In physics, there are important differences given to numbers that give direction, and those that do not. Numbers concerned only with **magnitude**, (size) are called **scalar** numbers. Numbers that both have a magnitude AND a direction are called **vectors**. Vector numbers obviously give more information than scalar ones do, so they are worth more to us.

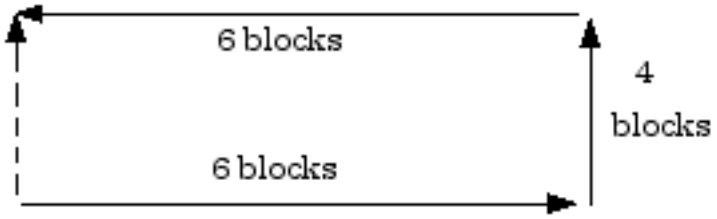
Motion is described as a change in position. You move, you change position! How fast you move is called **speed** or **velocity**. If you care only about how fast, it is speed. If you want to know also what direction it is moving, it is velocity, so speed is a scalar number, and velocity is a vector one. Here's why it is so important to know the difference: you are in a car wreck. You were traveling at 25 mph and the guy that hit you was going 29 mph. Was it a bad wreck?

Since you were only given speed information, it is hard to tell: did the guy hit you head on, from the side, or did he rear-end you? It makes a big difference. Now if the wreck had been described in vector terms, you would know: You were headed north at 25 mph when a maniac headed south smacked you. Ouch, you are in the hospital now... (I'll come visit tomorrow and bring your homework) The units of speed or velocity will be m/s or km/hr.

Before we can calculate speed and velocity, we need to know two other terms: **distance** and **displacement**. Both deal with how far you have moved, but distance is scalar, and displacement vector. Units for both will be some distance unit, like m, cm, km, et cetera. Displacement is not always just distance with a direction. If the trip is a straight line, that is true, but if the direction changes during a trip, the displacement is a straight line from beginning to end (with the direction), which means it will be shorter.

If you walk down the street for 6 blocks north, your distance covered was 6 blocks, and your displacement was 6 blocks north. Only difference is the naming of the direction. (The direction can be as simple as forward, that way, up, et cetera) If we went 6 blocks forward, then turned left 4 blocks, then took another left for 6 blocks we have traveled a total distance of 16 blocks, but our displacement is only 4 blocks left. Why?

The distance is simply adding up the total motion: 6 + 4 + 6 = 16 blocks total.



The displacement is the distance from the starting point to the end point (the dashed line!) which is clearly 4 blocks to the left.

To calculate speed, we divide the distance traveled by the time it took. Velocity is calculated by dividing the displacement by the time. Their formulas look like this:

s = speed	d = distance	t = time
v = velocity	d - displacement	t = time

$$s = \frac{d}{t} \qquad v = \frac{d}{t}$$

If I traveled at 112 km/hr for 6.0 minutes, how far did I go?

First, make all the units match. To change km/hr into m/s, divide by 3.6 to get 31.1 m/s. Change 6.0 minutes into 360 seconds, so now m/s and s are compatible units. We are looking for displacement so after algebra d = v t = (31.1 m/s) x (360 s) = 11196 m
after rounding, we get 11 000 m or 11 km. **Do problems A for homework!**