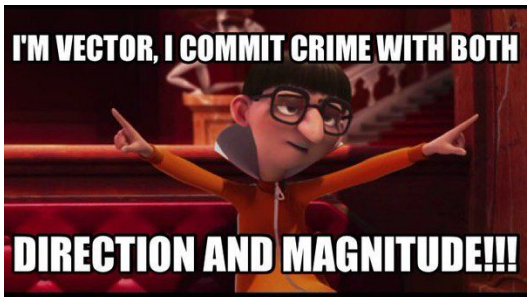
Introduction to Motion

"for assuredly, I say to you, if you have faith as a mustard seed, you will say to this mountain, 'Move from here to there,' and it will move; and nothing will be impossible for you." Matthew 17:20

- Scalar quantity: has only magnitude (size or amount)
  Vector quantity: magnitude and direction; represented by arrows of length and direction

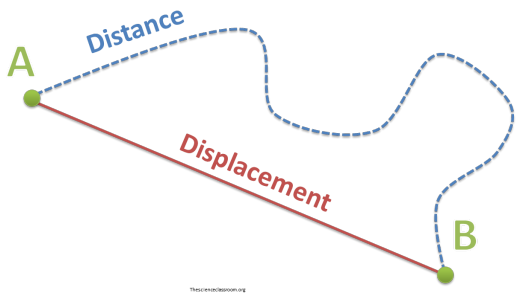


- Distance: scalar quantity representing total length of object's path; total distance traveled along any path; one dimension so object only has two directions that it can go
- Displacement: object's change in position; depends only on the final and initial positions, not the path taken

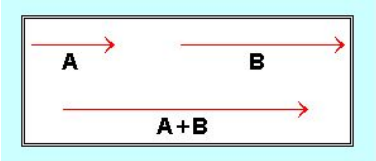
  Displacement = final position - initial position

  $\Delta x = x_{final} - x_{initial}$

  Displacement is a vector, having direction and magnitude; signs indicate directions of travel



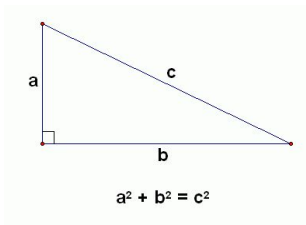
  Ex: [p.215]
  Going from home to school is displacement, but including the total distance traveled to a friend's house in between is distance traveled
- Vector addition: combination of two different vectors
  Resultant: answer in vector addition; new vector with magnitude and direction

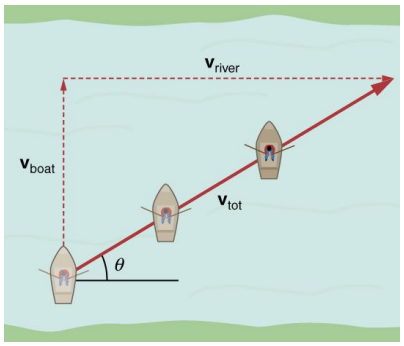


- Collinear vectors on the same line → (+) / ← (-)
  Add the vectors by adding the signed numbers:

Ex: linear displacement
A student travels from his school to his friend's house 3.0km east of the school then travels to a store 5.0km west of his friend's house. 3.0km + (-5.0km) = -2.0km or 2.0km west

- When displacement is not linear, but a diagonal, use Pythagorean theorem:





Ex: [p.217]
[Application p.217]

<u>Describing Motion</u>

- Speed: measure of how quickly an object moves; equals distance traveled per unit time:
  Speed = $\frac{\text{distance}}{\text{time}}$ or $s = d / t$
  Speed is a scalar quantity
  [Application p.218]
- Velocity: displacement of an object per unit time:, where displacement is change in position:
  Velocity = $\frac{\text{displacement}}{\text{Time}}$ or $v = \frac{\Delta x}{t}$
  Velocity is a vector quantity and should include direction
  [ex.: p.219]
  [Application p.220]
- Acceleration: change in velocity because objects speed up or slow down during travel; acceleration occurs when an object experiences a change in either speed, direction, or both
  Average acceleration is change in velocity per unit time:
  Acceleration = $\frac{\text{final velocity - initial velocity}}{\text{Time}}$ or $a = \frac{vf - vi}{t}$ or $a = \frac{\Delta v}{t}$
  [ex: p.220]
  Deceleration: negative acceleration (slowing down or stopping)
  [Application p.222]