In the previous investigation we learned about quantities and the difference between fixed and varying quantities. An example of a *fixed quantity* is the width of this classroom. An example of a *varying quantity* is your distance from the front door of your home as you traveled to school this morning.

1. In your summer job at the home improvement store you have the responsibility of ordering materials when they run low. You need to keep track of how much wire is remaining on wire spools in the store. Identify the quantities in this situation.

   a. A new spool of electrical wire has 60 feet of wire. What quantities *vary* (change) in this situation?

   b. How does the amount of wire remaining on the spool vary (change) as some length of wire is cut from the spool?

   c. Given the following total amounts of electrical wire that have been cut from the spool, determine the total amount of electrical wire remaining on the spool.

Total amount of wire cut from spool	Representation of the total amount of wire remaining on the spool	Total amount of wire remaining on spool
12 feet		
17 feet		
39.5 feet		
43.8 feet		

   d. Explain the process you used to compute the amount of wire remaining on the spool.

In algebra, we often want to write a general formula to describe the process of determining the value of one quantity (amount of wire remaining on the spool) for varying values of the other quantity (the total amount of wire cut from the spool). Mathematicians needed a way to talk about and represent these changing values when writing formulas, so they created the idea of ***variable***.

Variable

A variable is a letter or symbol that represents the varying values that a particular quantity can have.

We can define two variables to represent values of the two quantities that are changing in our problem. We do this by writing:

> Let x represent the total amount of wire (in feet) cut from the spool.
> Let y represent the total amount of wire (in feet) remaining on the spool.

e. What does it mean in this context if $x = 32$? What is the corresponding value of y and what does it represent?

f. What does it mean in this context if $y = 37.2$? What is the corresponding value of x and what does it represent?

g. As the amount of wire cut from the spool varies from:
   i. 0 to 5 feet, how does the amount of wire left on the spool change?

   ii. 5 to 10 feet, how does the amount of wire left on the spool change?

   iii. 0 to 60 feet, how does the amount of wire left on the spool change?

Defining a Variable

When we define a variable to represent the value of a quantity that can change, we need to include as much information as possible. We should:

1. include the object's attribute we are imagining measuring,
2. a clear indication of where we are measuring from (as needed), and
3. the units you will use to measure the quantity.

Without these three elements it can often become difficult to interpret the meaning of the variable's value.

2. Someone defines a variable as "Let d represent the distance." They then say "d changes from 5 to 7." Why does this definition make it difficult to understand what the student wants to communicate and what should be done to improve the definition?

3. Define variables to represent two quantities that could be related in each of the following situations. (Be specific in defining your variables and don't forget to include the units (feet, meters, etc.))
   a. A runner moving down the track from the starting line in a 100-meter race.

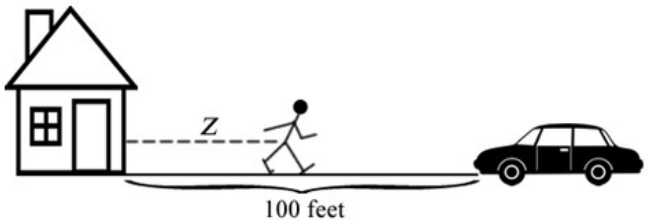
   b. Sarah blowing up a balloon to increase the volume of air in the balloon.

   c. The number of pounds of candy that a customer purchases at a store determines how much the customer must pay.

4. Sarah is filling her car tank with gasoline that is priced at $3.48 per gallon.
   a. What quantities vary in this situation? Define variables to represent at least two that you identify.

   b. What is a reasonable range of values each variable can take on in this situation? Be sure you can justify your answers.

5. Imagine that you are walking from your house to your car. Use this figure to answer the following questions.



   a. Name a fixed distance in this situation.

   b. Name two varying distances in this situation.

   c. What variable represents the distance that you are from your house as it changes?

   d. How does the value of z change as you walk from your house to your car?

   e. How does your distance from your car change as you walk from your house to your car?

   f. Illustrate each quantity's value with a drawing. Remember that your house and your car are 100 feet apart.
      a. The distance of your car from your house.

      b. Your distance from your house as you walk x feet from your car toward your house. (Hint: Begin by making a drawing of your house, your car and yourself, and then label x on your drawing.)

      c. Your distance from your house as you walk y feet away from your parked car in a direction away from your house.