Lesson Plan

Vats Grade 8 Write Algebraic Expressions

CCSSM: Grade 8

DOMAIN: Functions

Cluster: Use functions to model relationships between quantities.

Standard: 8.F.4: Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

Clarification: The clarification is an explanation of the indicator and objective and how these math concepts appear in the puzzle.

Materials and/or Set Up*:* ***Functions, Functions-Answers, Interactive Resource 1A; Interactive Resource 1B; Interactive Resource 1A and B Answers; Interactive Resource 2A; Interactive Resource 2B; Interactive Resource 2A and B Answers; Interactive Resource 3; Interactive Resource 3-Answers; Assessment***

Relevant Vocabulary: sequence, function rule, term, function table, coefficient, constant

Note to Teacher – The students should have a confident understanding of level 1 of Vats and they should have been exposed to level 2 of Vats before this lesson is implemented. This lesson draws connections between sequences and function rules. However, term 1 is implicitly counted as term "0" for the purposes of this lesson. For example, the sequence 2, 5, 8… would be written as $y = 3x + 2$.

In the implementation of this lesson, it is recommended that the ***Interactive Resources*** be projected to encourage a rich and active discussion of math strategies and concepts.

Activities:

1. After students have played level 1 and 2 of Vats, ask them to share their experiences and strategies.

2. Ask the students to take out a sheet of paper. Divide the class into two teams and have the team members sit together.

    - Have each team pick a leader. Assign Team A's leader the number 4. Assign Team B's leader the number 7. Have leaders write their number on the chalkboard and stand next to their number. Have the students record the initial value for each team on their own paper.
    - Assign the number 5 to each of the remaining members of Team A. Assign the number 3 to each of the remaining members of Team B.
    - Have a member of Team A stand. Ask the class: What is the total value of Team A now? (*4 + 5 = 9)* Record the 9 next to the 4 on the board.

- Have another member of Team A stand. Ask the class: What is the total value of Team A now? (*9 + 5 = 14)* Record the 14 next to the 9 on the board.
- Continue this process for the remaining members of Team A. The resulting sequence should be 4, 9, 14, 19, 24, 29, 34, 39 …. The students should record this information on their papers.
- Have a member of Team B stand. Ask the class: What is the total value of Team B now? (*7 + 3 = 10)* Record the 10 next to the 7 on the board.
- Have another member of Team B stand. Ask the class: What is the total value of Team B now? (*10 + 3 = 13)* Record the 13 next to the 10 on the board.
- Continue this process for the remaining members of Team B. The resulting sequence should be 7, 10, 13, 16, 19, 22, 25 …. The students should record this information on their papers.

3. Facilitate a class discussion to determine the number of students each team would need to have standing so that both teams would have the same value. Point out that each team's leader MUST be standing as part of the solution. *(4 people on Team A and 5 people on Team B so that both teams have a value of 19)*

4. Repeat the previous activity in smaller groups. Separate each team into two groups so that there is a total of four groups. Have each group pick a leader, assign a value to that leader, and assign a value to all other members in the group. Ask the students to record their group's sequence.

5. Have each group meet with the other group from their team to find the number of students needed so that each group has the same total value. Tell the students that they may have an infinite number of regular group members if needed. Instruct the students to justify their solution using the sequence generated by each group. Facilitate a class discussion to share each team's solution. *(Note that it is possible that two groups may generate sequences that have no common elements; for example, one sequence could contain only even numbers while the other contains only odd numbers.)*

6. Have students work in pairs to complete ***Functions.*** Facilitate a class discussion to review the solutions.

7. Lead students to discover the connection between ***Functions*** and the previous group activity. Stress the connection that the "regular" team members are the Coefficient of '*x*' and that the Team Leader is the Constant *(as he/she was "constantly" standing.)* Point out that students can predict ANY term in the sequence once they know the function rule. Ask them to predict the 100^{th} term of the sequence for Team A (*504*) and the 427^{th} term of the sequence for Team B. (*1288.*) Challenge the students to determine when the sequences will have the same value again (*y = 34, when x = 6 for Team A and x = 9 for Team B*) and how many times the values will be the same (*infinitely many*).

