Science Activity: Feeling 3-D Magnetic Field

Name of the Expert: Prof Babasaheb D Sutar

Name of the Activity: Feeling Magnetic field in three dimensions

Material, Tools required:

1) Coconut hair oil filled bottle
2) Iron fillings
3) Different types of magnets

Activity Steps:

1) Fill the iron fillings in the oil bottle and shake the bottle.
2) Bring slowly the horse shoe magnet near the bottle and place it on the surface of the bottle. Observe the pattern formed by the iron fillings inside the bottle.
3) Replace the magnet and again observe the pattern.
4) Sketch the pattern on paper.

Learning Outcome:

The magnetic field of a magnet is present in three dimensions.

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Explanation:

In school books the magnetic field is always shown in two dimensions around a magnet by means of flux lines originating from North Pole and ending in South Pole. This is the limitation of drawing in two dimensions. However, in real case the magnetic field is present in three dimensions. For example the earth is a big magnet having the field everywhere. It is popular misconception in students that the magnetic or electric filed exists in two dimensions only. The figures are drawn accordingly. Further much attention is not given to draw the flux lines. The density of the flux-lines at the poles is more. It goes on decreasing away from the poles.

This activity tries to put a light on the fundamental facts about the magnetic field lines, how they are originated and how they can be observed using basic laboratory magnets.

We collected the iron fillings from a hardware workshop and sieved them using usual tea-sieve from kitchen to get fine particles. The clear coconut oil is filled in a bottle (a readymade coconut hair oil bottle can also be useful) and the iron fillings were immersed in it. The cover of the bottle is carefully tightened. The bottle shook vigorously and held vertically. A bar magnet is put slowly on the transparent side of the bottle. The particles are gathered near the poles and it is also observed that they are arranged themselves along a certain pattern near the magnet inside the bottle. The density of the particles is more at the two ends of the bar magnet and along the body of the magnet it is less and almost parallel to it. The iron fillings also shoot off away from the poles inside the oil making hair-strand like structure. These observations clearly show the magnetic field represented by flux lines is present in all directions for a magnet that is in three dimensions.

If we use a horseshoe magnet the similar pattern is observed as shown in above graphics.