TÍTOL **– ELECTRICITY AS LOGICAL MYSTERY.I**

Àrea - **TECHNOLOGY**

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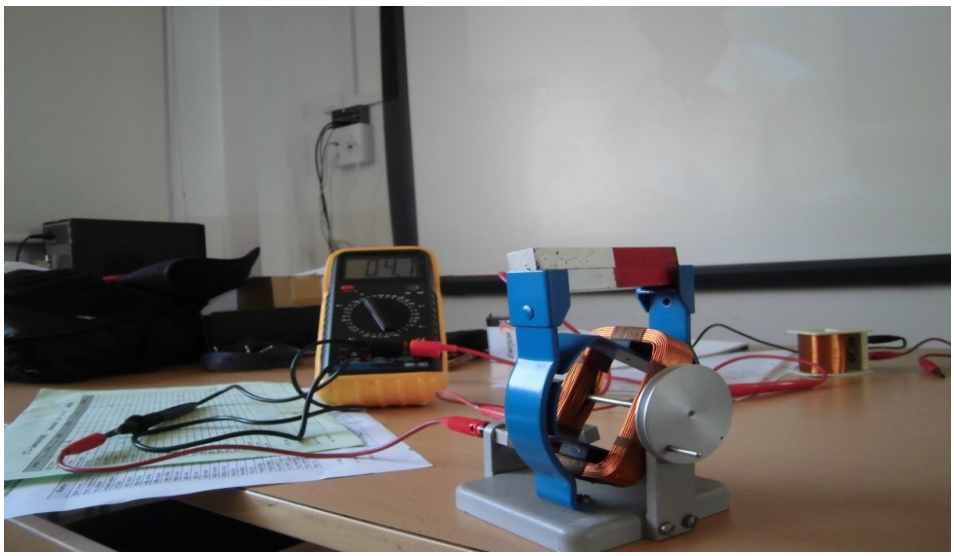

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TÍTOL – ENERGY -

ELECTRICITY MYSTERY I

1. CONSTRUCT YOUR OWN MAGNET !!! JUST WITH ELECTRICITY

What is an electromagnet?

An electromagnet is a magnet that is created when electricity flows through a conductor, otherwise, no magnet effect appears. Unlike a permanent magnet, the strength of an electromagnet can easily be changed by changing the amount of electric current that flows through it. The poles (Nord- South) of an electromagnet can even be reversed by reversing the flow of electricity (poles + and -).

An electromagnet works because an electric current induces a magnetic field. The magnetic field goes around the conductor. The typical way in which electromagnets are built is to wrap many coils of wire around a ferromagnetic core. When electricity passes through the coils of wire, a magnetic field develops around it, which is caught in the ferromagnetic core.

How can I make an electromagnet?

It is fairly easy to build an electromagnet. All you need to do is wrap some copper wire around an iron core (look at the picture). If you attach a battery to the wire, an electric current will begin to flow and the iron core will become magnetized. When the battery is disconnected, the iron core will lose its magnetism. (RUNNING A REAL EXPERIENCE IN CLASS)

