Kinematics Terms

- *Mechanics*- the study of the motion of objects.

- *Kinematics* - the science of describing the motion of objects using words, diagrams, numbers, graphs, and equations.

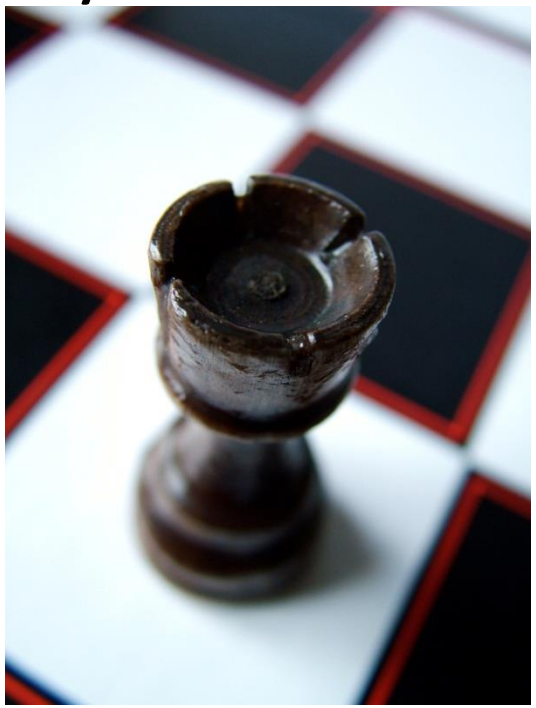
There are two types of quantities in Science

- Scalar- a quantity that has only magnitude (size)
  - Example: time, temperature, speed

- Vector- a quantity that has magnitude AND direction
  - Knowing what direction it goes is as important as how much there is.
  - Examples- displacement, velocity, force, momentum

Position

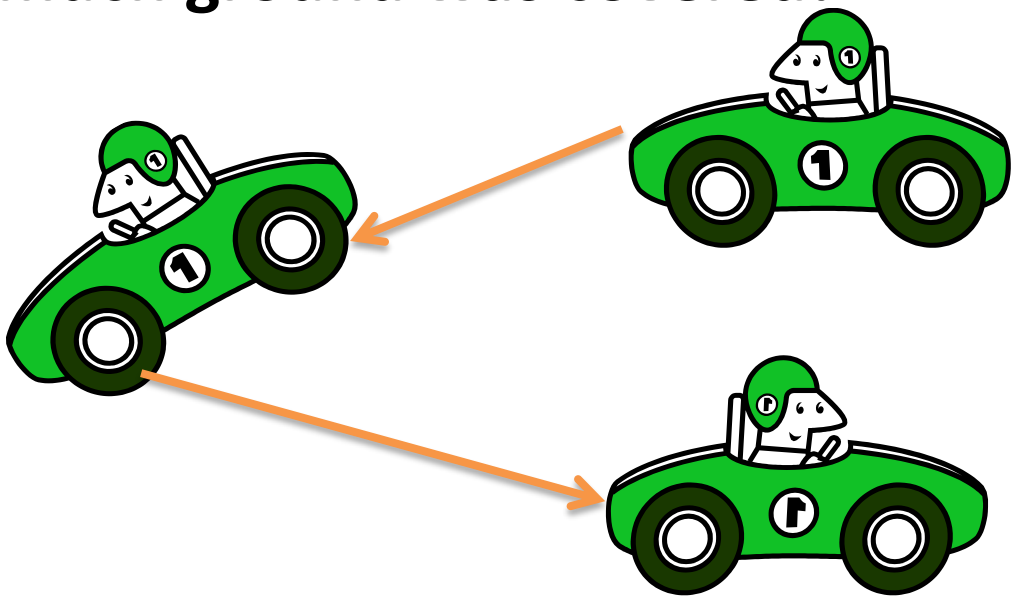
- Definition – **WHERE** something is located.
- Units = Meters (m)
- Symbol = *x*



There it is!

