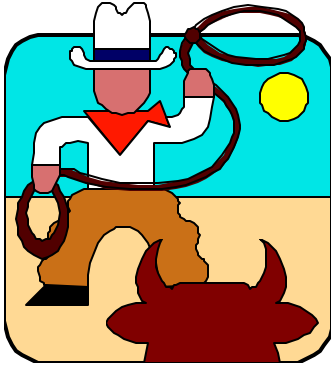


Problem of the Month

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?

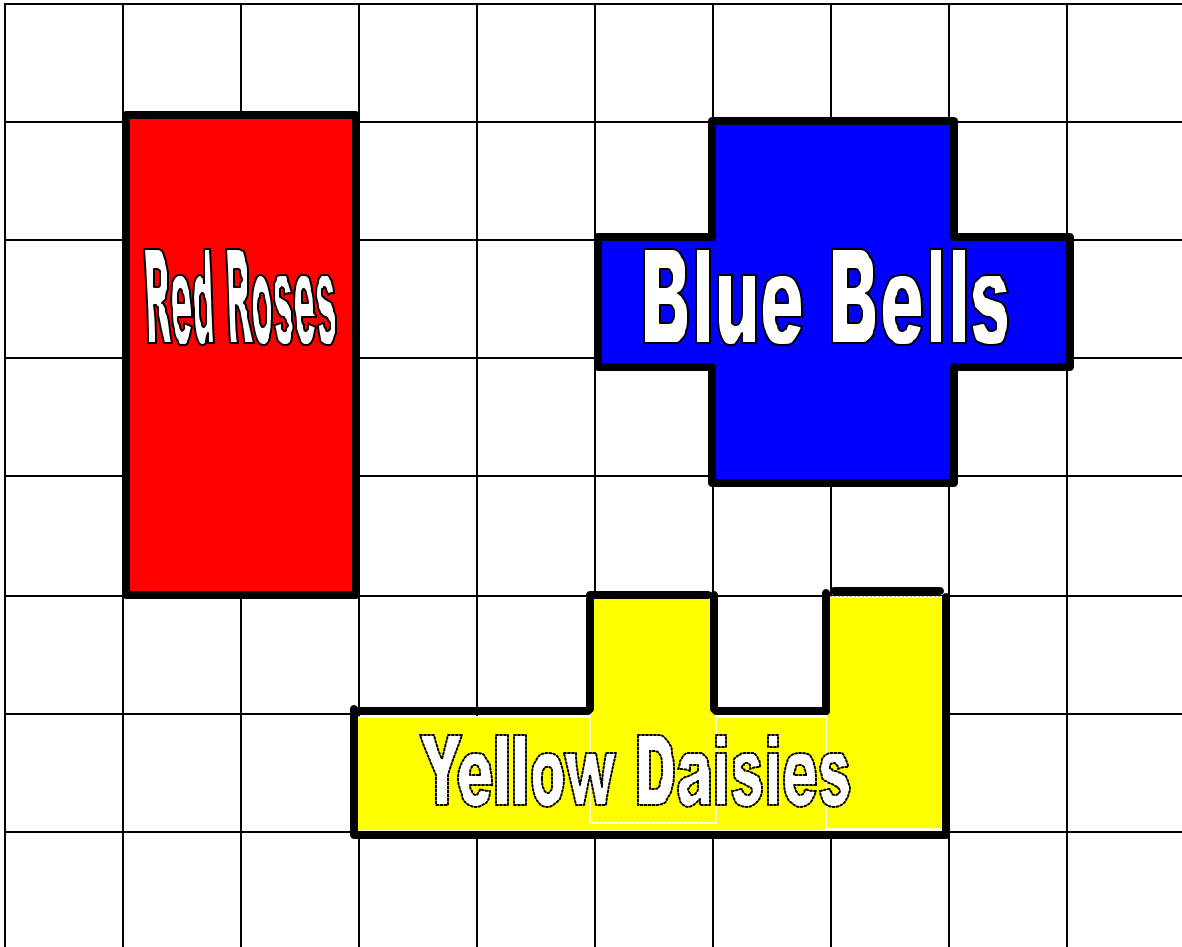
Arrange the tiles so that they make a different shaped rectangle. Draw a picture of the new rectangle.

