Waterville Primary School Progression of Skills and Vocabulary in Science – Forces and Magnets

Year 3

KS1 National Curriculum

Pupils should observe that magnetic forces can act without direct contact, unlike most forces, where direct contact is necessary (for example, opening a door, pushing a swing). They should explore the behaviour and everyday uses of different magnets (for example, bar, ring, button and horseshoe). Pupils might work scientifically by: comparing how different things move and grouping them; raising questions and carrying out tests to find out how far things move on different surfaces and gathering and recording data to find answers their questions; exploring the strengths of different magnets and finding a fair way to compare them; sorting materials into those that are magnetic and those that are not; looking for patterns in the way that magnets behave in relation to each other and what might affect this, for example, the strength of the magnet or which pole faces another; identifying how these properties make magnets useful in everyday items and suggesting creative uses for different magnets.

Pupils should be taught:

- Compare how things move on different surfaces.
- Know how a simple pulley works and use making lifting an object simpler.
- Notice that some forces need contact between two objects, but magnetic forces can act at a distance.
- Observe how magnets attract and repel each other and attract some materials and not others.
- 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.
- Describe magnets as having two poles.
- Predict whether two magnets with attract or repel each other, depending on which poles are facing

Prior Learning

Linked Learning:

- No Forces National Curriculum objectives in KS1.
- May have an awareness of how to make things stop and start.

Vocabulary:

Force, push, pull, twist, contact force, non-contact force, magnetic force, magnet, strength, bar magnet, ring magnet, button magnet, horseshoe magnet, attract, repel, magnetic material, metal, iron, steel, poles, north pole, south pole

Key skills to be taught

asking relevant questions and using different types of scientific enquiries to answer them

setting up simple practical enquiries, comparative and fair tests

gathering, recording, classifying and presenting data in a variety of ways to help in answering questions

reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions

using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions

identifying differences, similarities or changes related to simple scientific ideas and processes

using straightforward scientific evidence to answer questions or to support their findings.

Key Ideas	Possible Activities
What is a force?	• Change shape of materials by twist, stretch, etc. Identify action as push or pull. • Use toy cars, bean bags, etc. Make them move / move faster / slower / further. • Identify size of push or pull. Model as force arrows. • Explore: push/pull objects. Describe how hard it is
How can we show and measure contact forces?	• Two pupils lean into each other or hold hands and lean back. Use to model pushes and pulls. Build model of force arrows (balanced/unbalanced) • Explore pulls by using cord attached to a Newton Meter. Practice using equipment. Use force arrows to model. • Fair test – What happens to the distance an object can be moved when we increase the push force? Twang plastic ruler (vary pull back distance) onto bean bag/blocks • Fair test: What happens the pull force need to stretch more elastic bands be 1cm? Predict & measure force needed to pull objects in classroom
What is gravity?	• Model gravity by using an extended spring. Model using force arrows. • Is gravity always the same? Imagine being on the moon. • Fair test – How big a splat does a water bomb make when it is dropped from different heights? Use food colouring if possible. Make a ‘release rod’. • Fair test: How does the height at which we drop a ball effect how high it bounces? Explore other variables
How do magnets behave?	• Use the force arrow model to describe the effect of a magnet on an object & magnet-magnet. Role play. • Explore attract / repel. Develop associated terminology. Predict whether magnets will attract or repel • Explore: play with bar magnets. Develop terminology • Explore: different types of magnet (e.g. bar, horse-shoe, different sizes, etc). Predict strength
Are all magnets the same?	• Make a suspended paper clip (tape paper clip on string to bottom of jar. Tape magnet onto inside of lid) • Guide a paperclip along a maze/fishing for treasure. • Discuss everyday / specialized uses of magnets • Fair test: Which magnet is the strongest? Pull magnet apart from paper clip along a ruler or count number of paper clips it can pick up. • Fair test: Which materials weaken a magnet? Place materials between magnet and paper clip
Which materials are magnetic?	• Investigate which materials / everyday objects are magnetic. Metals / non-metals. Aluminium? • Classify materials into magnetic and non-magnetic.

Next steps in Year 5:

- Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object and the impact of gravity on our lives.
- Identify the effects of air resistance, water resistance and friction, which act between moving surfaces.
- Recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.
- Describe the movement of the Earth, and other planets, relative to the Sun in the solar system.
- Describe the movement of the Moon relative to the Earth.
- Describe the Sun, Earth and Moon as approximately spherical bodies.
- Describe the idea of the Earth’s rotation to explain day and night and the apparent movement of the sun across the sky.