Distance

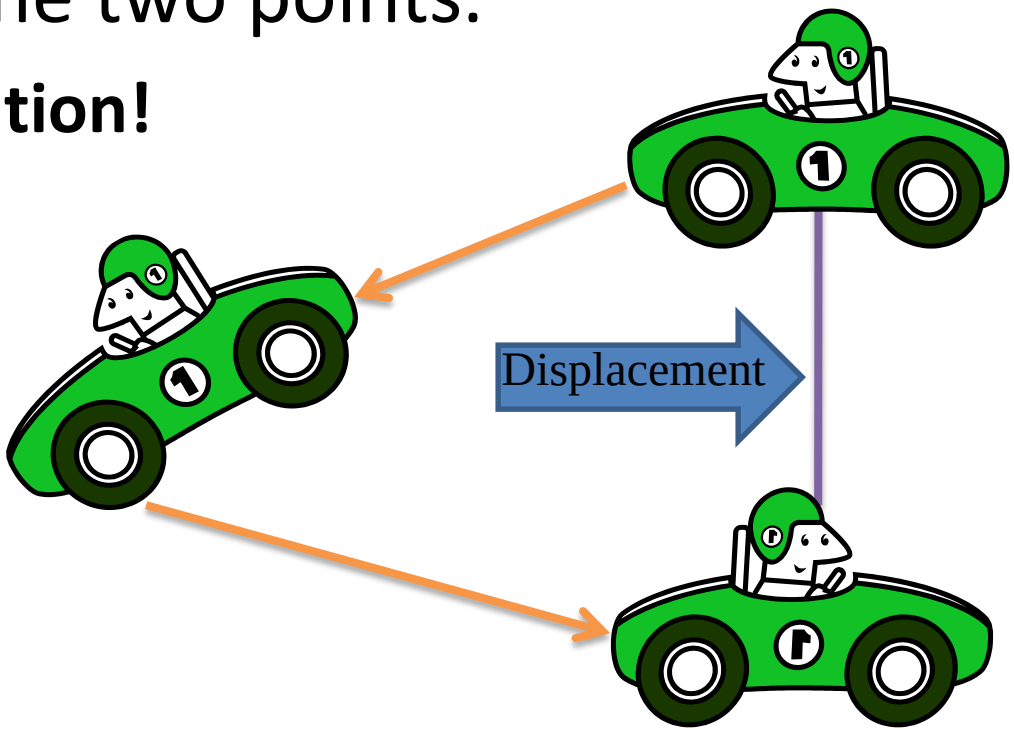
- Definition – the length between the initial position of an object and its final position, as it goes along a specific path (not always a straight line!)
  - **HOW FAR!** Or **How much ground was covered!**
- Units = Meters (m)
- Symbol = *d*



Displacement

- Definition – A *vector* that points from an object's initial position to its final position and has a magnitude that equals the shortest distance between the two points.
  - **How far out of position!**
- Symbol: Δx

  $[\Delta x = x_f - x_i]$
- Units = Meters (m)



Distance vs Displacement Examples

1. What is the displacement of the cross-country team if they begin at the school, run 10 miles and finish back at the school?

2. What is the distance and the displacement of the race car drivers in the Indy 500?

Time

- Definition- **WHEN** something happens
- Tells you the *instant* something happens
- Units- seconds (usually measured from a reference point in time.)
- Symbol: *t*

