**Oct 15th, 2011**

**Accessing magnet**

Objectives

Students will get access to different shapes of magnets. They will understand the concepts of (1) positive & negative poles, (2) magnetic field, (3) magnetic force. They will practice the skill of observation and inference.

Method:

Observation and experiment

Material:

* Bar magnet
* U-shape magnet
* Compasses
* Student balances
* Iron file
* 4”x6” rectangular transparent containers

Background

5-8 graders all have experiences playing with magnet. The phenomena of magnet are interesting to kids. However, they are not aware that the interaction between two magnets, either drawing or repelling, is caused by magnetic force. They have no idea about magnetic field because it is unperceivable directly by five senses. In this class, they will learn another type of force, which could also strengthen their conception of force, pull and push in their words. They can see magnetic field of a magnet visualized by iron files.

Class information:

Grade level: 5-8

Subject area: Physics, classic electromagnetism

Duration: 2 hours.

Procedure:

9:30 – 9:45

Pre-assessment on students’ understanding of the nature of science (NOS) their scientific skills. There will be a class discussion about what science is, why we learn science, and how to do science. Students will be reviewed on important skills for inquiry.

9:45 -10:00

Students will share their experiences with magnets. And each group will be given two bar magnets to observe. Probing questions will be “what do you think make two magnets move toward or away from each other?” “How can you make two repelling magnets ‘like’ each other?” “I accidentally broke a magnet into two parts. Can I put or stick them back together as one?”

10:00 - 10:30

Students will be given two different shapes of magnet, bar magnet and U-shape magnet. They will be asked what are the similarities and differences between the two types of magnet. They will be given a variety of objects to try which one of them can be picked up by a magnet. After that, they will be guided to summarize the key features of a magnet, including that 1. A magnet is a solid that can only pick up iron; 2. A magnet has two poles; 3. A magnet can draw or repel another magnet. Finally, students will be given a compass to identify whether it is a magnet or not.

10:30 - 10:45

Snack time

10:45 -11:40

Students will be asked first what causes the interaction between two magnets. Then the teacher will review the concept force and types of force they have already known. After that the teacher will reveal that the interaction between two magnets is caused by another type of force, magnetic force. Students will feel both strong and weak magnetic forces first. Then they will design an experiment to measure the magnitude of the magnetic force.

Suggested procedures of measuring magnetic force:

1. Put a magnet on the balance to measure its initial weight.
2. Put another magnet 5 cm above the one on the balance. Record the weight.
3. Lift the magnet to 7 cm above the one on the balance. Record the weight again.
4. Think about what changed the weight of the magnet. (magnetic force) How large is it.

After this, students will be able to quantify the magnitude of a magnetic force. And they will figure out that the closer the two magnets are, the larger the magnetic force would be.

11:40 - 12:00

Students will spread out iron file on a 4” X 6” transparent container. Then they will put both a bar magnet and a U-shape magnet beneath the container. The iron file will display certain patterns. Students will draw pictures of the patterns. After that the teacher will reveal that it is because of the magnetic field of each magnet. It exists even though we cannot actually see it. Finally, students will be asked why a compass can point at the direction of south all the time. This question will be answered by a video regarding the global magnetic field. Then students will know the earth is a giant magnet.

Video

<http://www.youtube.com/watch?v=5SXgOWYyn84>

or

http://www.youtube.com/watch?v=CiCBrXKIH\_0&feature=related

Lab-sheet

Compare U-shape magnet, circle magnet and bar magnet. Use your own words to describe what a magnet is.

Do you think a compass is a magnet? Why?

1. Put a magnet on the balance to measure its initial weight.
2. Put another magnet 5 cm above the one on the balance. Record the weight.
3. Lift the magnet to 7 cm above the one on the balance. Record the weight again.

|  |  |  |
| --- | --- | --- |
| Initial weight (g) | Weight with another magnet 3 cm above it (g) | Weight with another magnet 6 cm above it (g) |
|  |  |  |

What can you infer about magnet from this experiment?

