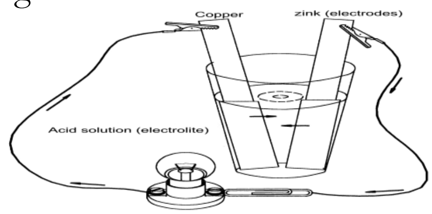
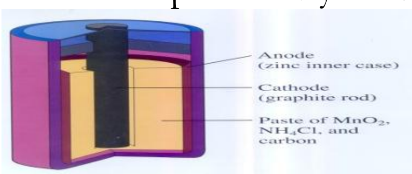
What are the big ideas?
Energy, Work, Motion & Simple Machines Trifold

- [ ] A wet-cell battery is made using two different metals and a liquid electrolyte.



- [ ] Example of a wet cell battery.
- [ ] Example of a dry cell battery.

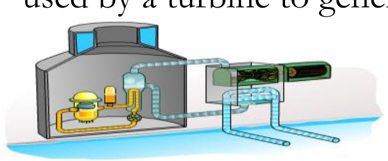


- [ ] Batteries produce electrical energy.
- [ ] Batteries contain a limited amount of energy.
- [ ] Charging a storage battery puts energy back into it.
- [ ] The energy stored in a battery can be converted into different forms such as: light, heat, and mechanical energy. Energy is conserved.
- [ ] The amount of energy stored in a rechargeable battery depends on the time the battery is charged.
- [ ] Forces are pushes or pulls on objects.
- [ ] There are different kinds of forces, and each has unique properties.
- [ ] Elastic forces are proportional to the stretch of the elastic material producing the force.
- [ ] The weight of an object is proportional to the mass of the object.
- [ ] The magnitude of sliding frictional force depends on the nature of the surface that it slides across.
- [ ] The magnitude of sliding frictional force is proportional to the weight of the object moving across a horizontal surface.
- [ ] When an applied force counterbalances frictional forces on it, an object moves at a constant speed.
- [ ] A motor exerts its maximum force under specific conditions.
- [ ] Work is the product of force and distance (W=F x d).
- [ ] No work is done if an object is never moved a distance, so it doesn't matter if you push against a wall all day, if it never moves a centimeter, though you may be tired you never did any work.
- [ ] A motor does work when lifting a load.
- [ ] Power is the rate of doing work.
- [ ] The power of a motor is proportional to the number of batteries connected to it in series.
- [ ] Falling bodies release potential energy and can provide the energy to light a bulb.
- [ ] Sun gives heat and solar energy.
- [ ] Plants transfer the suns energy into chemical energy during photosynthesis.

- Cars run on gas (fossil fuel) that store chemical energy and when the car is turned on and the motor starts running that chemical energy is converted to mechanical energy.
- Electrical energy is being transformed constantly into mechanical energy to run machines.

- **Types of Energy**:

a. Solar-energy from the sun.
b. Sound
c. Heat-transfer of thermal energy associated with motion. All matter is made up of particles too small to be seen. As heat energy is added to a substance, the temperature goes up indicating that the particles are moving faster. The faster the particles move, the higher the temperature. Sources of heat energy: burning material, the sun, and electricity
d. Potential-energy of an object due to its position (stored). This energy just has the "potential" to move (rock at the top of a hill, water behind a dam, stretched rubber band).
e. Kinetic-energy of an object due to its motion (rock *rolling* from the top of a hill, water *falling* over a dam, *releasing* a stretched rubber band). Notice the *verbs* show the motion.
f. Chemical-energy released when particles of matter react. *Chemical energy* is energy stored in particles of matter. Chemical energy can be released, for example in batteries or sugar/food, when these particles react to form new substances.
g. Electrical-energy flowing through an electric circuit. Sources of electrical energy include: stored chemical energy in batteries; solar energy in solar cells; fuels or hydroelectric energy in generators.
h. Mechanical-energy due to the motion or position of an object. *Mechanical energy* is the energy due to the motion (kinetic) and position (potential) of an object. When objects are set in motion or are in a position where they can be set in motion, they have mechanical energy. *Mechanical Potential energy: Potential energy* is stored energy. Mechanical potential energy is related to the position of an object. Examples: A stretched rubber band, and water behind a dam *Mechanical Kinetic energy*: *Kinetic energy* is the energy an object has due to its motion. Mechanical kinetic energy increases as an object moves faster. Example: a moving car .
i. Nuclear- originates from the splitting of uranium atoms in a process called fission. At the power plant, the fission process is used to generate heat for producing steam, which is used by a turbine to generate electricity.

