Science 9 Unit 4: Electricity
Reading Logs – SCIENCE in ACTION

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1.0 – Electrical energy can be transferred and stored.

1.1 – Static Electricity

Draw an atom including Protons, Neutrons and Electrons and clearly indicate particle charges.

When the number of protons and electrons

are equal, the molecule is _____.

Opposite charges _____

Like charges _____

Define the following using words AND pictures

Static Charge

Charge Separation

Electrical Discharge

Van de Graaff Generator

1.2 – Current Electricity

Static charges do not work very well for operating electrical devices. Electrical current is produced when charges move in a continuous flow.

An electrical current flows _____ until

_____.

The **rate at which current flows** is measured in _____ called

_____ for short and shown by (A). These are named after

_____.

The measure of the amount of electrical energy carried by each particle is

known as _____. This is also known as the "potential difference".

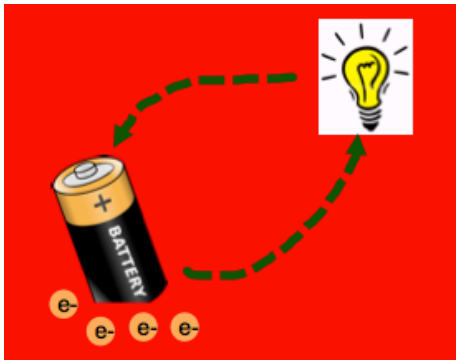
The unit for measuring electrical energy carried by each particle is known as

the _____ and shown by (V).

When an object builds up more of one type of charged particle it is said to have a _____

_____.

"Static" means not moving. In this case the electrons are building up and not flowing.



If charged particles flow rather than build up it is called an _____

_____.

This has at least 2 requirements:
1.

2.

1.3 – Electrical Safety

Any person coming in contact with a power line may create an unintended path for the

electricity. Such a path is called a _____ because _____

_____.

When it comes to electrical safety should you be more concerned about Volts or Amps? Explain your answer:

Write the definition of an **insulator** and give 4 different examples:

List 5 Electrical Safety Pointers:

-

-

-

-

-

Explain how a fuse and circuit breaker both work to keep you safe. Explain how a fuse is different than a circuit breaker (include pictures)!

1.3: Connect your Understanding

A. A power line carrying high amounts of current falls on a car, but the people inside are not electrocuted. Explain.

B. Are all electric shocks to the body dangerous? Explain.

C. Tall buildings often have a steel-lightening rod that is connected to the ground with a wire. Lightening tends to strike these rods during storms. Why are these rods added and how do they work?

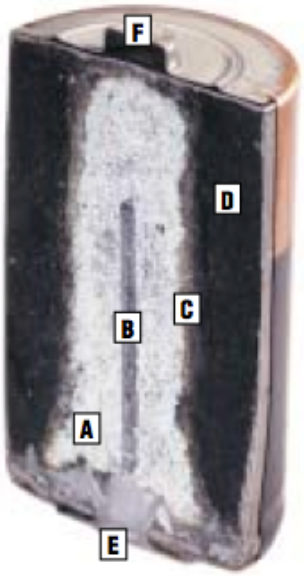
D. You notice a friend removing the third prong of a plug so that the plug will fit into an extension cord that has only two holds. Is the removal of this third prong safe? Explain why or why not?

E. Draw a symbol you might see representing an electrical hazard.

1.4: Cells and Batteries

The electricity-producing cells that we use every day in flashlights and portable radios are _____ _____. The chemicals inside are a paste. The chemical reaction releases free electrons.

Label the parts of the Dry Cell below:



A.

B.

C.

D.

E.

F.

Wet Cells – Draw a simple wet cell in the space below. Be sure to label your electrodes as positive or negative and indicate charge direction.

	A wet cell uses a liquid electrolyte that is usually an _____. Wet cells are generally cheaper and easier to make than dry cells but we don't use them as commonly today because:_____. A common example of a wet cell we do use every day is: _____

Write a definition and give an EXAMPLE of the following:

Primary Cell:

Secondary Cell:

Electrolysis:

Electroplating:

What is the difference between a battery and a cell? *Use pictures AND words to demonstrate your understanding.*

Who made the first practical battery? _____

Comprehension Questions:

1. A car designer has proposed a new car battery. She is planning to test the following different electrode combinations:
    a. both zinc
    b. zinc and copper
    c. both copper
    d. zinc and carbon
    e. both carbon

    Will all these combinations work? Explain why or why not?

2. Computer circuits can be damaged by static discharges. To prevent this, technicians usually wear an anti-static strap that is connected to the metal case of the computer. Explain how wearing such a strap protects computer circuits.

2.0 – Technologies can be used to transfer and control electrical energy.

2.1 – Controlling the flow of electrical current

In the boxes below use + symbols to represent nuclei and – symbols to represent electrons and demonstrate how they behave in insulators, conductors and conductors with voltage applied.

