ACET Junior Academies'

Scheme of Work for Science

Big Idea - Forces

Year 3 – Magnets (Forces)

About this unit:

PoS – Forces

This unit continues the work on Forces that was started in the Rocks & Forces unit. Throughout this unit we will be reinforcing the fact that a force is a push or a pull, and encouraging students to use the term 'push force' and 'pull force' where appropriate. The concept of a force is always the same – it is something which exerts a push or a pull – but when we are studying magnets, the students should realise that magnets exert a non-contact force. This can be difficult for them to grasp, as magnets clearly do contact each other, but we want them to understand that they *feel the force* before they touch each other, and that they come into contact because of the force.

There are many opportunities in this unit for students to develop their investigative skills. While they are exploring magnets, they should be encouraged to use scientific terms and explanations where they can, to make links with other units.

The concept of magnets can seem a little 'stand-alone', but the concepts they learn – particularly about attraction and repulsion – are fundamental to understanding some difficult concepts at KS3, KS4 and beyond. Understanding this well now, and being able to discuss it, will put the students in an excellent position to move on in science beyond KS2.

Unit structure

This unit is structured around seven science enquiries:

1. What do you remember about forces?
2. Attractive? or Repulsive?
3. Can we make a magnet useful?
4. Can a magnet make a ghost?
5. How strong is your magnet? *Part 1*
6. How strong is your magnet? *Part 2*
7. What happens to iron age artefacts?

Links to previous and future National Curriculum units

Y3 Autumn 1 – Rocks & Forces

- Y5 - Forces

<table>
<tr><th colspan="4">Enquiry 1: What do you remember about forces?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="3">Y3 – Rocks and Forces</td><td>EA – Identifying, grouping and classifying

Asking questions
Making predictions
Recording data</td><td rowspan="3">Can your children:
- Remember that forces are a push or a pull
- Name some magnetic and non-magnetic objects
State that magnetism is a force which can be felt without objects touching</td><td rowspan="3">Horizontal:
History – iron age

Vertical:
Y5 - Forces</td></tr>
<tr><td>Key concepts:</td></tr>
<tr><td>Magnets can push and pull each other without touching.
Some metals are magnetic. Other materials are non-magnetic.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Magnet, attract, pull, metal, non-metal, plastic, wood, ceramic, glass, plastic</td><td colspan="2">Students often don't realise with magnets that a force is experienced by the magnets before they touch each other – it's a non-contact force.</td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">What is a force? A push or a pull. A force makes something move, changes the way it moves, or changes its' shape.

Friction is a force that pushes back against an object when it's moving.
Demo – is there friction when objects don't touch each other? Rub your hands together, then move them past each other without touching. Which one gets hot?

Magnets – how are they like and unlike friction? Like – can push and pull. Unlike – they don't touch each other to work. Teacher should demonstrate this with two magnets – show that one magnet will move towards another before the magnets have touched – and will repel in the same way.

What do we want to find out about magnets?
Investigate magnetic and non magnetic materials in the room. Try and get students to categorise them according to whether they can feel a force – a push or a pull (it should be a pull they feel, unless the other material is also magnetic).</td><td>Bar magnets</td><td></td></tr>
</table>

Students should discuss how to record the data in an organised way. They could try out on whiteboards. There is no right/wrong – as long as it's organised and easy to see. Have tables ready for students who cannot make their own (after they have been able to explore/attempt) *GD students can identify what **type** of materials are magnetic/non magnetic. Encourage them to use a range of words to describe the properties of materials. Painted surfaces, e.g fridge – is the white paint magnetic? or the metal underneath? What does this tell you about the strength of the attraction?* Link to iron age. NOT all metals are magnetic. Iron is the most common magnetic metal – metallic objects which are attracted to metals usually contain iron.		

<table>
<tr><th colspan="4">Enquiry 2: Attractive? Or Repulsive?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td></td><td>EA – Pattern seeking

Asking questions
Making predictions
Observing and measuring

Key concepts:
Magnets have a north pole and a south pole.
North is attracted to south. N-N repel each other, S-S repel each other.</td><td>Can your children:
- State that magnets have a north and south pole
- Describe what happens when different poles are next to each other</td><td>Horizontal:
PE – it's quite hard to walk around with your arms outstretched for a period of time!

Vertical:
Y5 - Forces</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Magnet, pole, north, south, opposite, similar, attract, repel</td><td colspan="2">Red and blue are there so you know that all blue sides are similar, and that they are opposite poles to the red sides. You don't need to remember whether they are North or South.</td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">When students investigate the objects in a room, they usually sense a 'pulling' force to metals that contain iron. They need to understand that magnets can produce a 'push' force too. They have often experienced this if they have played with a wooden train track.

Using the words 'attract' and 'repel' – students investigate two magnets. When do they push, and when do they pull? Students should recognise when to use the words 'attract' and 'repel'.

Emphasise that the pushing and pulling happens BEFORE the magnets touch each other – magnetism is a non-contact force.

Magnets have a north and a south pole. Students should learn that opposite poles attract, and similar poles repel.