Draw the pattern of the iron file above each magnet.

|  |  |  |
| --- | --- | --- |
| Bar magnet | U-shape magnet | Circle magnet |
|  |  |  |

**Oct 22nd, 2011**

**Magnetism and Electricity**

Objectives

Students will learn electricity and relate it to the magnetism they learnt in the previous week. They will understand the concepts of (1) static and (2) flowing electricity, (3) basic electric circuit with the concept of current, flow and direction of current, closed and open circuit, and resistance. They will practice the skill of observation and inference.

Method:

Observation and experiment

Material:

1. Magnetism related:

* Bar magnet, U-shape magnet, Compasses
* Student balances
* Iron file
* 4”x6” rectangular transparent containers

1. Electricity related:

* Plastic rod, rubber rod, wooden scales
* Wool, Aluminium pieces, paper pieces
* Bulbs, bulb holders, batteries, battery holders
* Connecting wires, switches

Background

5-8 graders all have experiences of electricity. However they do not know about the basic circuit diagrams and how to trace the flow of electricity in a circuit diagram. They do not know electronic terminologies such as open/closed circuit. In this class, they will learn these things in the way used in physics/electronics language. They will start appreciating the similarity between electricity and magnetism as how these two concepts are form of one single entity electromagnetism.

Class information:

Grade level: 5-8

Subject area: Physics, classic electromagnetism

Duration: 2 hours.

Procedure:

9:30 – 9:45

Revision of previous class (October 15th, 2011) on magnetism, We asked students what they learned about magnetism. How they understood magnetic field and how they saw difference in magnetic field produced by different magnetic fields.

9:45 – 10:00 Engage1

Students will be shown a movie on static electricity

<http://www.youtube.com/watch?v=VhWQ-r1LYXY>

and asked the questions on static electricity. They were asked thought-provoking questions such as “where do you experience such static electricity?” or “why should we call these as static electricity?”

10:00 – 10:45 Explore1

Students will perform many experiments based on static electricity. First they will repeat the experiment shown in movie above, and experience themselves the static electricity generated by the plastic rod. Next they will rub the plastic rod with wool and pick the aluminum pieces or paper pieces. They will try the same experiment with wooden scales, and see the difference between plastic rod and wooden scales. Thus they will see that plastic rods can pick the small aluminum pieces more easily than wooden scales. This will guide them to the notions that static electricity will be generated when there is a re-arrangement of electrons on the surface and this will be easier for plastic rod than on wooden scale.

10:30 – 10:45 Explain1

Students distributed in 3-4 groups will share and then discuss the ideas group-wise. Here they will be asked to discuss scientific questions such as “how does the rearrangement of the electrons help attracting other things to plastic rods?” or “What do you think is the similarity between static electricity between a plastic rod – aluminum and Magnet – iron pair?”

10:45 - 11:00

Snack time

10:45 -11:00 Engage2

Students will be asked first what they know about flowing electricity. They will be asked about the electricity as our primary source of advancement? They will be asked from what sources do we get the electricity?

From the conversations from students they will know that electrical energy is the power source of much advancement. Electricity can be generated from the conversion of energy from one form into another. For example, water/tidal energy into electricity via hydroelectric; coal/burning energy via thermal; nuclear energy into electric energy; wind into electric energy; solar energy into electric energy; and chemical energy into electric energy. They will be able to give examples for each type of conversion. Students will appreciate the fact that chemical energy from battery and the electricity that powers up the lecture room, computers are only different forms of energy. Thus they will appreciate that this energy can be transported from one place to another. With this students will be prompted to think about which the most convenient form of the energy that can be transported is. Students will then be introduced to the chemical batteries; the chemical energy that is most commonly used for such purposes.