Insulator	Conductor – no voltage	Conductor – voltage applied

Define **superconductors**, give an example and the name of the scientist who discovered them:

Complete the following table

	Definition	**Measured in:**	**Symbol**
Resistance		Ohms	
Voltage			V
Current		Amperes	

How is a polygraph an application of resistance?

What is the difference between a switch and a rheostat (a variable resistor)?

2.2 - Modeling and measuring electricity

Using the analogy of flowing water clearly describe **voltage**, **resistance** and **current** using words AND pictures.

Rewrite Ohm's Law to measure each of the following:

Voltage

Current

Resistance

2.3 - Analyzing and building electrical circuits

List the 4 parts of a circuit

1.

2.

3.

4.

Draw a these parts in a simple circuit

Draw and describe a series circuit.

Draw and describe a parallel circuit

3.0 – Devices and systems convert energy with varying efficiencies

3.1 Energy Forms and Transformations

Use words AND pictures to define the following terms

Energy	**Thermocouple**

Complete the chart. Write the description in your own words!

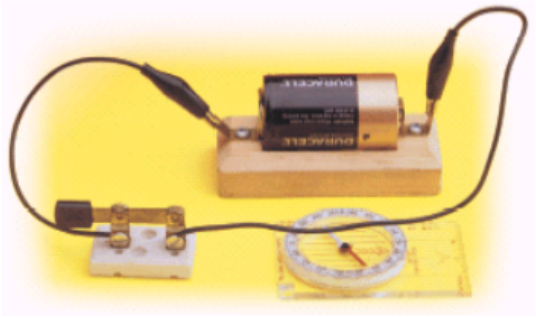
Energy Form	Description	Example

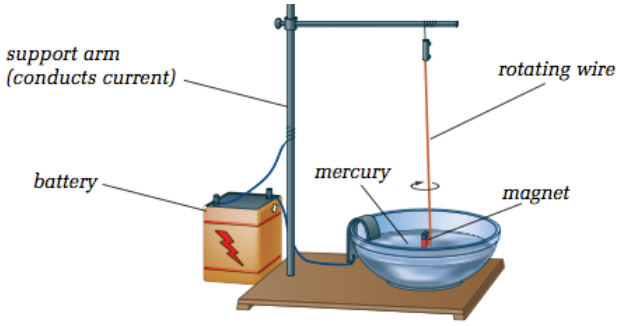
Explain how energy can be transformed and give two examples of devices that can be used.

3.2 Energy Transformations Involving Electrical and Mechanical Energy

What is Oersted's Law?

For each of the devices shown below record **who** is credited with their discovery, **how** they work and how they contributed to devices we use today.





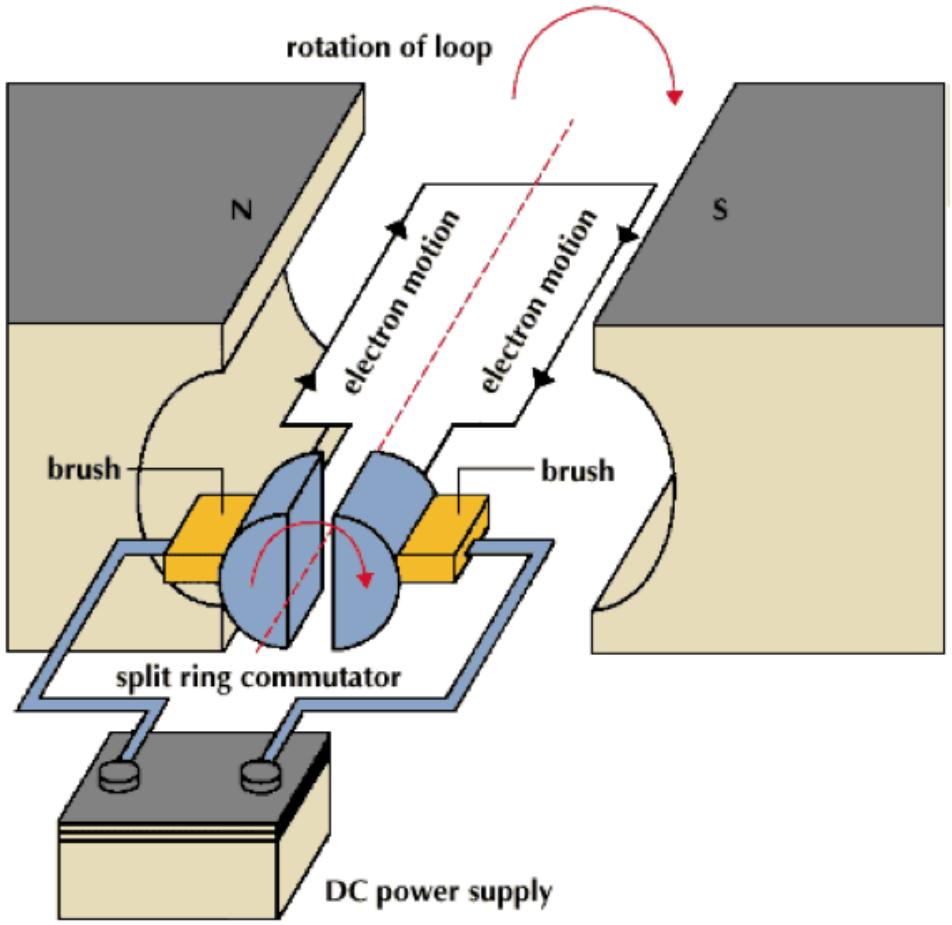
How do the following contribute to electric motors?

