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Year 5	Term 4	Unit title – Forces

Brief description of main content of this unit: Sc5/4.2 Forces

Sc5/4.2a explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object

Sc5/4.2b identify the effects of air resistance, water resistance and friction, that act between moving surfaces

Sc5/4.2c recognise that some mechanisms including levers, pulleys and gears allow a smaller force to have a greater effect

Vocabulary – Types of forces: gravity, friction, air resistance, upthrust, weight

Measuring forces: Newton meter, Newtons (N)

Particles

Surface area

Push, pull

Balance

Mass – grams and kilograms

Mechanical devices – gears, levers, pulleys, springs

Key Scientists

Sir Isaac Newton (1642 – 1727) – Formulated the laws of motion - http://www.bbc.co.uk/history/historic_figures/newton_isaac.shtml

Christopher Cockerell (1910- 1999) – Inventor of the hovercraft - http://www.design-technology.info/inventors/page11.htm

Archimedes (c.287 - c.212 BC) – Greek inventor - http://www.bbc.co.uk/history/historic_figures/archimedes.shtml

Home learning links: https://classroom.thenational.academy/units/forces-717d

Other Useful Information

Forces can:

1. Stretch an object
2. Tear things
3. Squash things
4. Bend things
5. Make an object turn or spin
6. Twist an object

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7. Make an object move
8. Make a moving object go faster
9. Stop a moving object

Direction of the force is shown by arrows

A Newton meter is used to measure the amount of force.

Measuring forces

Forces are measured in Newtons (N)
100g is equal to 1N
1g is equal to 0. 01N
1kg is equal to 10N

Types of forces:

1. Springs and elastic bands –
Materials that are elastic are able to be stretched. They return to their original shape when no longer being stretched.

2. Gravity and Weight –

Gravity –
Gravitational force is a pull towards the centre of an object such as the Earth. All objects have a gravitational force, but the size of the force is related to the mass of the object. Objects with big masses have very large gravitational forces. The Moon, having less mass than the Earth, has a gravitational pull one fifth of the Earth's.

Weight –
Weight is the pull of the Earth's **gravity** on the mass of an object. All objects exert a force of **gravity** on each other; the size of the force depends on their masses mass is being pulled down by a bigger force. For example, A 2 kilogram bag of salt is being pulled down with a force of twenty.
An increase in mass does not affect how fast an object will fall towards Earth. The result of the bigger pull on the bigger object is the same as the effect of a smaller pull on a smaller object.

3. Friction in air and water

Friction –
Friction is the resulting force from two surfaces rubbing together. These surfaces include solids, liquids and gases.

Air resistance –

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Objects moving through air experience the frictional force of the air, which acts in the opposite direction of their movement. So, when objects fall through the air, the air resistance is the force that acts in the opposite direction of gravity. In the air, the air particles rub against the object causing friction. The greater the rubbing, the greater the air resistance will be. An object falling faster will have more air resistance because there will be more particles rubbing against the object. The one with a large surface area will be more affected than one with a small surface area. Thus, the effect of air resistance depends on the surface area and the rate at which the object is falling. There can come a point for a falling object where effects of air resistance and gravity are balanced. At this point it will fall at a steady speed; it has reached terminal velocity. Different objects can take different amounts of time to reach terminal velocity. A person with a parachute will reach this more quickly because the parachute builds up air resistance more quickly. A heavier parachutist reaches Earth before a lighter parachutist because, although the air resistance is the same, the gravitational force is greater on the heavier one and so he/she accelerates for longer before reaching terminal velocity.

The effect of a parachute trapping air is like the upthrust that objects experience in water. The particles are squashed together, and so push back against the object.

Upthrust –

Upthrust in water is the force pushing up against an object. If this force balances the gravitational force pulling the object down, then it will float.

A submerged object also has upthrust pushing against it. One can measure this by measuring the objects weight out of the water with a Newton meter, and then measuring its weight when in the water. The weight in the water is less, and the difference is the upthrust provided by the water.

Lesson No.	Key Learning Objectives Linked to National curriculum (differentiated)	Activities & Teaching & Learning strategies (including assessment opportunities)	Cross curricular links
1	LI - To be able to identify the effects of air resistance that act between moving surfaces. Success Criteria	See Kent scheme of work. See Twinkl Resources on SharePoint **Starter** – What do the children already know about forces? Children could fill out the KWL grid with what they know and what they want to find out. **What do you want to know?** As a class gather children' questions about what they want to know about forces. These could be recorded on the white board/ in books or on the working/science boards.	

