ASTROEDU

Peer-reviewed Astronomy Education Activities

Levitating Astronaut

Levitate an astronaut with the power of magnetism.

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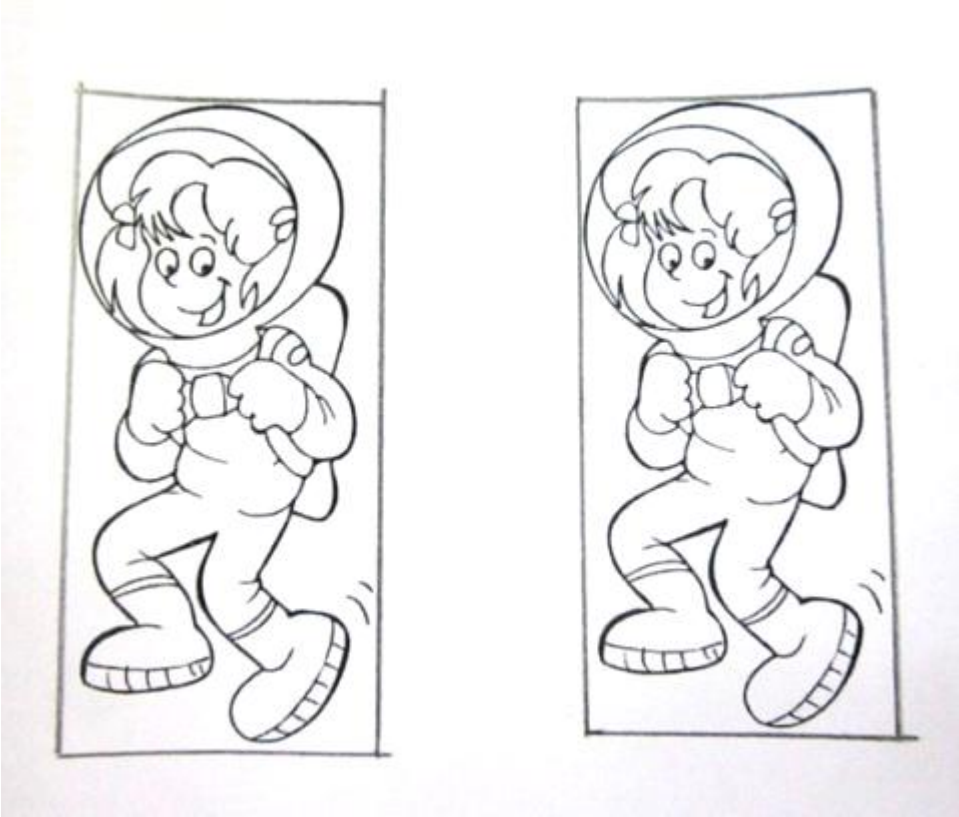

AGE

8 - 12

LEVEL

Primary, Middle School

TIME

45min

GROUP

Group

SUPERVISED

Yes

COST PER STUDENT

Low Cost

LOCATION

Small Indoor Setting (e.g. classroom)

CONTENT AREA FOCUS

Other

CORE SKILLS

Asking questions, Developing and using models, Planning and carrying out investigations, Constructing explanations

TYPE(S) OF LEARNING ACTIVITY

Modelling, Direct Instruction, Fun activity

KEYWORDS

Magnets, Magnetism, Force, Charge, Levitation, Gravity, Astronaut

GOALS

Students will learn about the forces of attraction and repulsion between magnets, about the forces of attraction between magnets and magnetic materials, and that objects are pulled downwards because of the gravitational attraction between the objects and the Earth. Students will practice questioning and investigating models.

LEARNING OBJECTIVES

- Students will be able to explain the idea that magnetism is a force that can cause attraction or repulsion depending on orientation and type of material.
- Students will be able to explain the idea that gravity is a force that pulls objects towards the Earth (or other masses), and that magnetism works against this force in the levitating astronaut model.
- Students will observe how changing the conditions affects the levitating model.
- Students will discuss some reasons for building models, their uses and limitations.

EVALUATION

In small groups, ask students to discuss the following problems. Ask for students to volunteer their answers to the class and ask the rest of the class if they would add any other points.
- Explain why we are held to the ground, while astronauts float in space.
- Predict what would happen if magnets made from different materials were used, and to explain their reasoning.
- Why is building models important and what are their strengths and limitations?

MATERIALS

- Neodymium magnet
- Paper clip
- Four 3 mm screw
- Large piece of wood
- Two small piece of wood
- Cup hook
- Thread
- Astronaut image

BACKGROUND INFORMATION

Magnetism:

Magnets are solid objects that have the ability to attract materials such as iron, cobalt, and nickel, along with various other alloys.

All objects are composed of atoms, which are made up of several different particles, including negatively charged electrons that rotate around the atom nucleus. In magnetic objects the electrons are, at least largely, spinning in the same direction around the nucleus – this is what causes the object to become magnetic.

