

# *Acquiring Unit of Learning* *Science Autumn 1*

**Unit:** Forces

**Subject Coverage:** Science

Lesson Title: What forces do

Learning Intention: I can describe what forces are and what forces do.

Key Skills: observation; using models and diagrams; illustrating; communicating scientific facts

Lesson Guide:

- Begin by asking pupils what they think a force is and if they can give examples.
- Introduce force as a push or pull that acts on an object and affects its motion.
- **Discussion Points:**
  - Explain that forces can change the speed, direction, or shape of an object.
  - Emphasise that forces are measured in **Newtons (N)** and can act in different directions.

Types of Forces and Their Effects

- Discuss common types of forces, such as:
  - **Gravity:** Pulls objects toward each other, especially toward the Earth.
  - **Friction:** Opposes motion, slowing down moving objects.
  - **Air Resistance:** A type of friction that acts on objects moving through air.
  - **Applied Force:** Any push or pull applied to an object by another object or person.
- Describe the effects these forces can have, like starting or stopping movement, speeding up, or changing direction.
- **Visual Aid:**
  - Show diagrams of objects experiencing different forces, such as a falling object (gravity) or a moving car (friction).

Activity: Observing Forces in Action

- Conduct simple demonstrations where pupils can observe the effects of forces:
  - For example, push a toy car to show applied force, or drop an object to demonstrate gravity.

- Encourage pupils to identify which force is acting on the object and describe its effect.
- **Reflection:**
  - Discuss why different forces produce different effects and how the strength and direction of the force influence the result.

### Real-World Applications of Forces

- Briefly discuss how understanding forces is essential in everyday life:
  - **Transport:** Forces impact how cars, bicycles, and planes move.
  - **Sports:** Athletes use forces to jump, throw, or kick.
  - **Engineering:** Knowledge of forces helps build stable structures.
- Emphasise that recognising forces is important for solving real-world problems related to movement and stability.
- **Activity:**
  - Ask pupils to brainstorm other situations where forces are involved and explain the types of forces acting in each example.

### Plenary: Reviewing Key Concepts

- Summarise the effects of forces, the types of forces, and their impact on motion and direction.
- **Reflection Activity:** Ask pupils to complete an 'review your learning' activity by answering, "What is one example of a force, and how does it affect an object?"

Resources: <https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/what-forces-do>

Lesson Title: The different kinds of force

Learning Intention: I can identify and describe different kinds of force and their effects.

Key Skills: categorising; analysis; communicating scientific concepts

Lesson Guide:

- Begin by asking pupils to name any types of forces they know and describe their effects.
- Introduce **contact forces** (forces that require objects to touch) and **non-contact forces** (forces that act at a distance).
- Discussion Points:
  - Explain that contact forces include **friction**, **air resistance**, and **applied force**.
  - Describe non-contact forces like **gravity**, **magnetic force**, and **electrostatic force**.

Exploring Contact and Non-Contact Forces

- Describe key contact forces:
  - **Friction**: Opposes motion between surfaces in contact, slowing objects down.
  - **Air Resistance**: A type of friction that acts on objects moving through air.
  - **Tension**: The force in a stretched object, like a rope or cable.
- Describe key non-contact forces:
  - **Gravity**: The force of attraction between masses, especially toward Earth.
  - **Magnetic Force**: The attraction or repulsion between magnetic objects.
  - **Electrostatic Force**: The attraction or repulsion between charged particles.
- Visual Aid:
  - Use diagrams showing examples of each type of force, such as a falling object (gravity) or a moving car (friction and air resistance).

Activity: Identifying Forces in Everyday Examples

- Provide pupils with various scenarios (e.g., a book on a table, a magnet attracting a paperclip, or a balloon rubbing on hair) and ask them to identify which forces are acting in each situation.
- Encourage pupils to categorise each force as contact or non-contact.
- **Reflection:**
  - Discuss how contact and non-contact forces operate differently and why some forces act over a distance while others require contact.

