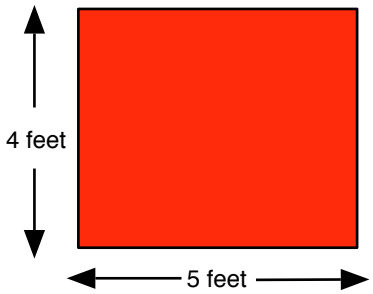
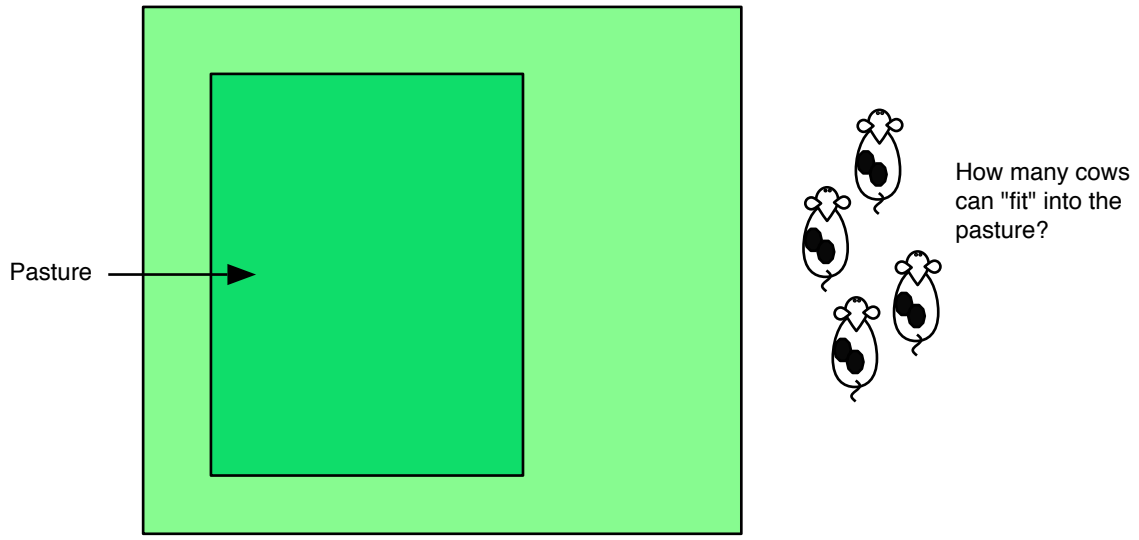


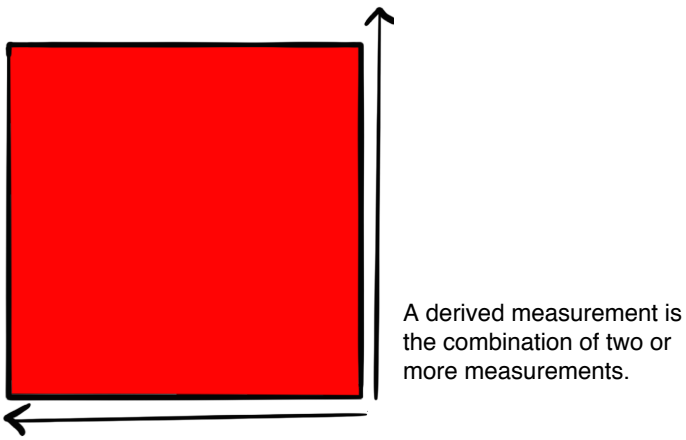
Lesson 2: Finding Surface Area

In Lesson 1, we introduced you to the concepts of base measurements. You learned that there were three base measurements: length, mass and time. In Lesson 1, our focus was on length. Before we move to our second base measurement in the next lesson (which is mass), let's take a look at our first set of *derived* measurements. Derived measurements are those made by doing a math operation with a set of *base* measurements. This may sound complicated, so let's look at an example to show you that it's really rather simple.

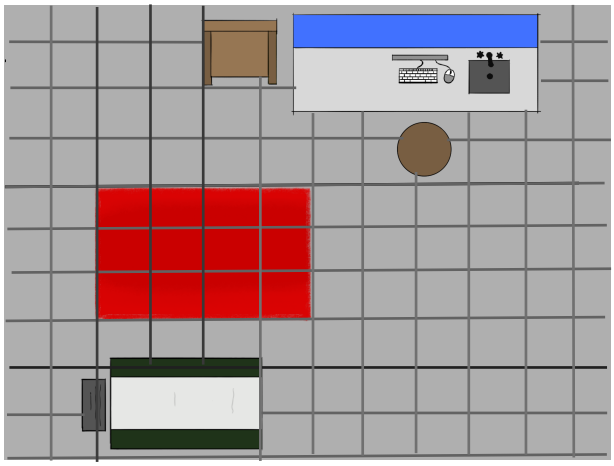
Refer back to the illustration we used in Lesson 1 when we were talking about purchasing a piece of land. We said you needed to put a fence around the land to allow your cows to eat grass in the pasture. Let's pretend now that you learn it's important to not put too many cows on the pasture which might result in damage to the grass. You learn it's recommended to allow a certain amount of space for each cow on the grass. This amount of space necessary for each cow is called surface area.