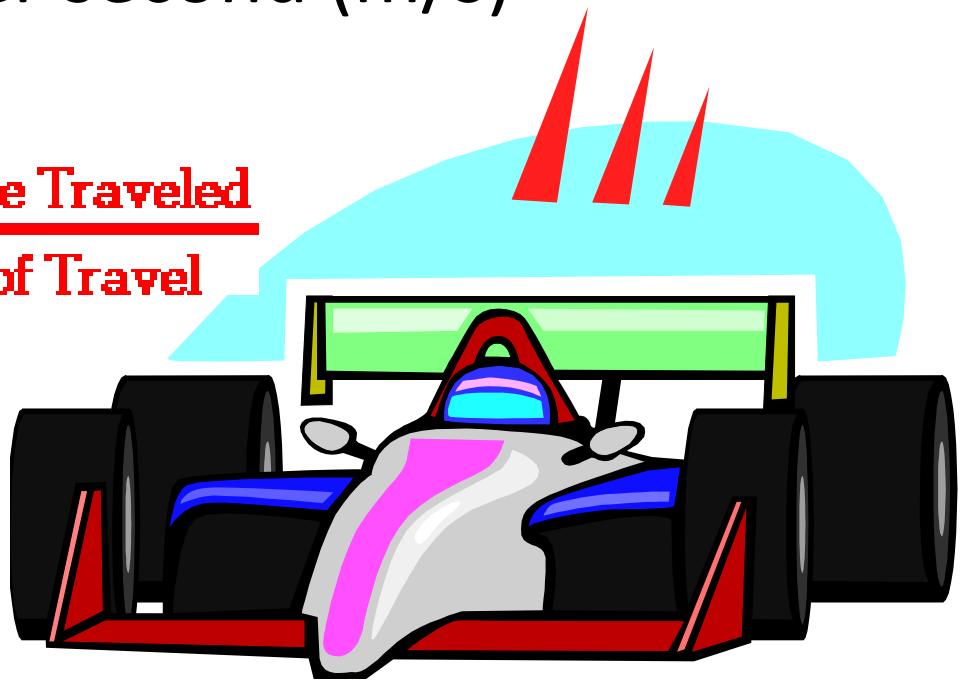
Duration

- Definition – **HOW LONG** something takes to do an action.
- Units = Seconds (s)
- Symbol: Δt
- 60 seconds = 1 minute
- 60 minutes = 1 hour
- 24 hours = 1 day

Speed

- Definition – A *scalar* model of **HOW FAST** an object is moving
- Units = Meters per second (m/s)
- Symbol: *s*

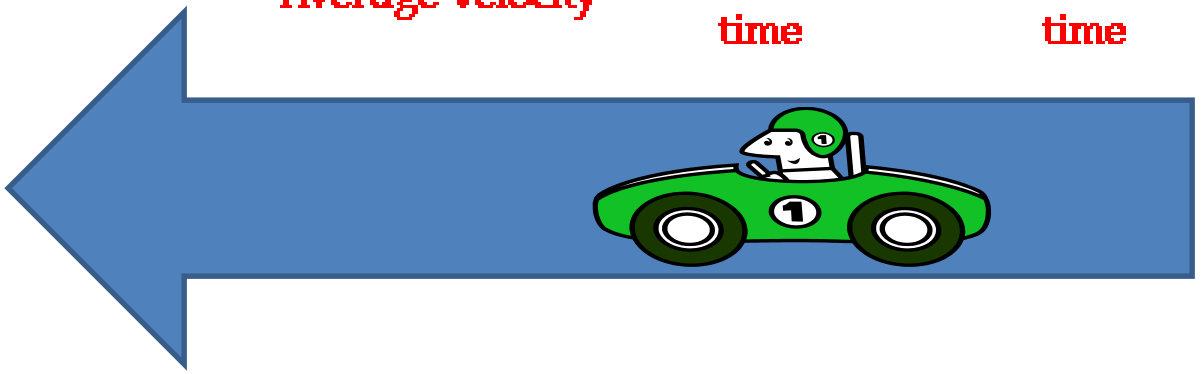
$$\text{Average Speed} = \frac{\text{Distance Traveled}}{\text{Time of Travel}}$$



Velocity

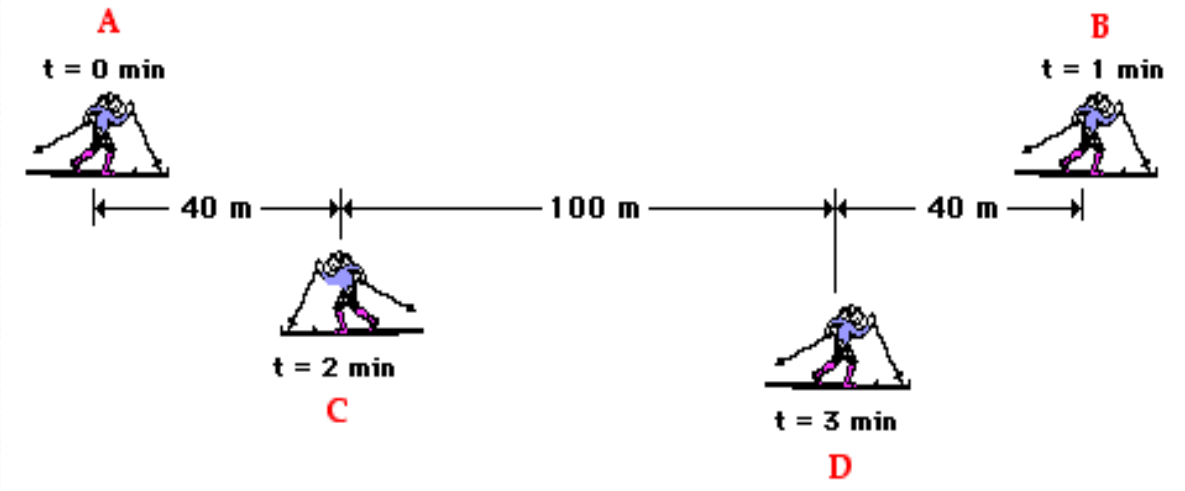
- Definition – A *vector* that describes **HOW FAST** an object is moving
- Units = Meters per second (m/s)
- Symbol: ***v***