#### Real-World Applications of Different Forces

- Briefly discuss the importance of understanding different forces in real-world contexts:
  - **Engineering:** Engineers consider friction and gravity when designing machines.
  - **Transportation:** Air resistance affects vehicle design for fuel efficiency.
  - **Technology:** Magnetic and electrostatic forces are crucial in electronic devices.
- Emphasise that recognising these forces is essential in solving practical problems and designing effective systems.
- **Activity:**
  - Ask pupils to think of other examples where forces are involved in daily life and identify the types of forces at play.

#### Plenary: Reviewing Key Concepts

- Summarise the different kinds of forces, categorising them as contact or non-contact forces, and their impact on objects.
- **Reflection Activity:** Ask pupils to complete an 'review your learning' activity by answering, "What is one example of a non-contact force, and how does it act on objects?"

Resources: <https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/the-different-kinds-of-force>

Lesson Title: Measuring forces

Learning Intention: I can use newton meters to measure forces accurately.

Key Skills: measuring; use of scientific apparatus; data recording; interpreting; application

Lesson Guide:

- Begin by asking pupils how they think we can measure a force and what units might be used.
- Introduce the **Newton (N)** as the unit of force, named after Sir Isaac Newton.
- **Discussion Points:**
  - Explain that forces are measured using a **force meter** or **Newton meter**, which shows the amount of force applied.

Using a Newton Meter

- Demonstrate how a Newton meter works:
  - When a force is applied, the spring inside the meter stretches, moving the scale to show the force in Newtons.
- Emphasise that the reading on the Newton meter corresponds to the force applied, with more force causing greater extension of the spring.
- **Visual Aid:**
  - Show a labelled diagram of a Newton meter, highlighting the spring mechanism and scale.

Activity: Measuring Forces in Practice

- Provide pupils with objects of different weights to measure the force of gravity acting on them using a Newton meter.
- Encourage pupils to record their readings and compare how heavier objects produce larger force measurements.
- **Reflection:**
  - Discuss how the Newton meter readings correlate with the weight of each object and why more massive objects exert greater gravitational force.

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|          |                 | <p><b>Real-World Applications of Measuring Forces</b></p> <ul style="list-style-type: none"> <li>Briefly discuss why it's important to measure forces accurately: <ul style="list-style-type: none"> <li><b>Engineering:</b> Knowing the forces involved helps engineers design safer structures and machinery.</li> <li><b>Sports Science:</b> Understanding forces can improve athletic performance and reduce injury risk.</li> <li><b>Medicine:</b> Measuring muscle force is important in physiotherapy and rehabilitation.</li> </ul> </li> <li>Emphasise the importance of precision in measuring forces in various fields to ensure safety and efficiency.</li> <li><b>Activity:</b> <ul style="list-style-type: none"> <li>Ask pupils to think of situations where measuring force is critical and discuss the impact of accurate force measurement in these contexts.</li> </ul> </li> </ul> <p><b>Plenary: Reviewing Key Concepts</b></p> <ul style="list-style-type: none"> <li>Summarise how to measure forces with a Newton meter and the significance of the Newton as a unit of force.</li> <li><b>Reflection Activity:</b> Ask pupils to complete an 'review your learning' activity by answering, "Why is it important to measure forces, and what unit do we use?"</li> </ul> <p>Resources: <a href="https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/measuring-forces">https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/measuring-forces</a></p> |
| Lesson 4 | Mastery Content | <p><b>Lesson Title:</b> Using force arrows</p> <p><b>Learning Intention:</b> I can draw and label force arrows to accurately represent forces acting.</p> <p><b>Key Skills:</b> creating diagrams; critical analysis</p> <p><b>Lesson Guide:</b></p> <ul style="list-style-type: none"> <li>Begin by asking pupils how they think we can visually represent forces acting on an object.</li> <li>Introduce <b>force arrows</b> to show the size and direction of a force on a diagram.</li> <li><b>Discussion Points:</b></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

- Explain that the length of an arrow represents the **magnitude** (size) of the force, and the direction of the arrow shows the **direction** in which the force acts.
- Mention that multiple forces can act on an object at the same time, each represented by a different arrow.