Students can investigate a range of different magnets, to see whether they can identify the north and south poles.

Activity – in the hall or outside – students can write 'N' and 'S' on their hands. Walk around with their arms outstretched – what happens when they encounter another student? There are two fundamentals: N-N and S-S should move away without touching, N-S should come into contact (like a</td><td>Magnets in pairs

Red/blue magnets

Hall/outside – somewhere with enough space</td><td></td></tr>
</table>

high 5). Students can develop their own rules for the activity - Do they stay in contact once attached? How can they separate? Perhaps some students could be 'people', moving the magnets around, rather than the magnets just walking around on their own. Similar factors repelling each other, while opposite factors attract is an important concept in science in KS3 and KS4 – particularly with electricity and nuclear physics. There is no need to discuss this here, but it's a good opportunity to get students to grasp the fundamental concept, and to realise that in future they will be applying it to more than magnets		

<table>
<tr><th colspan="4">Enquiry 3: Can we make a magnet useful?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td></td><td>EA – Problem solving

Asking questions
Making predictions
Key concepts:
Magnets are attracted to certain metals. They can only repel another magnet.
The force of magnets can not be felt very far from them.</td><td>Can your children:
- State that repulsion only happens between two magnets
- Tell you that the force of a magnet can only be felt a certain distance away from it</td><td>Horizontal:
D&T

Vertical:
Y5 - Forces</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Magnet, useful, attract, repel, like/similar, opposite, pole</td><td colspan="2"></td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">Where do we use magnets to help us in our daily lives? Students to think of examples.

See link right for an example of how the repulsion of magnets is useful (attraction is more commonly useful). Repulsion only works between two magnetic objects. Attraction works between a magnet and a suitable metal.

Design something useful using a magnet. Students can either annotate a drawing, or they could try and make whatever it is they design.

Simple – picking something metal up (mechanics use these to pick up dropped screws from inside engines), keeping a fridge door closed, instead of poppers on clothes.

A compass to show explorers which way to go - Link to Geography. Students will need guidance if they are to design/make this.

Students will need to explore how far away from a magnet the force can be felt – some magnets are stronger than others, but they all have a limit as to how far away the force can be detected.</td><td>Useful objects that use magnets

A range of magnets</td><td>https://www.wish.com/product/5a4211f6446c9c1e04587987?hide_login_modal=true&from_ad=goog_shopping&_display_country_code=GB&_force_currency_code=GBP&pid=googleadwords_int&c=%7BcampaignId%7D&ad_cid=5a4211f6446c9c1e04587987&ad_cc=GB&ad_curr=GBP&ad_price=31.00&campaign_id=6493229882&gclid=CjwKCAjw95D0BRBFEiwAcO1KDMQqbshIC6_LMWczonL9ujLxhc7unZupkLQk1ky69VZrRScpRBjKnhoCnccQAvD_BwE&share=web</td></tr>
</table>

GD students may want to explore electromagnets – these are magnets which can be made to be extremely strong, and which can be turned on and off, unlike most 'normal' magnets. They don't need to know how they work, but they could investigate how they are used, and why it's an advantage to be able to turn them off.		

<table>
<tr><th colspan="4">Enquiry 4: Can a magnet make a ghost?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td rowspan="3"></td><td>EA – Pattern seeking

Asking questions
Making predictions
Observing and measuring</td><td rowspan="3">Can your children:
- Tell you that a magnet exerts a non-contact force
- Tell you something they found out by making/playing with their ghost</td><td rowspan="3">Horizontal:
D&T

Vertical:
Y5 - Forces</td></tr>
<tr><td>Key concepts:</td></tr>
<tr><td>A magnet can pull on something without touching it.
Scientists can find out how strong magnets are by investigating them.</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Magnet, attraction, pull force, distance, measure</td><td colspan="2"></td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">Use the link to make paperclips – and other objects – ‘float’.

Note that the objects will float when the force of their weight pulling them down is balanced against the magnetic force pulling them upwards – a concept for greater depth students to explore, but no need to teach it.

The magnet can be sellotaped to a ruler, sticking out over the top of a pile of books, and the string attached to the table with plastecine. Students can then put a thin paper bag over the top of the paperclip to make a ‘ghost’ that looks like it’s floating.

There is lots that students can explore here – does the thickness of the paper bag have an effect on the length of the string needed? Can you ‘twang’ the string to see how strong your magnet is? Students should be encouraged to think of questions that they can then use their ‘ghost’ to answer</td><td>Magnets
Paper clips
Rulers
Sellotape
Paper bags
String
Plastecine/clay/something to attach string to the table</td><td>http://www.capat.org/engpaperclip.htm
https://www.coolmagnetman.com/magclips.htm</td></tr>
</table>

<table>
<tr><td colspan="4">Enquiry 5: How strong is your magnet? To be continued in E6.</td></tr>
<tr><td>Links to previous learning</td><td>Scientific skills</td><td>Assessment criteria</td><td>Curricular links</td></tr>
<tr><td rowspan="2"></td><td>EA – Comparative and fair testing