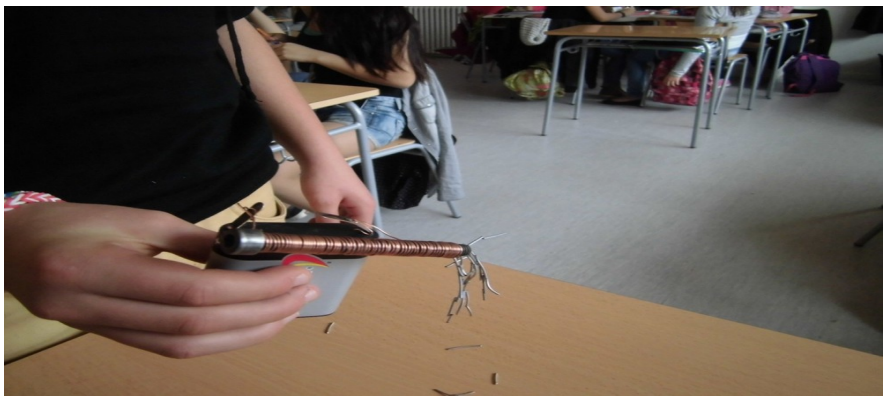
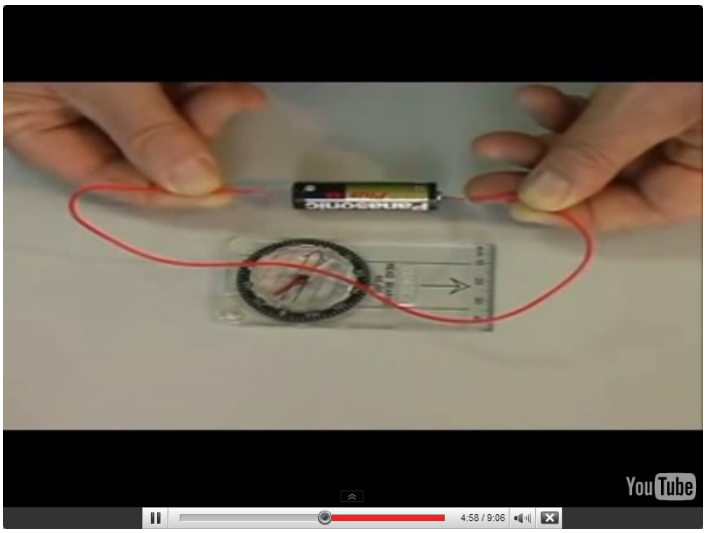


Fig.1

To learnt more watch the video 1:
http://www.neok12.com/video/Electromagnetism/zX606e5c5b58714d07054151.htm



Activity 1

Recalling

1 What happens to the iron if the battery is disconnected?

Understanding

2 Is iron a permanent magnet?

Applying

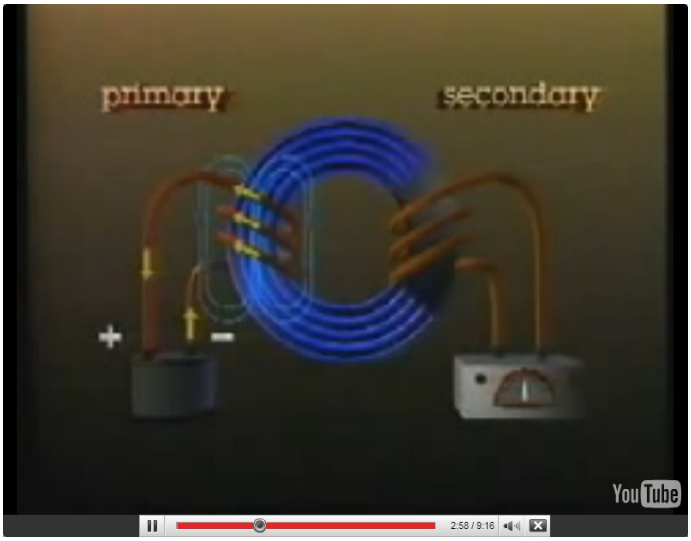
3 Which is the relationship between electricity and magnetism?

ELECTRICITY MYSTERY II

2. OBTAIN YOUR OWN ELECTRICITY !!! JUST WITH A MAGNET

As you already know electricity is a physical phenomena associated with the presence and flow of electric charge. But, how can we get it?

