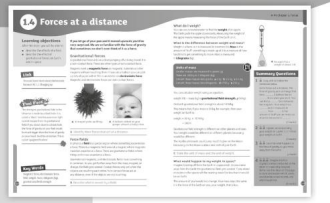
1.4 Forces at a distance



Physics NC link:

- non-contact forces: gravity forces acting at a distance on Earth and in space
- gravity force, weight = mass × gravitational field strength (g), on Earth g = 10 N/kg, different on other planets and stars.

Working Scientifically NC link:

- present observations and data using appropriate methods, including tables and graphs.

Band	Outcome	Checkpoint	
		Question	Activity
Developing	Identify gravity as a force that acts at a distance (Level 3).	A	
	State that gravity changes with distance (Level 4).		Starter 1
	With help, draw a table and present results (Level 3).		Main 1
Secure	Describe the effect of a field (Level 5).	1	
	Describe the effect of gravitational forces on Earth and in space (Level 5).	3	Main 2, Plenary 1
	Present results in a simple table (Level 4).		Main 1
Extending	Apply the effects of forces at a distance to different fields (Level 7).		Starter 1, Main 2, Plenary 1
	Explain how the effect of gravity changes moving away from Earth (Level 7).		Main 1, Main 2
	Present results in a table, ensuring they are reliable (Level 6).		Main 1

Maths
In the student book students use number size and scale, and the quantitative relationship between units of mass and weight.

In the practical students extract and interpret information from graphs and tables they have produced.

Literacy
Students communicate ideas and information to a wide range of audiences by writing holiday brochures for different planets for homework.

Students collaborate and use exploratory talk when they present ideas for the Olympics in Space.

APP
Use an abstract model of forces to explain gravitational force (AF1).

When doing the practical, repeat sets of observations or measurements where appropriate, selecting suitable ranges and intervals (AF4).

Interpret data from the Gravity cups practical, recognising obvious inconsistencies (AF5).

Key Words
magnetic force, electrostatic force, field, weight, mass, kilogram (kg), gravitational field strength

Answers from the student book

In-text questions	**A** magnetic forces, electrostatic forces, and gravitational forces/gravity **B** A field is a region where something experiences a force. It doesn't have to be touching the thing to produce the force. **C** Mass is measured in kg, weight is measured in newtons.
Activity	**Units of mass** **a** 2000 g **b** 3500 g **c** 400 g **d** 4.7 kg **e** 0.25 kg

Summary questions	**1** mass, electrostatic, magnetic, force, newtons, mass, kilograms (7 marks) **2** The gravitational field on Jupiter is bigger. Weight increases with gravity. Mass does not change. (3 marks) **3** Gravity gets weaker. (1 mark) **4** Example answers (6 marks): Events that involve throwing something a distance would produce new records, javelin/shot put/hammer, Because the gravitational field strength is less, Events that involve lifting things would produce new records, weightlifting, Because the gravitational field strength is less, Objects will travel further before they hit the ground, Events that are affected by air/water resistance would not be affected, cycling/swimming

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Starter	Support/Extension	Resources
The levitating paperclip and spinning pepperoni (10 min) Students list similarities and differences between a levitating paperclip and a spinning pepperoni sausage, naming forces involved. Tie thread to the paperclip, attach thread to the bench, hold a magnet so the paperclip levitates. Suspend a pepperoni sausage from a clamp stand using thread. Hold an electrostatically charged balloon near the pepperoni sausage – it turns. Although this does not involve gravity, this can show how forces get weaker with distance.	**Support**: Demonstrate the scenarios and ask students which non-contact force was used. **Extension**: Students explain what happens if the other pole of the magnet faces the paperclip, or different materials are moved between the magnet and paperclip.	
Contact and non-contact forces (10 min) Students group forces given on the interactive resource into contact and non-contact forces as a recap and introduction to this lesson.		**Interactive**: Contact and non-contact forces
Main	**Support/Extension**	**Resources**
Gravity cups (25 min) Prepare sealed containers (e.g., drinking chocolate containers) by placing different masses of sand in each to represent different celestial bodies. For example, 100 g for Earth, 17 g for the Moon, 270 g for Jupiter, 38 g for Mars, and 120 g for Saturn. Students weigh the containers, and use $W = mg$ to decide on which planet/Moon the container would weigh that amount. Students present data in a table. It is extremely important at this stage to distinguish between g (gravitational field strength) and g (for grams).	**Support**: A support sheet is available with a pre-drawn table for results, and a step-by-step guide to work out the identity of each station. **Extension**: Students explain why the mass of the container varies.	**Practical**: Gravity cups
A meal on the Moon (15 min) Provide a graph showing mass (*x*-axis) against weight on the Moon (*y*-axis). Students weigh items of food and use this and the graph to calculate the weight of each food on the Moon.	**Support**: Students explain if an astronaut gains or loses mass if their meal weighs less on the Moon.	
Plenary	**Support/Extension**	**Resources**
Match the weight (5 min) Provide a list of 5 masses (and 5 equivalent weights) on the Earth and on the Moon. Students link the correct masses and weights.	**Support**: Present data for one mass at a time. **Extension**: Students use the idea of gravity and weight to explain their answer.	
Olympics in space (5 min) Ask students to compare an astronaut doing sport on the Earth and on the Moon (wearing the same clothes) – long jump, high jump, basketball, and so on.		
Homework	**Support/Extension**	
Write a holiday brochure for a trip to another planet. Explain what the conditions would be like, and how to prepare for the trip.	**Support**: Provide summary data about a specific planet (temperature, atmosphere, surface, distance). **Extension**: There is scope for a detailed discussion linking the conditions and preparations needed.	
An alternative WebQuest homework activity is also available on Kerboodle where students research the International Space Station.		**WebQuest**: International Space Station