

# Alief ISD Middle School Science STAAR Review

## Reporting Category 2: Force, Motion, & Energy

8.6.A demonstrate and calculate how unbalanced forces change the speed or direction of an object's motion

### Force

A **Force** is a Push or a Pull that can change motion.

### How Force is Measured

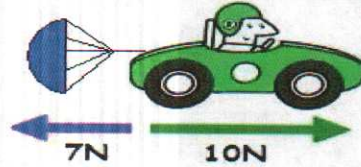
**Newton** - The SI unit used to measure force. The symbol for **Newton** is **N**.



**Net Force** = mass x acceleration

$$F = m \times a$$

I am a roller skater with a mass of 72kg. If I am accelerating toward a wall at  $3.7\text{m/s}^2$ , what will be the amount of force at which I hit the wall?



Net force = 3N to the right

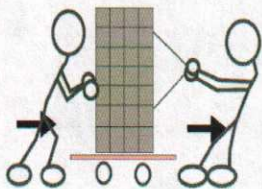


**Spring Scale** – Measures Force in Newtons (N).

### Net Force

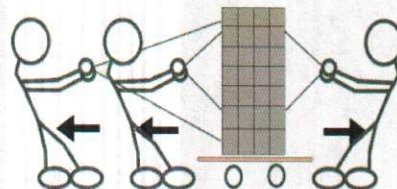
When more than one force acts on an object, the forces combine to form a **Net Force**. The combination of all the forces acting on an object is the **Net Force**.

Push 1 + Pull 1 = Net Force 2 to the right



Net Force = 2 →

Push 2 - Pull 1 = Net Force 1 to the left



Net Force = 1 ←

**ADD** forces in the same direction

**SUBTRACT** forces in opposite directions.

Magnitude is the size of a force.

8.6.C investigate and describe applications of Newton's law of inertia, law of force and acceleration, and law of action-reaction such as in vehicle restraints, sports activities, amusement park rides, Earth's tectonic activities, and rocket launches

## Newton's 1<sup>st</sup> Law

**Newton's First Law:** An object at rest will remain at rest unless acted on by an unbalanced force. An object in motion continues in motion with the same speed and in the same direction unless acted upon by an unbalanced force.

This law is often called the Law of Inertia



**Examples of Newton's 1st Law:**

- Car suddenly stops and you strain against the seat belt (vehicle restraints) because our bodies want to keep moving
- When riding a horse, the horse suddenly stops and you fly over its head
- Ketchup stays in the bottom (at rest) until you bang (outside force) on the end of the bottom
- Can you think of another example? \_\_\_\_\_

## Newton's 2<sup>nd</sup> Law

**Newton's Second Law:** Acceleration is produced when a force acts on a mass. The greater the mass (of the object being accelerated) the greater the amount of force needed (to accelerate the object). It can be measured by

$$F = M \times A$$

This law is often called the Law of Acceleration

	<p style="text-align: center;"><b>Calculate</b></p> $\underline{\quad F \quad} = \underline{1000 \text{ kg} \times 0.5 \text{ m/s/s}}$ $\underline{\quad F \quad} = \underline{\quad 500 \text{ N} \quad}$
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**Examples of Newton's 2nd Law:**

- Hitting a baseball- the harder the hit, the faster the ball goes accelerating
- A grocery cart filled with lots of food vs. an empty grocery cart
- The positioning of football players – massive players on the line with lighter (faster to accelerate) players in the backfield
- Can you think of another example? \_\_\_\_\_

## Newton's 3<sup>rd</sup> Law

**Newton's Third Law:** For every action there is an equal and opposite re-action. For every force there is a reaction force that is equal in size, but opposite in direction. This law is often called the **Law of Action-Reaction.**

**Examples of Newton's 3rd Law:**

- Momentum of the car moving forward and the car comes to a sudden stop, our body pushes against the seat (action) belt and the seat belt pushes back (reaction).
- When you lean on the wall to rest, the weight on the wall provides the reaction force and the wall pushes back on you (reaction force) with the same force.
- As the gases move downward, the rocket moves in the opposite direction.
- Can you think of another example? \_\_\_\_\_

Use the Arrows to show Action and Reaction in the pictures below.