The most used form for generating electricity is based on Faraday's law, and it is called ELECTROMAGNETIC INDUCTION. It can be experimented by simply rotating a magnet within closed loops of a conducting material (e.g. copper wire). But leave the video 2 explains that:



http://www.neok12.com/video/Electromagnetism/zX64684e515b03424656740a.htm

Electromagnetic induction was discovered independently by Michael Faraday and Joseph Henry in 1831; however, Faraday was the first to publish the results of his experiments. In Faraday's first experimental demonstration of electromagnetic induction (August 29, 1831), he wrapped two wires around opposite sides of an iron ring or "torus". Based on his assessment of recently discovered properties of electromagnets, he expected that when current started to flow in one wire, a sort of wave would travel through the ring and cause some electrical effect on the opposite side. He plugged one wire into a galvanometer, and watched it when he connected the other wire to a battery. Indeed, he saw a transient current (which he called a "wave of electricity") when he connected the wire to the battery, and another when he disconnected it. This induction was due to the change in magnetic flux that occurred when the battery was connected and disconnected. Within two months, Faraday had found several other manifestations of electromagnetic induction. For

example, he saw transient currents when he quickly slid a bar magnet in and out of a coil of wires(Fig.3 and 4), and he generated a steady (DC) current by rotating a copper disk near the bar magnet with a sliding electrical lead ("Faraday's disk", Fig.5).

Faraday's experiment try to induce a current from a magnetic field, with a battery on the left, an iron ring in the centre, and a galvanometer on the right (Fig.2).
Change in the magnetic flux of the left coil induces a current in the right coil.

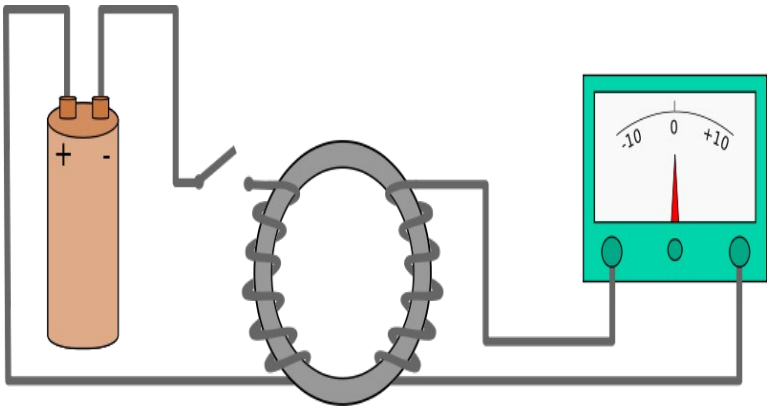


Fig.2

Activity 2

Answer the following questions:

1 Which other electromagnetic manifestations did Faraday find?
2 Which geometrical shape is related to the word “torus”?
3 How many circuits are there in Faraday’s experiment? Can you draw them?
4 Why we don’t associate the name of Joseph Henry to the electromagnetic induction discovery?
5 The text only treats about electrical effects of the electromagnetic induction. In your opinion, which other effect can be induced?

3. A BRIEF HISTORY OF ELECTROMAGNETIC THEORY [1]

Source: http://en.wikipedia.org/wiki/Electromagnetism

Originally electricity and magnetism were thought of as two separate forces. This view changed when:

While preparing for an evening lecture on 21 April 1820, Hans Christian Oersted made a surprising observation. As he was setting up his materials, he noticed a compass needle deflected from magnetic north when the electric current from the battery he was using was switched on and off. This deflection convinced him that magnetic fields radiate from all sides of a wire carrying an electric current, just as light and heat do, and that it confirmed a direct relationship between electricity and magnetism.

At the time of discovery, Oersted did not suggest any satisfactory explanation of the phenomenon, nor did he try to represent the phenomenon in a mathematical framework. However, three months later he began more intensive investigations. Soon thereafter he published his findings, proving that an electric current produces a magnetic field as it flows through a wire.