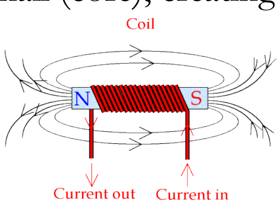


The Law of Conservation of Energy- States that energy cannot be created or destroyed. It may be transformed from one form into another, but the total amount of energy never changes. Energy can be changed from one form to another.

- Closed Circuits must have:
  a. power source (like a battery)
  b. Conductor (usually a copper wire)
  c. a device to transfer the electricity
- Circuit energy can be transformed into other types of energy: sound (mp3 player) motion (fan), light (light bulb) and heat (toaster).
- Magnetism-A magnet produces a magnetic field. The field can push and pull on a magnetic object (like an iron nail) without actually touching it. This is because the electrons are moving in the same direction.

- When you take a copper wire and spin it around a magnet really fast, you can create an electrical field.

Electromagnets are created by taking an electrical wire and wrapping it around an iron nail (core), creating a strong magnet sometimes an electromagnet is called a solenoid.



- The soft iron inside the coil makes the magnetic field stronger because it becomes a magnet itself when the current is flowing.

Soft iron is used because it loses its magnetism as soon as the current stops flowing. Soft iron is said to form a temporary magnet.
In this way, the electromagnet can be switched on and off
by turning the electricity on and off.

- Steel forms a permanent magnet.

If steel was used inside the coil,
it would continue as a magnet after the electricity was switched off.
It would not be useful as an electromagnet.
Permanent magnets are needed for
electric motors, generators, loudspeakers and microphones.

- The strength of the magnetic field around the coil can be increased by
  1. Using a soft iron core (core means middle bit).
  2. Using more turns of wire on the coil.
  3. Using a bigger current.
- Reversing the direction of the current will reverse the magnetic field direction.
- An electromagnet is used in the electric bell, relay, circuit breaker, loudspeaker and microphone.

☐ Generators are created by taking strong magnets, copper wire, iron cores and rotate the coil wire really fast around the magnet or vice versa. This generator could power a small machine or some big ones can power a whole home.

☐ Unbalanced forces change the motion of objects.

☐ Average speed is distance travelled divided by time of travel.

☐ A constant unbalanced force can make an object steadily increased its speed.

☐ Friction can act against the motion of an object and decrease its speed.

☐ Changes in motion are a result of the combined action of applied forces and friction.

☐ Energy can be stored in a compressed spring.

☐ Kinetic energy is energy of motion.

☐ Energy stored in a spring can become kinetic energy.

☐ Friction works to reduce the kinetic energy of moving objects.

☐ Gravitational potential energy is energy associated with the position of an object.

☐ Gravitational potential energy and kinetic energy can interchange forms as object changes its height energy is conserved.

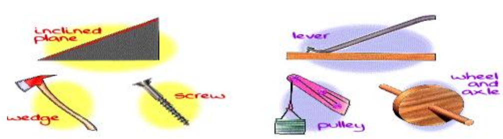
☐ Technological designs apply physical science principals.

☐ Three types of Heat Transfer:

a.Convection-heat transferred by direct contact (fire heats a pot and in turn boils water).

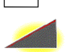
b. Conduction- transfer of heat through moving fluids (a hot pot handle to your hand).

c.Radiation-heat transferred by indirect contact through space without particles (sitting around the fire and feel the radiant heat or tanning in the sun).



☐ Simple machines reduce the amount of force required to do work.

☐ **<u>The Six Types Simple Machines List:</u>**

 ***Inclined plane***- An *inclined plane* is a sloping surface, like a ramp on a truck or a wheelchair ramp and stairs. They reduce the amount of force required to lift an object. An inclined plane can be designed to reduce the force needed to lift a weight in two ways:

(1) increase the length of the ramp or

(2) decrease the height of the ramp.

By increasing the distance the effort force moves (length of the ramp) relative to the distance the weight is lifted (height of the ramp). An inclined plane can reduce the effort force needed. Two types of inclined planes are wedges and screws.

 ***Screw*** - Inclined planes that are wound around a post or cylinder are called *screws*. Screws can be found in bolts and jar lids. Work by increasing the force you apply and by changing its direction (cylinder with an inclined plane wrapped around it).

 ***Wedge*** - One inclined plane or two back-to-back inclined planes that can move are found as knife blades or nails. Has inclined planes as its sloping sides and changes the direction of the force you apply.

 ***Wheel and axle*** - A type of lever (consists of two circular objects (a shaft or axle through the center of a wheel. Wheel and axles consist of two

circular objects: a central shaft, called an axle, inserted through the middle of a wheel. Wheel and axles can be found as door knobs, steering wheels, screwdrivers, gears, and bicycles wheels.