Sudden stop



Leaning on wall



Rocket lifting off

8.6.B differentiate between speed, velocity, and acceleration

## Speed, Velocity & Acceleration

**Speed** is the rate used to measure the distance traveled over a period of time.



**Velocity** is a measure of the speed in a given direction.



**Question:** A green helicopter is moving up at 30 kilometers per hour. A blue helicopter is moving down at 30 kilometers per hour.

- A. Are the helicopters' speeds the same? Explain.
- B. Are the velocities the same? Explain.

- **Acceleration** is the change of velocity over a period of time.
- If speed or direction changes, then you have acceleration.

In your own words, explain the differences between speed, velocity, and acceleration.

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7.7.A contrast situations where work is done with different amounts of force to situations where no work is done such as moving a box with a ramp and without a ramp, or standing still

## Work

**Work** is the amount of force applied times the distance over which it is applied. In order for work to occur or happen... THE OBJECT MUST MOVE IN THE DIRECTION OF THE FORCE APPLIED.

$$\text{Work} = \text{Force} \times \text{distance} \quad \boxed{W=f \times d}$$



Solve:

1. A force of 825 N is needed to push a car across a lot. Two student push the car 35 m . How much work is done?
2. You push against the wall for 3min with a force of 10 N. How much work is done? Explain.

## Work or No Work?



Leaning



Pushing

Leaning on wall: Work or No Work?

Pushing skateboard forward: Work or No Work?

Lifting barbell over your head: Work or No Work?

Standing in the rain: Work or No Work?



Lifting



Standing

6.8.A compare and contrast potential and kinetic energy

## Potential Energy

Forms of Energy	Description of Energy
<b>Potential</b>	Energy that is stored in an object.

*Example:* The rubber band chicken. As the rubber band is stretched and placed in the hold position, the rubber band will store energy.



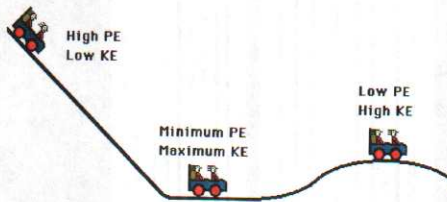
## Kinetic Energy

Forms of Energy	Description of Energy
<b>Kinetic</b>	Energy of motion; Based on the mass and speed of the moving object.

*Example:* The flying rubber band chicken. As the rubber band is released it becomes energy in motion.

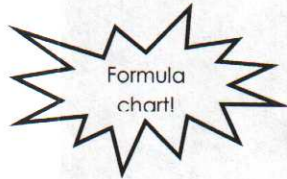


## Potential to Kinetic Energy



When the coaster is at its highest point on the track, it has the greatest potential energy. As the coaster loses height it gains speed: PE is transformed into KE. As the coaster gains height it loses speed: KE is transformed into PE.

6.8.C calculate average speed using distance and time measurements



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

$$s = d/t$$

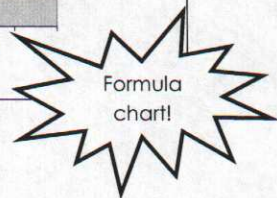
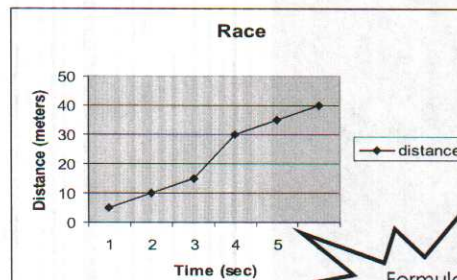
Solve:

1. You arrive in my class 45 seconds after leaving math which is 90 meters away. How fast did you travel?
2. You need to get to class, 200 meters away, and you can only walk in the hallways at about 1.5 m/s. (if you run any faster, you'll be caught for running). How much time will it take to get to your class?

