**National Curriculum Objectives:**
*(Statutory Requirements)*

a) Compare how things move on different surfaces
b) Notice that some forces need contact between two objects, but magnetic forces can act at a distance
c) Observe how magnets attract or repel each other and some materials and not others
d) Compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials
e) Describe magnets as having two poles
f) Predict whether two magnets will attract or repel each other, depending on which poles are facing.

**Experimental and investigative work focuses on:**

| Planning an investigation: | Obtaining and evaluating evidence: |
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| 1. Asking relevant questions and using different types of scientific enquiries to answer them.<br>2. Setting up simple practical enquiries, comparative and fair tests. | 3. Making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment.<br>4. Gathering, recording, classifying and presenting data in a variety of ways to help in answering questions.<br>5. Recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables.<br>6. Reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions<br>7. Using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions.<br>8. Identifying differences, similarities or changes related to simple scientific ideas and processes.<br>9. Using straightforward scientific evidence to answer questions or to support their findings. |

**Most children will:**

- **Understand** that a force is a push or a pull.
- **Describe** how a range of things move.
- **Explain** what is meant by the words magnetic and non-magnetic.
- **Explain** the scientific meaning of words attract and repel.
- **Describe** a number of different-shaped magnets.
- **Ask relevant questions** about magnets and use a scientific enquiry to answer them

**Some will progress less and will:**

- **Explain** that forces make objects speed up, slow down, change direction or stop*;* change the shape of objects.
- **Carry out** an enquiry to find out how things move on different surfaces.
- **Understand** that not all metals are magnetic.
- **Describe** the forces between magnets, and between magnets and magnetic materials.
- **Name** some ways in which magnets are used at home and at school.
- **Record** findings.

**Others will progress further and will also:**

- **Recognise** that a force acts in a particular direction, which can be shown on a diagram by an arrow.
- **Record** my findings and draw conclusions
- **Describe** some common objects that are magnetic
- **Understand** that magnetic forces can act at a distance.
- **Describe** other ways in which magnets could usefully/creatively be used.
- **Explain** simple conclusions from their findings.

**Key Vocabulary:**

**Previously taught:** condensation, plants, leaves, animals, rough, smooth, hard, soft, shiny, alive, not alive, dead

**New:** sorting rocks- grains, crystals, fossils, rocks, slate, marble, chalk, granite
Types of soil- soils, clay, stone, pebble, absorbent, sieve, separate

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| 1 | To understand push and pull forces.<br><br>Assessment: 1 | Remind children about work done on materials in Y2. Ask – *How can the shape of some solid objects be changed?* By squashing, bending, twisting & stretching. Point out that this was done by applying forces – pushes & pulls. Demonstrate using some Plasticine/playdough– push & pull it into different shapes.<br>Ask for a volunteer & gently pull them to their feet, then push them carefully across the room, finally changing the direction in which you are pushing them. Ask children what you are doing to the child – *making them move by applying a force*. Define a force as something, such as a push or pull, which can change the rate (speed) or direction of movement (motion) of an object, i.e. make objects speed up, slow down, change direction or stop*;* change the shape of objects.<br>Think of 3 examples of places where you might find forces in action e.g. the classroom, the park, a school playground, the seaside. Can children suggest forces that they might see being applied, e.g. opening & closing a door or a drawer, pulling someone back & then pushing them on a swing, kicking a football, throwing a ball, building a sandcastle, etc. Point out that all of these forces require contact between two objects (one of which may be a person or an animal!). Explain that scientists show where & in what direction a force is acting by using arrows. Draw a diagram of a door being opened & indicate the pulling force with an arrow. Ask *what force will be applied to close the door?* Show children the diagram of a boy kicking a ball & ask a volunteer to show the force using an arrow (some children may point out that gravity/air resistance is also acting on the ball – if so, agree & explain that they will find out more about this in Y5). Label playground activities together at http://www.iboard.co.uk/iwb/Force-Labels-54. | Independent activity:<br>Ask children to choose one of the settings and draw a picture showing one or more activities you might see using pushes and pulls. They should ring the pulls in one colour and pushes in another colour and label them. Use *session resources* to generate and talk about ideas. Ask children to add arrows to their pictures.<br><br>Independent activity:<br>Look at the collection of toys and ask children to suggest ways in which the toys can be sorted. Carry out children's ideas and then sort into 'Can Move' and 'Cannot Move'. Take the toys that can move and sort them again perhaps by the way they move or how fast they move, etc. Discuss the forces that are needed to make the toys move.<br><br>Support: Children use pushes and pulls to move a toy horse at http://www.bbc.co.uk/schools/scienceclips/ages/5_6/pushes_pulls_fs.shtml and a car at http://www.bbc.co.uk/schools/scienceclips/ages/6_7/forces_movement_fs.shtml. | Do children understand what is a push? What is a pull? | Plasticine/playdough or similar.<br><br>A collection of toys that move in different ways and some that don't move. |

