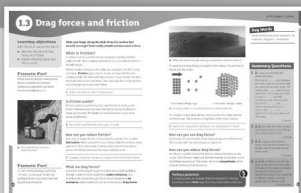● P1 Chapter 1: Forces

1.3 Drag forces and friction

Physics NC link:
● forces: associated with rubbing and friction between surfaces, with pushing things out of the way; resistance to motion of air and water.

Working Scientifically NC link:
● select, plan, and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent, and control variables, where appropriate.

Summary questions	
1	friction, rough, force, air resistance, water resistance, air/gas, water (7 marks)
2	Water resistance slows the bird down. (1 mark)
3	The brake blocks become worn away because of friction between the surfaces. (2 marks)
4	6 mark question. Example answers:
	Air resistance depends on area.
	Bigger area means that more molecules hit the parachute.
	The air resistance is bigger with a bigger parachute.
	Air resistance depends on speed.
	Bigger speed means that more molecules hit the parachute.
	The air resistance is bigger with a bigger speed.
	The biggest air resistance will act on a large parachute attached to a fast car.

Band	Outcome	Checkpoint	
		Question	Activity
Developing	Identify examples of drag forces and friction (Level 3).	C, 1	
	Describe how drag forces and friction arise (Level 4).	A, B	Starter 1
	Carry out an experiment to test a prediction of friction caused by different surfaces (Level 4).		Main 1
Secure	Describe the effect of drag forces and friction (Level 5).		Main 2, Homework
	Explain why drag forces and friction arise (Level 6).		Main 1
	Plan and carry out an experiment to investigate friction, selecting suitable equipment (Level 5).		Main 1
Extending	Explain the effect of drag forces and friction in terms of forces (Level 7).	3, 4	
	Explain why drag forces and friction slow things down in terms of forces (Level 7).	3, 4	
	Plan and carry out an experiment, stating the independent, dependent, and control variables (Level 7).		Main 2

Maths
In the practical students plot and draw graphs selecting appropriate scales for the axes when representing their results.

Literacy
In the student-book activity students write up their practical, planning and adapting writing style to suit audience and purpose.

APP
In the student-book activity students plan to test a parachute (AF4).
Investigate designs used to reduce drag forces (AF3).
Interpret data, conclusion, and evaluation (AF5).

Key Words
friction, lubrication, water resistance, air resistance, drag force, streamlined

Answers from the student book

In-text questions	A Friction can stop something moving or it can slow down something that is moving.
	B The friction produces the force between your foot and the floor that means that you can walk forwards.
	C You need to lubricate surfaces to reduce friction.
	D air resistance
Activity	**Testing a parachute**
	Keep these things the same:
	● the weight of the object beneath the parachute
	● the area of the parachute
	● the thickness of the material.

Starter	Support/Extension	Resources
Slipping and sliding (10 min) Students name surfaces that are slippery/non-slippery and compare them. They list features of the best surfaces to slide on with the idea of reducing friction.	**Support**: Show images of different surfaces (e.g., icy road, wet road, a slide, tarmac). Group these as high/low friction.	
Friction and drag (10 min) Students list three or four objects (or animals) that move easily through water. The interactive resource can then be used to identify features that change friction and drag.	**Extension**: Students suggest how birds alter their shape to change their speed or stop quickly.	**Interactive**: Friction and drag

Main	Support/Extension	Resources
Investigating friction (35 min) Students use newtonmeters to pull a box with masses in it along different surfaces. They record and analyse their results, drawing a graph of their results.	**Support**: An access sheet is available with a given method and results table.	**Practical**: Investigating friction
OR		**Skill sheet**: Choosing scales
Streamlining (optional practical) Students drop 1 cm³ of plasticine in a column of water. They change its shape and compare how the shape affects the time taken to fall a fixed distance, and link this with forces involved. The plasticine can be retrieved using thread. Students present data in a table.	**Extension**: Students measure the cross-sectional area for each shape. They look for a relationship between area and time, plotting a suitable graph.	**Skill sheet**: Planning investigations
Resources have not been provided for this practical.		**Skill sheet**: Recording results
		Skill sheet: Drawing graphs

Plenary	Support/Extension	Resources
Phonebook friction (10 min) Interleave the pages of two magazines or phonebooks. Ask students to hold the spines and pull them apart.	**Extension**: Students explain why it is hard to separate the magazines (each page in contact contributes to the total friction to be overcome).	
Shoes for the job (10 min) Students match features of different sport shoe soles with the surfaces and movement (e.g., football, rugby, ice skating, running, ballet).	**Support**: Students identify if soles of shoes have a large/small surface area, and if they are rough or smooth. Teacher links this to the sport's requirements.	

Homework	Support/Extension	
Students write a short article about how the design of sportswear for athletes, swimmers, and runners helps them move faster.	**Support**: Students list design features of sportswear that increase speed. **Extension**: Students link specific features of clothes to how it reduces drag, for example, close fitting or smooth.	

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Resources