The publication of James Clerk Maxwell's 1873 *Treatise on Electricity and Magnetism* showed the interactions between both, and the main effects resulting from these interactions are:

1 Electric charges attract or repel one another with a force inversely proportional to the square of the distance between them: unlike charges attract, like ones repel.
2 Magnetic poles attract or repel one another in a similar way and always come in pairs: every north pole is yoked to a south pole.
3 An electric current in a wire creates a circular magnetic field around the wire, its direction depending on that of the current.(previous Fig.1)

4 A current is induced in a loop of wire when it is moved towards or away from a magnetic field, or a magnet is moved towards or away from it, the direction of current depending on that of the movement.(Fig.3 and 4)

WE RUN EXPERIENCE OF POINT 3 AND 4 (pictures of 4th point associated)

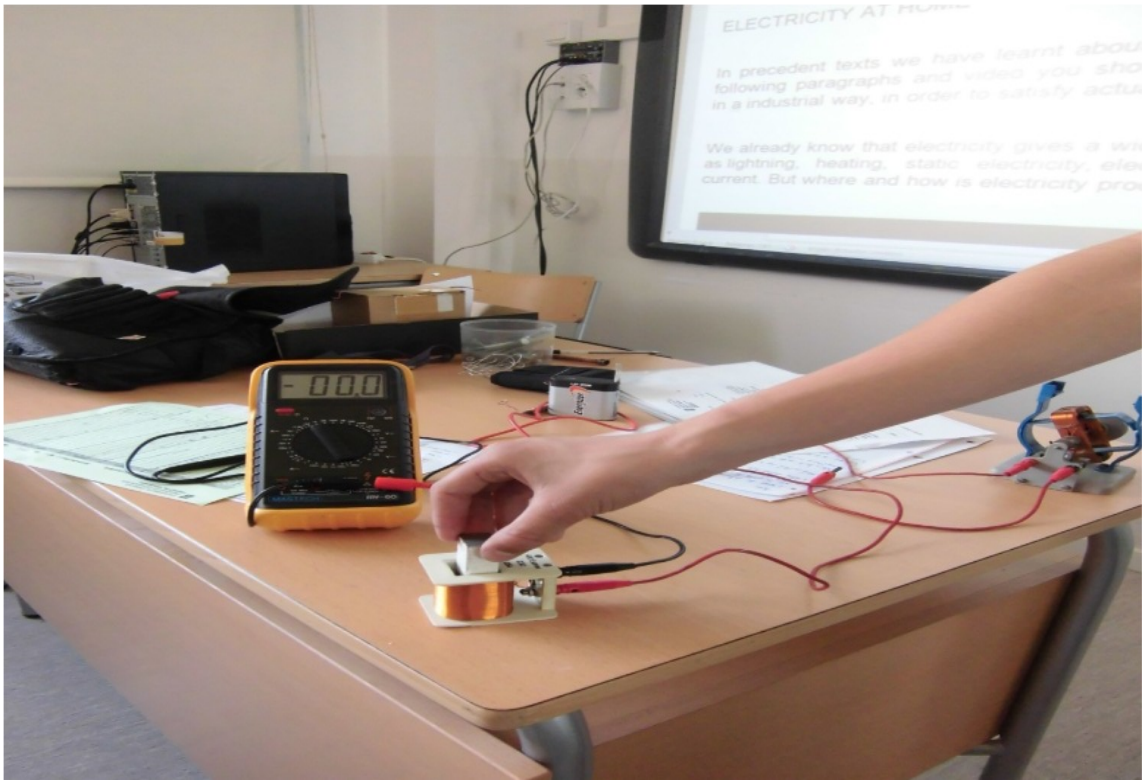
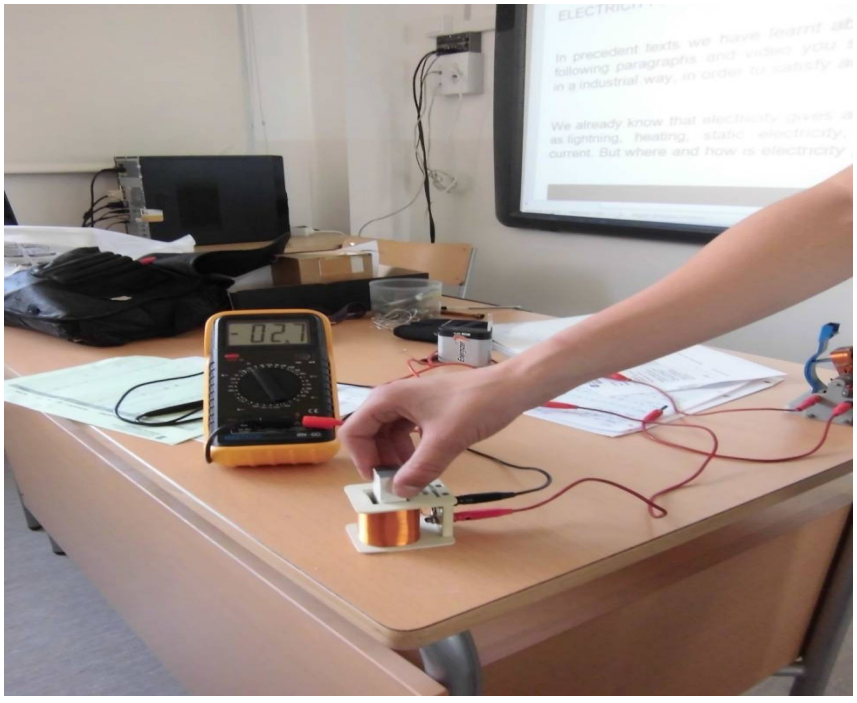