8. Using ***Interactive Resource 1A,*** have students work on ***Interactive Resource 1B***. Facilitate a class discussion to lead the students to determine the connection between the Function Rule and the movement for the vats. The number of spots on the vat represents the variable coefficient (*Vat A: 7, Vat B: 6*) while the number of spots until the vat's desired exit-point represents the constant (*Vat A: 1, Vat B: 3*). The mix- number will be the resulting *y*-value. (*15*) Often this mix number will occur at different *x*-values. Determining the mix number for two adjoining vats is helpful in level one, but it becomes necessary in levels two and three when the player encounters a drawbridge *(a green*

glowing bridge).

Differentiation Suggestions:

- If the students are having difficulty determining the function rule, have them repeat the group activity where the students choose a value for the leader and a value for the other team members. For more practice, have the students work in small groups using ***Interactive Resource 2A*** and ***Interactive Resource 2B***.
- For the students who have mastered this concept quickly, use ***Interactive Resource 3*** in which students must explain why there isn't always a common outcome.

Assessment:

- Distribute the ***Assessment*** resource sheet.
- Answers:
  1. *$y = 5x + 6$*
  2. *2419*
  3. *Part A: Jack will have $23 in 3 weeks; Jill will have $23 in 4 weeks.*
     Part B: They will both have $43 in 8 weeks.

Follow Up:

- Have students return to the puzzle to apply what they learned in the lesson. Ask: Did the lesson help you to clarify the math in the puzzle? How? What other strategies could you have used to help you solve the puzzle? Additionally, check student game progress through the Administrator's Tool to determine students' level of understanding.

- Provide the students with this scenario:

  Suppose that you want to move your avatar and two green monsters all at the same time. The three Vats involved have these three function rules:

Vat A	Vat B	Vat C
$y = 8x + 2$	$y = 5x + 3$	$y = 3x + 1$

  Is it possible to find a number of times to mix that will result in all three vats opening at the same time? If so, what is the number of times you should mix? If not, explain why not. (*It is possible to open all three vats at the same time. You should mix 58 times. For Vat A, $x = 7$; for Vat B, $x = 11$; for Vat C, $x = 19$.)*

Real World Connection:

- Provide students with this scenario:

Sam has $2,300 in his college fund. He deposits $100 per month into the account. Michelle has $2,700 in her college fund. She deposits $50 per month into the account.

- In how many months will Sam have $2,700? How much will Michelle have at that time? *(Sam will have $2,700 in 4 months. Michelle will have $2,900 at that time.)*

- In how many months will both Sam and Michelle have the same amount? What will that amount be? (*They will both have the same amount in 8 weeks. The amount will be $3,100.)*

Functions

Team A

Sequence: 4, 9, 14, 19, 24, 29, 34, 39, …

Function Rule: $y = 5x + 4$

x	Function Rule	y
0	$y = 5(0) + 4$ $y = 4$	4
1	$y = 5(1) + 4$ $y = 5 + 4$	9
2	$y = 5(2) + 4$ $y = 10 + 4$	14
3	$y = 5(3) +$ ___ $y =$ ___ + ___	19
4	$y =$ $y =$	24
5		
11		

Team B

Sequence: 7, 10, 13, 16, 19, 22, 25, …

Function Rule: _____

x	Function Rule	y
0		
1		
2		
3		
4		
5		
11		

Functions – Answers

Team A

Sequence: 4, 9, 14, 19, 24, 29, 34, 39, …

Function Rule: $y = 5x + 4$

x	Function Rule	*y*
0	$y = 5(0) + 4$ $y = 4$	4
1	$y = 5(1) + 4$ $y = 5 + 4$	9
2	$y = 5(2) + 4$ $y = 10 + 4$	14
3	$y = 5(3) + \mathbf{4}$ $\mathbf{y = 15 + 4}$	19
4	$\mathbf{y = 5(4) + 4}$ $\mathbf{y = 20 + 4}$	24
5	$\mathbf{y = 5(5) + 4}$ $\mathbf{y = 25 + 4}$	**29**
11	$\mathbf{y = 5(11) + 4}$ $\mathbf{y = 55 + 4}$	**59**

