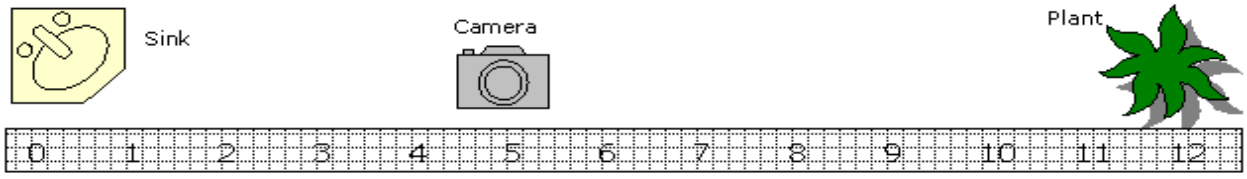
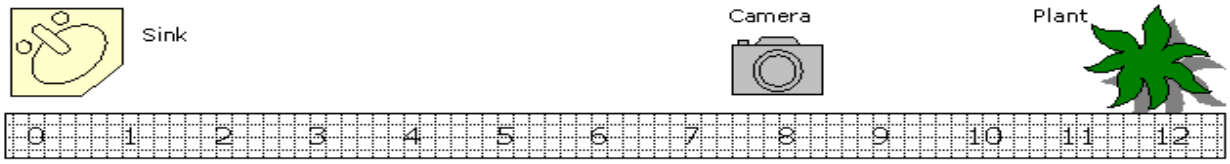
Position and Distance

What is the difference between position and distance?

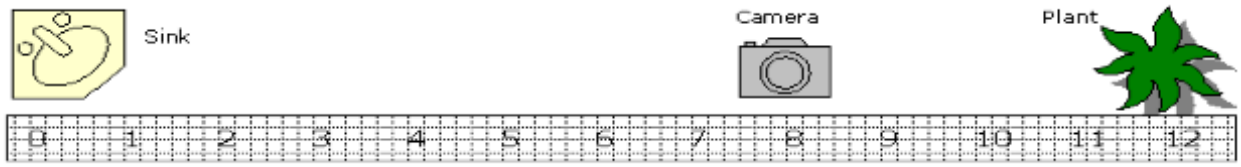
Look at the picture below. When you ask, “Where is the camera?” you are asking for the position of the object. Very often position may be defined in terms of its *distance* from other objects, hence the confusion. Distance is the amount of space between two points; distance is a quantity. Position is the location of an object compared to a reference point; position is a distance with a direction.



A person might describe the picture above thus: “The camera is 5 cm to the right of the sink. The plant is 12 cm to the right of the sink.” These statements imply that if the zero mark of a ruler were at the sink, the camera is 5 cm to the right and the plant is 12 cm to the right.
What happens when an object moves? We use the same terminology.



Example 1: In the picture below the camera has moved so that it is 8 cm from the sink. How much did its position change?



To keep things straight, we define the starting and ending positions of the objects: the starting or initial position is defined as x_i = 5 cm. The ending or final position is defined as x_f = 8 cm. The change in the camera’s position is

Dx = final position – initial position

$Dx = x_f - x_i$

Dx = 8 – 5 = 3 cm.

Example 2: The camera starts at 6 cm and moves so that it is 2 cm from the sink. How much did its position change?

Here x_i = 6 cm, and x_f = 2 cm
Dx = 2 – 6 = -4 cm.
Since we define position as having increasing values toward the right, the negative value of Dx indicates that the camera has moved to the left.

What is distance?
The distance along a straight line is the difference between the position readings – however, distance is defined as a positive quantity. Whether the object moves to the left or the right, the distance is always positive, while its change in position can be positive or negative. The distance does not contain information about the direction, while the change in position does.

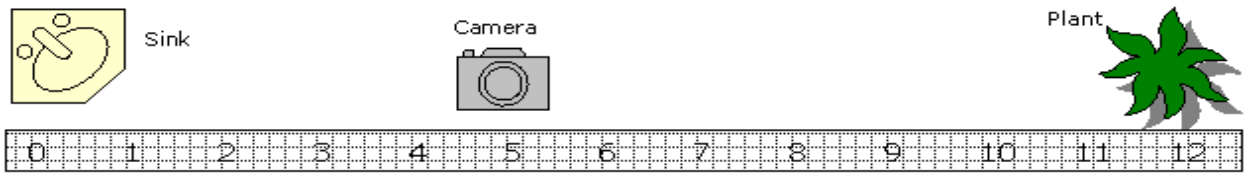
Mathematically, we write distance as the magnitude (also called the amount or absolute value) of the change in position. This is indicated by the standard mathematical symbols.
In example 1, the distance the camera moves is $|Dx|$ = |8 – 5| = 3 cm.
In example 2, the distance the camera moves is $|Dx|$ = |2 – 6| = |-4| = 4 cm.

The **change in position** is the difference between the final and initial position readings:

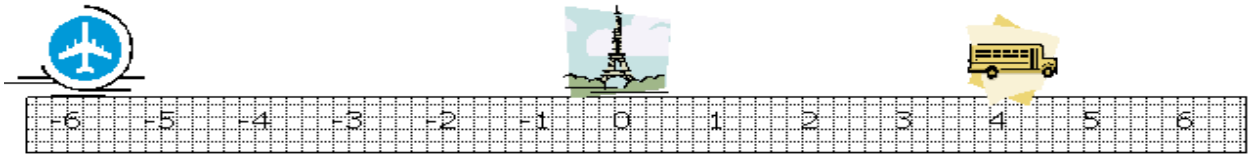
$$\Delta x = x_f - x_i .$$

The **distance** along a straight line is the magnitude (or amount) of the change in position $|Dx| = |x_f - x_i|$

Distance is frequently used to figure out how far apart two objects are.
Example 3: the distance between the camera and the plant is $|Dx| = 12 - 5 = 8$ cm.



Example 4: (scale in km).
The distance between the school bus and the plane is $|Dx| = 4 - (-6) = 10$ km



Positions are frequently defined by placing objects on a graph, where the "zero" is a convenient reference point.

Here are the symbols we have used:

x_i for initial or starting position

x_f for final or ending position

$\Delta x = x_f - x_i$ for change in position
(Note that the change in position can be a positive or a negative value)

$|\Delta x| = |x_f - x_i|$ for distance

(Note that distance is the absolute value of change in position)

In a later activity we will use similar symbols for clock readings:

t_i for initial or starting clock reading

t_f for final or ending clock reading

$\Delta t = t_f - t_i$ for the time interval

Information From:
http://www.columbia.k12.mo.us/ojhs/Entry%204--Position%20vs.%20Distance.htm