Fig.3 and 3’



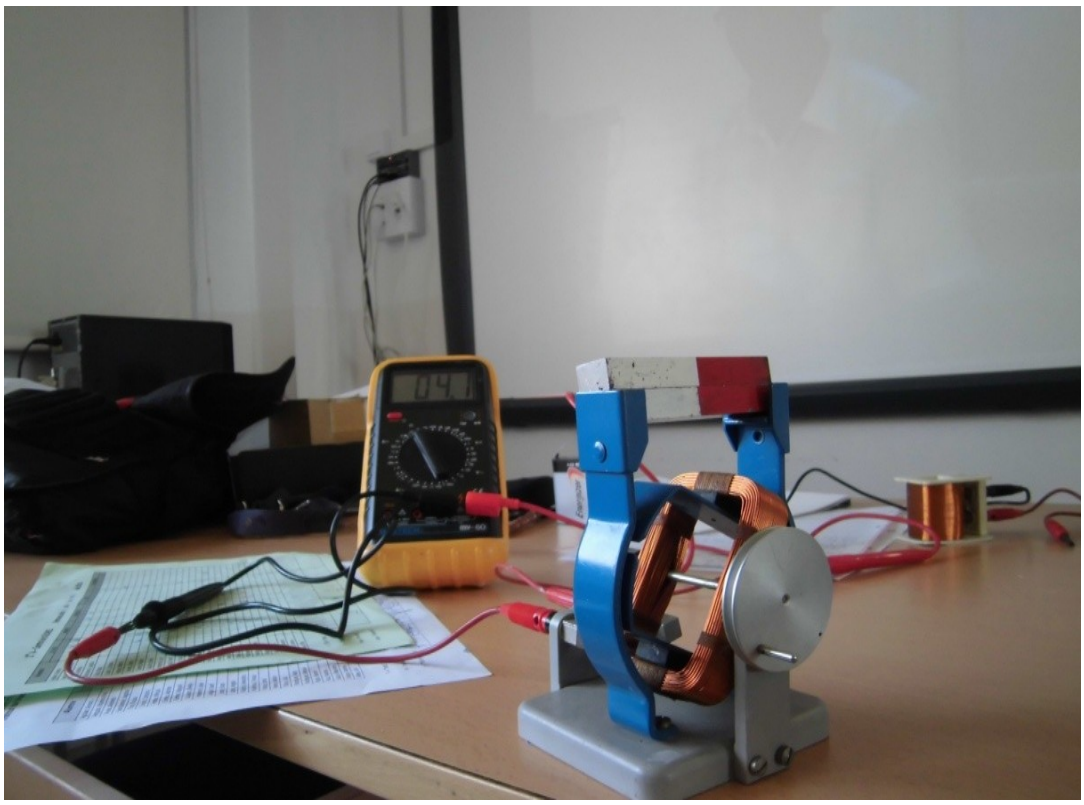


Fig.4

Activity 3

3.1 Can you translate:" unlike charges attract, like ones repel".

3.2 Give a synonym for "yoked".

3.3 Do you think that electromagnetism discovery was the work of only Ørsted? Why?

3.4 Give the names of all the europeans scientists, related to this topic, found from the beginning of this chapter.

