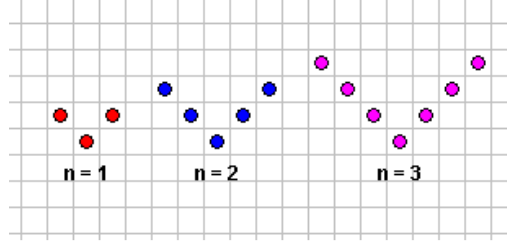


Some problems that use patterns.

Solve these on a separate sheet of paper.

1. In the dot pattern V-numbers, we discovered that there were $d=2n+1$ dots in the n th pattern.



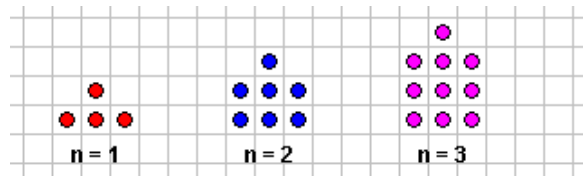
There is 1 dot at the bottom of the pattern, and 2 sets of n dots, one on either side.

- At what step (n) of the pattern are there 101 dots?
- What is the highest pattern step (n) that you could make with 84 dots?
- What is the highest pattern step (n) that you can make with A dots? (make sure you explain what to do if you have a remainder when dividing)
- What is the smallest pattern step (n) that would include at least 140 dots?
- What is the smallest pattern step (n) that would include at least B dots? (explain remainders)
- If you solved e using an equation, show how to solve by reasoning about the pattern. If you solved e by reasoning, show how to solve using the equation.

2. At the convention, each attendee gets a badge. There are 3 badge holders left over from the previous convention, and then new packages of badge holders are opened. Badge holders come in packages of 8.

- Find an equation telling how many badge holders there are available if n packages are opened. Explain the equation.
- If there are 20 people at the convention, how many packages of badge holders will be opened?
- If there are 100 people at the convention, how many packages of badge holders will be opened?
- If there are N people at the convention, how many packages of badge holders will be opened?
- If you solved d using an equation, show how to solve by reasoning about the pattern. If you solved d by reasoning, show how to solve using the equation.

3. For the dot pattern tower numbers:



- Find and explain an equation for tower numbers (how many dots in pattern n)
- Is there a tower that has exactly 100 dots? If so, how many stories does it have? If not, how do you know?
- How many stories tall (n) would the shortest tower be that had at least 264 dots?
- How many stories tall (n) would the shortest tower be that had at least A dots?
- How many stories tall (n) would the highest tower you could make with 126 dots be?
- How many stories tall would the highest tower you could make with B dots be?
- If you solved f using an equation, show how to solve by reasoning about the pattern. If you solved f by reasoning, show how to solve using the equation.

4. In a pattern block train made with trapezoids, the perimeter of a train made with n blocks is $p=3n+2$, because each of the n trapezoids have 3 units on the top and bottom, and there are 2 more units on the left and right ends of the train.

- Is there a trapezoid train that has a perimeter of exactly 100 units? If so, how many blocks does it take to make the train? If not, how do you know it's impossible?
- How many pattern blocks would it take to make a train that has a perimeter of at least 234 units?
- How many pattern blocks would it take to make a train that has a perimeter of at least P units?
- If you are only allowed a maximum perimeter of 150 units, how many pattern blocks would it take to make the longest such train?
- If you are only allowed a maximum perimeter of P units, how many pattern blocks would it take to make the longest such train?
- If you solved e using an equation, show how to solve by reasoning about the pattern. If you solved e by reasoning, show how to solve using the equation.