Waterville Primary School Progression of Skills and Vocabulary in Science – Forces

Year 5

KS1 National Curriculum

Pupils should explore falling objects and raise questions about the effects of air resistance. They should explore the effects of air resistance by observing how different objects such as parachutes and sycamore seeds fall. They should experience forces that make things begin to move, get faster or slow down. Pupils should explore the effects of friction on movement and find out how it slows or stops moving objects, for example, by observing the effects of a brake on a bicycle wheel. Pupils should explore the effects of levers, pulleys and simple machines on movement. Pupils might find out how scientists, for example, Galileo Galilei and Isaac Newton helped to develop the theory of gravitation. Pupils might work scientifically by: exploring falling paper cones or cup-cake cases, and designing and making a variety of parachutes and carrying out fair tests to determine which designs are the most

Pupils should be taught:

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- Identify the effects of air resistance, water resistance and friction, which act between moving surfaces.
- Recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect

Prior Learning

In Year 3:

- Compare how things move on different surfaces.
- Know how a simple pulley works and use making lifting an object simpler.
- Notice that some forces need contact between two objects, but magnetic forces can act at a distance.
- Observe how magnets attract and repel each other and attract some materials and not others.
- 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.
- Describe magnets as having two poles.
- Predict whether two magnets with attract or repel each other, depending on which poles are facing.

Vocabulary:

Force, gravity, Earth, air resistance, water resistance, friction, mechanisms, simple machines, levers, pulleys, gears

Key skills to be taught

planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary

taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate

recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs

using test results to make predictions to set up further comparative and fair tests reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations

identifying scientific evidence that has been used to support or refute ideas or arguments.

Key Ideas	Possible Activities
Review contact forces	• Explore pushes (wooden push rod) / pulls (sling) of objects around classroom using a force meter. • Model of balanced / unbalanced forces (two force arrows) • Demo: 'balancing forks/nails/cans' • Explore – push/pulls of different weights using force meter. • Explore – build the best balloon powered car.
What is the effect of friction?	• Develop model of force using push/pull and friction. Draw examples using two arrows. • Reducing friction. Useful friction. • Demo: How can we push this box more easily? (wheels, rollers, lubricants, etc); sorting nuts in a jar • Fair test: what effect does friction have on the speed of a balloon rocket? (raced across string, add lubricants)
What is the effect of air resistance?	• Demo: rocket with different sized parachutes; potato cannon; marshmallows catapult, blow air into bottle with hairdryer then try push paper ball into bottle, stab potato with a straw; rocket with different sized parachutes. • Make balloon hovercrafts / spinning helicopters. • Fair test: does air resistance change when we pull different sized parachutes (run with bin bags attached to force meter)? • Fair test: does the size of parachute effect how quickly an egg will fall? Save the egg! • Explore: make the best paper airplane / marble run
Review non-contact forces	• Develop understanding of gravity as a force. Link to force model. • Demo: balancing balloon; make ping-pong ball float (hairdryer/ straw and cone); drop two different weight objects. • Explore: bungee jumping eggs (use tights). Work out distance needed to stop the egg from smashing, use marbles to practice. • Fair test: How does the height at which we drop a ball effect the height of its bounce? (could make bouncy ball) • Fair test: add weights to force meter. Record
What is up-thrust?	• Air/water resistance in response to gravity= upthrust/drag. Link to particle and force models. Draw examples using force models. • Demos: holes in bottle of water; dancing raisins; float an egg in salt water; Cartesian diver • Build home-made submarine • Fair test: measure up-thrust of different weights in water using force meter. • Fair test: streamlining! How does the shape of an object effect how stream lined it is? Plasticine dropped through wallpaper paste. Could vary viscosity of the paste. • Explore: does an orange float or sink? (unpeeled/peeled)
What is a machine?	• Lever as a simple machine. Allows smaller force to have a greater effect. Examples. Force multiplier. • Pulleys and gears. Ride bikes in different gears, etc • Fair test: how does the length of a lever affect the force needed to lift a load? Change position of fulcrum to lift a load. • Explore: make catapults

Next steps in KS3

- Magnetic fields by plotting with compass, representation by field lines.
- Earth's magnetism, compass and navigation.
- Forces as pushes or pulls, arising from the interaction between two objects.
- Using force arrows in diagrams, adding forces in one dimension, balanced and unbalanced forces.
- Moment as the turning effect of a force.
- Forces: associated with deforming objects; stretching and squashing – springs; with rubbing and friction between surfaces, with pushing things out of the way; resistance to motion of air and water.
- Forces measured in Newtons, measurements of stretch or compression as force is changed