3.5 How can you define electromagnetism in a simple way?

3.6 What is the meaning of "induced"?

3.7 How did people from 19th century live without electricity at home? Describe a regular day.

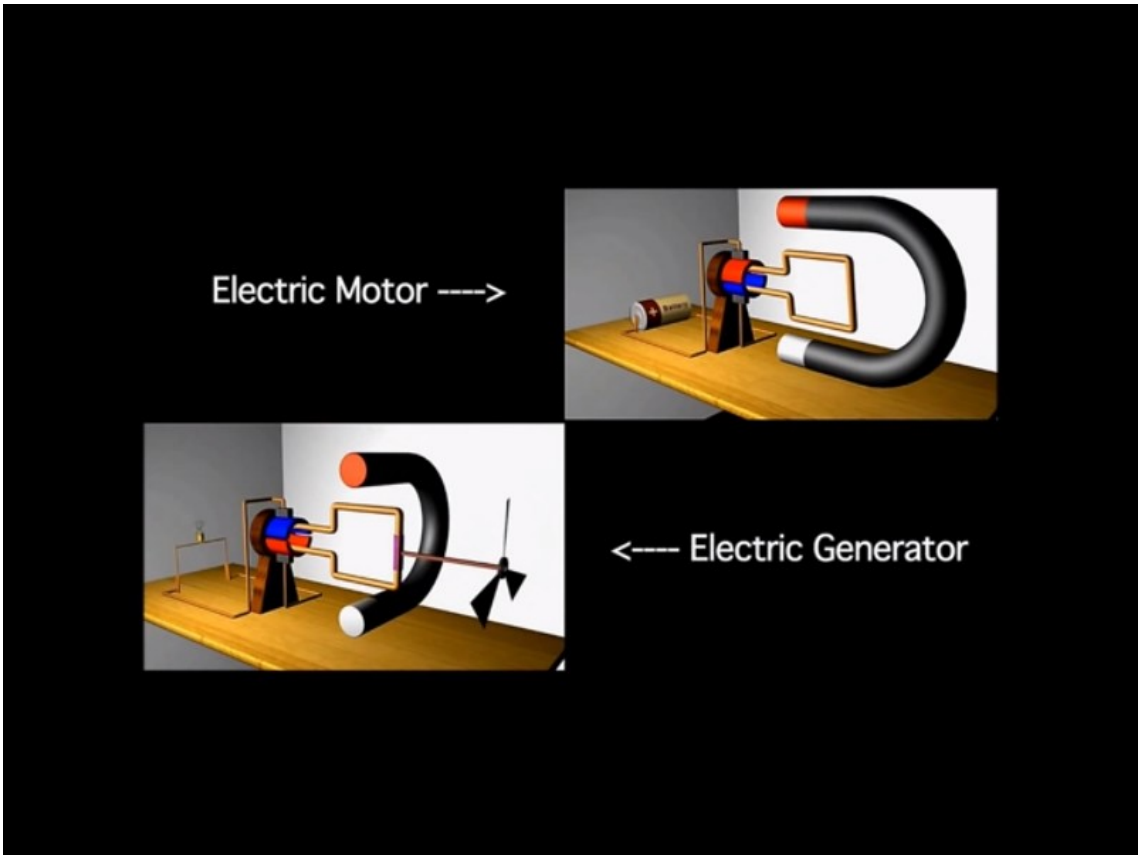
3.8 Can you draw the interactions effects exposed at point 4?

