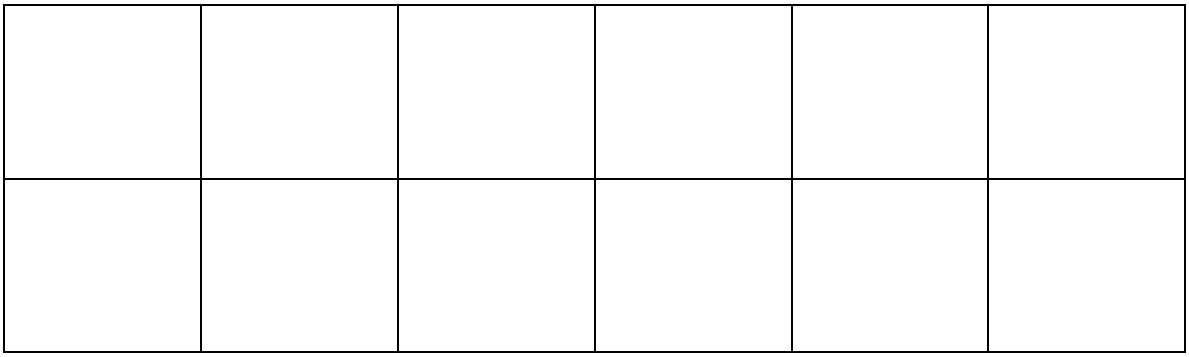
Surrounded and Covered

Level A

Tex has a home on the range (where the deer and the antelope play). He has a patio made out of square tiles. The tiles are a foot long and a foot wide. How many tiles are in his patio?



Arrange the tiles so that they make a different-shaped rectangle. Draw a picture of the new rectangle.

Can you arrange the tiles so that you make a square? Why or why not?

How many more tiles do you need to make a big square patio? Draw the new patio and tell how many tiles there are in all.

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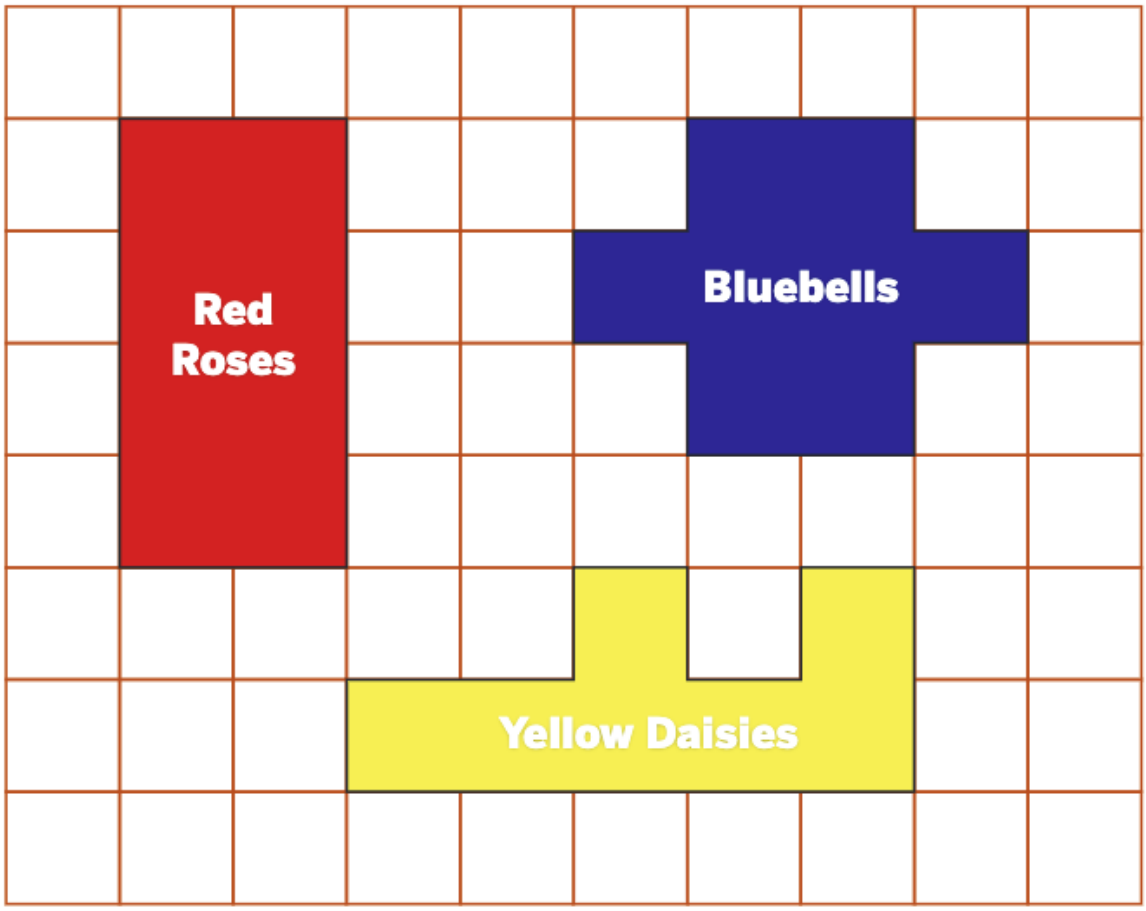
Level B

Tex decides to build his patio with three flowerbeds. The flowerbeds are different shapes. In the first he plants red roses, in the second he plants bluebells, and in the third he plants yellow daisies. Which flowerbed has more space to plant the flowers? Explain how you found your answer.