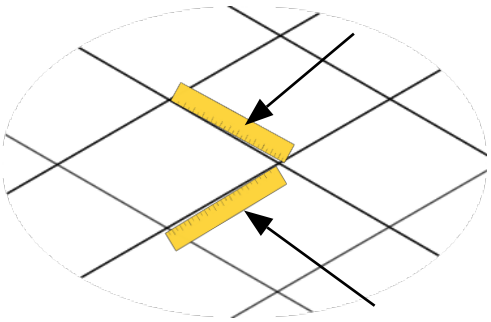
Area is an amount of space which is measured in two directions or two dimensions. The measurements taken are two length measurements. Recall that length is a *base* measurement and in our illustration we are going to perform an operation with these two measurements. The amount of area we find will be a *derived* measurement (it resulted from an operation of two or more base measurements.)



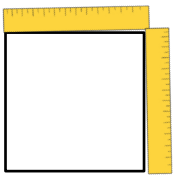
Before we determine how to measure the area of this portion of pasture, let's look at a simpler situation. Look at the diagram below. This in an overhead view of a doctor's exam room. Note that the floor of this room is covered with square floor tile.



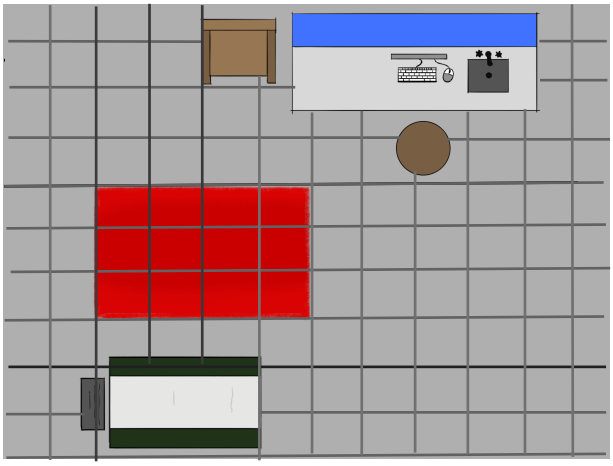
Let's take a portion of this floor and examine each floor tile. If you look closely below you can see that alongside the edge of one of the tiles is a 12-inch (or one foot) ruler. Note another tile with a similar ruler along an adjacent edge of a tile. We can say that the distance (length) along each side of each tile is 12 inches or one foot. We can then say that each tile covers one square foot of area. It's one foot by one foot or 1 foot x 1 foot which equals 1 foot squared. Each floor tile covers an area of one square foot.

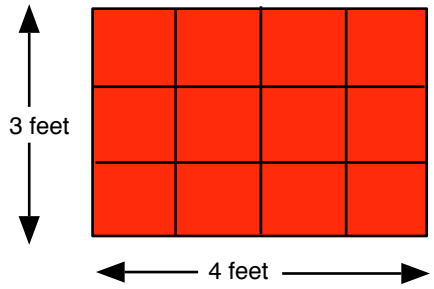


Each floor tile measures 1 foot on each edge. We can say that the surface area of each tile is one square foot or 1 ft^2.

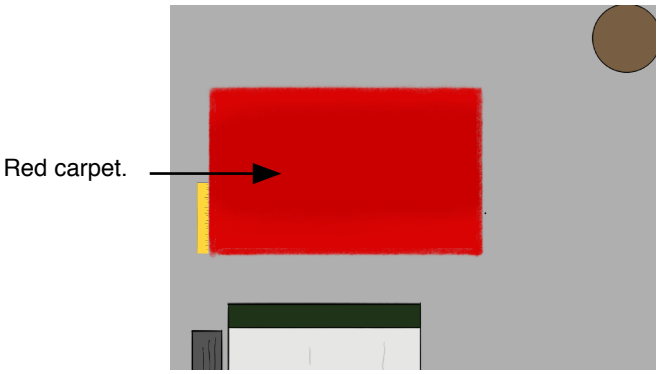


Now, look at the set of floor tiles in the diagram on the next page. Focus your attention on the red tiles. Again, let's assume that the distance along each edge of the tiles is one foot. Note that in our set of red floor tiles that we have four columns of tiles (sets going up and down) with each column having three tiles. We can say that we have four sets of three tiles or 4 times 3, which equals 12 tiles. Since each tile is one square foot, we can say we have 12 square feet of tiles or 12 ft^2.