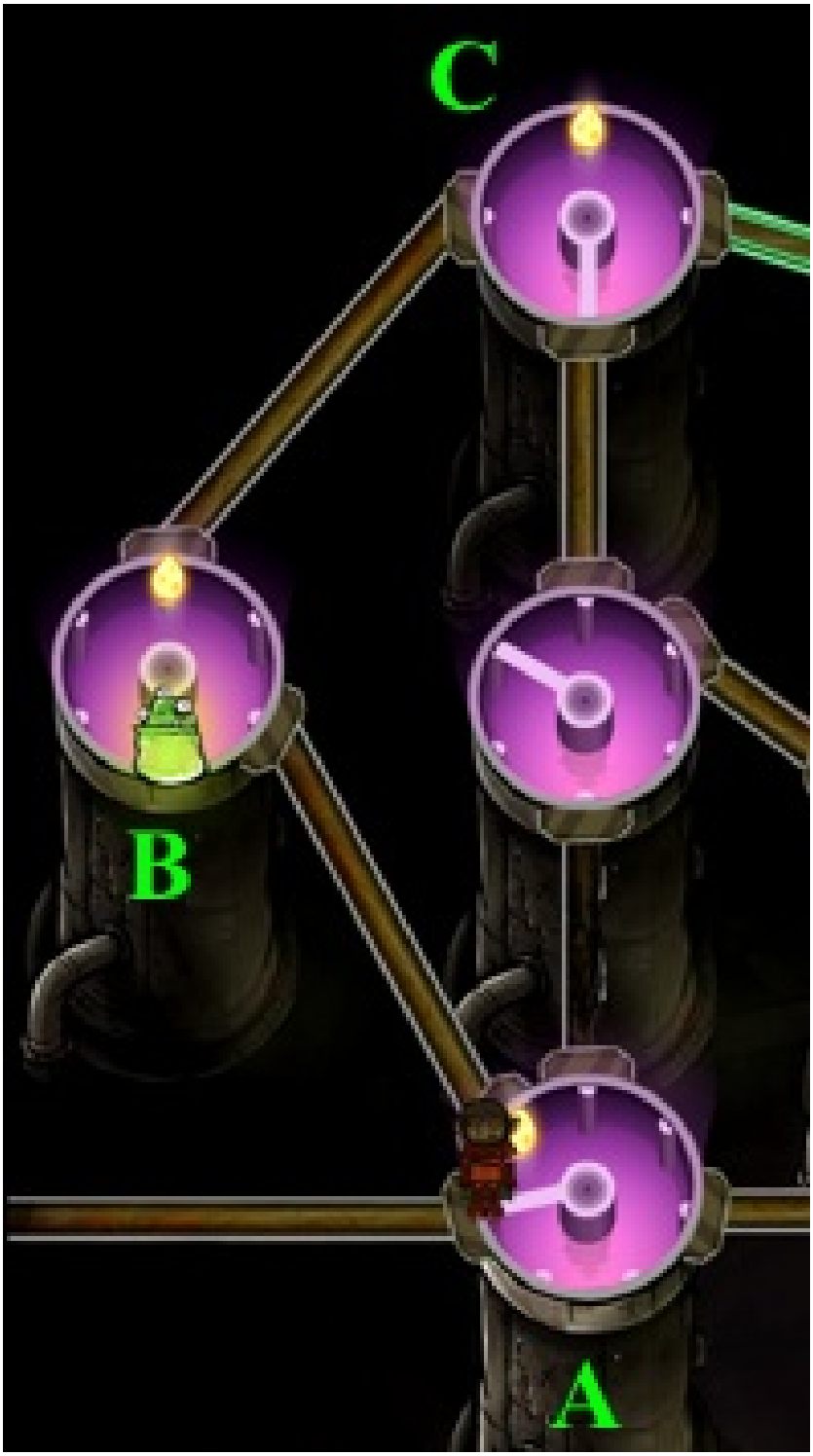
Team B

Sequence: 7, 10, 13, 16, 19, 22, 25, …

Function Rule: $\mathbf{y = 3x + 7}$

x	Function Rule	*y*
0	$\mathbf{y = 3(0) + 7}$ $\mathbf{y = 7}$	**7**
1	$\mathbf{y = 3(1) + 7}$ $\mathbf{y = 3 + 7}$	**10**
2	$\mathbf{y = 3(2) + 7}$ $\mathbf{y = 6 + 7}$	**13**
3	$\mathbf{y = 3(3) + 7}$ $\mathbf{y = 9 + 7}$	**16**
4	$\mathbf{y = 3(4) + 7}$ $\mathbf{y = 12 + 7}$	**19**
5	$\mathbf{y = 3(5) + 7}$ $\mathbf{y = 15 + 7}$	**22**
11	$\mathbf{y = 3(11) + 7}$ $\mathbf{y = 33 + 7}$	**40**

