

Chapter 10 - Motion

Section 1 - Measuring Motion

Objects in motion are all around us



How do you know if something is in motion?

You must observe the object in relation to another stationary object



The stationary object is a reference point, or reference frame (this is often the Earth)

Distance measures the length of the actual path taken by an object



Displacement is the total change in the position of an object

Speed is the distance traveled divided by the time interval during which the motion occurred

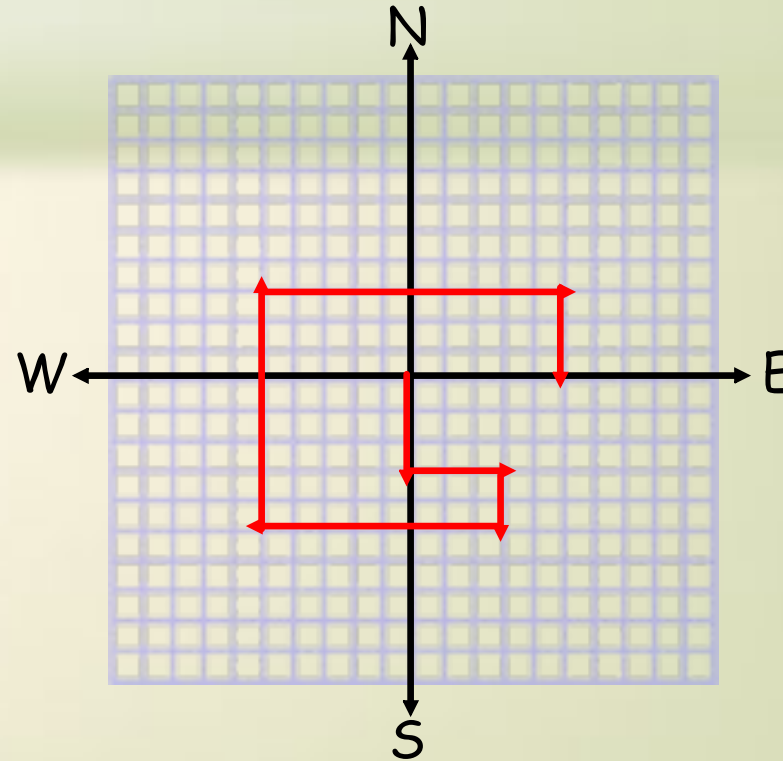
The SI unit for speed is $\frac{\text{meters}}{\text{second}}$

When an object covers equal distances in equal amounts of time has a constant speed

Time (s)	Distance (m)
0	
1	
2	
3	

There are **two** differences between distance and displacement:

Which is shorter ... distance or displacement?



Distance: Doesn't have to be straight line
Not always a particular direction

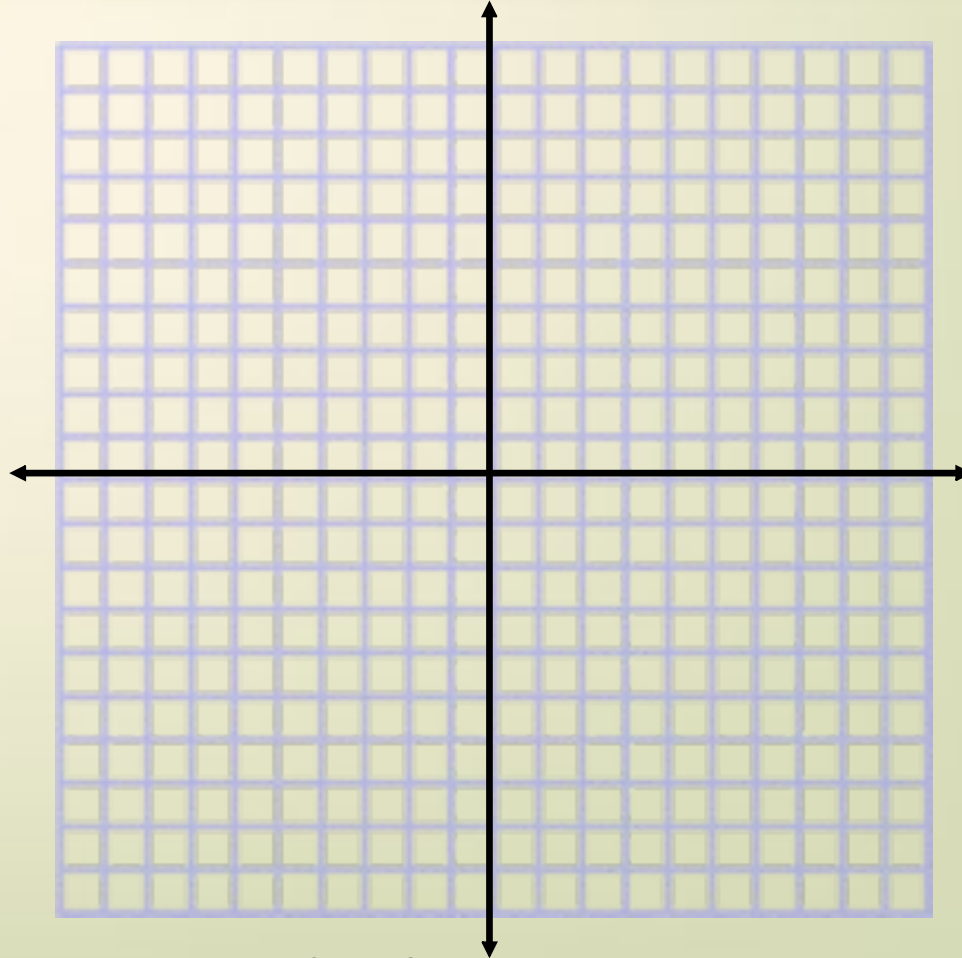
Displacement: Has to be a straight line
Always in a particular direction