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	ALL must be able to identify forces as pushes and pulls MOST should be able to identify forces acting on an object SOME could identify and explain the forces acting on an object	Children identify pictures on Twinkl PPT as pushes or pulls. Discuss. Explain how forces affect the movement of an object and discuss the different types of force as shown on the PPT. can the children identify the forces as pushes and pulls? **Direct teaching** – https://www.bbc.co.uk/bitesize/topics/zvpp34j/articles/zywcrdm Identifying forces bingo – as a whole class differentiated sheets. Play the form of bingo. You read out a card and the children have to fill it in on their bingo boards. Can the children identify the forces at work on their sheet? In pairs talk about forces. Children to read the story 'Talk about forces' and highlight or underline the forces that are in the story. In the next column, they should then briefly explain the forces that are being applied in each example. Can children identify and explain together the different forces acting on objects? **Activity - Forces in Action:** Children complete the **Forces in Action Activity Sheet** by identifying the forces and drawing arrows to show the direction in which they apply a force. Can children identify and explain the different forces acting on objects? **Plenary – What have they found out? Force Examples:** Children share their own examples of forces acting on objects and discuss with a partner. Can children reflect on whether they can identify and explain the different forces acting on objects? **EXT/Activity ideas** – Make a forces poster Write a story like the 'Talk about Forces that they read'	
2	LI: To explain that unsupported objects	See Kent scheme of work. See Twinkl Resources on SharePoint	

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	fall towards the Earth because of the force of gravity acting between the Earth and the falling object Success criteria: ALL must be able to explain the effect of gravity MOST should be able to explain Isaac Newton's role on developing the theory of gravity SOME could accurately measure the force of gravity on pulling objects	**Starter** – Drop a bouncy ball and ask children to discuss their ideas about gravity using the prompts on the **Twinkl PPT**. Explain to the children about the force of gravity. Use the PPT to support and the clip https://www.bbc.co.uk/bitesize/topics/zf66fg8/articles/zqbm3k7 **Direct teaching** – Chn could start the lesson by investigating how long it takes for a spinner to fall. See Kent Teach plans. Discovering Gravity: Children discuss any existing knowledge they have of Isaac Newton and discuss briefly how Isaac Newton developed his theory of gravity. Children use the Newton and Gravity Fact Sheet to answer the comprehension questions on the differentiated Newton and Gravity Activity Sheet. Can children explain Isaac Newton's role in developing a theory of gravity? Introduce weight and mass and explain to the children the difference between them. Twinkl PPT to support if needed. **Activity – Measure the Force of Gravity:** Explain how children will measure the weight and mass of different objects using the **PPT**. Children complete the differentiated **Measuring Gravity Activity Sheet** with their prediction, results and conclusion, and conduct the investigation in pairs. Can children measure the weight of objects? Can children explain that the weight of an object is caused by gravity pulling it down? **Plenary** – Discuss what the children have learned in the lesson. Can they make a like between mass and weight?	
3	LI: To be able to identify the effects of air resistance that act	See Kent scheme of work. See Twinkl Resources on SharePoint	Computing

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	between moving surfaces. Success criteria: ALL must be able to investigate the effects of air resistance MOST should be able to explain how air resistance effects moving objects SOME could plan and conduct an investigation into the effects of air resistance	**Starter** – https://www.bbc.co.uk/bitesize/subjects/z2pfb9q friction and resistance clip. **Gravity and Falling:** Use the **Twinkl PPT** to explain that gravity causes objects of the same size and shape but of different mass to fall at the same rate. Discuss Galileo's experiment and how it proves this. (Children may find this hard to grasp as air resistance often causes objects with less mass to fall more slowly.) Children discuss how when a feather and a hammer fall on the Moon, they land at the same time due to no air resistance. **Direct teaching – Air Resistance:** Use the **PPT** to explain the effects of air resistance, and how this affects objects falling when on Earth. Children discuss the useful and unhelpful effects of air resistance using the diagrams on the PPT. **Activity - The Perfect Parachute:** Explain the context of the investigation using the **Lesson Presentation**. Ensure children understand how to make their different parachutes. Children discuss the possible variables, then reveal the suggestions on the **Lesson Presentation**. They should make their own decisions about how to plan the experiment and record their choices and their prediction on the differentiated **Perfect Parachutes Activity Sheet**, then conduct their investigation. Children complete their results on the activity sheet. Can children plan and carry out their own investigation into the effects of air resistance on different parachutes? **Children could create their own table to collect the results and write them straight into their books.** **Super Skydiving:** Children come to their conclusion in the form of a report on the differentiated **Super Skydiving Report Activity Sheet – this can be used as a template and children can write straight into their books**. Can children explain the effects of air resistance on moving objects?	