Interactive Resource 1A



Interactive Resource 1B

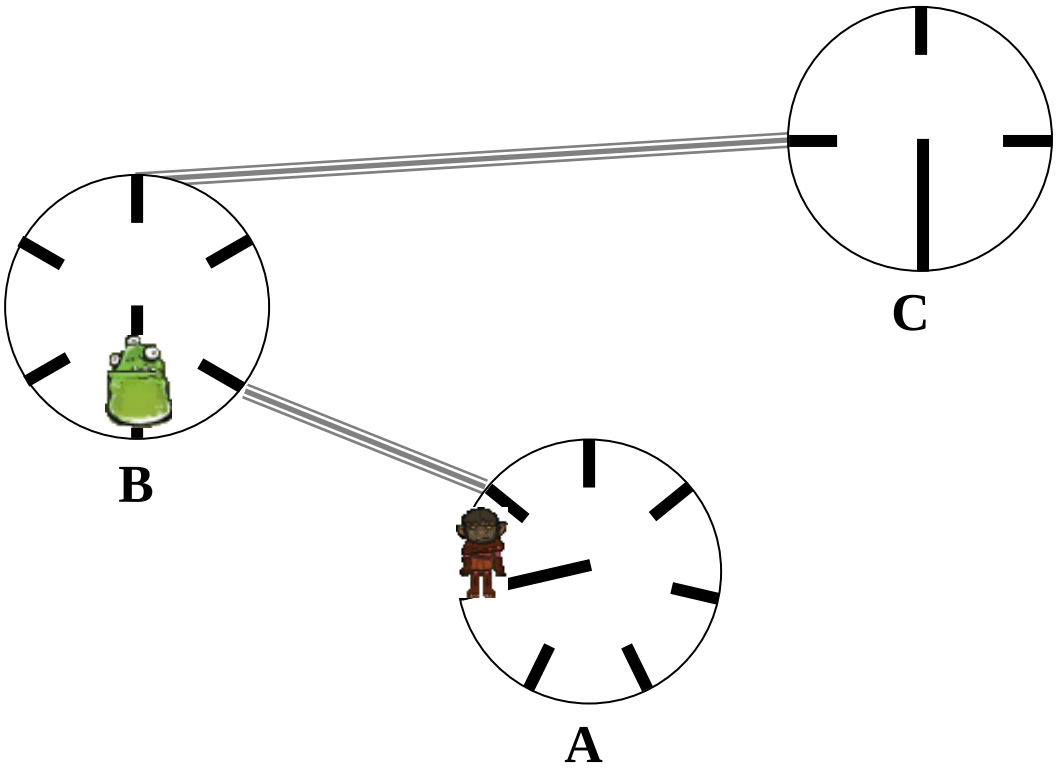
Determine the rules needed to move your avatar from Vat A to Vat B and at the same time move the green monster from Vat B to Vat C.

Sequence: _____ Sequence: _____

Function Rule A: _____ Function Rule B: _____

x	Function Rule	*y*
0		
1		
2		
3		
4		
5		

x	Function Rule	*y*
0		
1		
2		
3		
4		
5		



Interactive Resources 1A and B - Answers

Determine the rules needed to move your avatar from Vat A to Vat B and at the same time move the green monster from Vat B to Vat C.