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| 2 | Compare how things move on different surfaces.<br><br>Assessment:a, 1, 2, 3, 4, 5, 6, 7 | Tell children that today they are going to investigate how different things move. Sit children in a circle & place a selection of objects in the centre. Ask volunteers to choose an object & explain how they think it moves (could use pictures in *session resources* instead/as well). Agree that things can be moved in lots of different ways - sometimes humans push or pull, sometimes it is a motor, sometimes the wind or water and so on, but that they all need a force acting on them to move.<br><br>Show children a ramp supported by books or blocks & allow a toy vehicle to run down it & across the floor. Explain to children that gravity is making the toy vehicle run down the ramp. Briefly explain that gravity is a force that pulls everything towards the centre of the Earth (they will learn much more about this force in Y5). Point out that you have not pushed the vehicle!<br><br>Tell children that they are going to set up an enquiry in groups to find out how different surfaces affect the movement of the vehicle. *What will we need to change?* The surface. Ensure that children realise this will be the only variable in their enquiry. Ask how they can make it a fair test, i.e. not push the vehicle, start at the same place, measure to the same place, e.g. behind back wheels, etc. Discuss the two alternative ways of changing the surface – the ramp covering or the floor surface on to which the vehicles run off the ramp (which is easier). | Independent activity:<br>Divide the class into groups to carry out the enquiry. Together children fill in the enquiry template (*session resources* – a partly filled in version is available for the less able) including a diagram of the equipment used. Have the equipment available for children to choose what they need. Point out that children should predict which surface will allow the vehicle to travel furthest & which the shortest distance & why they think this. They should keep a record of the results (if required there is a template in *session resources*). Tell children that scientists repeat their measurements to be sure they are accurate (each measurement should be similar for each surface, but won't be exactly the same). Add the three measurements together & divide by 3 to get the mean average, & use this figure on their graphs. Children can draw their own bar charts on squared paper or use the block graph template in *session resources* (change the scale if appropriate for the results the children are recording). Finally children should write the conclusions, explaining what they have found out. | Which surface allowed the vehicle to travel the furthest? | A selection of objects that move in different ways, e.g. child's windmill, clockwork toy, pull & release toy car, radio controlled vehicle/figure, battery driven toy, vehicle that has to be pushed, pull-along toy, spring-controlled pop-up toy, mains-operated game like Scalextric, slinky, bath toy water wheel, etc. Ramps (floorboard, shelf, etc.),<br><br>blocks or books to raise one end of the ramps, some toy vehicles, a range of surfaces, e.g. carpet, bubble wrap, wood, fabric, paper, corrugated card, sandpaper, etc.<br><br>Measuring tapes, squared paper. |