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		Plenary – Challenge pairs to take it in turns to each talk for a minute about air resistance. How much can they explain about what they have learned?	
4	LI: To identify the effects of water resistance Success criteria: ALL must be able to explain the effects of water resistance MOST should be able to identify streamlined shapes SOME could minimise the effects of water resistance on an object	See Kent scheme of work. See Twinkl Resources on SharePoint **Starter – Water Resistance:** Children discuss their experiences of water resistance using the image on the **PPT** as a stimulus. Explain the force of water resistance, referring to the diagram on the **PPT**. **Direct teaching -** The context could be that a submarine company has contacted the children requesting some help with the design of their new mini-sub. Ask children to describe what it is like to walk through water e.g. in a swimming pool and to suggest why it is difficult. Elicit their ideas about why fish and boats can move through water with relative ease. If necessary, prompt them to think about shape. **Streamlined Shapes:** Explain streamlining using the examples on the **PPT**. Children work in groups to conduct the mini-investigation into streamlined shapes as described on the **PPT**. Explain why the shapes fell at different speeds as a result of some shapes being more streamlined than others. Can children identify streamlined shapes? Show children a tall cylinder filled with water and talk with them about what they could do, using this apparatus and a small piece of plasticene, to find out which shapes move easily through water. Help children to decide what to measure e.g. time from dropping the plasticene into the cylinder until it gets halfway down or to the bottom. The children will need to regularly pour the water into a washing-up bowl in order to remove the plasticene. Alternatively, you can try tying piece of string to the blue tack	

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		Activities - **Boat Building:** Children complete the boat race challenge as described on the **PPT**. Provide children with the junk modelling equipment so they can make their boats, then time how long it takes each boat to cross the water tray. Children then work on their own to complete the differentiated **Boat Race Activity Sheet** by drawing and labelling their design and making a prediction for how well they think their boat will move through the water. Can children discuss how they might minimise the effects of water resistance in their design? **Plenary** – What have the children learned today? Chn can present what they have found out to their partners or the class.	
5	**ASSESSMENT WEEK** LI – To apply my understanding of forces Success Criteria ALL must be able to identify the forces MOST should be able to explain the effect of gravity SOME could explain the effects of friction and resistance	See Kent scheme of work. See Twinkl Resources on SharePoint **Starter** – To go over the learning for the term so far. What have the children learned what have they done? Clips on BBC Bitesize to support starter. **Direct teaching – Twinkl Assessment on SharePoint** **Plenary** – Find other activities on Kent scheme of work or Twinkl – extra activities. Marvellous Mechanisms – Twinkl is an extra lesson that could be completed.	

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6	LI – To identify the effects of friction Success Criteria ALL must be able to explain the effects of friction on a moving vehicle MOST should be able to investigate the effects of friction created by different materials SOME could recognise and control variables in an investigation	See Kent scheme of work. See Twinkl Resources on SharePoint **Starter** – https://www.bbc.co.uk/bitesize/subjects/z2pfb9q friction and resistance clip. **What Is Friction?** Children discuss the statements about friction and decide if they are true or false. Share the answers and explain them using the information on the **PPT**. Can children explain how friction affects a moving vehicle? **Direct teaching – Friction in Action:** Using the **PPT**, discuss how brakes on a bicycle make use of the force of friction. **Design a Brake Pad:** Explain the context of the investigation and how to carry it out, referring to the **PPT**. **Reliable Results:** Discuss the variables with the children, pointing out the need to keep the variables not being tested or measured the same in order to gather reliable results. Groups of children discuss how they can try to keep the controlled variables consistent. Can children recognise and discuss how they will control variables in an investigation? **Activity - Find the Best Brake Pad:** Children complete their prediction on the differentiated **Investigating Friction Activity Sheet**. They will then conduct the investigation and complete the table on the activity sheet with their results. Once completed, the children will demonstrate which material they think makes the best brake pad, and explain their choice on the activity sheet. You may wish to film or photograph the children's demonstrations, or they could present them to the rest of the class. Can children investigate the effects of friction created by different materials?	

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		Solve and Explain: In pairs, children discuss how to solve the problem on the **PPT** explaining the science behind their solution. Share children's ideas and share the example answer with the class. **Plenary** – Fill in the grid that they started with. What have they learned this term?	