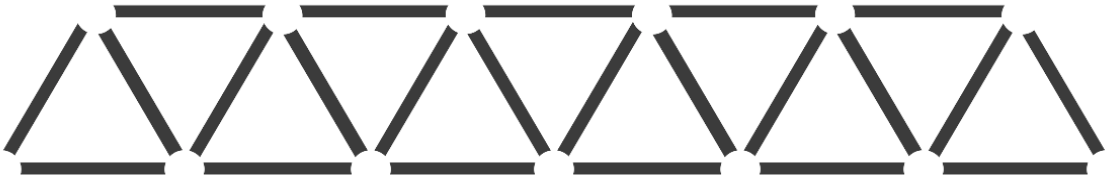
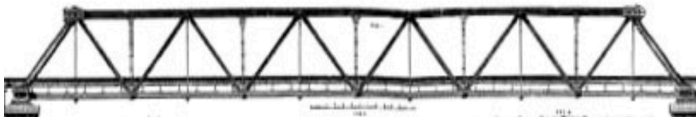
TRUSS PATTERNS

The Warren Truss is one of the most famous designs used in building bridges, and for good reason. Its use of equilateral triangles allows it to support more weight than many other truss patterns.

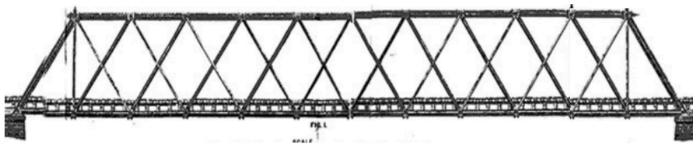
The image above is of a **6-span** bridge that uses a Warren Truss. It is called a 6-span because it has 6 steel beams across the bottom. It uses a total of **23 steel beams** to build. You can see the 23 beams more clearly in the diagram below.



1. How many beams would it take to build a 2-span bridge? 3-span bridge? 4-span bridge?
2. How many steel beams would it take to build a 50-span bridge? How do you know?
3. Describe a rule for calculating the number of steel beams needed based on the span length of the bridge.
4. Create a picture/diagram that would help someone understand **why** your rule works.
5. (+) Repeat Questions 1-4, this time using the Supported Warren Truss and the Double Warren Truss.



Supported Warren Truss
(6-span)



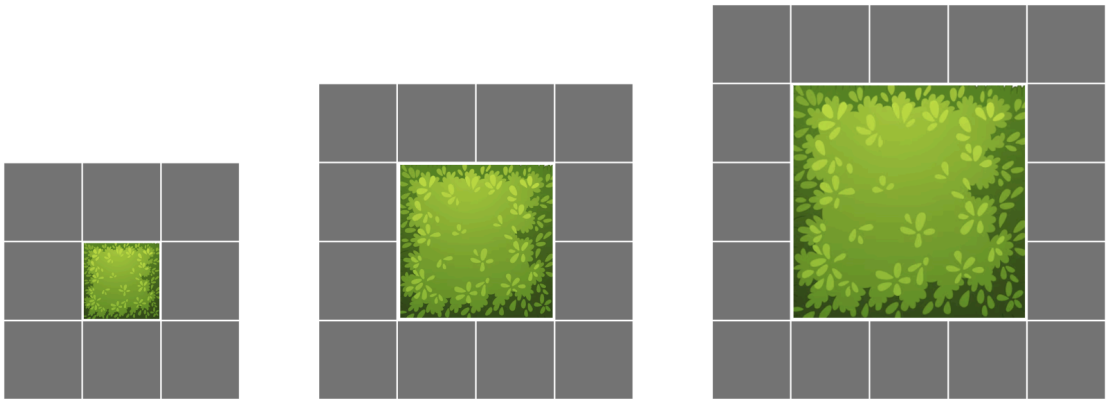
Double Warren Truss
(6-span)

ON YOUR OWN

Truss Patterns

Can I interpret and create expressions?
What does it mean for expressions to be equivalent?

1. A local landscaping business frequently uses square concrete tiles to form a border around gardens and other grassy areas. Because they use them so often, it would be helpful for them to know how many tiles they will need based on the size of the area they are bordering.



1 x 1 Garden | **2 x 2 Garden** | **3 x 3 Garden**

a. How many square tiles would it take to border a 4 x 4 garden? 10 x 10? 50 x 50?

b. Create a rule that will give the number of square tiles needed based on the dimensions of the garden. Draw a picture that helps explain why your rule works.

2. Here are several different expressions that students have created for Question 1. The variable n represents a side length of the garden and the value of the expression is the number of square border tiles needed.

Student 1	Student 2	Student 3
$4(n + 2)$	$(n + 2)^2 - n^2$	$2(n + 2) + 2n$

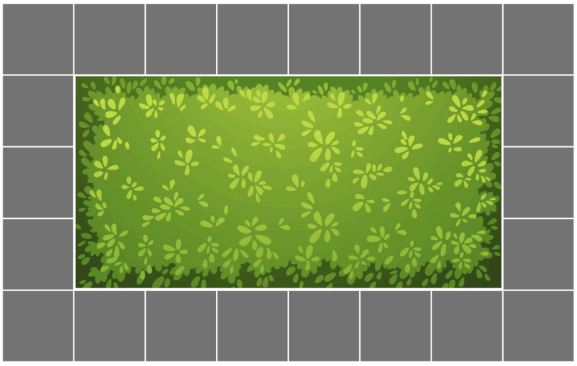
a. Are all three of these expressions **equivalent** to each other? That is, do the expressions have the same value for *all* values of n?

b. Which of these expressions, if any, correctly model the garden border situation? How do you know?

c. (+) How do you think each student might have been 'seeing' the garden border problem to come up with their expression? (For example, where might Student 1 see the '$n + 2$' in the pictures? Why are they multiplying it by 4?)

3. Andre says that $10x + 6$ and $5x + 6$ are equivalent because they both equal 16 when x is 1. Do you agree or disagree that these are equivalent expressions? Explain your reasoning.

4. (+) Of course, not all garden areas will be square in shape. Sometimes, the garden area might be rectangular.



a. How many tiles would be needed to border a 4x7 garden? 6x10 garden? 20x53 garden?

b. Create a rule that will give the number of tiles needed based on the length and width of the garden.

5. (+) Some customers even request that the garden area be bordered with more than one 'layer' of tiles. Extend your rule from Question 3b to give the number of tiles needed based on the length, width, and number of layers.