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Lesson Plan: Magnets and Magnetic Fields

Project Type: Module

Teaching Plan:
Total lesson/challenge time: 1.2 hours
- Ask group what they know about magnets 5 min
- Introduce concept of polarity and how magnets are polarized while other things are not (kind of like in the lava lamps when the magnet didn't stick to the table made of wood) 5 min
- Talk about magnets in everyday life - magnetic poles of the earth, compasses, etc. 5 min
- Introduce newer, more unknown concepts of magnets - the magnetic field and how magnetism can be a force. Ask some foreshadowing questions - "Do you think magnets are stronger than gravity?" 5-10 min
-Module Time. 45 min (15 min/module)
    Module 1: Exploring Magnets (Active science)
    Module 2: "Anti-gravity" Machine (Demonstrating magnetism as a force)
    Module 3: Creating 3D Magnetic field. (Visualization of a magnetic force)
-Wrap-Up and Conclusions. 10 min
    Evaluation: Why does magnets behave the way they do? (Compare the group's initial ideas about magnets to their final ideas)

Teaching Styles Addressing:
-Active: Children are exploring the magnets' properties in Module 1.
-Reflective: Explain magnetism using a compass and how it works, or how maglev trains work
-Sensing: Have kids explore, touch, and feel the magnets. Discover how they work through experience.
-Intuitive: Show students how magnets can work through a table, and ask them why they think magnets can do this. See if they can discover the magnetic field through intuition.
-Visual: By creating a 3D magnetic field, the students can see the magnetic fields surrounding the magnet.

Lesson Goal
To teach the students about the basic properties of magnetic fields, and how magnetism can be a force. Other concepts will be explained as well, such as magnetism in different metals.

Mentors Scientific Background
In order to teach the lesson mentors should be familiar with the following concepts:
-How Magnets interact with other Compounds
- A question that will definitely come up is why magnets stick to one metal, but not another. Why? When something is a magnet, basically what it means is that all the electron orbital shells are aligned in the same orientation. Materials are not inherently magnetic because most

of the time, they are aligned randomly and their magnetic fields cancel each other out. When aligned similarly, they create a magnetic field. The difference between some metals is how their electrons interact with a magnetic field. Iron is called ferromagnetic, and that means it will keep the magnetism - the electrons will maintain their orientation for a certain time interval after the magnetic field is removed. Other materials, called paramagnetic are only magnetized when within a magnetic field, and lose that magnetism when the magnetic field leaves. In addition, it is much harder for a paramagnetic to align its electrons, so while there will be a net magnetic field, it will be much weaker (as some of the electrons will still not be aligned - and will be cancelling out forces). In a ferromagnetic, however, nearly all electron orbitals are aligned.

-Magnetic fields

-Mentors should know the basic properties of magnetic fields. Magnetic fields are vectors with both a magnitude and a direction, pointing from the north pole of the magnet to the south pole of the magnet. The magnetic field's strength decreases proportionally to the square of the distance away from from the magnet, but they continue to exist at large distances from the magnet. They just becomes much weaker forces.

-Applications of magnets

CRT, hard drives, vinyl, maglev,credit cards, motors, fMRI, fridge magnets, speakers, electronics in general are all applications of magnets.

Introduction for the Mentees

The lesson plan begins with simple questions about magnets, that make the students think a little deeper about their basic knowledge of magnetic fields. The main goal is to make the students fascinated about the idea of magnets, and how they work. After posing main questions (A compass uses magnets, why? or Why can magnets work through tables?, etc), we will explain the concepts behind each question (magnetic poles/magnetic fields). The idea is to have the kids fascinated and engaged in the topic before breaking up into the modules.

Modules/Demos, or Project

The lesson plan is divided into three main modules:

-Module 1: Exploring Magnets (Active science)

- Magnets, multiple kinds, will be spread amongst the tables
- This is a free-form module, asking for the kids to experiment themselves with the magnets.
- Assign objectives, and have them complete the worksheet/data-table about a magnets interactions with other objects

-About half of table should be pre defined objects for them to test and other half can be whatever they want to try in the classroom

- At the end of the module, ask if they noticed anything weird about the magnets. Ask why it stuck to some metals but not others.

-Module 2: "Anti-gravity" Machine (Demonstrating magnetism as a force)

The mentees will build an "anti-gravity" machine. First, they will tape a string with a paper

clip attached on the bottom of a plastic cup. The student can then hold a magnet above the paper clip and lift the paper clip up from the bottom of the plastic cup. More specifically, We will then ask the students why this happened. Then, we will describe to them how the pull of the magnet is stronger than the pull of the earth, which causes the paperclip to be lifted up.

If there is extra time, you can create a small “challenge” for the kids. This challenge uses the same materials. Simply get a plastic cup, fill it up, and put a paperclip at the bottom. Now, challenge the group to get the paperclip out without getting themselves or the magnet wet.

-Module 3: Creating 3D Magnetic field. (Visualization of a magnets force/field)

Instead of exploring magnetism as a force, we will now look at it as a field. First ask them to notice that when playing with magnets, they worked against each other even when not touching. Instead, we can look at magnetism as a field, where it has effect everywhere from where the magnet, not just when the magnet is touching something. We can compare this concept to heat radiation. You don’t have to touch the object to get burnt, just put your hands some distance away from it and you can feel the heat. And if you put your hand closer, it gets more intense. This is the same as with magnets.

Closing Activity and Discussion

After finishing all three modules students will be asked about why the magnets did what they did in the various modules. Maybe if we have enough extra things left over then those can be prizes for answering the questions correctly. We will also have the students share their findings from Module 1.

As out assessment tool, we will ask the students how the properties of the magnets are similar to the properties of polar molecules that they learned about from our Lava Lamp Lesson.

If there is extra time, we can also discuss how magnets interfere with monitors and also how monitors work.

Worksheet

Ask students in Module 1 (self-learning, hands-on magnet experimentation) to create a chart and test materials around the classroom. Have them show what was attracted to the magnets, and what wasn’t. See if they can find out a reason why. (Make sure they don’t get the magnets too close to any monitors.)

Materials

Module 1
- Ring magnets
- Block magnets
- Pencils (used as stands for ring magnets)

Module 2
- Plastic cups
- String

- Tape
- Paperclips
- Square magnets

Module 3
- Baby oil
- Bar magnets
- Steel wool
- Paper towels