11:00 – 11:45 Explore2

Students will make the simple electrical circuit and turn on the light bulb. They will be explained about the direction of electric current from the positive direction to the negative direction. Students will know about closed and open circuit and the concept of resistance.

11:45 – 12:00 Explain2

Students are shown the videos of types of energy and

<http://www.youtube.com/watch?v=8JVV7BlRj0M&feature=related>

Modern power grids and how electricity is distributed

<http://www.youtube.com/watch?v=38EEmWHI0C8>

Lab-sheet

Compare static electricity generated from different materials.

Create a simple circuit and light a light bulb.

**Oct 29th, 2011**

**Electricity**

Objectives

Students will learn electricity and concepts in electronics. They will learn series and parallel circuits. They will understand the magnetism generated by electricity – electromagnet. They will practice the skill of observation and inference.

Method:

Observation and experiment

Material:

* Bulbs, bulb holders, batteries, battery holders
* Connecting wires, switches
* Copper coil, plastic rods, long galvanized nails

Background

Students do not know about the series and parallel circuits and how to draw circuit diagrams. They will know temporary magnetism generated by the flowing electricity and measure strength of such magnetism.

Class information:

Grade level: 5-8

Subject area: Physics, classic electromagnetism

Duration: 2 hours.

Procedure:

9:30 – 9:45

Revision of previous class (October 22th, 2011) on basic electricity. We will ask students what they learned about basic electricity in the previous class. This will include types of electricity (static and flowing); open and closed circuits; direction of electric current in a closed electric circuit.

9:45 – 10:00 Engage1

Students will be shown a movie on types of electricity

<http://www.youtube.com/watch?v=6GUjcIkj2vU&feature=related>

They will be explained electronic circuit diagrams.

10:00 – 10:30 Explore1

Students will be asked to repeat the experiments and make the tabular observations shown in the video.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Compare brightness to the simple circuit | Which bulb is brightest | Which bulb is closest to the negative terminal | What happens when a bulb is removed |
| Series – 2 bulbs |  |  |  |  |
| Series – 3 bulbs |  |  |  |  |
| Parallel – 2 bulbs |  |  |  |  |
| Parallel – 3 bulbs |  |  |  |  |

Based on these experiences they will be asked to design their own circuit designs, such as one light bulb controlled by two switches. For this activity groups of 3-4 students will work together and draw the circuit diagram of their design.

10:30 – 10:45

**EVALUATE:**

* Students’ journals will be observed.
* Each group will present their unique design from the given apparatus. We will observe the students at their tables and listen to what they are discussing.
* We will assess their understanding to see if they think a how the wiring of bulbs in the classroom in designed in parallel circuit fashion.

10:45 - 11:00

Snack time

11:00 – 11:20

Students will design their own circuits. They will share their results with other peer groups.

11:20 – 11:30

Students will be asked about temporary magnets. They will discuss where they see such electromagnets, for example, electromagnet in roller coaster.

11:30 -12:00 Engage2

Students will be asked to generate temporary magnets by wounding copper wire around the galvanized nail and put this construct in the circuit. An electromagnet generated with such a circuit will hold a few paper clips. By connecting more batteries in the circuit, students will know the strengths of electromagnet.

**Nov. 5th**

**Technology of electromagnetism, telegraph**

Objectives

Students will put into practice the knowledge they have learned about electromagnetism. They will have a general idea about the electromagnetic technology in reality, including electrical motor, electric generator, and magnetically levitated train. They will understand the mechanism of a telegraph, and work in pairs to build their own telegraph.

Method:

Demonstrating experiment, trial and error.

Material:

* Batteries
* Battery holders
* Rolls of electrical wires at different size
* Nails
* Steel stripes
* Masking tape
* Scissors
* Paper clips
* Modeling clay
* Card board

Procedure:

9:30- 9:45

The teacher will review electromagnetic phenomena covered in previous classes. Students will compare electrical magnet and permanent magnet under the guidance of the teacher. Then they draw conclusions about the pros and cons of electrical magnet.

