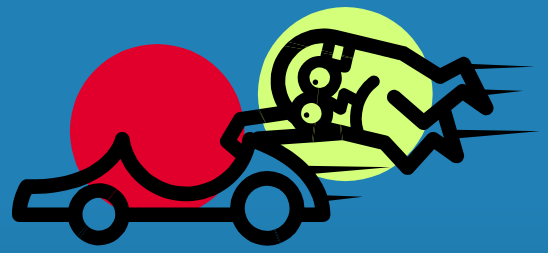
Velocity and Acceleration



GPS

- **S8P3. Students will investigate relationship between force, mass, and the motion of objects.**
- a. Determine the relationship between velocity and acceleration.

Speed

- A force is a push or a pull
- When a force acts on an object, one possible result is motion.

Speed

- A reference point is generally a stationary object such as a tree, a street sign, or a line on the road.
- Once a reference point has been established, it is possible to define the motion of an object in terms of speed, position, and direction.

Speed

- The speed of an object refers to how fast an object moves.
  - To determine speed you need to know both the distance an object moves and the amount of time needed to travel.

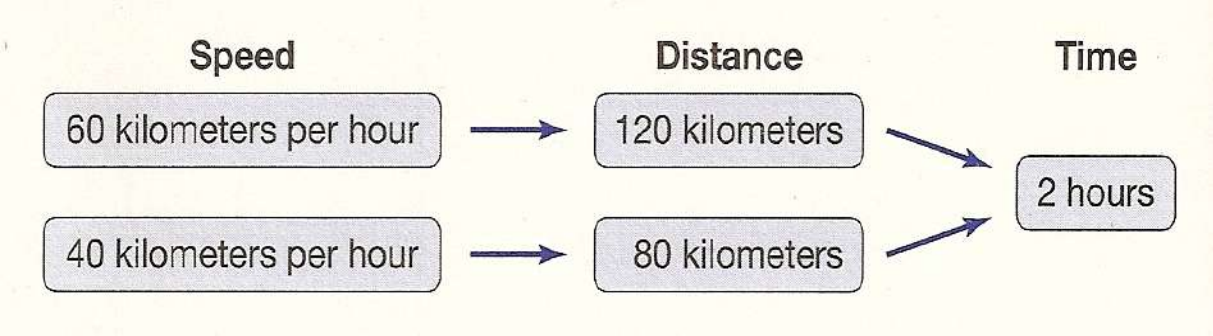
Speed

- Calculations using formulas
- Most objects do not move at a constant, unchanging speed.
- When you use the formula to find the speed of an object you're actually finding the object's average speed.

$$\text{speed} = \frac{\text{distance}}{\text{time}} \text{ or } s = \frac{d}{t}$$

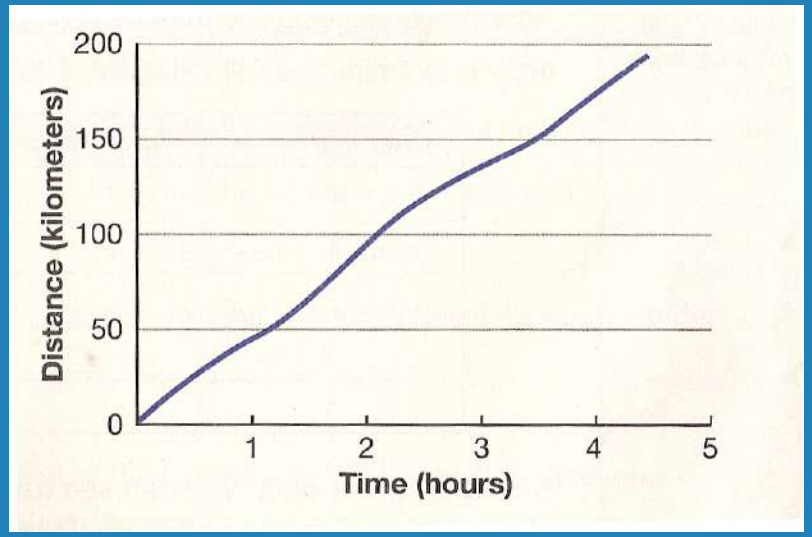
Speed

- The diagram shows how two automobiles with different speeds move during the same amount of time.



Speed

- Speed can be shown on a graph of distance vs. time.
- Notice that the line of this graph is not straight. This is because the object's speed changes.



Velocity

- **Velocity** is the speed of an object in a **particular direction**.
- Suppose that two cars traveled at 50 kilometers per hour on the same highway for 2 hours. After two hours, the cars are 200 kilometers away from each other. How is this possible?
- **Answer: They were traveling in opposite directions.**

Velocity

- Speed describes distance and time, but does not indicate direction.
- When the direction of an object's movement is included, you are describing an object's velocity.

Velocity

- Velocity changes when the speed or the direction of an object changes.
  - If a sailboat's speed goes from 4 knots to 7 knots, its velocity has changed. If the sailboat continues moving at 7 knots, but changes direction, its velocity has again changed.

Acceleration

- Acceleration is the rate at which an object's velocity changes.
  - Velocity changes when an object's speed and direction changes.
  - Acceleration of an object also changes if its speed or its direction changes.

Acceleration

- You can calculate the average acceleration of an object by using the following equation.

$$\text{Average Acceleration} = \frac{\text{final velocity minus starting velocity}}{\text{time}}$$

Acceleration

- Acceleration is recorded in units such as meters per second squared (m/s^2).

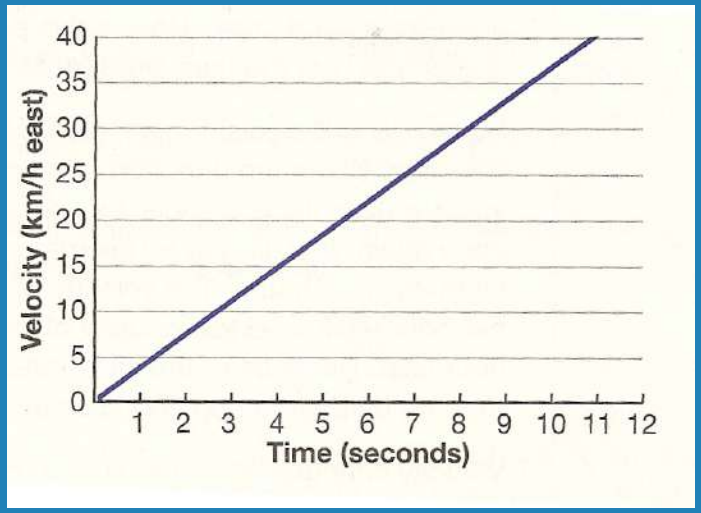
Acceleration of a car

Time (seconds)	Velocity (meters per second east)
0	0
1	5
2	10
3	15
4	20

- Based on this data, you can see that the acceleration of the car at any time is 5m/s/s or 5 m/s^2. Every second, the velocity of the car increases by 5 m/s.

Acceleration

- Assume that the following graph plots your acceleration (velocity vs. time) during a car trip. The graph shows that at 10 seconds, the velocity of the car was 35 kilometers per hour east.



- These equations can be used to calculate the average acceleration of the car.

$$\text{acceleration} = \frac{35\ \text{km/h east} - 0\ \text{km/h east}}{10\text{s}}$$

$$= \frac{35\ \text{km/h}}{10\text{s}} = 3.5\ \text{km/h/s east}$$