### How to Draw and Interpret Force Arrows

- Describe the basics of drawing force arrows:
  - Start from the point of application, with the arrow pointing in the direction of the force.
  - Adjust the length of the arrow to represent stronger or weaker forces.
- Show examples of force diagrams with arrows representing various forces, such as gravity, friction, and applied force.
- **Visual Aid:**
  - Use a diagram of an object with several force arrows, illustrating how the length and direction of each arrow convey information about the forces.

### Activity: Drawing Force Arrows on Diagrams

- Provide pupils with different scenarios (e.g., a book on a table, a car moving forward, or a hanging object) and ask them to draw force arrows to represent the forces acting on each object.
- Encourage pupils to consider the size and direction of each force, such as gravity pulling down, normal force pushing up, or friction opposing motion.
- **Reflection:**
  - Discuss how drawing force arrows helps us understand the interactions acting on an object and why balanced and unbalanced forces result in different outcomes.

### Real-World Applications of Force Diagrams

- Briefly discuss the importance of force diagrams in real-life applications:
  - **Engineering and Design:** Engineers use force diagrams to design safe structures and machines.
  - **Physics and Mechanics:** Force diagrams help in analysing motion and predicting the behaviour of objects under different forces.



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|          |                 | <ul style="list-style-type: none"> <li>• Emphasise that understanding force diagrams is crucial for interpreting how objects interact in various contexts.</li> <li>• <b>Activity:</b> <ul style="list-style-type: none"> <li>◦ Ask pupils to think of situations where force diagrams would be useful and discuss why representing forces accurately is important in those situations.</li> </ul> </li> </ul> <p><b>Plenary: Reviewing Key Concepts</b></p> <ul style="list-style-type: none"> <li>• Summarise the purpose and method of using force arrows to represent forces acting on objects.</li> <li>• <b>Reflection Activity:</b> Ask pupils to complete an 'review your learning' activity by answering, "What does the length and direction of a force arrow represent in a diagram?"</li> </ul> <p>Resources: <a href="https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/using-force-arrows">https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/using-force-arrows</a></p> |
| Lesson 5 | Mastery Content | <p><b>Lesson Title:</b> Balanced and unbalanced forces</p> <p><b>Learning Intention:</b> I can use the idea of resultant force to explain whether a change of speed occurs or not.</p> <p><b>Key Skills:</b> understanding; analysis; predicting</p> <p><b>Lesson Guide:</b></p> <ul style="list-style-type: none"> <li>• Begin by asking pupils if they have experienced friction in everyday activities, like sliding on different surfaces.</li> <li>• Introduce <b>friction</b> as a force that opposes motion between two surfaces in contact.</li> <li>• <b>Discussion Points:</b> <ul style="list-style-type: none"> <li>◦ Explain that friction acts in the opposite direction to movement and slows objects down.</li> <li>◦ Mention that friction depends on the <b>roughness</b> of surfaces and the <b>force pressing them together</b>.</li> </ul> </li> </ul> <p><b>Factors Affecting Friction</b></p> <ul style="list-style-type: none"> <li>• Describe key factors influencing friction:</li> </ul>                                                             |

- **Surface Texture:** Rough surfaces create more friction, while smooth surfaces create less.
- **Weight or Force:** Heavier objects experience more friction due to greater force pressing them against a surface.
- Explain that friction can be both useful (e.g., for walking) and a hindrance (e.g., in machines with moving parts).
- **Visual Aid:**
  - Use diagrams to show how different surfaces (e.g., sandpaper vs. ice) affect the level of friction on a sliding object.

#### Activity: Investigating Friction with Different Surfaces

- Provide pupils with materials like sandpaper, cloth, and smooth plastic, and ask them to observe how an object (e.g., a small block) moves across each surface.
- Encourage pupils to note which surfaces create more resistance and which allow smoother movement.
- **Reflection:**
  - Discuss how each surface affected the object's movement and why some surfaces produced more friction than others.