Commutator
Armature

Define the following terms in your own words and draw a diagram if it helps you to understand.

Direct Current	Alternating Current
Transformer	Electromagnet

How motors work using diagrams.



Coil - The coil is made of copper wire and is wound onto an armature. The coil becomes an electromagnet when a current flows through it.

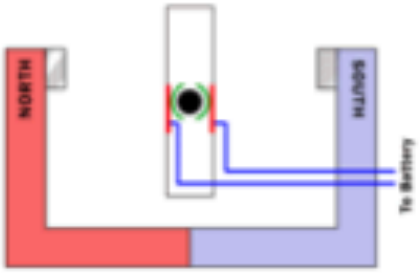
Armature - The armature supports the coil and can help make the electromagnet stronger. This makes the motor more effective.

Permanent Magnets - There are two permanent magnets. They produce a steady magnetic field so that the coil will turn when a current flows through it.

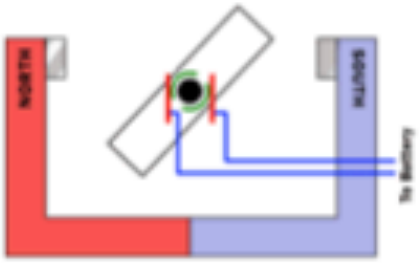
Commutator - Each end of the coil is connected to one of the two halves of the commutator. The commutator swaps the contacts over every half turn.

Brushes - The brushes press on the commutator. They keep contact with the commutator even though it is spinning round. The current flows in and out of the motor through the brushes.

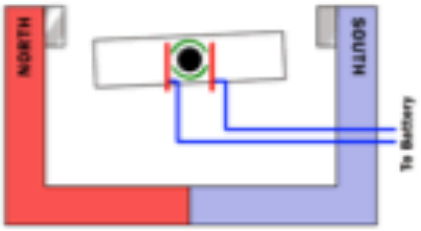
Energy Source - Supplies the current electricity, which will be converted into the mechanical energy of the motor.



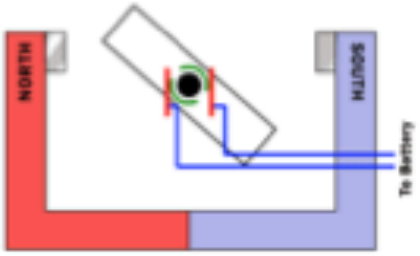
- The motor is connected to a battery. When the switch is closed, the current starts to flow and the coil becomes an electromagnet.
- The electrons move clockwise, making the top of the armature a north pole and the bottom of the armature a south pole.



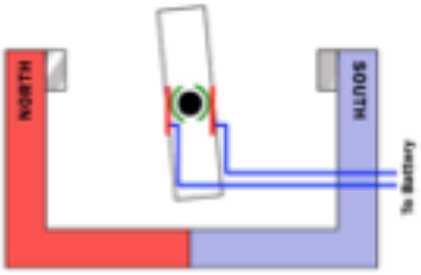
- The north pole of the armature is attracted to the south pole of the permanent magnet on the right. (And the south pole of the armature is attracted to the permanent magnet on the left.)
- So the top of the coil turns towards the right.



- Once the armature gets to this position, there is no turning force on it because the electromagnet of the coil is lined up with the permanent magnets. To keep the armature spinning, the commutator breaks contact in this position. So the current stops for an instant, but the momentum of the armature keeps the armature moving.



- The contacts are reconnected, but they are not the other way around. So, the side of the armature that used to be the south pole is now a north pole. This provides the drive for the armature to keep moving.



- The electrons move clockwise, making the top of the armature a north pole and the bottom of the armature a south pole.
- The commutator will keep swapping contacts every half turn, in this way the motor keeps spinning.