Distance-time graphs can help determine speed

X-axis = independent variable (time)

Y-axis = dependent variable (distance)

What does constant speed look like?
What does an object that is speeding up look like?
What does a stationary object look like?



The slope of a line is steeper for faster moving objects

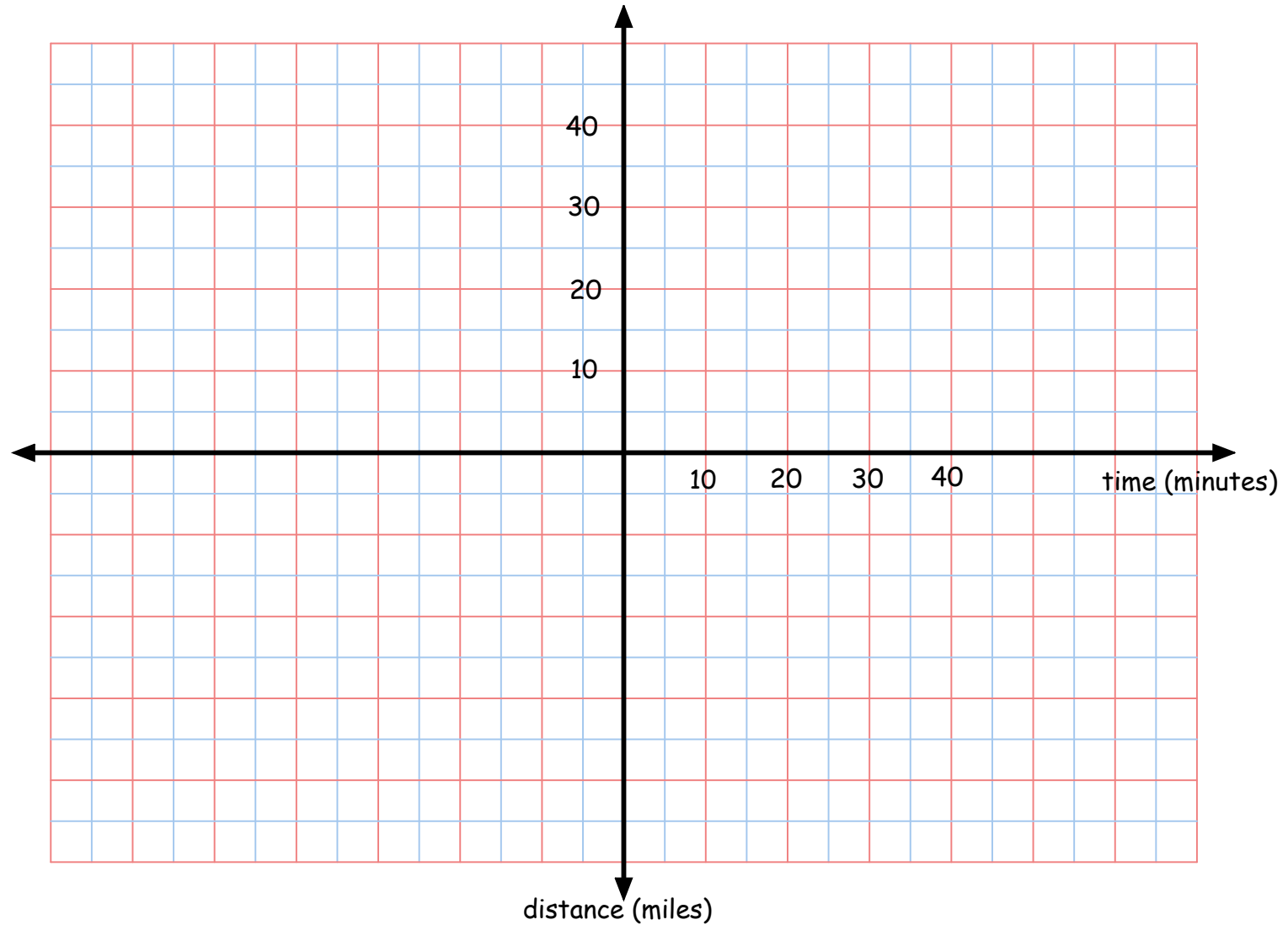
What about objects without constant speed?