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| 3 | Describe magnets as having two poles.<br><br>Assessment: e, 6, 7 | Show the children a bar magnet and if possible a lodestone (naturally magnetised rock called magnetite) – see *session resources*. Tell them the story of Magnes, a Greek shepherd. Legend has it that one day to his surprise the iron nails in his shoes stuck to a rock. The rock was called magnetic rock after Magnes or after the area of Greece where this was supposed to have occurred: Magnesia. Stories of magnetism date back to the first century BCE in the writings of Lucretius, and the 'magical powers' of magnetite are mentioned in the writings of Pliny the Elder. http://www.howmagnetswork.com/history.html and http://www.tooter4kids.com/Magnets/history.htm. *Magnets are made from materials that contain nickel, iron, or cobalt. When these materials are exposed to a magnetic field, the structure of the material is actually changed on a microscopic level. The molecules are rearranged into lines (called polarized). When enough of the molecules are polarized, it becomes a magnet*. Pieces of lodestone, suspended so they could turn, were the first magnetic compasses and their importance to early navigation is indicated by the name lodestone, which in Middle English means 'course stone' or 'leading stone'. The Chinese developed the mariner's compass some 4500 years ago. The earliest mariner's compasses were made from a splinter of lodestone carefully floated on the surface of water.<br>So lodestones are naturally occurring compasses. Show children a range of modern compasses. Ask if any of the children have ever used a compass & what they used it for. Explain that the Earth acts as if it has a very large bar magnet (with its south pole positioned towards the geographic North Pole) running through the centre which creates a powerful magnetic field. Other magnets align themselves with this – the north pole of the magnet pointing towards the geographic North Pole). Together work through the activity at http://resources.hwb.wales.gov.uk/VTC/20050301/Geography/Keystage2/direction/northsout/introduct/default.htm. | Independent activity:<br>Children can make their own compass by stroking a needle (straightened paper clip, hair clip or safety pin) with a magnet (repeated from 20 to 50 times rubbing in the same direction – not back & forth & lifting the magnet away on the back stroke). Particles in the object are aligned by this stroking. Then gently lay the needle on the surface of water in a petri dish or similar. A small piece of cork (coin-shaped) can be used to make the floating easier – push the magnetised needle through the cork or balance it on top of the cork & float on the water. Children write a short explanation of what they did, including a labelled diagram. Could also try making a magnetic sling (*see session resources*) – like an ancient compass.<br><br>Independent activity:<br>Draw a picture of Magnus the shepherd discovering a lodestone, write what might have happened.<br><br>Plenary<br>Discuss the results of the enquiry & the conclusions that children drew. Tell children that they will find out more about friction (as well as gravity) when they are in Y5. Friction is the force that resists the movement of two surfaces in contact with each other. The different levels of friction between the wheels of the toy vehicles & the various surfaces tested caused the results of their enquiry today. Point out that we move using pulls – our muscles pull our bones to create movement. We can move in different ways on different surfaces too, e.g. sliding on ice, trudging through mud or sand, & running on grass or tarmac! | What is a bar magnet? | Bar magnets, piece of lodestone.<br><br>Range of compasses & of maps.<br><br>Needles, paper clips, etc.<br><br>coin-shaped pieces of cork , plastic bottle top or polystyrene discs cut from disposable cups,<br><br>petri dishes or small bowls,<br><br>water. |

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| 4 | Compare and group together a variety of everyday materials on the basis of whether they are attracted to magnets or not.<br><br>Assessment: d, 3, 5, 6, | Remind children that they have already found out that lodestone (magnetite) is a naturally occurring magnet. Show them some bar magnets, explaining that we use magnets like these today instead of pieces of lodestone.<br><br>Tell children that we say that a material is magnetic if it is attracted to a magnet (and that it is non-magnetic if it is not attracted to a magnet). Show children a magnet attracting a pile of paper clips or pins. Explain that a magnet is very useful for picking up small items like these if you have dropped them accidently!<br><br>Ask children to suggest things that might be magnetic . Don't comment on the accuracy at this time, but explain that we'll look back at the list after they have set up some enquiries.<br><br>Plenary<br>Review and consolidate the idea that not all metals are magnetic. Ask again which metals are magnetic. Make a list of metals that are attracted to magnets, iron, cobalt, nickel and some iron alloys, e.g. steel. Some stainless steels are not magnetic and some 1p, 2p ('copper') coins are attracted to magnets (thin copper coating over a steel disc). Aluminium cans are not magnetic, whereas 'tins' are usually made of iron/steel (not tin!) and are magnetic. Show children examples of these & their magnetic properties. This fact is used to separate the different kinds of drink & other cans/tins at recycling plants. A short video clip showing how recycled materials are sorted can be seen at http://www.recyclenow.com/facts-figures/how-it-recycled/recycling-centre and clicking on 'Cans' takes you to another short video at http://www.recyclenow.com/facts-figures/how-it-recycled/cans. Can also watch cars being recycled using magnets at http://www.bbc.co.uk/learningzone/clips/using-magnets-to-sort-scrap-metal/2186.html. | Ask if children think that all metals are magnetic. Have a show of hands if they agree. If not, which metals do they think are magnetic? Tell them that people often think that all metals are magnetic, so children are going to test this. Challenge them in pairs or small groups to sort a set of different metal objects and metals into those which they think are magnetic & which they think are non-magnetic. Then give children time to test using a bar magnet. Sort them into two piles again – magnetic & non-magnetic. Bring children back together and ask if their predictions were correct.<br>Children write a short report on their findings, including a diagram to show what they did. They can fill in a table of results (*session resources*) and draw simple conclusions about which metals are magnetic.<br><br>Independent activity:<br>Give each child a bar magnet and ask them to investigate objects found around the room to see if they are magnetic or non-magnetic. Provide a selection of materials including both magnetic & non-magnetic objects both metal & non-metal, e.g. pencil sharpeners (plastic & metal), rulers (metal – for DT, plastic & wooden), erasers, pencils, paper clips, drawing pins, bulldog clips, mathematical practical apparatus such as dice & cubes, split pins (butterfly clips), coins, whistles, maths compasses, treasury tags, magnifying glasses/hand lenses, etc. Also give children the opportunity to test other objects in the classroom. Again children can fill in a results table (*differentiated session resources*). More able children could draw their own results table. Bring class back together & ask for feedback on their findings. | Which materials are attracted to magnets? | Bar magnets,<br><br>sets of metal discs,<br><br>several pins/paper clips.<br><br>Metal objects found in classroom, e.g. pencil sharpeners, drawing pins, bulldog clips, coins, etc.<br><br>Non-metal objects found in classrooms, e.g. erasers, rulers, pencils, mathematical practical apparatus, etc. An aluminium can & a 'tin' can. |

