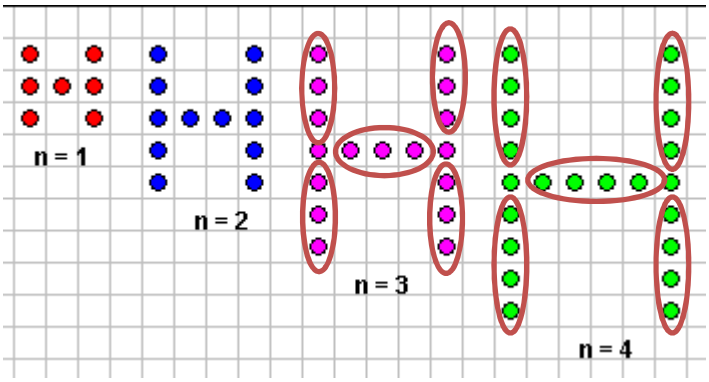
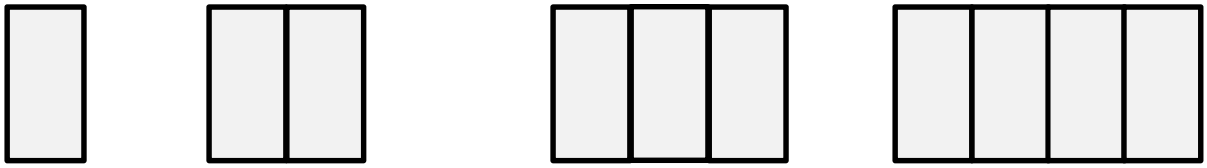
Pattern Practice Problems

1. a. Find and circle some helpful sets/groupings in the pattern below
b. Write an explanation of how to draw the 10^{th} shape in the pattern.
c. Find a formula that tells how many dots will be in the n-th shape of the pattern. Explain how your formula matches the visual pattern.



b. In the middle, draw 12 dots horizontally. Then from the dot on the left, make 10 more dots up, and 10 more dots down. From the dot on the right, make 10 dots up and 10 dots down.
c. One formula is (n+2)+4n because there's a set of n+1 dots horizontally, and 4 more sets of n dots going up and down.
Another formula is 5n+2 because there are 5 sets of n dots (where I circled them in the picture) and 2 more dots where the sets meet that always stay the same.

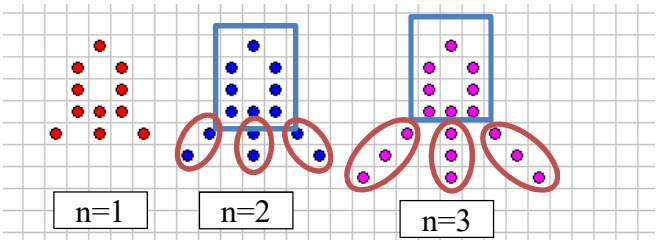
2. This pattern is made out of dominos: rectangles **1 unit wide and 2 units long**.
Find a formula to tell what the perimeter of the n-th pattern is, and explain your formula.



n=1 n=2 n=3 n=4

The nth pattern will have a perimeter that is 2n+4. There are n dominoes, and each one has length 2 showing: 1 on the top and 1 on the bottom, so that's 2n. There are also 4 more units showing, 2 on the left, and 2 on the right.

3. In the rocket pattern (below)



a. Find a formula that tells how many dots it takes to make the n-th rocket. Explain how your formula fits the pictures.
The rocket body always has 8 dots (blue)
Then there are 3 rocket fins (red), and each fin has n dots, so the pattern is **8+3n**

b. What is the biggest rocket you can make using only 80 dots?
80=8+3n
72=3n
n=24. You can make the 24th rocket.

c. Explain how to find the biggest rocket you can make using D dots.
D=8+3n
D-8=3n
n = (D-8)÷ 3. Subtract 8 to use 8 dots to make the rocket body. Then divide by 3 to split the rest of the dots up evenly to make the fins.
If there's a remainder, then round down to the nearest whole number because you can't use more than 80 dots.

d. What is the smallest rocket that has at least 100 dots?
100=8+3n
92=3n
n=30R2
To be more than 100 dots, I would have to make the 31st rocket

e. Explain how to find the smallest rocket that has at least N dots.

N=8+3n
N-8=3n
n = (N-8)÷ 3.
Subtract 8 to use 8 dots to make the rocket body. Then divide by 3 to split the rest of the dots up evenly to make the fins.
If there's a remainder, round up, because we need to have at least N dots.

4. Amy has **round beads** in 7 rainbow colors (ROYGBIV) and she has **magnet beads** that she puts on the ends as fastners **(all the same length)**. She is using them to make necklaces. She made a necklace with one rainbow with magnet ends for a Barbie doll, and she made a necklace with 2 rainbows and magnet ends for another doll.

1 rainbow (9 beads) 

2 rainbows (16 beads) 

a. If Amy made a necklace with 3 rainbows, how many beads would it have?