You can then calculate average speed, which is the total distance traveled divided by total time it took the object to travel that distance



$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

Instantaneous speed is the speed of an object at a specific point in time



Calculating average speed of a car traveling to Thief River Falls

What's the difference between
speed and **velocity**?

Speed is how fast an object is moving

Velocity is the **speed AND direction** of motion

Direction are often given in cardinal directions
(east, west, south, or north)

Sometimes direction is describe as + or -

Practice!!

Find the velocity in m/s of a swimmer who swims 100 meters toward the shore in 72 seconds



Resultant Velocities

What if you are moving one direction while on another object moving the other direction?

You are on a bus traveling 15 m/s east. You walk to the back of the bus traveling 1 m/s west.

What is your resultant velocity?



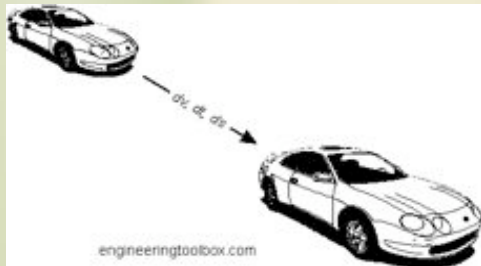
Section 2- Acceleration

What is acceleration?

When you increase (or decrease) speed, your velocity changes



Any change in velocity is called acceleration



Acceleration is measured in m/s^2

Lets fill out the chart below...assume an object is accelerating at a rate of 5 m/s^2

Time (s)	Velocity
0	
1	
2	
3	

Time (s)	Distance (m)
0	
1	
2	
3	

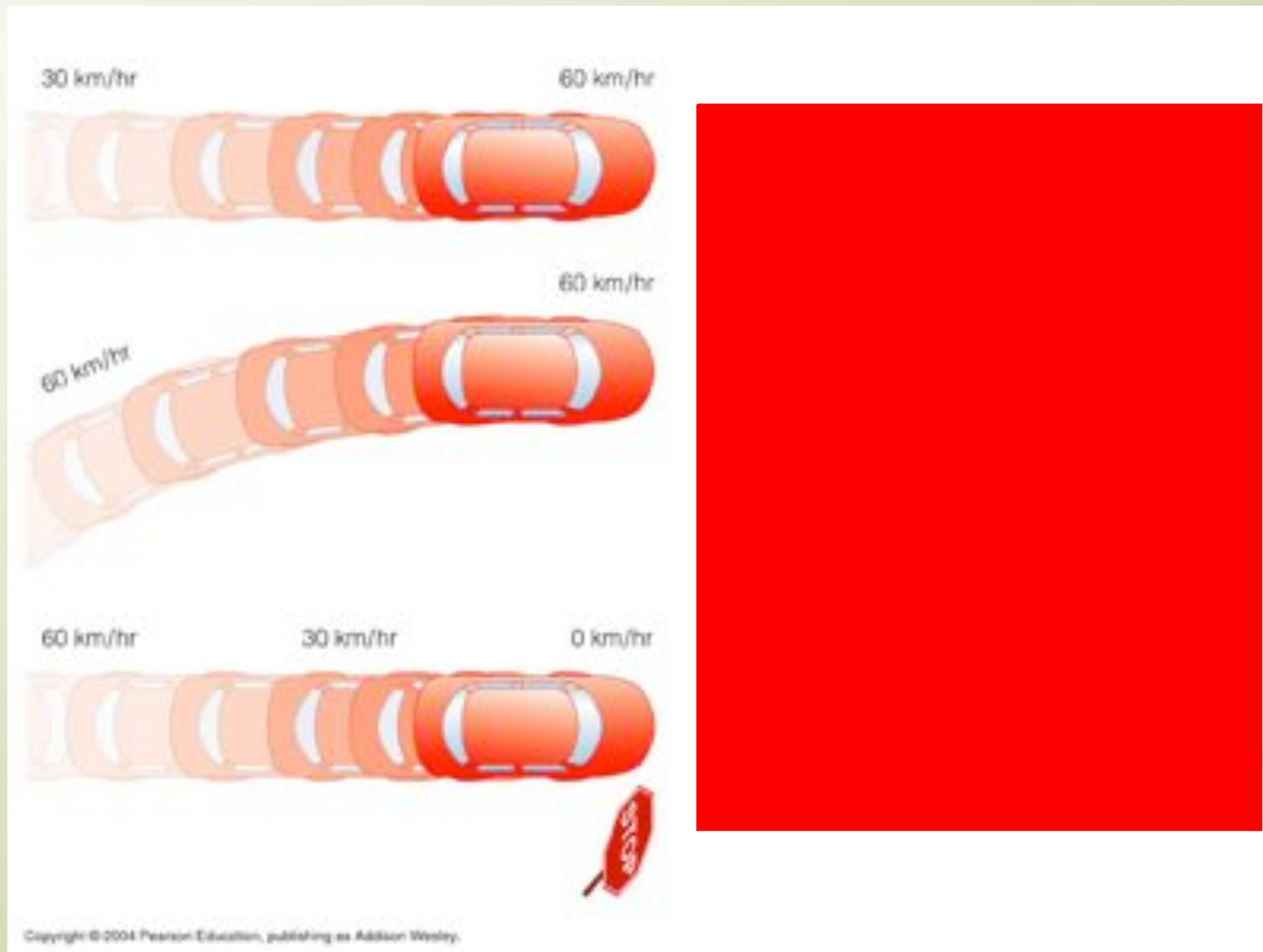
Are you accelerating right now?