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| 5 | Predict whether two magnets will attract or repel each other.<br><br>Assessment:c,f | Give out bar magnets to children. They pair up and explore what happens if the 2 magnets are placed close to each other. Ask for feedback. Establish that sometimes the magnets moved closer together, and at other times they pushed away from each other.<br><br>Draw a diagram of two magnets on IWB. Point out that the ends are coloured differently – red & blue/black usually. They also are sometimes labelled N & S. Explain that every magnet has a north and south pole, just like the Earth. Opposite poles attract - the north pole attracts the south pole and the south pole attracts the north pole. Like poles will repel (push away from) each other - so if you place two north poles together or two south poles together they will push each other away. Learn the vocabulary 'attract' and 'repel'. Keep referring to the forces of attraction between magnets and magnetic materials. Ensure that children understand the difference between magnets and magnetic materials. Two magnets can show attraction and repulsion, when a magnet and magnetic material are put close together, only attraction occurs.<br><br>Point out that magnetic forces can act at a distance – hold the magnets near to each other, rather than touching to see if they attract or repel each other. Then try putting some paper clips near to a magnet – *how near does the magnet have to be to exert a force on the paper clip?* Show children the video clip at http://www.bbc.co.uk/learningzone/clips/magnetism-and-magnetic-poles/286.html which demonstrates the magnetic forces working to attract or repel. | Demonstrate the magnetic field of a bar magnet using iron filings in a sealed container (to avoid the dangers of inhalation of iron filings by children). Point out that the magnetic field is invisible but we can tell that it's there by the fact that magnets have an effect on magnetic materials (including iron filings) at a distance, i.e. magnetic forces act at a distance.<br>The magnetic field is demonstrated using iron filings at http://www.bbc.co.uk/learningzone/clips/the-3d-magnetic-field-of-a-bar-magnet/287.html (the last part of the video mentions electromagnets, so you may wish to stop it before that point). Give children some time to draw a labelled diagram to show how iron filings arrange themselves in a magnetic field. Point out that the magnetic field is strongest at the poles.<br><br>Independent activity:<br>Give children the opportunity to explore magnetic attraction and repulsion again. They then draw pictures of bar magnets with poles labelled showing how they attract or repel. Less able: write sentences 'Opposite poles attract' and 'Like poles repel.' More able: write a paragraph describing their enquiry & explaining what they found out.<br><br>Plenary<br>Show & discuss the video clip at http://www.bbc.co.uk/learningzone/clips/magnets-and-their-invisible-force/2185.html with children - | Will these magnets attract or repel each other? | Bar magnets, paper clips, iron filings in a sealed container. Access to internet |