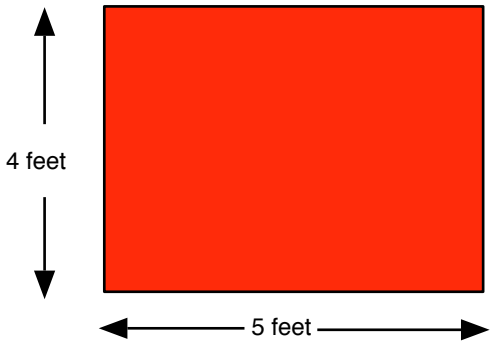


Now, take a look at the diagram below. Note that it shows a similar room, however, the room no longer has floor tiles covering the floor. Instead, there's a piece of red carpet on the floor. Let's suppose you would like to know how many square feet are in this piece of carpet. How would you go about finding this area?



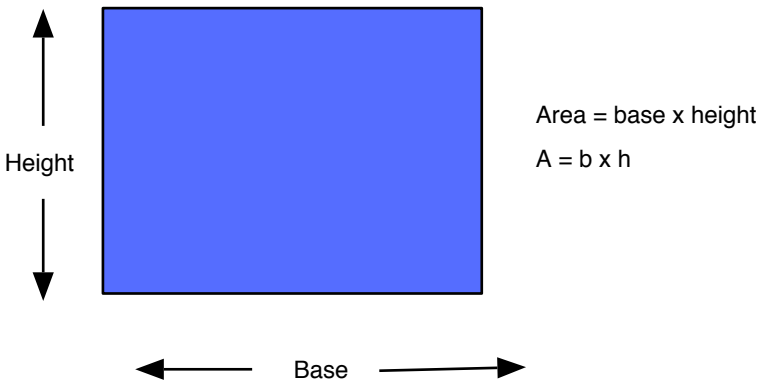
Refer back to our calculation of the area of the red floor tiles. Note that we multiplied the distance across the "bottom" edge of the tiles (how many columns we had) times the "height" of each column. We can do the same operation to find the area of the piece of carpet.

To do so, we can take the ruler and measure how many feet there are along the "bottom" edge of the carpet. We then find the "height" of each "column." In this case, we can see that the "bottom" edge of the carpet measures 5 feet and the "height" measures 4 feet. By multiplying the length along the bottom by the height of each column, we can see that the number of square

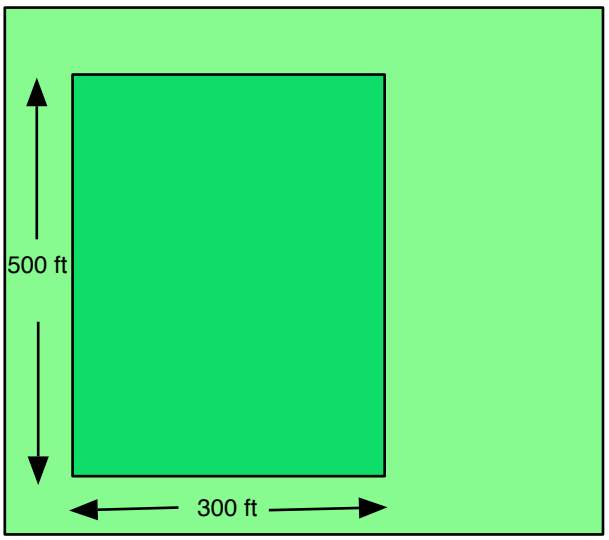


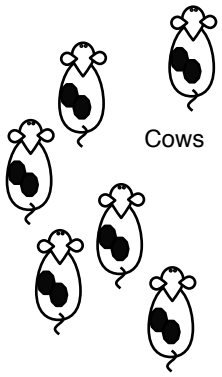
feet in the piece of carpet equals 20 square feet. Another way to write the derived measurement is 20 ft^2. Keep in mind that this is a *derived* measurement in that it comes from a math operation completed with two or more *base* measurements.

Often the "bottom" measurement we've been looking at in these examples is called the base, as it's the supporting portion of the structure above. Therefore, when we measure the area of a square or rectangle we can say that the area equals the base times the height of the shape. Using symbols to represent the measurements we can say A = b x h or A = bh (A = area, b = base and h = height).