Yes!!! Why??

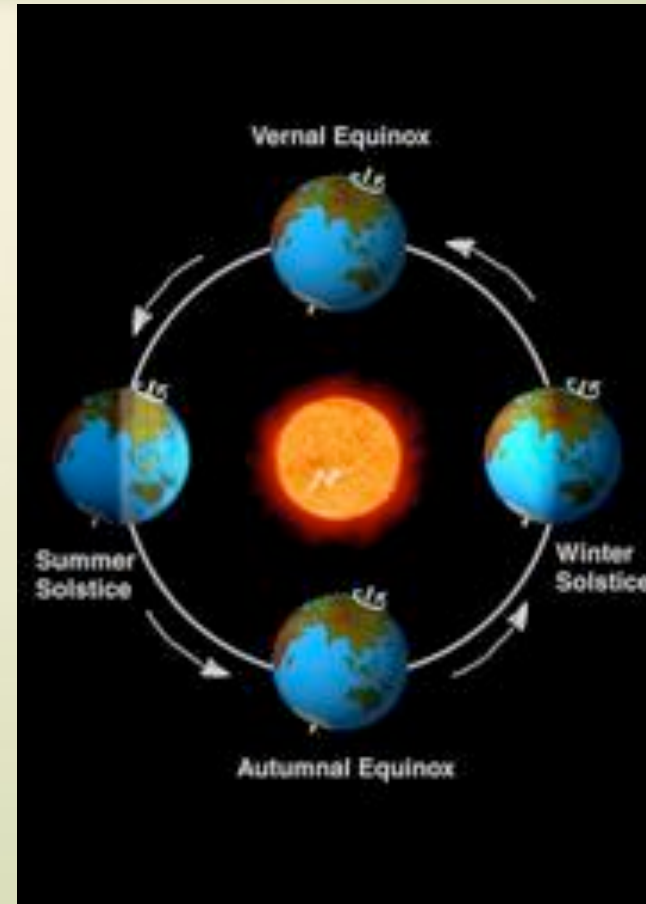


Remember, acceleration is change in VELOCITY over time

Velocity has a speed AND direction



Therefore, any uniform circular motion is constant acceleration!!



Calculating Acceleration

$$\text{acceleration} = \frac{\text{final velocity} - \text{initial velocity}}{\text{time}}$$

Mr. K's 2010 Camaro can accelerate
from 0 km/h to 96 km/h in 3.7 sec



What is the acceleration?

Can you have a negative acceleration?