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| 6 | Understand that some forces need contact between two objects, but magnetic forces can act at a distance.<br><br>Assessment:b, | Show children a range of magnets, pointing out that they are not all bar-shaped. Give one of each to groups of children and allow them some time for free exploration. Bring class back together & ask volunteers to explain where the two poles are on the various magnets. *How can we show this?* Use the north or south pole of a bar magnet to show attraction & repulsion between the various magnets. Ask questions such as: *Can anyone show us how two horseshoe-shaped magnets attract & repel each other?* Ask if children have any questions for which they would like to find an answer. If you have some sealed iron filings available show children the magnetic fields of the various shaped magnets.<br>Magnets are used in many different ways – some shapes are useful for particular tasks. Ask children to suggest games/toys in which magnets are used, e.g. fishing game, Magnetic Shapes (Galt), magnetic dressing dolls sets, easels with magnetic letters & numbers, magnetic building blocks, magnetic dart boards, magnetic drawing boards, wooden train sets that are coupled using magnets, etc. Write their ideas on f/c. Now ask if they can think of any other places in which magnets are used, e.g. large coins used in classroom, compasses, cupboard or fridge doors, fridge magnets, at recycling plants (remind children of video clips they watched), magnetic notepads for shopping lists, etc. Show children a video of a maglev (magnetic levitation) train at http://science.howstuffworks.com/transport/29341-extreme-engineering-maglev-train-video.htm. A list (for adults) is provided in *session resources* - you may wish to describe some of these in simple terms. | Independent activity:<br>If you have a range of games that use magnets, give children an opportunity to explore these games. Explain that you will be asking them how magnets are used in the game. Bring class back together & ask random children to describe one of the magnetic games/toys that they looked at & how magnets were used in the game/toy. *Which did they like the best?*<br><br>Independent activity:<br>Give children a further opportunity to explore a range of different-shaped magnets. They should draw & label the different magnets, marking the two poles.<br><br>Independent activity:<br>Challenge children to think of a new use for magnets – this may be a game/toy or it may be something useful in the home or at school. Allow them to discuss ideas with a partner for 2 minutes, then brainstorm the ideas that children have had. Write a list of suggestions on f/c. Then put children into groups to design a new use for magnets. They should discuss their ideas (based on suggestions already collected), vote on which to proceed with & then draw & label their chosen idea on an A3 piece of paper. Allow about half an hour for this task. | How do magnets work? | A number of a range of different shaped magnets: disc, horseshoe, ball, ring, bar. Iron filings in a sealed container. A range of games/toys that use magnets, e.g. fishing game, magnetic building blocks, wooden trains coupled by magnets, etc. (ask children to bring any they have into school). Access to internet |

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| 7 | To investigate which is the strongest magnet.<br><br>Assessment: 2, 3, 4, 5, 6, 7 | Tell children that they are going to do an enquiry to answer the question *Which is the strongest magnet?* Give each group a set of 4 different magnets & some paperclips. Find out how many paper clips are attracted to each magnet. Ask if this is a fair test. *What do we mean by a fair test? What are we keeping the same? What are we changing?* Ask children to record their findings (*session resources*) and explain what their results show (draw conclusions), e.g. I expected the biggest magnet to be the strongest, but the smallest magnet picked up eight paper clips, so it was the strongest. A more able group could use alternative *resource* using rulers to measure results.<br><br>Bring the class back together. Compare results and look for patterns. Children often think the biggest magnets will be the strongest, though this is not necessarily so. Horseshoe magnets are often the strongest, because their two poles have been brought close together.<br><br>Explain that next children are going to carry out their own enquiries about magnets. They will need to think of some questions to answer. Talk in mixed ability table groups and then share ideas with the class. Record the questions on the f/c to use later (or children fill in *session resource*). Eg. *Do magnets work through a table/aluminium foil/other materials? Do magnets work in water? How many books will stop a magnet working? How far away can a magnet attract a paperclip? How many grams can a magnet lift? Are 2 magnets stronger than 1?* I'm sure your children will come up with other ideas! | Look list of questions suggested by the children and either allocate a question to each group or allow children in groups, pairs or individually to choose a question to investigate (depending on amount of resources available). Go through each question with children suggesting what they would keep the same and what they would change. Model how to fill in an enquiry sheet using one of the questions (*session resources*, 2 levels). Children then fill in the sheet for their own enquiry with appropriate support or supporting each other.<br><br>Children collect the equipment they need (have a range of things available) and carry out their enquiry. Everyone should have a chance to see what happens and to do appropriate measurements (if applicable). Children record their results during the enquiry. They may wish to draw a table for their results. *Was it what children had expected (predicted)?* Help children to draw some simple conclusions – what happened and why. If time children should also draw a labelled diagram of the equipment they used. | Which is the strongest magnet? How do you know? | 4 different-shaped magnets (could be different sizes of same shape) for each group,<br><br>paperclips,<br><br>rulers.<br><br>Other equipment will depend on the questions that children choose to try and answer. |