 ***Pulley-*** a pulley has a grooved wheel with a rope running along the groove. Pulleys can change the amount and/or the direction of the force applied (*effort force*). By arranging the pulleys in such a way as to increase the distance that the effort force moves relative to the distance the weight moves, a pulley can reduce the effort force needed.
Movable pulleys are used to reduce the effort force. Pulleys that are *moveable*, meaning that they are not attached to a structure, can be found on construction cranes and as part of a block and tackle system.
A single fixed pulley changes only the direction of the force (you pull down and the weight goes up.) Pulleys that are *fixed*, meaning that they are attached to a structure, can be found on the top of a flag pole and on window blinds.

*lever* – A *lever* is a rigid bar or board that is free to move around a fixed point called a *fulcrum*. The fulcrum may be placed at different locations along the bar.
A lever can be designed to reduce the amount of force required to lift a weight in two ways:
(1) By increasing the distance from the fulcrum to the point where the effort force is applied, or (2) by decreasing the distance the weight is from the fulcrum.
By increasing the distance the effort force moves relative to the distance the weight moves, a lever can reduce the effort force needed. Simple machine used to lift things, mainly used on heavy objects. A lever can increase the force applied many times over and can also change the direction. Levers that have the fulcrum between where the effort force is applied and the weight is located, can be found in tools scissors (2 levers working together) or a crowbar.
a. 1st Class- Levers that have the fulcrum between where the effort force is applied and the weight is located ex. see-saw (load is the person that goes up, and the effort applied is the weight of the person that goes down; the fulcrum s in the center between them). Other examples are a crowbar, scissors, nutcracker, wrench and the nail removing side of a hammer.
b. 2nd Class- Levers that have the fulcrum on the end and the effort force are applied on the other end to lift a weight in the middle can be found in tools, for example, a wheelbarrow, or a bottle opener, can opener or the flat end of the crowbar.
c. 3rd Class- Levers that have the fulcrum on the end and the effort is applied in the middle to lift a weight on the other end fishing rod (the fish is the load and the handle is the end of the fulcrum, hammer, broom, tweezers).

☐ Complex machines, also known as *compound machines*, consist of two or more simple machines.

Examples may include:

scissors consisting of two levers and two inclined planes (wedges);

a fishing pole consisting of a lever, a wheel and axle and a pulley;

a bicycle consists of levers (handlebars and handbrakes), wheel and axles (gears, wheels, and pedals), and a number of screws.

☐ Machines make doing work easier by reducing the effort force needed to do a given amount of work.

☐ The force of an object up an incline is proportional to the angle of the incline.

☐ The effort force to lift a load using a pulley system depends on the number of pulleys and how they are connected to the load.

☐ Levers balance when the product of a weight and its distance from the fulcrum on one arm are equal to the product of another weight and its distance from the fulcrum on the other arm.

☐ Mechanical advantage describes how much machines multiply effort force.

☐ Actual mechanical advantage is less than ideal mechanical advantage because of friction.

☐ Efficiency is the ratio of work output to work input.

☐ Technological design is a process to create solutions to meet human needs.

☐ In science, "work" is defined with an equation. Work is the amount of force applied to an object (in the same direction as the motion) over a distance. By measuring how much force you have used to move something over a certain distance, you can calculate how much work you have accomplished.

☐ The formula then for Work is Work = F × d

☐ The *unit for Work is measured in Joules* or (J)

☐ A *joule* of work is actually a *newton·meter*; both units represent the same thing: work! In fact, one joule of work is defined as a force of one newton that is exerted on an object to it a distance of one meter.

☐ A *spring scale* is used to measure force. Force (including weight) is measured in SI units called *newtons* (N).

☐ For the following situations, determine whether work was done. Write "work done" or

☐ "no work done" for each situation.

a. An ice skater glides for two meters across ice.

b. The ice skater's partner lifts her up a distance of 1 meter.

c. The ice skater's partner carries her across the ice a distance of 3 meters.

d. After setting her down, the ice skater's partner pulls her across the ice a distance of 10 meters.

e. After skating practice, the ice skater lifts her 20-newton gym bag up 0.5 meter.

How much work is done on a 10-newton block that is lifted 5 meters off of the ground by a pulley?

<table>
<tr>
<td>What are you looking for?
The amount of work done by a pulley in a unit of newtons and meters.</td>
<td rowspan="3">Solution:

Work= 10 N x 5 m

Work= 50 newton-meters/50 joules /50 J

Sentence:

The pulley did 50 newton-meters or 50 joules or 50 J of work.</td>
</tr>
<tr>
<td>What information have you been given?
The lift force applied by the pulley= 10 N</td>
</tr>
<tr>
<td>What is the formula or relationship?

W=F x d
Work (joules) = Force (newtons) x distance (meters)
1 newton·meter = 1 joule

1.0 joule=1.0 N x 1.0 meter=1.0 newton-meter</td>
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