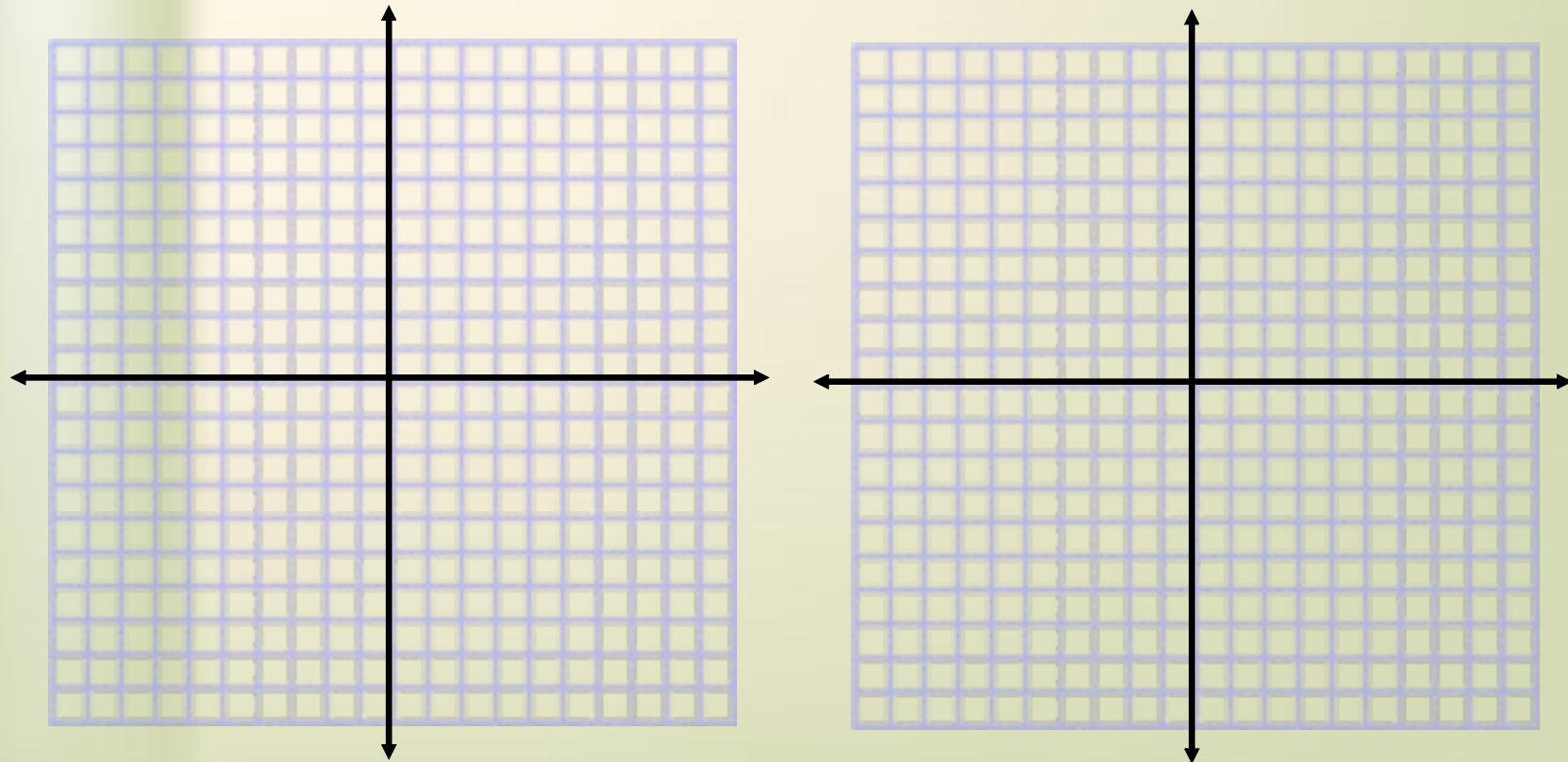
SURE!

$$\text{acceleration} = \frac{\text{final velocity} - \text{initial velocity}}{\text{time}}$$