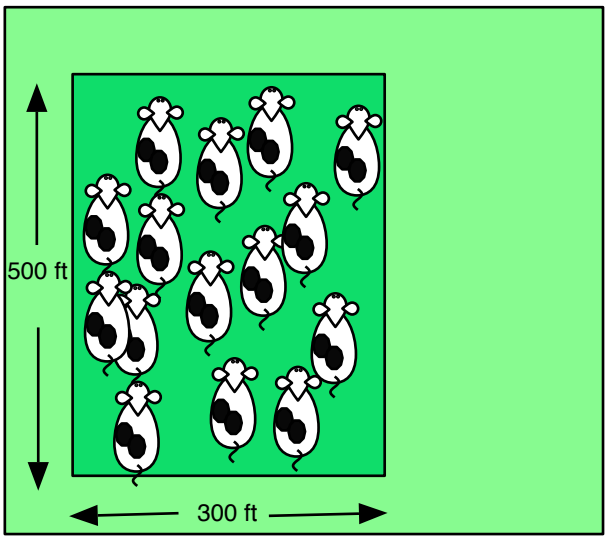
Let's go back now to our cows in the pasture illustration. Look at the diagram below. Note that we have outlined the area of the land which will become the pasture for the cows. Note that the length of the base of the pasture has been measured to be 300 feet. Note that the "height" of the pasture is 500 feet. Based upon our discussions above, how many square feet make up the





pasture? If we were to lay out floor tile over the grass, we'd have three hundred columns of tiles each being 500 tiles "high." Therefore we have 300 feet x 500 feet = 150,000 square feet or 150,000 ft^2.

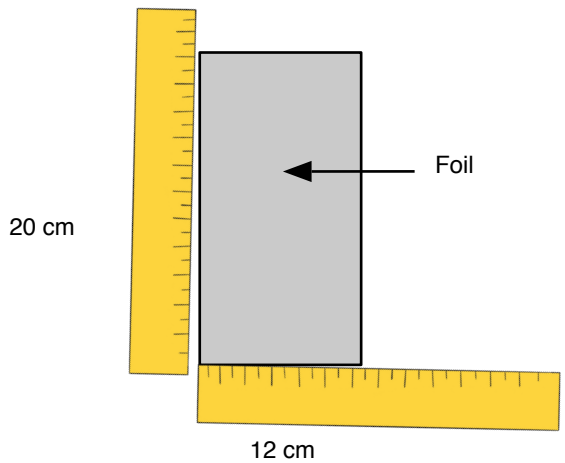
If we had learned that each cow requires 10,000 square feet of pasture, we could take our total square feet of pasture (150,000 square feet) and divide it by the amount each cow requires (10,000 square feet): 150,000/10,000 = 15. So, theoretically we could place 15 cows on our pasture.



Fifteen cows could "fit" into our pasture based upon our calculation of the surface area of the pasture.

So to review, we learned that to find the surface area of a square or rectangular shape, we multiply the length of the base of the shape times the height of the shape (knowing that these are columns of square units within the shape).

Let's look now at another example. In this case, instead of using the English system of measurement, let's use the SI system and we'll look at an object much smaller than a piece of land. Let's pretend you have a flat, rectangular piece of aluminum foil. You've been asked to determine the area of this piece of foil. Your measuring instrument is a ruler that is divided into centimeters.



Note that the base of the piece of foil has been found to be 12 cm in length. Note that the height of the rectangle is 20 centimeters. We can also say each column has a height of 20 centimeters. To find the area of the piece of foil, we multiply these two values (base times height): 12 cm x 20 cm = 240 square centimeters. The surface area of the piece of foil is 240 square centimeters or 240 cm^2.

Let's move on to the design challenges for this lesson.

Challenge 1: This challenge will be very similar to Challenge A of Lesson 1. You will need to construct a picture frame like you did before, however, this picture frame must have an opening that is exactly 120 square centimeters. Once you have it completed have your mom, dad or teacher examine your work. Take your time and draw a good plan first on paper or using a computer program. Then remember, "measure twice, cut once."

Challenge 2: In this challenge, you'll make yet another picture frame. However, instead of having a specific opening area, for this frame the total area of the flat surface of the sides of the frame must be exactly 100 square centimeters. After constructing the frame, submit your creation to the crash test you utilized in Lesson 1. For this lesson, your frame must be able to survive being dropped at least 3 meters from the floor onto a hard surface. Once completed, decorate your frame and find a nice photo or piece of artwork for which to use it.