Sequence: 1, 8, 15, 22, 29, 36, …

Function Rule A: $y = 7x + 1$

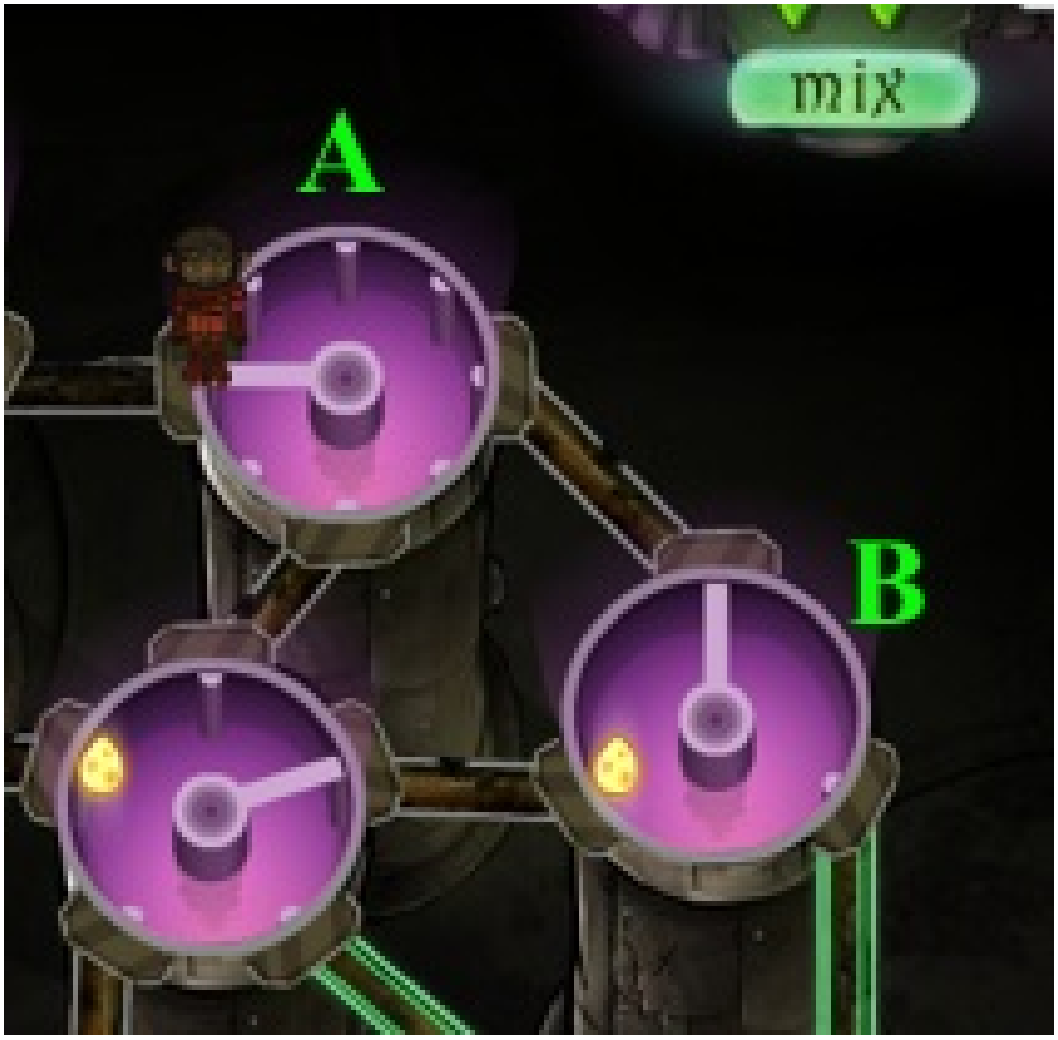
x	Function Rule	y
0	$y = 7(0) + 1$	1
1	$y = 7(1) + 1$	8
2	$y = 7(2) + 1$	15
3	$y = 7(3) + 1$	22
4	$y = 7(4) + 1$	29
5	$y = 7(5) + 1$	36

Sequence: 3, 9, 15, 21, 27, 33, …

Function Rule B: $y = 6x + 3$

x	Function Rule	y
0	$y = 6(0) + 3$	3
1	$y = 6(1) + 3$	9
2	$y = 6(2) + 3$	15
3	$y = 6(3) + 3$	21
4	$y = 6(4) + 3$	27
5	$y = 6(5) + 3$	33