Imagine a skier moving down a hill at 20 m/s coming to a stop in 0.50 sec



Acceleration can be determined from a velocity-time graph

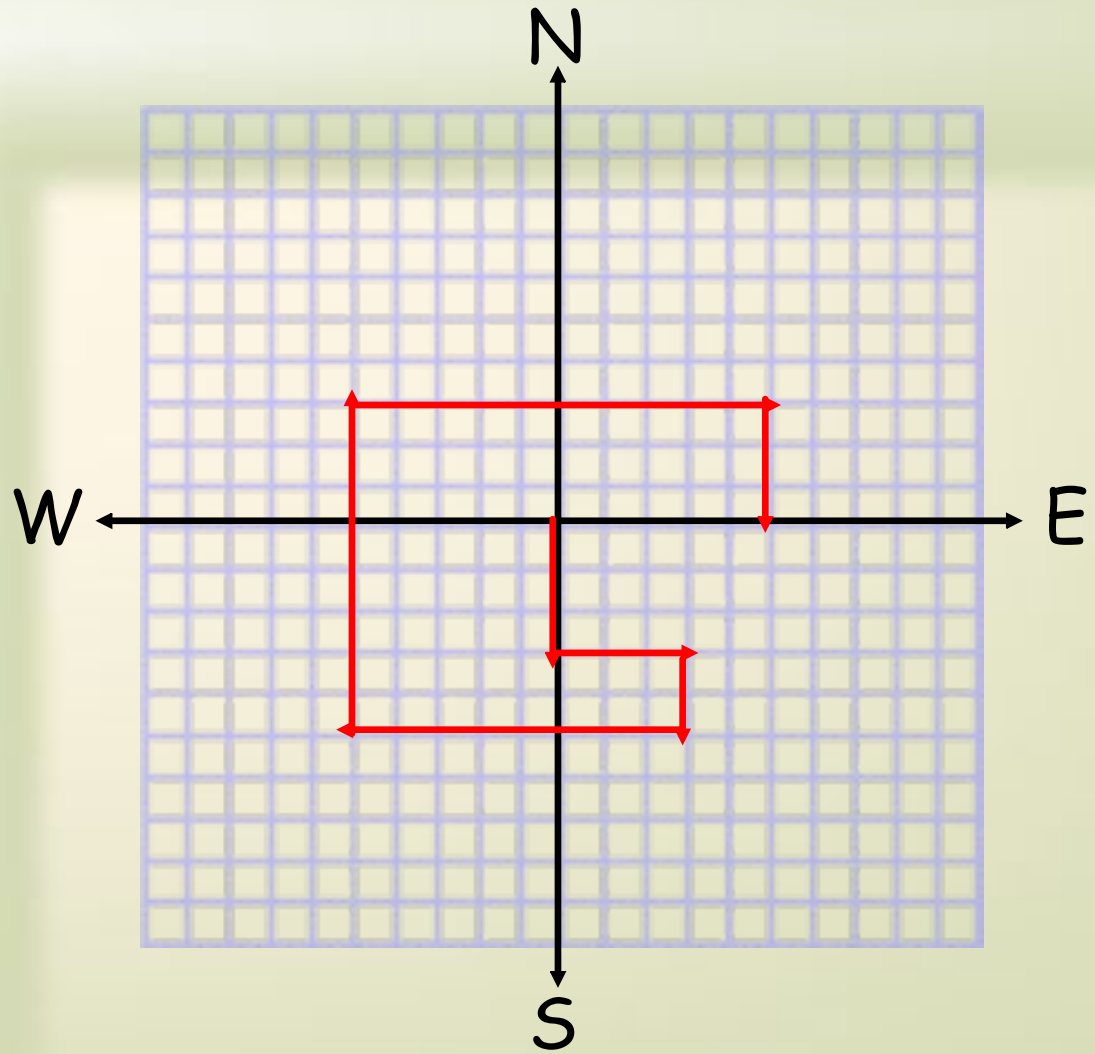


The slope of a line on a velocity-time graph will have slopes corresponding to their acceleration:

+ slope = + acceleration (speeding up)

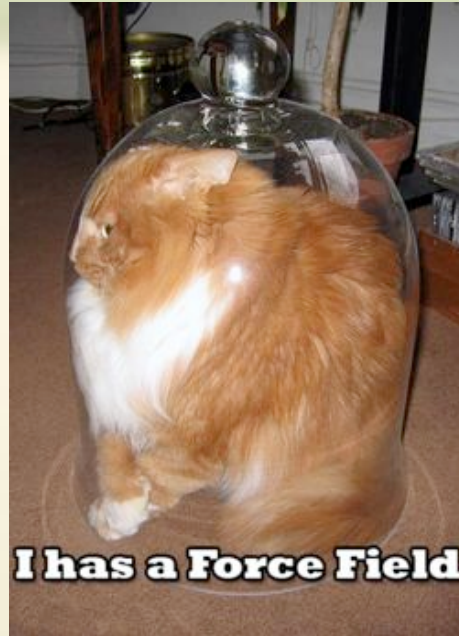
no slope = no acceleration

- slope = - acceleration (slowing down)



Section 3 - Motion and Force

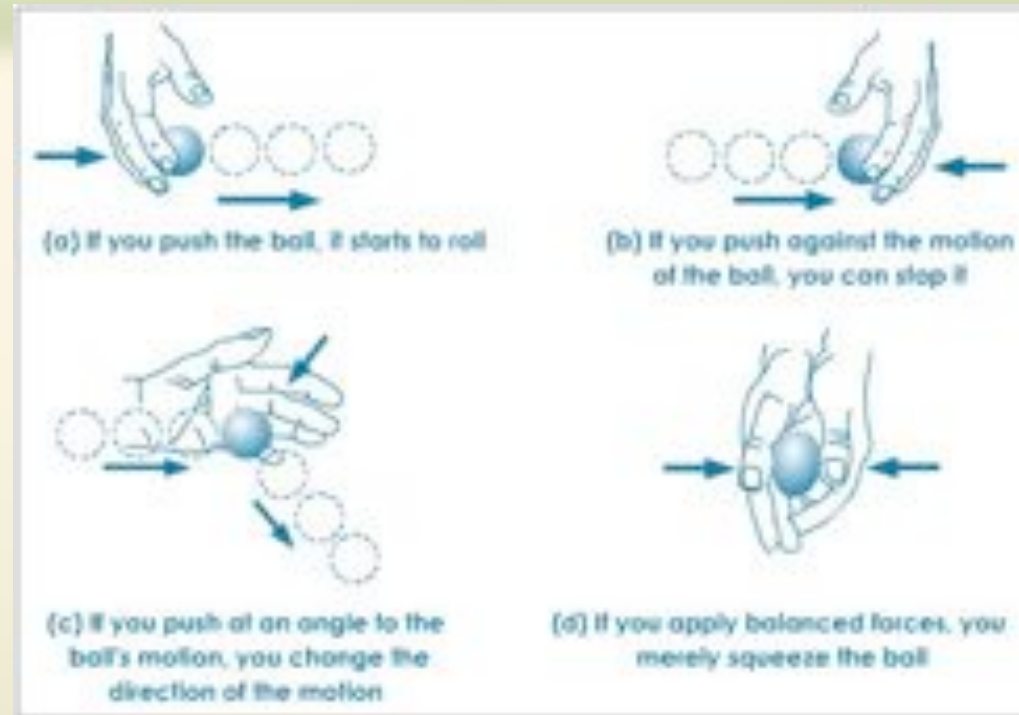
What do we mean when we use the word "force"?



