Overview of the Learning:
In this unit of learning children will investigate forces in action (gravity, air resistance, up thrust, friction) and make links to these forces in everyday life. They will investigate impact of variables upon these forces. The main focus is investigative learning where children will be: asking questions that can be answered by different types of investigative activity and decide the best approach to use; making predictions based on scientific knowledge; carrying out fair tests; making measurements and repeating them and finding averages to test accuracy of results; presenting findings in graphs, charts and tables and drawing conclusions that utilise more than one piece of supporting evidence, including numerical data and line graphs. They will devise criteria to evaluate their approaches, products and outcomes.

Core Aims
- develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics about humans and other animals.
- develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them.
- are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future.

Pupils should be taught to work scientifically. They will:
- 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.

Pupils should be taught about forces:
- explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling
### Expectations
Children can:

- compare and give reasons, based on testing, for how forces, including gravity, friction, air and water resistance, affect the movement of a variety of objects
- explain, through observation, that forces push and pull objects, making them change shape, and that there is always something doing the pushing or pulling either by contact or at a distance
- explain that drag forces tend to slow things down, including air resistance and, to a greater extent, resistance in liquids
- measure the size of a force.
- explain that there are forces of attraction and repulsion between magnets, and there are forces of attraction between magnets and magnetic materials
- Know that objects are pulled downwards because of the gravitational attraction between them and the Earth
- Understand that friction, including air resistance, is a force that slows moving objects and may prevent objects from starting to move
- Know that when objects [for example, a spring, a table] are pushed or pulled, an opposing pull or push can be felt
- measure forces and identify the direction in which they act.
- explain the weight is a force and is measured in newtons and that the greater the weight the greater the force
- explain that friction is a force that tries to stop things moving against each other
- know that gravity is a force that pulls all objects towards the Earth
- understand that upthrust is a force that pushes up on objects in water
- know that air resistance is a force that can only work when an object is moving and works against the direction of movement