Asking questions
Making predictions
Setting up tests</td><td rowspan="2">Can your children:
- Tell you that some magnets are stronger than others – and that it’s not related to their size
- Suggest how they can test the strength of a magnet</td><td rowspan="2">Horizontal:

Vertical:
Y5 - Forces</td></tr>
<tr><td>Key concepts:
Some magnets are stronger than others.
We can find things out by testing in different ways.</td></tr>
<tr><td colspan="2">Key terms</td><td colspan="2">Common misconceptions</td></tr>
<tr><td colspan="2">Magnet, attract, strong, stronger, measure</td><td colspan="2"></td></tr>
<tr><td colspan="2">Suggested activities</td><td>Resources</td><td>Useful links</td></tr>
<tr><td colspan="2">This will probably take two lessons. The students need to do some preliminary testing first. They will need access to two different magnets for the second lesson. Paperclips are the easiest resource to use in both lessons.

Students should be aiming to find which of two magnets is the strongest – and to be able to tell you HOW MUCH stronger it is.

First lesson – exploring how you can tell whether a magnet is strong or not. Students should be encouraged to do this themselves. The simplest ways are how far away they can be before they make a paperclip move – they will need to measure accurately, in mm – or how many paperclips they can pick up. Students should try out both methods, and come to a decision on what the best method is. They need to think about what issues they need to resolve in order to make the tests fair – trying to keep as many things as they can the same for both magnets.</td><td>Bar magnets
Rulers that measure in mm
Paperclips</td><td></td></tr>
</table>

<table>
<tr><td colspan="4">Enquiry 6: How strong is your magnet? Continued from E5</td></tr>
<tr><td>Links to previous learning</td><td>Scientific skills</td><td>Assessment criteria</td><td>Curricular links</td></tr>
<tr><td rowspan="3"></td><td>EA – Comparative/fair testing

Asking questions
Observing and measuring
Recording data
Interpreting and communicating data</td><td rowspan="3">Can your children:
- Tell you which the strongest magnet is
- Explain, using numbers, how much stronger one magnet is than the other.</td><td rowspan="3">Horizontal:

Vertical:
Y5 Forces</td></tr>
<tr><td>Key concepts:</td></tr>
<tr><td>We can measure how much stronger one magnet is than another.
We should be able to use numbers to say how much stronger one magnet is than another.</td></tr>
<tr><td colspan="2">Key terms</td><td colspan="2">Common misconceptions</td></tr>
<tr><td colspan="2">Magnet, attract, strong, stronger, measure</td><td colspan="2">Students often think that unexpected answers are wrong or ‘bad’. In fact, they can give us lots of good information – and show us how we could do the investigation better next time.</td></tr>
<tr><td>Suggested activities</td><td>Resources</td><td colspan="2">Useful links</td></tr>
<tr><td>Second lesson – carrying out the investigation. They can be given tables to record their results. They should be challenged to carry out the investigation like ‘real scientists’. Each magnet should be tested 3 times, and they should get a similar answer each time.

There is no need to work out a mean – just have an understanding that the results should be similar each time they do it. If not, they should re-do it until they have 3 similar results. If they don’t, they/you should question their methods. No need to say that they are ‘wrong’ – but how could their method be improved?

Students to write up their conclusions. Which is the strongest magnet? How do they know? How much stronger was the best magnet?

GD – Evaluate their results. Did they get exactly the right answer? If there a more scientific way they could get results? Did anything go wrong while they were doing their investigation?</td><td>A range of magnets
Rulers that measure in mm
Paperclips</td><td colspan="2"></td></tr>
</table>

<table>
<tr><th colspan="4">Enquiry 7: What happens to iron age artefacts?</th></tr>
<tr><th>Links to previous learning</th><th>Scientific skills</th><th>Assessment criteria</th><th>Curricular links</th></tr>
<tr><td></td><td>EA - Research

Asking questions
Making predictions

Key concepts:
Iron rusts and decays as it ages.
Most artefacts left from the iron age are not iron, as the iron has rusted away.</td><td>Can your children:
- Tell you that iron rusts and decays with time
- Explain why most artefacts that we find from the iron age are not actually iron.</td><td>Horizontal:
History – the iron age

Vertical:
Y5 - Reactions</td></tr>
<tr><th colspan="2">Key terms</th><th colspan="2">Common misconceptions</th></tr>
<tr><td colspan="2">Iron, rust, time, water, artefacts</td><td colspan="2"></td></tr>
<tr><th colspan="2">Suggested activities</th><th>Resources</th><th>Useful links</th></tr>
<tr><td colspan="2">What happens to iron as it ages? Prepare an investigation in advance – leave a nail in water for about a week, and leave another dry nail next to it – illustrate that rust happens when metal is damp.

Investigate metals at different stages of rusting (safety issue). Does this have a bearing on how many iron age artefacts will remain, compared to stone age? Link to history – not all artefacts were made of iron!</td><td>2 nails – one having been in water for a week previously, one dry</td><td></td></tr>
</table>