$$\text{Average Velocity} = \frac{\Delta \text{position}}{\text{time}} = \frac{\text{displacement}}{\text{time}}$$



Speed vs. Velocity Examples

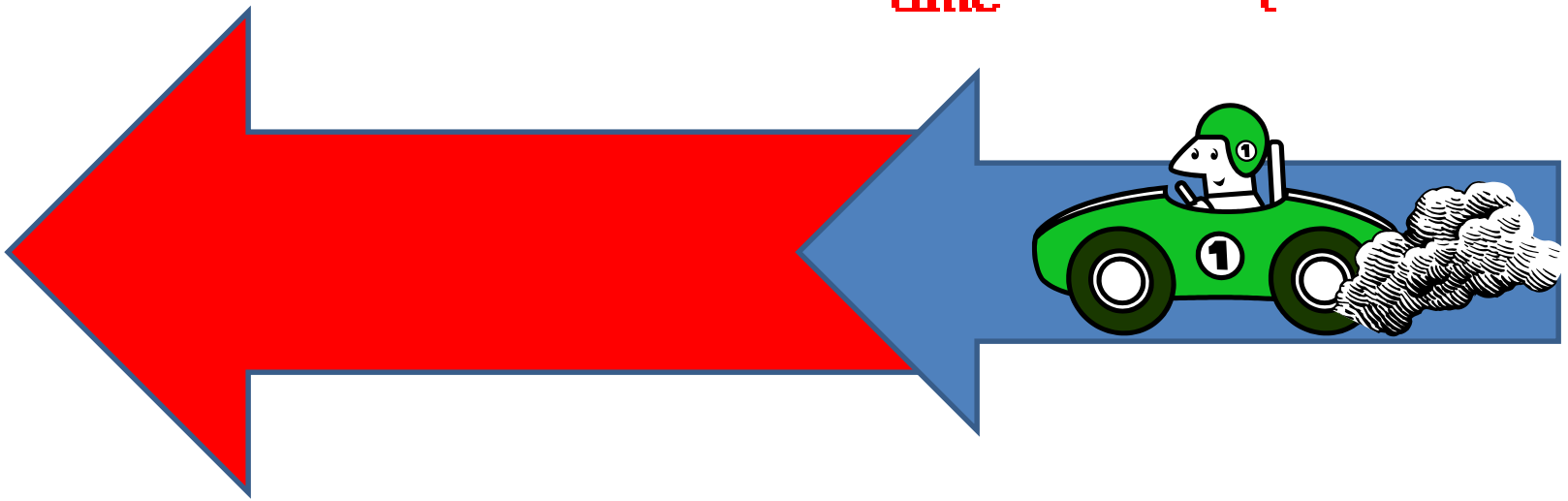
- 1. The diagram below shows the position of a cross-country skier at various times. At each of the indicated times, the skier turns around and reverses the direction of travel. In other words, the skier moves from A to B to C to D. Use the diagram to determine the average speed and the average velocity of the skier during these three minutes.



Acceleration

- Definition – The rate of change in velocity
  - **HOW QUICKLY?**
- Units = Meters per second squared (m/s^2)
- Symbo

$$\text{Ave. acceleration} = \frac{\Delta \text{velocity}}{\text{time}} = \frac{v_f - v_i}{t}$$



Ticker Tape Examples

- Imagine a car with a leaky engine that drips oil at a regular rate. Analyze the traces of the cars ventures as shown below. Assume it is traveling from left to right. Describe it's motion characteristics during each section of the diagram.