Interactive Resource 2A



Interactive Resource 2B

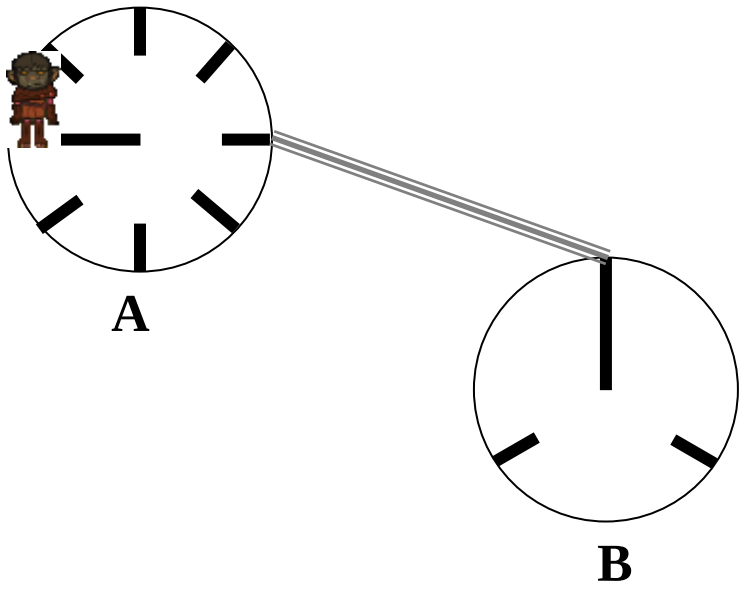
You want to use the smallest mix number possible to move your Avatar from Vat A to Vat B. Set up two Function Rules and two Function Tables to see how many times you need to mix the vats.

Function Rule A: _____

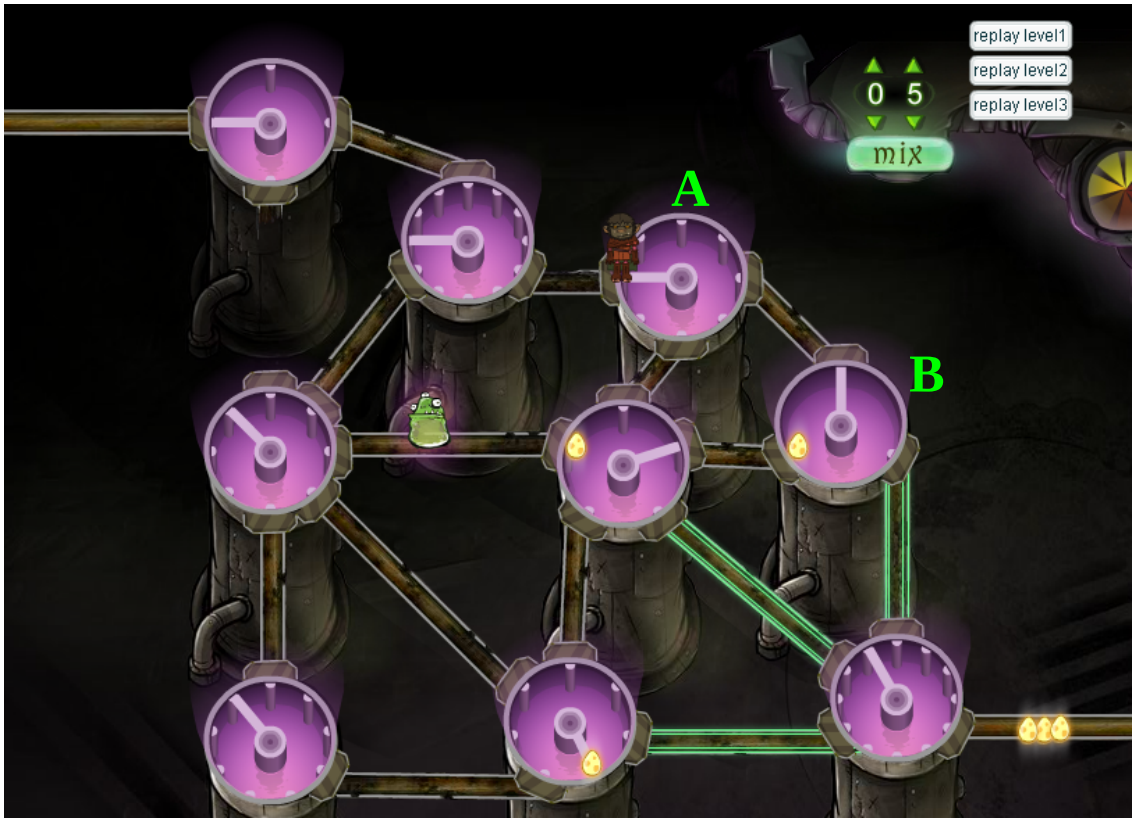
x	Function Rule	*y*
0		
1		
2		
3		
4		
5		

Function Rule B: _____

x	Function Rule	*y*
0		
1		
2		
3		
4		
5		



Interactive Resource 2A and B - Answers



You want to use the smallest mix number possible to move your Avatar from Vat A to Vat B. Set up two Function Rules and two Function Tables to see how many times you need to mix the vats.