Extension

4. ELECTRICITY AT HOME

In precedent texts we have learnt about electricity production discovery. In the following paragraphs and video you should discover how to produce electricity in a industrial way, in order to satisfy actual people needs in this field.

We already know that electricity gives a wide variety of well-known effects, such as lightning, heating, static electricity, electromagnetic induction and electrical current. But where and how is electricity produced at large scale?



Watch video 3: https://youtu.be/d_aTC0iKO68

A power station (also referred as a generating station, power plant, powerhouse or generating plant) is an industrial facility for the generation of large amounts of electrical energy. At the center of nearly all power stations is a generator, a rotating machine that converts mechanical energy (movement)

into electrical power by creating relative movement between a magnetic field and a conductor. Just like image shows:

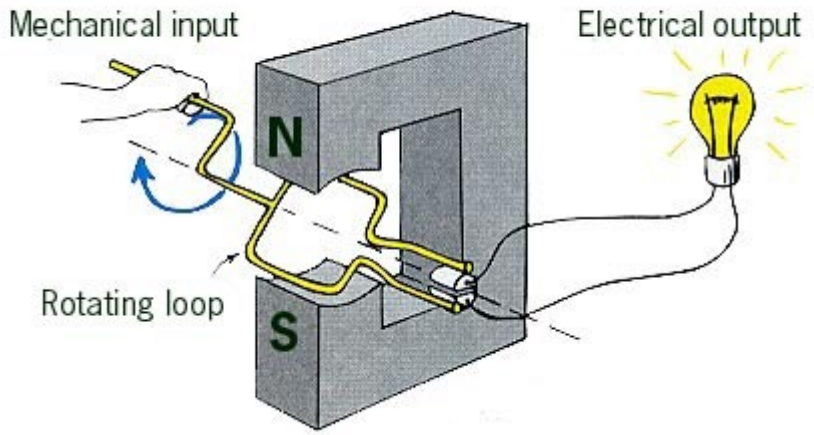


Fig. 5

At large scale we need huge magnets, kilometers of wire all around, and some motion or mechanical movement. The set is called GENERATOR or turbine-alternator group. The generator transforms the rotational movement into electricity.

Fig.6 http://es.wikipedia.org/wiki/Alternador

Fig.7: http://www.monografias.com/trabajos82/generadores-sincronos/generadores-sincronos2.shtml

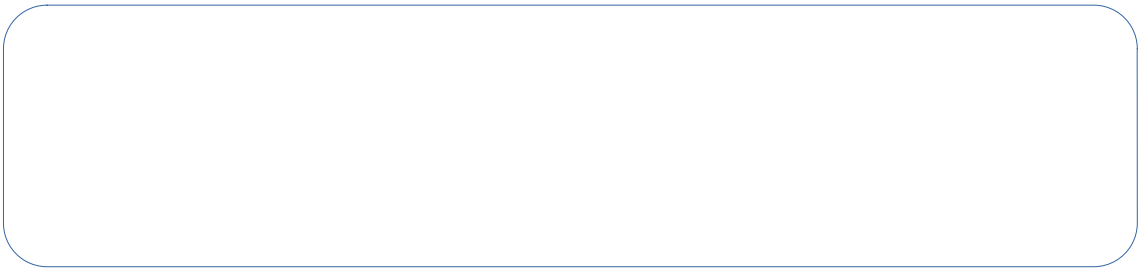
1But, where does the rotational motion come from?