<table>
<thead>
<tr>
<th>Learning Objectives</th>
<th>Suggested Learning Opportunities</th>
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<tbody>
<tr>
<td>• To review and explain what a force is.</td>
<td>Hook –<a href="http://www.bbc.co.uk/education/clips/zp4g9j6">http://www.bbc.co.uk/education/clips/zp4g9j6</a></td>
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<tr>
<td>• To present scientific ideas and thinking about forces thinking about pulls and</td>
<td>Animated video of forces in action <a href="http://www.engineeringinteract.org/resources/parkworldplot.htm">http://www.engineeringinteract.org/resources/parkworldplot.htm</a> - Animation for children to investigate to discuss with partner their initial ideas about forces prior to unit of learning</td>
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<tr>
<td>pushes</td>
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<td>• To consider what sources of information, including first-hand experience and a</td>
<td>Elicitation for Learning</td>
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<td>range of other sources, they will use to answer questions</td>
<td>Review children’s knowledge of forces by presenting them with a range of objects/ pictures eg</td>
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<td>pulling an object with a force meter over different surfaces, hanging an object on an elastic band,</td>
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<td>putting two like and unlike ends of a magnet together, dropping a paper parachute</td>
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<td>accompanied by questions eg</td>
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<td>– What does the force meter measure?</td>
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<td>– How does it work?</td>
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<td>– What would happen if you hung a heavier object on the elastic band?</td>
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<td>– What would happen if you put two horseshoe magnets together?</td>
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<td>– What slows the parachute?</td>
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<td>Discuss with children their answers to the questions. Pupils will be introduced to the idea that</td>
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<td>one body exerts a force, and this acts on another e.g. the Earth pulls downwards on objects on</td>
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<td>its surface, and the force between the two objects is gravity. When something begins to move,</td>
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<td>gets faster or slows down, a force is acting. When something happens that could make something</td>
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<tr>
<td></td>
<td>begin to move, get faster or slow down, a force is acting.</td>
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<td>Get children to complete annotated drawings onto pictures that represent their ideas. This is</td>
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<td>starting point to identify where children’s learning is so that learning can be personalised to</td>
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<td>move children’s ideas forward</td>
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</table>
| Explore – weight and force | To investigate the relationship between weight and force  
To use a forcemeter to make careful measurements, interpreting the scale correctly  
To use tables to present results, identifying patterns and drawing conclusions  
To use test results to make predictions to set up further comparative and fair tests  
To plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary | Introduce discussion of weight and gravity by asking children what they think the readings on the forcemeter are telling them. Let children investigate forcemeter and introduce force is measured in newtons  
Present children with a collection of everyday objects to investigate the force needed to lift them using a force meter.  
Ask the children to investigate the relationship between the weight of the object and the force needed to lift it  
Children are to repeat measuring and results and find averages and record appropriately  
Children are to record their finding using charts and graphs  
Children are to draw conclusions from their learning and link these to scientific ideas |
| --- | --- |
| Explore – force of objects in air and water | To investigate the relationship between the force needed to lift an object in and out of water  
To make careful measurements of force using a forcemeter  
To use tables to present results, identifying patterns and drawing conclusions  
To record measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.  
To record data and results of increasing complexity using scientific diagrams and labels, tables, bar and line graphs. | Ask children to use a forcemeter to weigh a series of objects suspended in air and then suspended in water. At this stage do not include objects which will float. Discuss patterns in the results, relating them to the downward pull of gravity on the object and the upward upthrust of the water. Ask children to explain what they observe.  
Ask the children to investigate the relationship between the force needed to lift an object in and out of water. Children are to repeat measuring and results and find averages and record appropriately. Children are to record their finding using charts and graphs  
Children are to draw conclusions from their learning and link these to scientific ideas |
| Fair test Investigation – “Will an object weight less in any liquid than it goes in air” | To investigate the relationship between Fair test Investigation – “Will an object weight less in any liquid than it goes in air” |
| The force needed to lift an object in and out of a variety of liquids  
| • To make careful measurements of force using a force meter  
| • To make predictions based on scientific evidence support ideas  
|   • To draw valid conclusions that utilise more than one piece of supporting evidence, including numerical data  
| • To record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.  
| Pose the question to the children: “Will an object weight less in any liquid than it goes in air”  
| Children discuss and plan how they are going to investigate this statement and carry out a fair test and record their results.  
| Get children to predict first and draw on existing science knowledge  
| Get the focus of their written investigation to be predictions and conclusions  
| Investigating air resistance  
| Children look at friction, how the force of air resistance affects moving objects, pushing and pulling and directions in which forces act. Suggested investigations are:  
| **Air Resistance Investigation**  
| This investigation asks children to consider what changes they can make to increase the amount of air resistance they feel when running across the playground with a large sheet of a card.  
| **Forces and Air Resistance**  
| Looking at pictures children are asked to use arrows to show the direction and size of the forces acting upon objects. Includes looking at the forces acting upon a plane in flight.  
| **Balloon Rocket**  
| This investigation asks children to consider changes to a balloon rocket: how the force pushing the rocket could be increased or ways in which the force of friction or the force of gravity acting on the rocket could be changed.  
| **Turbine Windmill**  
| In this investigation children consider changes they could make to a turbine windmill to increase the speed at which it turns. |
**Balloon Buggy Investigation**

Children build a balloon buggy and consider changes that would affect how far it goes. They then decide on one idea to investigate.

- To investigate the relationship between air resistance and moving objects
- To check measurements by repeating them
- To interpret a line graph and use it to describe the motion of spinners falling
- To investigate the relationship between surface area and air resistance

| Explore and investigate – The relationship between air resistance and moving objects |
| Selenia and the Victorian Adventure – Comic (see resource folder) |

Present children with a piece of A4 paper in different states eg flat, screwed up, folded and with them compare how long each one takes to fall to the floor. Get children to discuss what they think will happen and why?