"That storm had a lot of force"
"The Grygla BB team is a force
to be reckoned with"

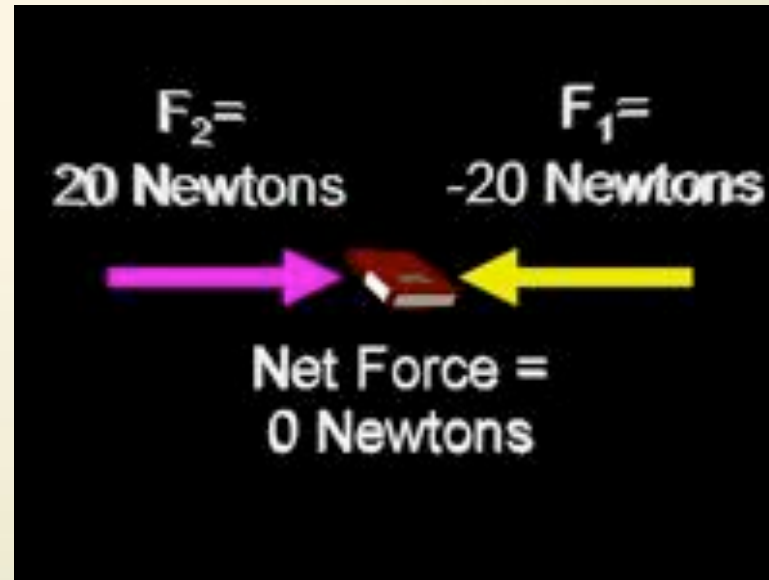
In science, a force is anything that changes the state of rest or motion of an object

When you throw or catch a ball, you exert a force to change the ball's velocity



Usually, many forces act on any given object...the net force is the combination of all of the forces acting on the object

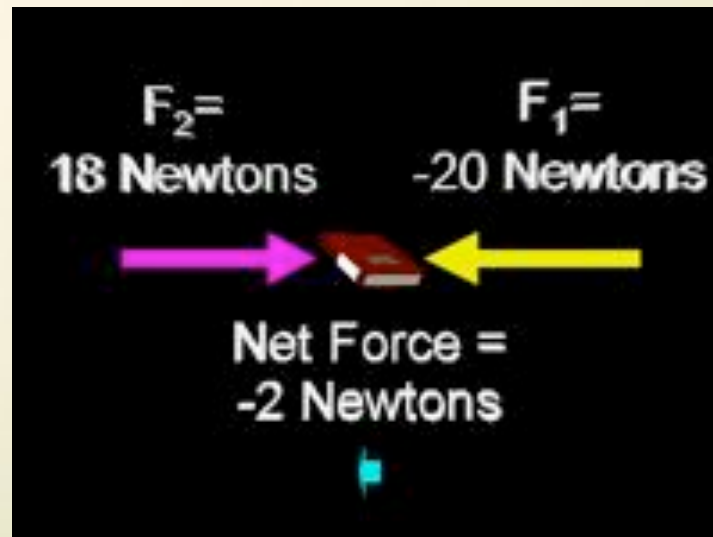
- An object will not accelerate if the net force is zero
- Balanced forces do not change motion



Examples: A light hanging from the ceiling
You sitting in your chair

Unbalanced forces cause acceleration

Arm wrestling - Whoever exerts the greater force, will create acceleration



If forces are applied from directions that are not opposite of each other they can create a movement in a new direction

Gravity is a force that pull all things toward the center of the Earth



There is an invisible force that acts on almost objects...what is it??

What happens when you take your foot off the gas pedal of a car?