6.8.D measure and graph changes in motion

## Graphing Motion

Time (sec)	Distance (m)
1	5
2	10
3	15
4	30
5	35
6	40



$$\text{Speed} = \frac{\text{distance}}{\text{time}} \quad S = \frac{d}{t}$$

6.9.C demonstrate energy transformations such as energy in a flashlight battery changes from chemical energy to electrical energy to light energy

# Energy

**Energy** is the ability to do work.

Forms of Energy:

1. **Electrical**
2. **Chemical**
3. **Radiant/Solar**
4. **Nuclear**
5. **Mechanical**

## Categories of Energy

Potential	Kinetic
1. Chemical 2. Mechanical 3. Nuclear	1. Radiant / Sunlight 2. Thermal / Heat 3. Electrical 4. Sound 5. Mechanical

\* **Mechanical Energy** can be both potential and kinetic.

## Electrical Energy

Forms of Energy	Description of Energy
<b>Electrical</b>	Delivered by tiny charged particles called electrons, this form of energy is typically moved through a wire.

Example: Lighting or Electricity



## Radiant Energy

Forms of Energy	Description of Energy
<b>Radiant / Solar</b>	Energy that travels as Visible light

Example: Sunshine



Solar Energy – energy from the Sun only

Radiant Energy – energy from all other light sources

Forces may move an object



Forces may transfer between objects.



## Types of Forces

**Balanced** – Forces that are equal in magnitude but opposite in direction. Balanced forces do not cause a change in the motion of objects.



**Unbalanced** - Force that cause a change in the motion of an object. One force must be larger than the other.





## Nuclear Energy

<i>Forms of Energy</i>	<i>Description of Energy</i>
<b>Nuclear</b>	Energy stored in the nucleus of an atom — the energy that holds the nucleus together.

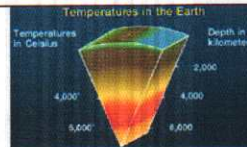
*Example:* Nuclear power plants split the nuclei of uranium atoms.



## Thermal Energy

<i>Forms of Energy</i>	<i>Description of Energy</i>
<b>Thermal / Heat</b>	The vibration and movement of the atoms and molecules within substances. As an object is heated up, its atoms and molecules move and collide faster.

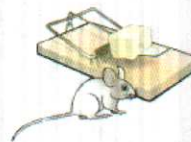
*Example:* Geothermal - heat from the earth.



## Mechanical Energy

<i>Forms of Energy</i>	<i>Description of Energy</i>
<b>Mechanical</b>	Potential energy stored in objects by tension. Kinetic energy when machine parts are moving.

*Example:* Gears or compressed spring; moving parts



## Sound Energy

<i>Forms of Energy</i>	<i>Description of Energy</i>
<b>Sound</b>	The movement of energy through substances. Sound is produced when a force causes an object or substance to vibrate.

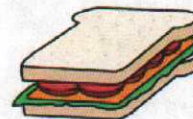
*Example:* Moving guitar strings



## Chemical Energy

<i>Forms of Energy</i>	<i>Description of Energy</i>
<b>Chemical</b>	Energy stored within the bonds of atoms and molecules.

*Example:* Gasoline, Batteries, or Food




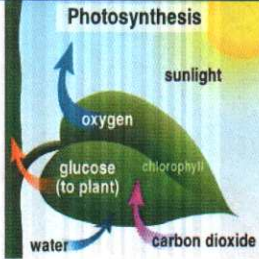


# Energy Transformations

**Energy can change from one form to another.**

*Example:* Kinetic Energy can turn into potential energy and back again.

Chemical Energy can be used to create Electrical Energy and  
Electrical Energy can be used to create Heat Energy

**Law of Conservation** – Energy cannot be created or destroyed but can only change from one form to another.

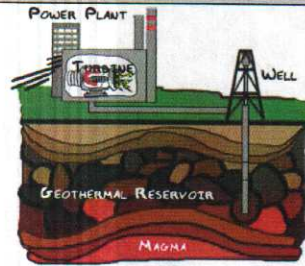
Chemical - Electrical	Radiant - Chemical
 <p>Batteries made of chemicals – Creates electricity to turn on the light bulb.</p>	 <p>Sunlight – Photosynthesis produces glucose</p>
Nuclear – Electrical	Mechanical - Sound
 <p>Nuclear Energy - Power Plant changes energy into electricity for homes</p>	 <p>Speaker movement –Vibrations create sound</p>

**Chemical - Mechanical**



Gas – Engine turns blade to cut grass

**Thermal – Electrical**



Heat from the Earth – Power Plant changes it to electricity for homes