Forces in Action: The Science of Movement

Learning objective: To explain that unsupported objects fall towards the Earth because of the force of gravity, and to investigate the effects of air resistance, water resistance, and friction.

Read each question carefully and use your scientific knowledge of forces to provide detailed explanations. Use the word bank to help you express your ideas clearly.

Nova the owl is observing the mechanics of flight and movement in the natural world. She notes that forces like gravity, friction, and air resistance act upon every object in motion. Whether a stone falls to the ground, a boat glides through water, or a cyclist pedals along a road, understanding these invisible forces is essential for mastering physics.

Word bank: gravity · air resistance · friction · surface area · upthrust · acceleration · drag · mass

1. Nova drops a feather and a pebble from the same height at the same time. Explain why the pebble hits the ground first, even though gravity acts on both objects. (2 marks)

2. Max the monkey is designing a parachute to land safely. Justify why increasing the surface area of the parachute helps it to fall more slowly. (2 marks)

3. Compare and contrast the effect of friction on a wooden block sliding across a smooth icy surface versus a rough carpeted surface. (2 marks)

4. If a boat is floating in a pond, identify the two opposing forces acting upon it that allow it to remain stationary on the surface of the water. (2 marks)

5. What might happen to a cyclist's speed if they were to crouch down low on their bike instead of sitting upright? Explain your reasoning using the concept of air resistance. (3 marks)

Draw: Draw a diagram of a bird in flight. Use arrows to label the forces acting upon it: lift, weight (gravity), thrust, and air resistance (drag).

Extension challenge: Imagine you are an engineer tasked with designing a vehicle to travel through a vacuum where there is no air. Write a short paragraph explaining how the absence of air resistance would change the vehicle's design and how it would move compared to a vehicle on Earth.