In each magnetic object, there are many different groups of atoms. Each group forms its own mini-magnet called a domain. Magnetic domains that are pointing in opposite directions cancel one another out. The more the domains that are aligned (facing the same direction), the stronger the overall magnetic field. In magnets all, or at least most, domains are facing the same direction, combining to create one large magnetic field.

All magnets have a north and south pole; this is due to the alignment of their domains. Opposite poles attract and the same poles repel.

Magnets can be natural or induced. Magnets that create their own magnetic fields all the time are called permanent or hard magnets. Temporary or soft magnets only create a magnetic field for a short time, after being in the presence of another magnetic field.

The strongest natural magnet is Lodestone. By repeatedly rubbing lodestone along a piece of iron in one direction, the iron also becomes magnetised (this is how compasses were created). It is essentially the same process that is used to magnetise the neodymium used in this activity.

Gravity:

Gravity is a force that attracts all objects to each other. This is why we don’t fall off the Earth even though it is round. It may help to think of ‘down’ as towards

the centre of the Earth. The more massive an object is, the stronger its gravitational pull. This is why gravity on the Earth is stronger than on the moon and people feel lighter on the moon (6 times lighter!). The reason why astronauts in space feel as though they are floating is slightly subtle: Astronauts do experience gravity when they orbit the Earth or Moon. However, because they are orbiting the planet, they are constantly falling towards the planet (like falling off a building but never reaching the ground). Being in free-fall feels like there is no gravity, even though there is. (It may help to be aware that a common misconception is that astronauts float because they feel no gravity in space.)

FULL ACTIVITY DESCRIPTION

Magnetic levitation, maglev, or magnetic suspension is a method by which an object is suspended with no support other than magnetic fields. Magnetic pressure is used to counteract the effects of gravity and any other accelerations.

Step 1

Fix a cup hook onto one small piece of wood.

Step 2

Fix a neodymium magnet into the other small piece of wood.

Step 3

Fix a screw into each corner of the large piece of wood.

Step 4

Attach both small pieces of wood to the larger piece using the inserted screws to make a frame.

Step 5

Tie the piece of thread to the paper clip.

Step 6

Glue the paper clip (now with thread attached) to the back of an astronaut image, then glue on the other astronaut image so the paper clip is hidden between the two.

Step 7

Attach the thread to the cup hook and adjust so that the astronaut does not reach the opposite end of the frame. (Cut away any extra thread.)

Step 8

Ask students to predict what will happen when you release the astronaut, and why they think so. (Will it fall or float or something else?) Make sure students

specifically discuss the idea of gravity as the reason the astronaut might fall, and be sure to ask students what gravity is.

Step 9

Then release the astronaut and watch it levitate!

Beyond building your levitating astronaut:

Now that you have built your astronaut, prompt students to observe it carefully, ask questions about the phenomenon they are observing, and experiment with the apparatus. For example, they could ask why the astronaut levitates, or what would happen if they change the orientation of the astronaut, or if they used different materials. You can break students into small groups to investigate these questions together, and share with them information about magnetism and gravity from the “Background Information” section.

You can also prompt students to discuss the idea of building models. Suggested discussion points:

- What is a model? Why is it useful to build models?
- What is the goal of this model of an astronaut?
- What are the strengths of this model? (How well does it represent reality?)
- What are limitations?
- How could the model be improved?

CURRICULUM

Country | Level | Subject | Exam Board | Section
— | — | — | — | —
UK | KS3 | Physics | - | Motion and Forces: Forces
UK | KS3 | Physics | - | Electricity and Electromagnetism: Magnetism
UK | KS2: Year 3 | Physics | - | Forces and Magnets

ADDITIONAL INFORMATION

Danger for children:

Do not let children under the age of 14 play with magnets and always supervise any child playing with these magnets. If several small magnets are swallowed, they can get stuck in the intestines and cause major swelling, life-threatening injuries, and surgery would be needed to remove them. If placed onto a television screen or computer monitor screen, it could permanently distort the colours on the screen.
Keep larger magnets out of children’s reach, as you would with sharp knives or other dangerous materials, as fingers can be crushed between powerful magnets.

Crushing, blood blisters, and cuts:

When larger magnets are brought close enough together they can have a surprising amount of power. Fingers are quickly caught between them which can cause blood blisters or cuts. Wear gloves when handling larger magnets and use caution. Practice handling smaller magnets first. Do not place these magnets up your nose or around the ears as they have soft tissue that will compress as the magnets attract each other through the tissue. As the magnets get closer, they exert more force that crushes the tissue still further.

Magnetically sensitive items:

Neodymium magnets are stronger than 'ordinary' magnets. Keep a safe distance (200mm+) between the magnets and all objects that can be damaged by magnetism. These include mechanical watches, heart pacemakers, CRT monitors and televisions, credit cards, diskettes and other magnetically stored media such as video tapes.

CONCLUSION

The activity demonstrates the concepts of magnetism and gravity in a fun and engaging manner.

ATTACHMENTS

- Astronaut image

CITATION

Roberts, S., 2014, *Levitating Astronaut*, astroEDU, , doi:10.14586/astroedu.1407

ACKNOWLEDGEMENT

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