SECTION 1 (PP. 313-318): AN OBJECT IN MOTION CHANGES POSITION.

Georgia Standards: S8P3a – *Determine the relationship between velocity and acceleration; S8CS7d – Recognize that there may be more than one way to interpret a given set of findings.*

1. **Position describes the location of an object.**
   The **position**, or location, of an object is described relative to a **reference point**. The choice of reference point affects how the position is described. For example, a city can be located by measuring its direction and distance from another city, or by using a grid system, such as the longitude-latitude system.

   There are two ways to measure the distance an object has traveled. One is to measure the length of the path the object has followed. Another is to measure the straight-line distance of an object from its starting point. This straight-line distance is called the **displacement** of the object.

2. **Motion is a change in position.**
   Motion is a change in position over time. How quickly or slowly the position changes, depends on an object's speed.

   How motion is observed depends upon the observer's point of view. The observed motion of an object is measured by comparing the object's motion relative to the observer's **frame of reference**. Someone observing a long jumper from the side would have a completely different interpretation of the jump than someone viewing the same jump from behind the athlete, as shown in the diagram below.

SECTION 2 (PP. 320-327): SPEED MEASURES HOW FAST POSITION CHANGES.

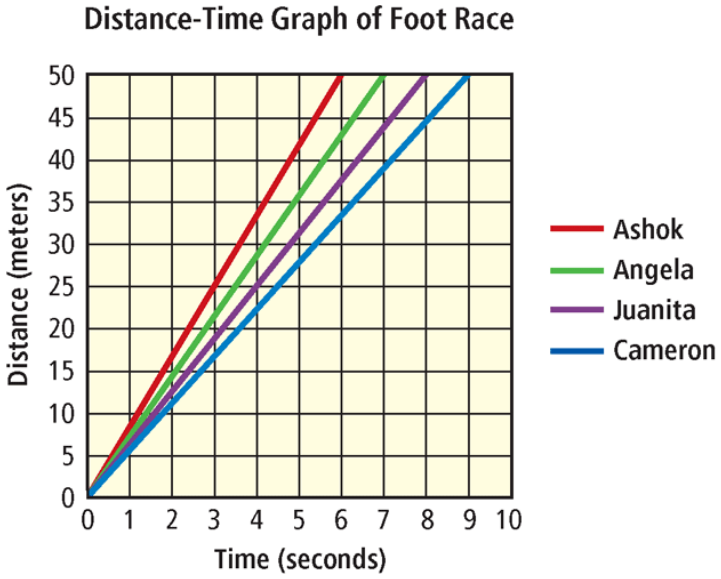
Georgia Standards: S8P3a – ***Determine the relationship between velocity and acceleration; S8CS3f – Use ratios and proportions, including constant rates, in appropriate problems.***

1. **Position can change at different rates.**

Speed is a measure of how fast something moves through a particular distance over a given amount of time.

$$Speed = \frac{Distance}{Time}, \text{ or } S = \frac{d}{t}$$

Average speed is the average of several **instantaneous speeds** whose measurements are taken over a specific period of time. A **distance-time graph** shows how both distance and speed change with time. You can use these graphs to determine the speed of an object by calculating the **slope** of the line. A positive slope means the object is moving away from its starting point. A negative slope means the object is moving back toward its starting point.

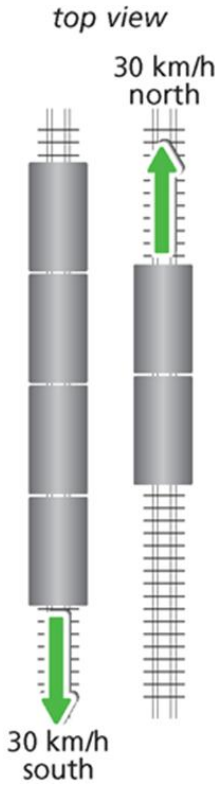


$$slope = \frac{change\ in\ distance}{change\ in\ time} = speed$$

2. **Velocity includes speed and direction.**

Velocity is speed in a specific direction. Velocity is an example of a vector. A **vector** is a quantity that has both size and direction. Vectors are shown by using arrows. The longer the arrow is of the object being scribed; the faster the speed of the object. The direction of the arrow indicates the direction of motion.

Speed and velocity are not the same. If two trains are traveling at the same speed in opposite directions, they will have the same speed but different velocities.



SECTION 3 (PP. 329-335): ACCELERATION MEASURES HOW FAST VELOCITY CHANGES.

Georgia Standards: S8P3a – *Determine the relationship between velocity and acceleration;* S8CS3f – Use ratios and proportions, including constant rates, in appropriate problems.

1. **Speed and direction can change with time.**
   Acceleration is the rate at which velocity changes over time. Contrary to popular misconception, acceleration is not limited to increases in velocity, but includes any change in velocity. The following are examples of acceleration:
   - Increase in speed
   - Decrease in speed
   - Any change in direction (regardless of the speed)

2. **Acceleration can be calculated from velocity and time.**
   Acceleration can be determined from the change in velocity over a given period of time. The formula for calculating acceleration is shown below:

$$a = \frac{final\ velocity - initial\ velocity}{time}\text{, or a} = \frac{vf - vi}{t}\text{, or a} = \frac{\Delta v}{t}$$

Negative acceleration is a decrease in velocity during a specific period of time. The acceleration formula yields a negative result when the final velocity is less than the initial velocity. A velocity-time graph shows how both velocity and acceleration change with time. Compare the velocity-time graph and the distance-time graph shown below for the same set of data. The graphs show a boy (1) starting and speeding up on his scooter, (2) coasting (velocity is constant), and (3) slowing to a stop.