#### Real-World Applications of Friction

- Briefly discuss the importance of friction in real-life contexts:
  - **Transportation:** Friction between tires and roads provides grip but also causes wear.
  - **Sports:** Athletes rely on friction for movement and control, like in running or skiing.
  - **Machinery:** Reducing friction in engines and machines improves efficiency and reduces wear.
- Emphasise that managing friction is important in various industries to enhance safety and efficiency.
- **Activity:**
  - Ask pupils to think of examples where friction is beneficial and where it is a challenge, discussing why controlling friction is necessary.

#### Plenary: Reviewing Key Concepts

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|          |                 | <ul style="list-style-type: none"> <li>Summarise the concept of friction, factors affecting it, and its effects on motion.</li> <li><b>Reflection Activity:</b> Ask pupils to complete an 'review your learning' activity by answering, "What are two factors that affect friction, and how does friction impact movement?"</li> </ul> <p>Resources: <a href="https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/friction">https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/friction</a></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Lesson 6 | Mastery Content | <p>Lesson Title: Friction / Reducing friction: practical / Reducing friction: analysis.</p> <p>Learning Intention: I can describe the characteristics of friction forces, explain what causes friction, and describe how friction can be reduced. / I can collect data to test the effectiveness of different lubricants, taking steps to ensure a fair test. / I can analyse data from an investigation to test the effectiveness of different lubricants.</p> <p>Key Skills: experimenting; measuring; collecting data; analysis; application</p> <p>Lesson Guide:</p> <ul style="list-style-type: none"> <li>Begin by asking pupils to recall what friction is and provide examples of when it is helpful or when it can be a problem.</li> <li>Discuss that while friction is essential for activities like walking, it can also be a hindrance, particularly in machinery where it causes wear and reduces efficiency.</li> <li><b>Discussion Points:</b> <ul style="list-style-type: none"> <li>Review that <b>friction</b> is a force that opposes motion between two surfaces in contact.</li> <li>Introduce the idea of <b>reducing friction</b> to increase efficiency and reduce wear in various applications.</li> </ul> </li> </ul> <p><b>Factors Affecting Friction and Ways to Reduce It</b></p> <ul style="list-style-type: none"> <li>Explain factors affecting friction:           <ul style="list-style-type: none"> <li><b>Surface Texture:</b> Smoother surfaces reduce friction, while rougher surfaces increase it.</li> <li><b>Lubrication:</b> Adding substances like oil or grease reduces friction by creating a smoother interaction between surfaces.</li> <li><b>Material Choice:</b> Some materials naturally have lower friction, like plastic or rubber.</li> </ul> </li> </ul> |

- Describe methods for reducing friction:
  - Using **lubricants** to make surfaces slippery.
  - Adding **wheels or rollers** to reduce direct surface contact.
  - **Streamlining** shapes to reduce air resistance (a type of friction).
- **Visual Aid:**
  - Show examples of objects with reduced friction, such as ball bearings in machinery or streamlined vehicles.

#### Activity: Investigating Friction with Different Surfaces and Lubricants

- Set up an experiment where pupils test the effect of different surfaces (e.g., sandpaper, cloth, smooth plastic) and lubricants (e.g., oil, water) on the movement of an object, like a small block or toy car.
- Encourage pupils to record observations, noting which surfaces or materials allow the object to move more easily and which create more resistance.
- **Reflection:**
  - Discuss how friction varies depending on the surface and the impact of lubricants on reducing friction, highlighting why this is useful in engineering and daily life.

#### Real-World Applications of Reducing Friction

- Briefly discuss the importance of reducing friction in real-life situations:
  - **Machinery and Engines:** Lubrication reduces wear, heat, and energy loss, improving efficiency.
  - **Transportation:** Streamlining vehicles reduces air resistance, saving fuel and increasing speed.
  - **Sports Equipment:** Skis, skates, and balls are designed to minimise friction for better performance.
- Emphasise that controlling friction is essential in many industries to enhance performance, safety, and efficiency.
- **Activity:**
  - Ask pupils to think of other examples where friction reduction is beneficial and discuss the techniques used in those situations.