3.3 Measuring Energy Input and Output

term	definition	Formula
POWER		
unit		

The faster a device converts energy, the _____ its power rating.

term	definition	Formula
Energy Consumption		
unit		

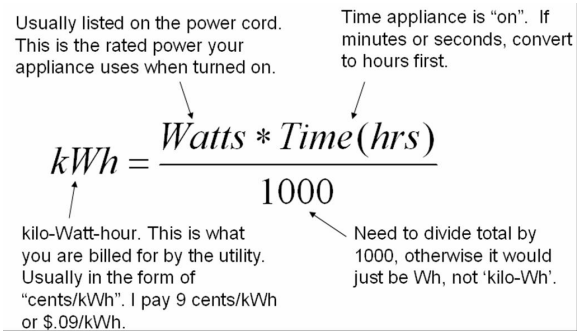
Give a typical power rating for each of the following small appliances (hint, you might need to look it up online):

Electrical stove _____

Calculator _____

Curling Iron _____

What is a Kilowatt Hour (in your own words)?



Explain how the Law of Conservation of Energy and Efficiency of electrical devices are related.

Efficiency is the ratio of the useful energy output to the total energy input in a device.

$$\text{percent efficiency} = \frac{\text{joules of useful output}}{\text{joules of input energy}} \times 100$$

3.2 and 3.3 Review

You probably want to carefully show formula and steps for solving so this could help you in your Electricity final ☺

Electrical Device	Power (W)	Time used in one day (s)	Energy used in one day (J)	Energy used (kJ)
Electric stove	7000	**1 hour**		
Fridge	615	**24 hrs**		
T.V.	200	**4 hrs**		
Incandescent Light Bulb	60	**6 hrs**		
Calculator	0.0004	**Half an hour**		

1. How much energy is used if you leave a 60W light bulb on for 10 minutes?

2. How much energy is used if you leave a 100W light bulb on for 10 minutes?

3. Electrical companies measure the amount of energy used in kilowatt hours (kWh) instead of W/s. How much energy does a fridge and stove use in 1 day in kWh (use the table above for the required values)?

4. What is the power rating of a toaster that requires 10A of current, when plugged into a 120V electrical outlet?

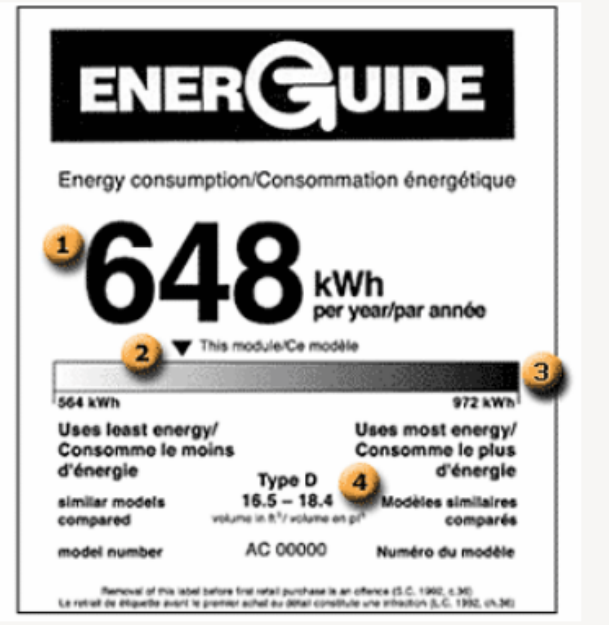
5. A hair dryer has a power rating of 1000W. The hair dryer is plugged into a 120V outlet. How much current flows through the hair dryer?

Type of Light	Description	Total Input Energy (J)	Useful Output Energy (J)	Percent Efficiency (%)
Incandescent 	- current passes through a tungsten filament (resistor) producing heat and light	1200	60	
Halogen 	- current passes through a tungsten filament surrounded by a halogen gas	1200	180	
Fluorescent 	- current passes through mercury vapour producing heat and light	1200	240	

Rank the light bulbs from **most** to **least** efficient.

3.4 Reducing the Energy Wasted by Devices

Explain the numbered components on the ENERGUIDE



1.

2.

3.

4.

Explain why an electric motor is more energy efficient than a combustion engine. Give at least 3 reasons.

Type of Vehicle	Total Input Energy (kJ)	Useful Output Energy (kJ)	Percent Efficiency (%)
Gas-powered Sport Utility Vehicle (SUV) 	675	81	
Gasoline-electric Hybrid 	675	195	

4.1 – Electrical energy sources and alternatives

Complete the following table:

Energy Sources	Description	Pros	Cons
Fossil Fuels			

What is the difference between renewable and non-renewable energy sources? (the more specific you are the better it will be for you)

4.2 – Electricity and the environment

Define by-product with respect to electricity generation: _____

_____

What harmful by-products result from electrical generation and how do they affect the environment?

What does sustainability mean? _____

_____

4.3 – Electrical technology and society

	Electrical Technologies
Benefits	1. 2. 3.
Disadvantages	1. 2. 3.