Get the children to devise their investigation using an autogyro to test out their ideas for example: the larger the surface area of the wings on an autogyro the longer it will take to fall/ The heavier the autogyro the quicker it will fall. Get the children to plan and carry out their investigation making accurate measurements, repeat their measures for accuracy finding averages

Get children identify a pattern in the results eg the larger the surface area, the longer it takes and to draw a conclusion from their work and evidence their conclusion using their data

Building on ideas developed in autogyro investigation, introduce children to a falling parachute, get children to identify forced in action as parachute falls

Get children to devise and carry out investigation to find out the relationship between surface area of parachute and air resistance (e.g. get children to make parachutes with varying surface areas e.g. 600 square cm, 400 square cm...and investigate time taken to fall) Get children to record time taken each parachute to fall, repeat tests to find averages, graph and chart results


Professor Newton interactive game where children can explore forces in action see effects of gravity/ use for discussion with partner

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**East Park Academy**
<table>
<thead>
<tr>
<th>Explore - Friction</th>
<th>Investigating forces in action when launching a rocket</th>
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<tr>
<td>Recap children’s prior learning about friction, show children range of pictures and get them to identify where friction occurs and it’s impact.</td>
<td>Elicit with children learning from their work on forces</td>
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<td>Provide the children with learning context: we are going to find out which training shoe is the best for P.E for indoors and outdoor activities</td>
<td>Provide children with small hand held rockets and launchers, in pairs get them to launch rockets and discuss forces in action as rocket moves through the air, get children to identify forces on annotated diagram</td>
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<tr>
<td>Elicit ideas from the children about the shoe needs to be able to do</td>
<td>Model to the children using rocket launcher kit, adding water to large pop bottle and using, how to launch rocket (This must be done outside for safety reasons) Get the children to discuss forces in action and to predict does the amount of water used to launch a rocket make a difference to the distance the rocket travels and if so why? If not why not?</td>
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<tr>
<td>Elicit ideas from the children the children how they will plan and carry out their investigation (investigation to be carried outside and inside to find out which show has best grip)</td>
<td>In small groups the children carry out their investigation repeating results</td>
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<tr>
<td><a href="http://rubble.heppell.net/simulations/nb_friction0.htm">http://rubble.heppell.net/simulations/nb_friction0.htm</a> friction video clips</td>
<td>Children share their results with rest of class (each group taking specified amount of water,</td>
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<tr>
<td><a href="http://www.sycd.co.uk/primary/mr_zippy/flash.htm">http://www.sycd.co.uk/primary/mr_zippy/flash.htm</a> Mr Zippy’s trainers context investigation</td>
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<tr>
<td><a href="http://www.engineeringinteract.org/resources/parkworldplot/flash/concepts/friction.htm">http://www.engineeringinteract.org/resources/parkworldplot/flash/concepts/friction.htm</a> Interactive site to consolidate learning about friction</td>
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<td>East Park Academy</td>
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| repeating results at least 3 times and find averages) Children in their investigate results and discuss what the results tell them
Children record their investigation using graphs, explain their results and draw conclusions based on all science learning from unit of work
http://www.bbc.co.uk/schools/ks2bitesize/science/physical_processes/forces_action/read1.shtml
Site children could explore at end of unit of learning to recap work on forces
http://www.ngfl-cymru.org.uk/vtc/ngfl/science/467/loader.swf
Interactive game children can use to recap learning over this unit of work |
| - To lead enquiries and investigations into the works and achievements of scientific key figures.
- To investigate the contributions of key scientific figures in exploring forces and gravity. exploration of key scientific figures – Isaac Newton, the Wright brothers and Galileo
Show the children a picture of Isaac Newton
Can they name who he was? What was he famous for?
Children to investigate the scientific works of Isaac Newton (recognised gravity as a force).
Children to further study the stories of Wright Brothers (built the first aeroplanes) and Galileo (movement of objects) |