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.

Level B:

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



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

Level C:

Tex wants to make a lawn in the front of his house. He buys enough sod to make a 10 ft. by 30 ft. rectangle section of sod for \$200 to see how well it grows and how durable it is when played on. After a week he decides he needs more sod, so he doubles the dimensions to 20 ft. by 60 ft and sends in a 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 wants his lawn to be 100 ft by 120 ft. How much more sod does he need and how much more does he need to pay? Explain how you figured it out.

Level D:

Tex has a home on the range (where the deer and antelope play). He wants to build a rectangular corral for his horses. He only has 170 feet of fencing. What size of corral should be built to make sure the horses have the most room? List the dimensions and area. Justify why you know you know the corral is as large as possible. Explain how you figured it out.

Tex gets a better idea. He has a barn on his ranch that is 80 feet by 120 feet. He decides to build the corral using one side of the barn and the 170 feet of fencing. What should be the dimensions of the corral now? What is the area? Explain your mathematical reasoning.

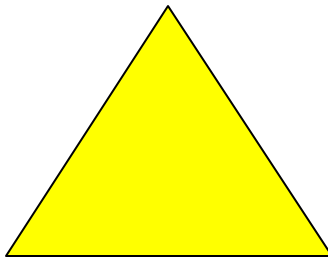
A year later, Tex needs a second corral. This time he has 240 feet of fencing. He doesn't want to use the other side of the barn, because it is near a small pond. He picks out a new location and realizes that he does not need to make the corral a rectangle. He designs a corral the shape of a hexagon. 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.

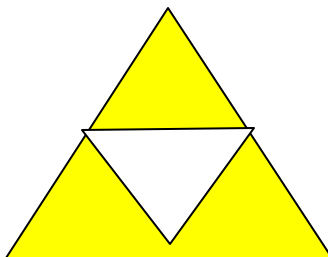
Level E:

A fractal is a geometric figure that has self-similarity, that is created using a recursive process, and that 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.

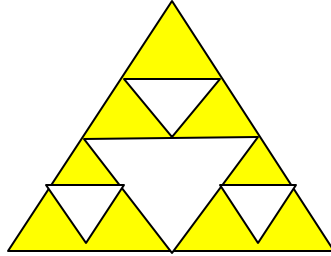
Sierpinski's Triangle is a fractal. This fractal is generated through a recursive process. The fractal can be viewed and analyzed at each stage of development. In its original stage the fractal is an equilateral triangle. For our purposes we will call this initial shape stage 0. For measurement purposes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



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



The process is repeated in stage 2, with three smaller triangles cut-out of 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. Justify your solution.

Problem of the Month

Surrounded and Covered

Primary Version Level A

Materials: Some type of square tile. Twelve manipulative tiles per group. Picture of the patio tiles (2 by 6) for each student.

Discussion on the rug: (Teacher holds up a picture of the patio) "This is a picture of a patio. What is a patio?" (Teacher solicits answers from students) "This patio is made out of tiles. Each square in this picture is one of these tiles." (Teacher holds up a tile). "What shape is this patio?" (Teacher might have students draw the outside perimeter to help students see the outside the shape is a rectangle) "How many tiles does it take to make this patio?" (Teacher solicits answers from students and has several students share how they counted them to find answer).

In small groups: (Each group has twelve tiles and a picture of the patio) "Check to see how many tiles you have." (The teacher solicits the counts from each student. The teacher lists the counts.) "Please make a copy of the patio with your tiles. Please draw a picture of your patio."

(The teacher asked the following questions)

Can you re-arrange the tiles to make a patio of a different shape?
How many tiles do you have now? Please draw it on a piece of paper.
Can you re-arrange the tiles to make a rectangle that is a different shape? How many tiles do you have now? Please draw it on a piece a paper.

Can you re-arrange the tiles to make a square with all the tiles?

(Teacher questions whether it is really a square)

Explain why you think it is or is not a square.

(At the end of the investigation have students either discuss or dictate a response to this summary question)

The Patio