Function Rule A: $y = 8x + 4$

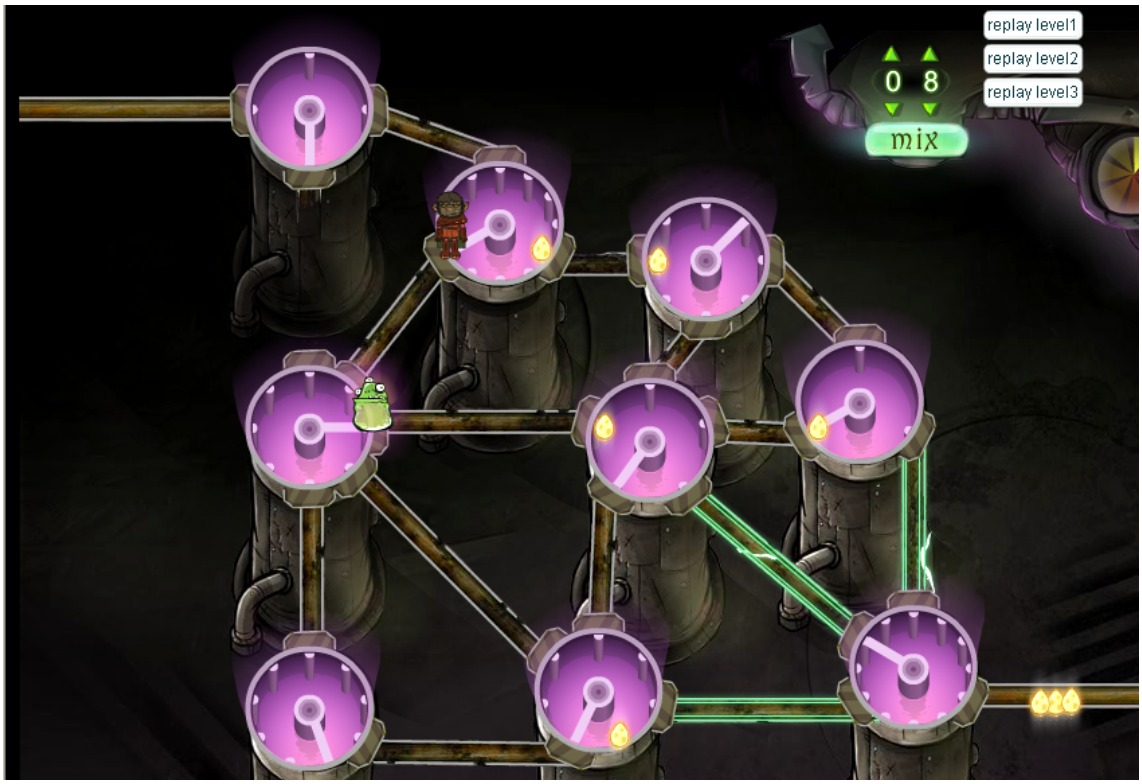
x	Function Rule	y
0	$y = 8(0) + 4$	4
1	$y = 8(1) + 4$	**12**
2	$y = 8(2) + 4$	20
3	$y = 8(3) + 4$	28
4	$y = 8(4) + 4$	36
5	$y = 8(5) + 4$	44

Function Rule B: $y = 3x + 0$

x	Function Rule	y
0	$y = 3(0) + 0$	0
1	$y = 3(1) + 0$	3
2	$y = 3(2) + 0$	6
3	$y = 3(3) + 0$	9
4	$y = 3(4) + 0$	**12**
5	$y = 3(5) + 0$	15

You should mix 12 times.

