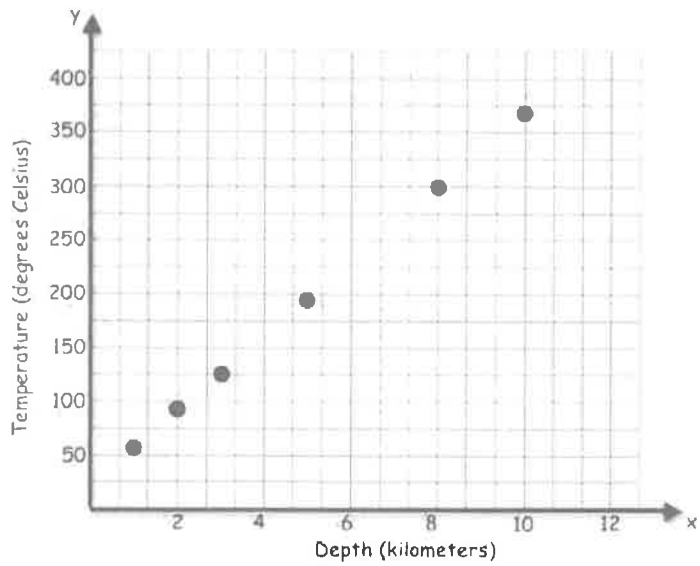
$$t = 35d + 20$$

In this rule, ***d*** is the depth of the rocks in kilometers.

a. Complete the table for this algebraic rule. Note that the table contains a process column. The first row has been completed for you.

Depth, *d* (kilometers)	Process	Temperature, *t* (degrees Celsius)
1	35 • 1 + 20	55
2	35 • 2 + 20	90
3	35 • 3 + 20	125
5	35 • 5 + 20	195
8	35 • 8 + 20	300
10	35 • 10 + 20	370

b. Create a graph for the geothermal energy situation. Use the table you created in part a.

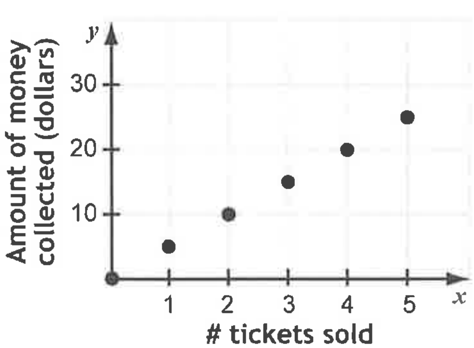


c. Use your table and/or graph to help you answer the following questions. Explain how you found your answers.

i. Find the temperature of the rocks at a depth of 3 kilometers.
125 degrees Celsius (explanations will vary)

ii. Find the depth if the temperature of the rocks is 195 degrees Celsius.
5 kilometers (explanations will vary)

3. Create tabular and algebraic representations of the information shown in the graph.



Rule for table/graph:
Amount of money collected = 5 • # tickets sold

Input (*x*) Number of tickets sold	Process	Output (*y*) Amount of money collected (dollars)
0	0 (5)	0
1	1 (5)	5
2	2 (5)	10
3	3 (5)	15
4	4 (5)	20
5	5 (5)	25

LESSON 1: STAYING SHARP

Practicing skills & concepts

1. Find the value of $b^2 - 4ac$ when $a = -2$, $b = 5$, and $c = -1$. Show your work.

$(5)^2 - 4(-2)(-1)$
$= 25 - (-8)(-1)$
$= 25 - 8$
$= 17$

2. Write an algebraic expression to represent each phrase:

a. 4 more than 7 times a number

$7x + 4$

b. 4 more than a number, then multiply the result by 7

$7(x + 4)$

Preparing for upcoming lessons

3. Consider the following magic number puzzle directions:

a. Start with a number, ***n***.
b. Divide ***n*** by 2.
c. Then add 11.

What is the algebraic rule for this magic number puzzle?

$(n/2) + 11$

4. An ***isosceles*** triangle has two congruent sides, called ***legs***. The third side is called the ***base***. An isosceles triangle has a base of 5 cm and a perimeter of 27 cm. What is the length of each leg of the triangle?

Answer with supporting work:

$27 - 5 = 22$
$22 \div 2 = 11$

Each leg is 11 cm.

*Data on this will be informative

Reviewing ideas from earlier grades

5. Bevil and Sona each got a big cookie. Sona gave Alfredo half of her cookie, and Bevil gave Alfredo one-third of his cookie. What fraction of a whole cookie did Alfredo get? Show evidence for your answer.

Alfredo received 1/2 + 1/3 of a cookie

$1/2 + 1/3$
$= 3/6 + 2/6$
$= 5/6$

Alfredo received 5/6 of a cookie

6. Match each tile below with the appropriate place on the number line.