Tex is going to build a little white fence around his flowerbeds. Measure around each flowerbed to see how long the fence must be. How long around is each fence? Explain how you found your answers.

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Level C

Tex wants to make a lawn in the front of his house. He buys enough sod to make a 10-foot by 30-foot rectangular section of sod for $200 to see how well it grows and how durable it is when played on.

Photo credit: photovs / iStock / Stock photo ID:1140801803

After a week, he decides he needs a second rectangular section, which means he will need to buy more sod This section of his lawn is double the dimensions of the first lot, so it will be 20 feet by 60 feet. He sends ir check for $400. The sod company calls and says he still owes money for the second order of sod. Explain why he still owes money and how much he owes.

Tex has decided he wants the second part of his lawn to be 100 feet by 120 feet. How much more sod does he need and how much more does he need to pay? Explain your reasoning.

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Level D

Tex has a home on the range. He wants to build a rectangular corral for his horses. He only has 170 feet of fencing.

Photo credit: wsfurlan / iStock / Stock photo ID:495666491

What size of corral should be built to make sure the horses have the most room? List the dimensions and area. Justify how you know the corral is as large as possible. Explain your reasoning.

A year later, Tex needs a second corral. This time he has 240 feet of fencing. He picks out a new location and realizes that he does not need to make the corral a rectangle. He designs a corral in the shape of a hexagon and still wants to maximize the area. What are the lengths of the sides and what is the area of the corral? Explain how you found your answer.

Tex thinks that maybe another shape would make an even larger area for his corral. Determine what the shape should be and its area and dimensions. Justify your answer using mathematical reasoning.

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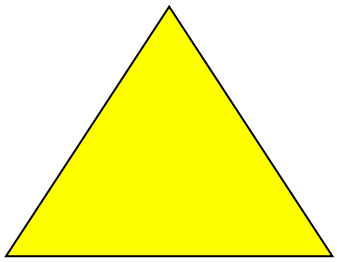
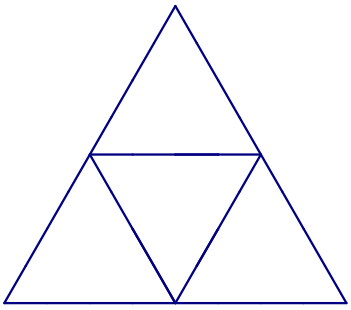
Level E

A fractal is a geometric figure that has self-similarity, which is created using a recursive process, and which is infinite in structure. A fractal is an object whose detail is not lost as it is magnified. In fact, the structure looks the same as the original. In contrast, a circle appears to become straight as a portion of it is magnified.

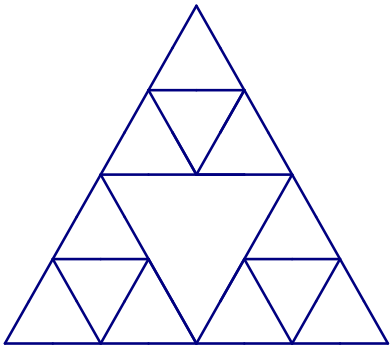
Sierpinski's triangle is a fractal. This fractal is generated through a recursive process. The fractal can be viewed and analyzed at each stage of development. In its original stage, the fractal is an equilateral triangle. For our purposes, we will call this initial shape Stage 0. For measurement purposes, we will say it has a perimeter of three linear units and one area unit. We will define the area as the yellow triangular region. We will define the perimeter as the linear units bordering the yellow area.



During the first iteration of the recursive process, a triangle is cut out of the center of the original equilateral triangle. The smaller cutout triangle is similar to the original but with a length of $\frac{1}{2}$ the Stage 0 length. Therefore, the perimeter, defined as the distance bordering the yellow area, has increased by $\frac{3}{2}$ linear units, making the perimeter $\frac{9}{2}$ units in length. The yellow area has been decreased by $\frac{1}{4}$, making the new area $\frac{3}{4}$ units in size. Below is Sierpinski's triangle at Stage 1.



The process is repeated in stage 2, with three smaller triangle cutouts in the remaining three sections of the original triangle. What is the total perimeter at Stage 2? What is the total area at Stage 2? Explain your calculations.



Sierpinski's triangle is generated following this recursive process. Draw a picture of Stage 3. Determine the area and perimeter of the triangle at this stage. Explain the mathematics.

Sierpinski's triangle is created using the recursive process indefinitely. The fractal has an infinite structure. Find the area and perimeter of Sierpinski's triangle for any Stage *n*.

Justify the mathematics.

Find the actual area and perimeter of Sierpinski's triangle as *n* approached infinity. Justify your solution.