#### Plenary: Reviewing Key Concepts

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|          |                 | <ul style="list-style-type: none"> <li>Summarise the concept of friction, factors affecting it, and methods for reducing it.</li> <li><b>Reflection Activity:</b> Ask pupils to complete an 'review your learning' activity by answering, "What is one method to reduce friction, and why might it be important in machines?"</li> </ul> <p>Resources: <a href="https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/friction">https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/friction</a></p> <p><a href="https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/reducing-friction-practical">https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/reducing-friction-practical</a></p> <p><a href="https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/reducing-friction-analysis">https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/reducing-friction-analysis</a></p>                                  |
| Lesson 7 | Mastery Content | <p>Lesson Title: Energy / Transferring energy</p> <p>Learning Intention: I can identify different energy stores that objects have and explain why they have each energy store. / I can identify when stores of energy change and describe causes of energy transfer between stores.</p> <p>Key Skills: identification; application; critical thinking</p> <p>Lesson Guide:</p> <ul style="list-style-type: none"> <li>Begin by asking pupils what they think energy is and if they can give examples of energy types (e.g., heat, kinetic, potential).</li> <li>Introduce energy as the ability to do work and explain that energy can be transferred or transformed but not created or destroyed (<b>conservation of energy</b>).</li> <li><b>Discussion Points:</b> <ul style="list-style-type: none"> <li>Explain that energy exists in various forms, such as <b>kinetic energy</b> (movement), <b>potential energy</b> (stored), <b>thermal energy</b> (heat), and <b>chemical energy</b>.</li> <li>Describe <b>energy transfer</b> as the movement of energy from one object to another (e.g., when heat flows from a hot object to a cold one).</li> </ul> </li> </ul> |

- Discuss **energy transformation** as the change from one form of energy to another (e.g., potential energy becoming kinetic energy when an object falls).

### Types of Energy and Examples of Transfers

- Describe common energy types and provide examples:
  - **Kinetic Energy:** Energy of motion, seen in moving vehicles or people.
  - **Potential Energy:** Stored energy, such as in a stretched rubber band or raised object.
  - **Thermal Energy:** Heat energy transferred from hot to cold objects.
  - **Chemical Energy:** Stored in fuels and food, released when they are used.
- Explain that energy can transfer through **conduction** (heat through direct contact), **convection** (heat through fluids), and **radiation** (heat through empty space).
- **Visual Aid:**
  - Show diagrams of energy transfer and transformation, such as a roller coaster gaining potential energy and transforming it to kinetic energy as it moves.

### Activity: Identifying Energy Transfers and Transformations

- Provide pupils with scenarios (e.g., a lit candle, a running car, or a moving ball) and ask them to identify the initial form of energy and how it transfers or transforms.
- Encourage pupils to discuss energy flow in each example, such as chemical energy in fuel transforming to kinetic and thermal energy in a car engine.
- **Reflection:**
  - Discuss the principle of **energy conservation**, where the total energy remains constant, only changing forms or transferring between objects.

### Real-World Applications of Energy Transfer

- Briefly discuss how understanding energy transfer is important:
  - **Engineering:** Engineers design machines to use energy efficiently.

- **Sustainability:** Understanding energy transformation helps in developing renewable energy sources.
  - **Daily Life:** Managing energy transfer (e.g., insulation to retain heat) improves comfort and saves energy.
- Emphasise that understanding energy transfer and conservation is essential in solving practical problems in various fields.
- **Activity:**
  - Ask pupils to brainstorm other examples where energy transfer is important and discuss how conserving energy impacts these scenarios.

#### Plenary: Reviewing Key Concepts

- Summarise types of energy, how they transfer and transform, and the principle of energy conservation.
- **Reflection Activity:** Ask pupils to complete an 'review your learning' activity by answering, "Give an example of energy transformation, and explain why it is important in real life."

Resources: [https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/energy /](https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/energy/)

<https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/forces/lessons/transferring-energy>