It would have 7+7+7+2=23 beads

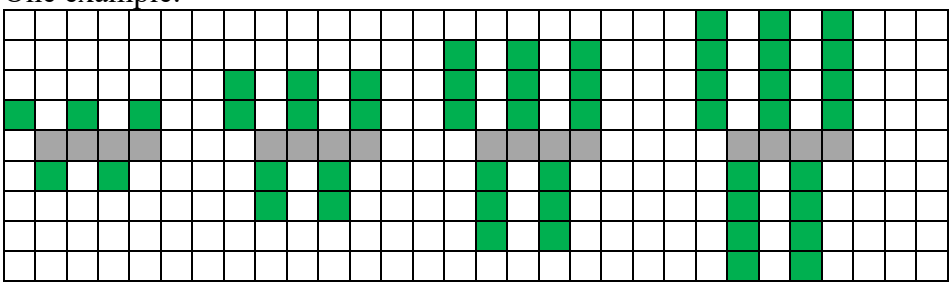
b. Amy cut a length of bead wire long enough for 57 beads. ***Show*** how to figure out how many complete rainbows can she make on a necklace with this bead wire.

I can use a formula 7n+2=57 and solve for n:
7n+2=57
7n=55
n=7 R 6
She can only make 7 complete rainbows—there wouldn't be enough room for the 8th rainbow to fit.

c. ***Explain*** how to figure out how many complete rainbows can be made on a necklace like this on a bead wire that is long enough for N beads.

7n+2=N
7n = N-2 Subtract 2 from N to make sure you leave room for the two magnets at the ends
n = (n-2)÷ 7 Then divide N-2 by 7 to find out how many sets of 7 beads will fit on the wire.
If there is a remainder then that represents a rainbow that's not complete, so don't include it in the answer (round down to the nearest whole number)

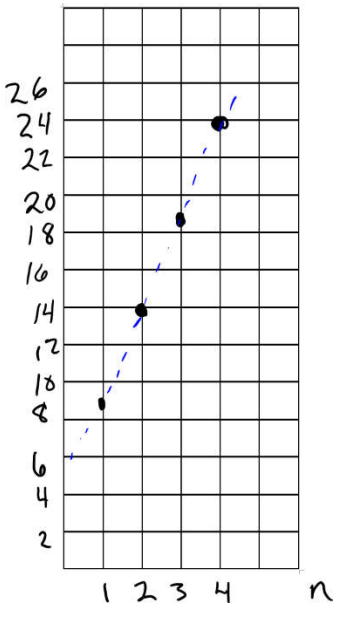
5. a. Draw a visual (number of squares) pattern for the function: 5n+4
One example:



b. Make a table and a graph showing how many squares are in the nth pattern.

n	Number squares	Difference
1	9	
2	14	
3	19	
4	24	

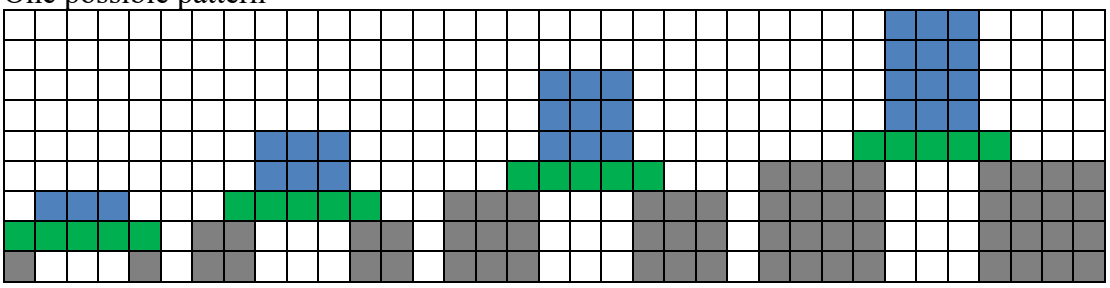
5
5
5



c. The pattern is linear. It grows by 5 every time.

6. a. Draw a visual (number of squares) pattern for the function: $2n^2+3n+5$

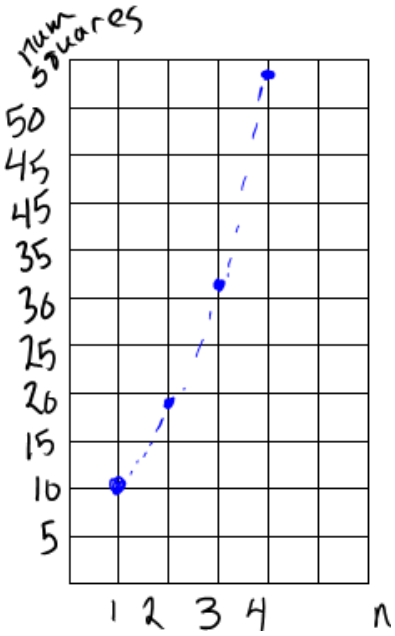
One possible pattern



b. Make a table and a graph showing how many squares are in the nth pattern.

n	Number squares	Difference
1	10	
2	19	9
3	32	13
4	49	17

9 > 4, 13 > 4



c. Show on your table how much the pattern grows by each time (blue—first differences—is enough for full credit). Is the pattern linear or slower than linear or faster than linear in how it grows?

The pattern increases by more the further it goes—it increases faster than linear growth. The differences in crease. [Optional: the differences go up by 4 every time]

7. Use the order of operations correctly to calculate:

a. $12-7+3$ **= 8**

b. $24\div2\div2\times3$ **= 18**

c. $80-5\cdot2^3+20\div5\times2$ **= 48**

d. $2\cdot6^2\div3$ **= 24**