Interactive Resource 3

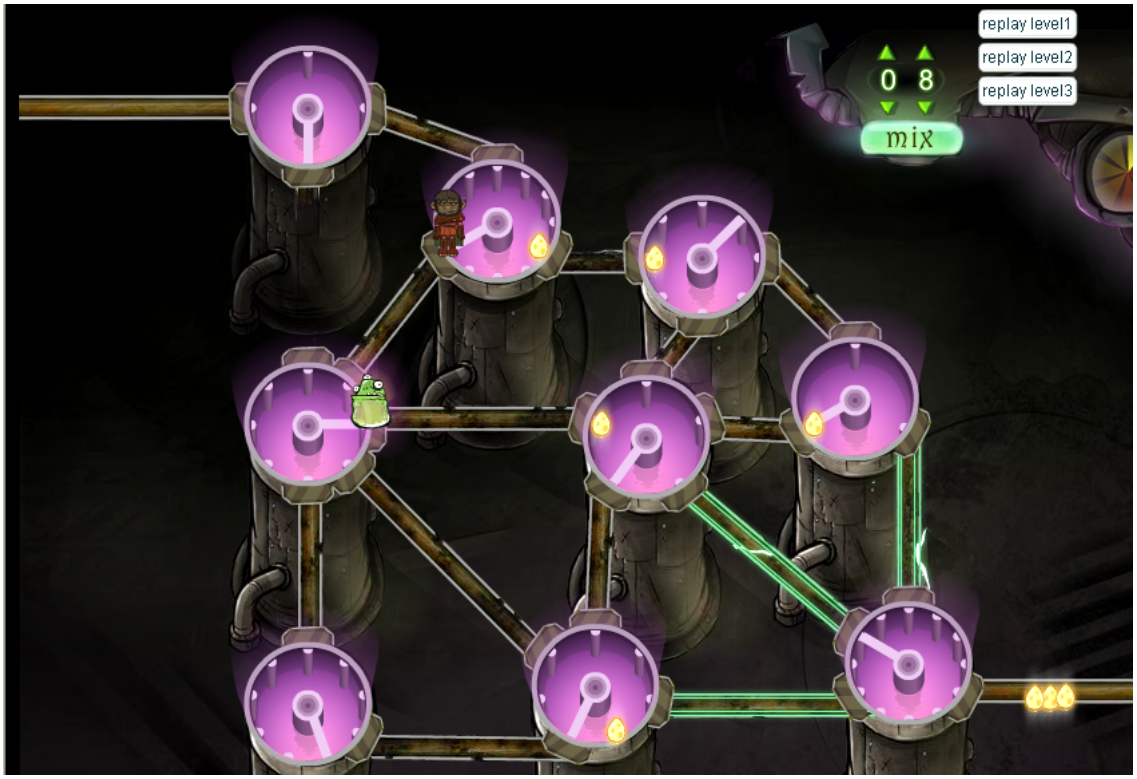


You want to move your Avatar from Vat A into Vat B in ONE step.

Create a set of Function Tables.

How many times should you mix the vats? Explain your answer.

Interactive Resource 3-Answers



You want to move your Avatar from Vat A to Vat B in ONE step.
Create a set of Function Tables.
How many times should you mix the vats? Explain your answer.

The move cannot be done in one step. Students should explain that one vat will always be odd and one vat will always be even, so there is no common outcome.

Function Rule A: $y = 12x + 8$

x	Function Rule	y
0	$y = 12(0) + 8$	8
1	$y = 12(1) + 8$	20
2	$y = 12(2) + 8$	32
3	$y = 12(3) + 8$	44
4	$y = 12(4) + 8$	56
5	$y = 12(5) + 8$	68

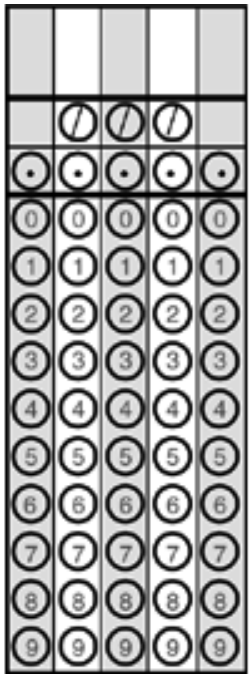
Function Rule B: $y = 8x + 5$

x	Function Rule	y
0	$y = 8(0) + 5$	5
1	$y = 8(1) + 5$	13
2	$y = 8(2) + 5$	21
3	$y = 8(3) + 5$	29
4	$y = 8(4) + 5$	37
5	$y = 8(5) + 5$	45

Assessment

1. Write a Function Rule for the Sequence: 6, 11, 16, 21…

2. Use the Function Rule: $y = 8x + 3$. What is the value of the 302^{nd} term?



3. Jack has $11 and earns $4 each week. Jill has $3 and earns $5 each week.

Part A
In how many weeks will Jack have $23? In how many weeks will Jill have $23?

Part B
In how many weeks will both Jack and Jill have the same amount of money at the same time?