9:45- 10:30

Students first discuss the possible application of electrical magnet in real world. Then the teacher plays the videos of other electromagnetic phenomena, such as Ampere force and Faraday’s effect, as well as their application in real world.

Videos

Electrical motor and electric generator

[http://www.youtube.com/watch?v=d\_aTC0iKO68&feature=related](https://pod51000.outlook.com/owa/redir.aspx?C=YLN5_p8VOEC6iET3oOn6yDy5yfcKb84ISjuS1WQGpAB4xmU4mol2SU-qy9paDUx6B4i_cv_K76I.&URL=http%3a%2f%2fwww.youtube.com%2fwatch%3fv%3dd_aTC0iKO68%26feature%3drelated" \t "_blank)

How to build an electrical motor

[http://www.youtube.com/watch?v=it\_Z7NdKgmY](https://pod51000.outlook.com/owa/redir.aspx?C=YLN5_p8VOEC6iET3oOn6yDy5yfcKb84ISjuS1WQGpAB4xmU4mol2SU-qy9paDUx6B4i_cv_K76I.&URL=http%3a%2f%2fwww.youtube.com%2fwatch%3fv%3dit_Z7NdKgmY" \t "_blank)

Magnetically levitated train

<http://www.youtube.com/watch?v=aIwbrZ4knpg>

Quantum levitation

<http://www.youtube.com/watch?v=UDdqzi1qPhQ>

10:30-10:45

Snack time

10:45-11:10

The teacher will engage students by demonstrate communicating with a telegraph. Then students will discuss in class how a telegraph works. After the discussion the teacher will reveal the answer and play the video of Morse code.

Morse code

<http://www.youtube.com/watch?v=_J8YcQETyTw>

11:10-12:00

Students will work in pairs to build their own telegraph. The teacher will help them with the problems and difficulties they will encounter.

**Nov. 12th : Review and Evaluation**

Objectives:

Students will be able to work out a conceptual map and clearly explain what they have learned about electromagnetism. They should be aware of the inquiry process and scientific methods they have applied as well. They will have a general idea about the development of electromagnetism in the history of physics. They should be creative in designing electromagnetism-related equipment.

Method: Conceptual map, history of science, trial and error

Material:

* Chart paper
* Markers with different colors
* All the materials used in the previous classes (Just in case)

9:30- 10:00

Students will be asked to reflect on the previous classes. They will work in groups to review what they have learned about electromagnetism, as well as the inquiry process. They will draw concept map to indicate the relationship between different concepts. They will also draw flow chart to show the inquiry process and inquiry skills involved.

10:00-10:30

Groups will share their concept map and flowing chart with their peers. One group will be presenting each time and the others will play the role as both audience and evaluators.

10:30-10:45

Snack time

10:45- 11:30

The teacher will summarize all the key concepts and phenomena with respect to electromagnetism, as well as the inquiry skills students have used, including observation & inference, doing experiments, collecting and evaluating data. A slide show will be played regarding the development of electromagnetism in history and the contribution of some world-famous scientists, such as Lorenz, Maxwell.

Slide show

[http://msnucleus.org/membership/slideshows/historyelectricity.html](https://pod51000.outlook.com/owa/redir.aspx?C=JQrf9manjUmafsX-gDb_HtzUxXmKb84IJP_-QX0zvwlAzBZSAqxgKpAQ7dc26zhEMWZIXBSz_HU.&URL=http%3a%2f%2fmsnucleus.org%2fmembership%2fslideshows%2fhistoryelectricity.html" \t "_blank)

11:30- 12:00

Students will be encouraged to brainstorm how they can use the knowledge of electromagnetism. They will work in pairs creatively to design some equipment involving electromagnetism. Then they will share their design with the whole class, which will be evaluated by their peers on its feasibility and practicability. If there is time left, students can try out their design with the materials at hand.