**Is it magnetic?**

Some things are magnetic.

A magnet attracts a magnetic object.

|  |  |
| --- | --- |
| 1. Steel nails | 2. Plastic rod |
| 3. Carbon rods | Rock, Boulder, Stone, Nature, Granite, Mineral, Solid4. Rock |
| Post, Box, Rusty, Tin Can, Wooden PostsCanada $0.05 1968.jpg5. Coin made of nickel | Tin, Drink, Water, Vector, Drinks, Graphics6. Aluminium drinks can |
| 7. Rusty can | Balloon, Blue, Shiny, Helium, Happy, Birthday, Party8. Balloon |
| 9. Copper pipes | |

Answer the question for **each** picture.

What does the picture show?

|  |  |
| --- | --- |
| **A** | Something that **is** magnetic. |
|  |  |
| **B** | Something that **is not** magnetic. |
|  |  |
| **C** | Something that **is sometimes** magnetic. |

*Physics > Big idea PEM: Electricity and magnetism > Topic PEM3: Magnets and electromagnets > Key concept PEM3.1: Magnetic fields*

|  |
| --- |
| **Diagnostic question** |
| **Is it magnetic?** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | The magnetic field around a magnet can be represented by field lines, which indicate the size and direction of the force of the magnet on the north-seeking-pole of another magnet. |
| Observable learning outcome: | Identify magnetic materials that are attracted to both the north- and south-seeking-poles of a magnet. |
| Question type: | Simple multiple choice |
| Key words: | Magnetic, metal, iron, steel, nickel, cobalt |

|  |  |
| --- | --- |
| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of ideas that are usually taught at age 5-11, to aid transition from earlier stages of learning. |

**What does the research say?**

It is a common misunderstanding to think that all types of metal are magnetic (Hickey and Schibeci, 1999; Van Hook and Huziak-Clark, 2007; Lemmer and Morabe, 2017). Hickey and Schibeci (1999) found that 39% of trainee science teachers (n=56) thought that magnets attract all types of metal. This misunderstanding is consistent with thinking that magnetism is caused by a static electric charge. In a study of children aged 9-11 (n= 33), the great majority did not think that magnets could attract non-metals (Bradamante and Viennot, 2007).

When students start studying magnetism, over half believe an electrically charged plastic rod held near to a pivoted magnet will make the magnet rotate, because the electric charge attracts one pole of the magnet and repels the other (Knight, 2004). The idea that magnetism is caused by static electric charge is very common (Driver et al., 1994), even amongst undergraduate science students (Maloney, 1985), and sometimes students refer to the idea of a ‘magnetic charge’ (Lemmer and Morabe, 2017). To challenge this misunderstanding, Hood (2012) uses an electrically charged balloon to attract both ends of a magnetic compass needle; and contrasts this with the observation that a magnetic pole of a magnet can attract just one end and repels the other.

**Ways to use this question**

Students should complete the question individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

The answers to the question will show you whether students understood the concept sufficiently well to apply it correctly.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

*Differentiation*

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

1. A
2. B
3. B
4. C
5. A
6. B
7. A
8. B
9. B

**How to respond - what next?**

The metals iron, cobalt and nickel are magnetic in normal conditions, as are the alloys that are made from them, such as steel. All other metals and all non-metals are not magnetic.

Many students are likely to think that all metals are magnetic, and those that know that only some metals are magnetic may not recognise the particular ones which are.

Students who think the plastic rod or balloon can sometimes be magnetic are likely to think that magnetism works in the same way as static electricity. They may think that the poles of the magnet have an electric charge.

The carbon rods are commonly used as an example of a non-metal that conducts electricity. If students have the misunderstanding that magnetism is caused by electricity, they may think that carbon rods are magnetic.

The rust on the rusty can is also called *hydrated iron oxide* and indicates that the can contains iron. Tin-cans are usually made of steel that is plated with tin to protect the can from corrosion.

The Canadian nickel coin was at times, which includes 1968, made from pure nickel. In the UK, ‘copper’ coins that predate 1992 are not magnetic, and those produced from 1992 onward are magnetic, because they are now made of copper plated steel.

Some rocks are magnetic, perhaps because like lodestone they contain iron. Lodestone is a form of iron oxide.

If students have misunderstandings about which materials are magnetic, it can help to give them a range of materials to investigate with a magnet. Magnetic materials are attracted to the magnet and materials that are not magnetic are not attracted. Pieces of iron, steel, nickel, possibly cobalt, and other metals can be labelled and included in the sample, as well as plastic rods and balloons. The latter could be given an electric charge and then tested with a magnet.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Steel nails: <https://pixabay.com/photos/metal-nails-steel-metallic-950169/>; balloon: <https://pixabay.com/vectors/balloon-blue-shiny-helium-happy-25734/>; rock: <https://pixabay.com/vectors/rock-boulder-stone-nature-granite-576669/>; drinks can: <https://pixabay.com/illustrations/tin-drink-water-vector-drinks-2443066/>; rusty can: <https://pixabay.com/photos/post-box-rusty-tin-can-3372033/>; Canadian nickel: By Awmcphee - Own work, CC0, <https://commons.wikimedia.org/w/index.php?curid=47923674>; other images: Peter Fairhurst (UYSEG).

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