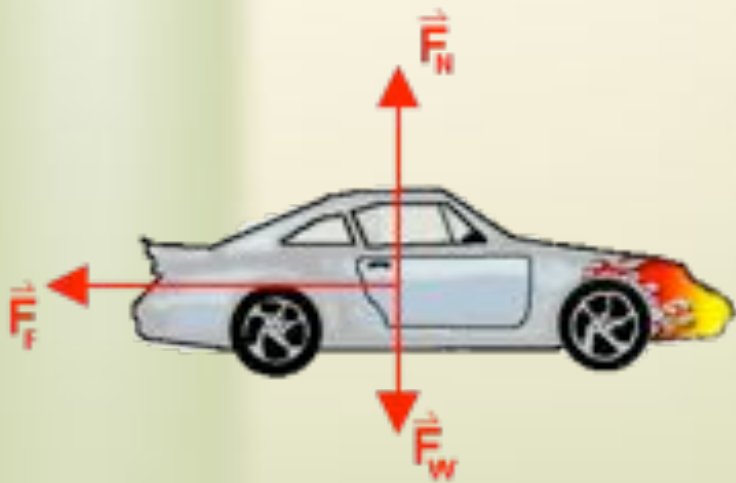
FRICTION!!



Friction occurs because the surface of any object is rough (even ones that feel smooth to us)

Because of friction, a constant force must be applied to keep things moving (such as a car)

The force in the forward motion must be *equal* to the force of friction to maintain the same speed



Friction also affects things that aren't moving

The friction between two surfaces that are stationary is called static friction

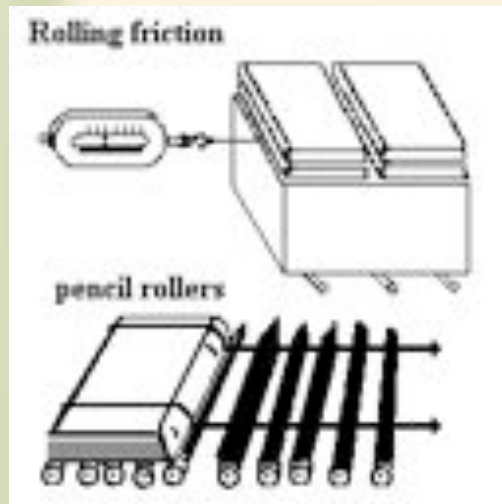


The friction between moving surfaces is called kinetic friction

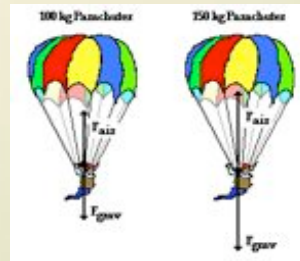
There are several types of kinetic friction

Sliding Friction - When objects slide past each other

Rolling Friction - A round object rolls over a flat surface



Rolling friction is usually **less** than sliding friction



Fluid Friction - Any object moving through liquid or air encounters friction

Fluid friction is unique, it **increases** as an object travels faster

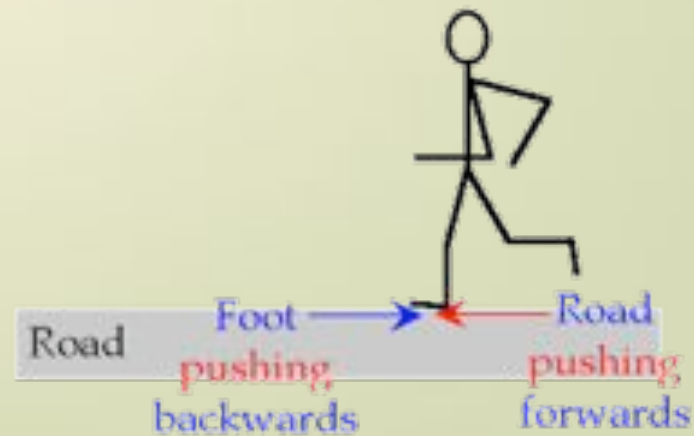
Friction can be a very good thing!

Without friction:

The tires of a car would not be able to push against the ground

Brakes would not be able to stop the car

We wouldn't be able to be able to walk!



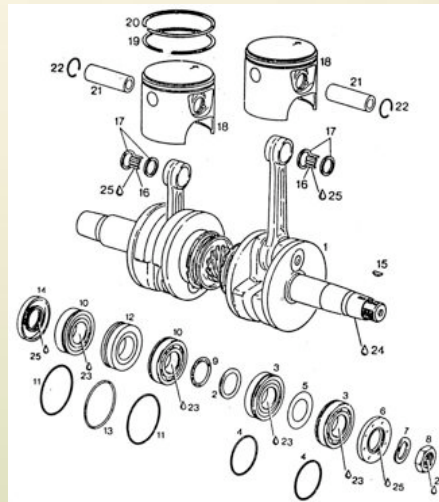
Harmful friction can be reduced:



Lubricants are substances that are applied to the surfaces to reduce the friction between them

Usually liquids, but can be solids or gases too

Wax



Motor Oil

Ball bearings

Air hockey table

Grease



Helpful friction can be increased:

We can use friction to make surfaces rougher

Sand on roads



Textured batting gloves



Steel wool

Extra weight to hold things down



Sandpaper