

## Chapter 6: Graphing and solving linear relations

### CH 6.1 - Representing Patterns

#### Vocabulary

##### Expression -

any number or variable, or a combination of operations ( $-$ ,  $+$ ,  $\times$ ,  $\div$ , etc.) involving numbers and variables.

Example:  $2n-2$  ;  $3-x$  ;  $y^2$

##### Equation -

- a mathematical statement with two expressions that are equal
- "has an equals" sign.

Example:  $y = 2x - 2$  ;  $p = 3n + 1$  ;  $y = 2x$  ;  $x = 4$

##### Dependent Variable - Output.

- a variable whose value depends on the value of another variable.
- always on the "y" axis of a graph.

Example: measuring a plant's height over time. The height depends on how long (time) it has been growing.

##### Independent Variable - Input.

- a variable whose value does not depend on the value of another variable.
- always on the "x" axis of a graph.

Example:

Plant height vs. time.  $\rightarrow$  The time does not depend on the height of the plant. So time is the independent variable.

## Describe a pictorial pattern with an expression

### Example -

1. Describe the pattern
2. Determine an expression to represent the pattern
3. How many squares in figure 12?
4. What figure number has 52 squares?

### Key Points

#### Describing the pattern

##### Determine what the pattern is

- How do the number of squares ( $s$ ) change as the figure number ( $n$ ) changes?

##### Make a table of values

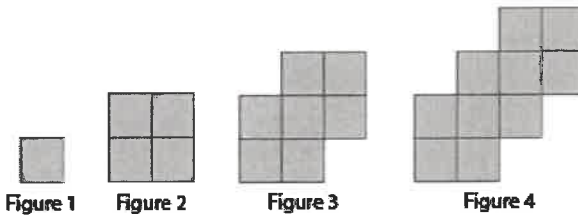
- Record the # of squares ( $s$ ) for each figure number ( $n$ )
- How many squares will there be in figure 6? 10?

↓  
16.

#### Representing the pattern with an expression

- What "rule" can we come up with for this pattern that gives us the correct number of squares for each figure number
- Check your expression by substituting in known values of  $n$  (figure number) to see if we get the correct value for  $s$  (squares)

Figure # =  $n$   
Squares =  $s$



① For every 1 figure # we gain 3 squares.

②

| $n$ | $s$ | $3n$        | $3n - 2$          |
|-----|-----|-------------|-------------------|
| 1   | 1   | $3(1) = 3$  | $3(1) - 2 = 1$ ✓  |
| 2   | 4   | $3(2) = 6$  | $3(2) - 2 = 4$ ✓  |
| 3   | 7   | $3(3) = 9$  | $3(3) - 2 = 7$ ✓  |
| 4   | 10  | $3(4) = 12$ | $3(4) - 2 = 10$ ✓ |
| 5   | 13  |             |                   |
| 6   | 16  |             |                   |

3 squares for every 1 figure. → so ~~the~~ multiply  $n$  by 3 first.   
 what we expect to see

③  $S = 3n - 2$  (figure 12).  $n = 12$ .

$$S = 3(12) - 2$$

$$S = 36 - 2$$

$$S = 34$$

④  $S = 3n - 2$  (squares).  $s = 52$

$$52 = 3n - 2$$

$$54 = \frac{3n}{3}$$

$$18 = n$$

"undo" everything that was done to ( $n$ ).  
Must do the same to both sides of equation.

#### Discrete Relationship -

- distinct points that are not connected (on a graph)
- a relationship with only a certain (finite) # of possible outcomes.  
ex. In our pattern above, we can only have 1, 4, 7, 10... squares. We cannot have 2, 3, 5, 6... # of squares.

**Try it out -**

- a) What expression and equation represent the number of circles in this pattern? Check your answer by substituting a known value into the expression.



Figure 1



Figure 2



Figure 3

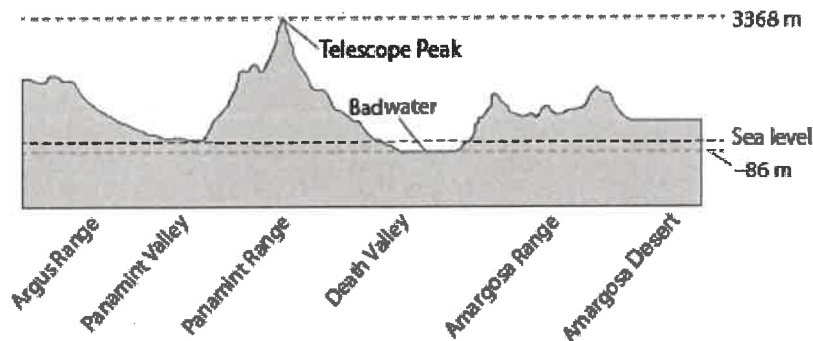


Figure 4

- b) How many circles are in Figure 71? Explain how you determined the answer.
- c) What figure number has 83 circles? How did you determine your answer?

## Describe a written patterns with an equation

Death Valley, located in eastern California, is the lowest point of elevation in North America, at  $-86$  m. A tourism company wants to make a promotional video of the region. They release a drone from the lowest point to film the landscape as the drone rises at a constant rate of  $2$  m/s. The drone continues up until it reaches a campsite located  $194$  m above sea level on the side of Telescope Peak (elevation  $3368$  m).



- Create a table of values showing the height of the drone from the time it is released ( $t = 0$ ) to when it reaches a height of  $194$  m. Use a time interval of  $20$  s for your table.
- Use your table to estimate how long it takes the drone to reach sea level, an elevation of  $0$  m. How accurate is your estimate? Explain your answer.
- What equation describes the relation between time and the height of the drone?
- What is the drone's height  $95$  s after it has been released?
- Use your equation to confirm your answer to part b).

a)

| time (s) | Elevation height (m) |
|----------|----------------------|
| 0        | -86                  |
| 20       | -46                  |
| 40       | -6                   |
| 60       | 34                   |
| 80       | 74                   |
| 100      | 114                  |
| 120      | 154                  |
| 140      | 194                  |

$$\text{rate} = \frac{2\text{m}}{1\text{s}} \quad \text{so} \quad \frac{2\text{m}}{1\text{s}} \times 20 = \frac{40\text{m}}{20\text{s}}$$

b)  $0$  m falls between these two points.  $-6$  is closer to  $0$  than  $34$  so the time should be closer to  $40$  s.  
est.  $\sim 42-44$  s.

$$c) \quad h = 2t - 86$$

$\uparrow$  change in elevation per second.

$$d) \quad h = 2(95) - 86$$

$$h = 190 - 86$$

$$h = 104\text{m.}$$

$$e) \quad 0 = 2t - 86$$

$$+86 \quad +86$$

$$86 = 2t$$

$$\frac{86}{2} = \frac{2t}{2}$$

$$43\text{s} = t$$

### Continuous Relationship -

- a relationship with an infinite # of possible outcomes.
- ex. you can find <sup>any # of</sup> times and elevations between the points given in the table.

Practice assignment: page 183 # 1, 2, 4, 8, two apply questions