_____
_____
_____

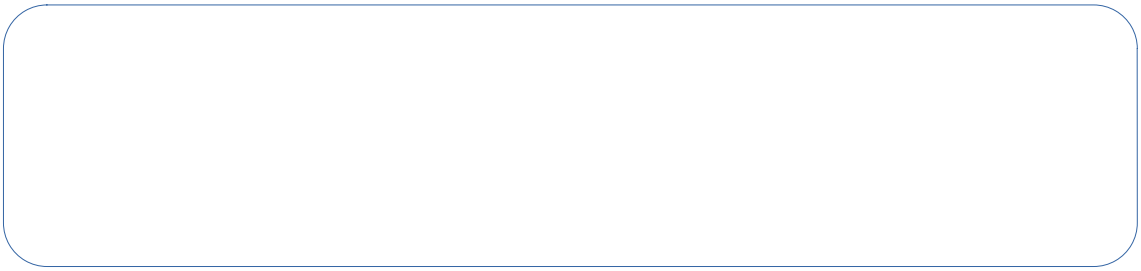
2. If it comes from river water the power plant is called _____ plant.
If it comes from wind the power plant is called _____ plant.
If it comes from water steam the power plant is called _____ plant.
If it comes from sea water the power plant is called _____ plant.

3. Draw the schemes or experiments explaining how to obtain electrical current from mechanical energy and its opposite (engine or motor), what means to obtain mechanical motion from electricity.

GENARATOR: MECHANICAL ENERGY into ELECTRICAL ENERGY



MOTOR: ELECTRICAL ENERGY into MECHANICAL ENERGY (motion or movement)



CONCLUSION I

Fill the gaps with the following words; electricity, electrical current, magnetic, electricity, movement, mechanical force, motor

Electric current induces a _____ field.

Magnetic field movements close to coils of wire induce _____.

Coils of wire movements close to a magnet induce _____.

Electric current going through coils of wire close to a magnet produces _____ and it is called _____.

MECHANICAL ENERGY or movement produces _____thanks to a GENERATOR.

ELECTRICAL ENERGY produces _____ thanks to a MOTOR or engine.

Assessment

Evaluating rubrics for Access and regular Energy tables & Conclusions

CATEGORY	4	3	2	1
Data Collection	Data was collected several times. It was summarized, independently, in a way that clearly describes what was discovered.	Data was collected more than one time. It was summarized, independently, in a way that clearly describes what was discovered.	Data was collected more than one time. Adult assistance was needed to clearly summarize what was discovered.	Data was collected only once and adult assistance was needed to clearly summarize what was discovered.
CONCLUSION	Student provided a correct conclusion clearly based on the data and related to previous research findings and the hypothesis statement(s).	Student provided a somewhat correct conclusion clearly based on the data and related to the hypothesis statement(s).	Student provided half conclusions with some reference to the data.	No conclusion was apparent OR important details were wrong.

Source 1: http://en.wikipedia.org/wiki/Electromagnetism

Fig. 1, 3, 3', 4 – Ana FRAU, INS Viladecans V, Barcelona, 2014
Fig.2 https://commons.wikimedia.org/wiki/File:Faraday_emf_experiment.svg
Fig. 5: Unknown
Fig.6: Budapest hidroelectrical Plant, early XX century from https://es.wikipedia.org/wiki/Alternador#/media/Archivo:Gorskii_04414u.jpg
Fig.7: https://www.monografias.com/trabajos82/generadores-sincronos/generadores-sincronos2.shtml

Video1: http://www.neok12.com/video/Electromagnetism/zX606e5c5b58714d07054151.htm, from @ www.ThePhysicsCafe.com

Video2: https://www.youtube.com/watch?v=VPxdl1zpcC8 from https://www.youtube.com/channel/UCmcOp41SXl8HpMcOqB6C7_g

Video3: https://youtu.be/d_aTC0iKO68 from https://www.youtube.com/channel/UCSGjZpojNawu2-GL88JGP4w