

Acquiring Unit of Learning

Science Autumn 1

Unit: Our solar system and beyond

Subject Coverage: Science

Lesson Title: The spinning Earth

Learning Intention: I can describe the motions of Earth to explain day, night, and a year, and describe the motion of the Moon to explain why it changes shape.

Key Skills:

Lesson Guide: observation; using and creating scientific models; explanation.

- Begin with a discussion: Ask pupils why they think we experience day and night.
- Introduce Earth's rotation as the reason for the cycle of day and night.
- **Discussion Points:**
 - Explain that Earth spins around its axis, an imaginary line running from the North Pole to the South Pole.
 - Highlight that as Earth rotates, different parts face the Sun, creating day, while the opposite side experiences night.

Earth's Axis and Rotation

- Describe Earth's axis as slightly tilted, which also impacts the amount of sunlight different regions receive throughout the year.
- Explain that one full rotation takes approximately 24 hours, leading to our concept of a day.
- **Visual Aid:**
 - Show a model or diagram of Earth's rotation, illustrating how parts of Earth experience day and night.

Time Zones and the 24-Hour Day

- Explain the concept of time zones, created to account for Earth's rotation and the different positions relative to the Sun across regions.
- Briefly discuss why we have different time zones, with some areas experiencing morning while others experience night.

- **Activity:**
 - Use a globe or interactive map to show how different parts of the world experience day and night at the same moment. Ask pupils to identify when it is day or night in various locations around the globe.
- **Reflection:**
 - Discuss how Earth's rotation not only causes day and night but also affects global timekeeping and our understanding of a 24-hour day.

Real-World Applications of Earth's Rotation Knowledge

- Briefly discuss the importance of understanding Earth's rotation:
 - **Global Communication:** Knowing about time zones is essential for international communication and travel.
 - **Navigation:** Early explorers and navigators used Earth's rotation and time to navigate accurately.
- Emphasise that understanding Earth's rotation is crucial in fields such as astronomy, geography, and global logistics.
- **Activity:**
 - Ask pupils to think of situations where understanding day and night cycles and time zones would be important and discuss their ideas.

Plenary: Reviewing Key Concepts

- Summarise how Earth's rotation causes day and night and the role of time zones in global timekeeping.
- **Reflection Activity:** Ask pupils to complete an 'review your learning' activity by answering, "Why do we experience day and night, and how does Earth's rotation affect our time zones?"

Resources: <https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/solar-system-and-beyond/lessons/the-spinning-earth>

Lesson Title: Our solar system

Learning Intention: I can describe our solar system, including ideas about the locations, movements, sizes, and distances of the different objects within our solar system.

Key Skills: Comparing; creating and interpreting models; questioning and hypothesising; observation.

Lesson Guide:

- Begin with a question: What do you think is included in our solar system? Encourage pupils to list planets, moons, the Sun, and other objects.
- Introduce the solar system as a collection of celestial bodies, all orbiting our star, the Sun.
- **Discussion Points:**
 - Explain that our solar system consists of the Sun, eight planets, their moons, dwarf planets, and other objects like asteroids and comets.

The Planets and Their Orbits

- Describe the layout of the solar system, with the Sun at the centre and planets orbiting in elliptical paths.
- Briefly introduce each planet, mentioning characteristics such as size, position from the Sun, and whether they are terrestrial (rocky) or gas giants.
- **Visual Aid:**
 - Show a diagram or model of the solar system, labelling each planet and demonstrating their relative distances from the Sun.

Other Objects in the Solar System

- Explain that the solar system also includes **moons** (natural satellites that orbit planets), **asteroids** (rocky objects primarily in the asteroid belt), and **comets** (icy bodies that develop tails when close to the Sun).

- Mention dwarf planets, such as Pluto, as smaller objects that orbit the Sun but do not clear their orbital path like regular planets.
- **Activity:**
 - Ask pupils to work in pairs or small groups to research one planet or object in the solar system and share an interesting fact about it with the class.
- **Reflection:**
 - Discuss why learning about the solar system helps us understand our place in the universe and the conditions necessary for life.

Real-World Applications of Solar System Knowledge

- Briefly discuss why studying the solar system is important:
 - **Space Exploration:** Understanding the solar system helps scientists and engineers plan missions to other planets and moons.
 - **Climate and Weather Patterns:** Knowledge of planetary atmospheres provides insights into Earth's own atmosphere.
- Emphasise that studying the solar system broadens our understanding of space, planetary conditions, and potential for life beyond Earth.
- **Activity:**
 - Ask pupils to consider how knowledge of the solar system could be applied in fields like space exploration, astronomy, and climate science.

Plenary: Reviewing Key Concepts

- Summarise the main components of the solar system, including the planets, moons, and other celestial objects.
- **Reflection Activity:** Ask pupils to complete an 'review your learning' activity by answering, "What is one interesting fact you learned about our solar system, and why is it important to study it?"

Resources: <https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/solar-system-and-beyond/lessons/our-solar-system>

Lesson Title: Gravity

Learning Intention: I can describe the effects of gravity acting towards the centre of a nearby planet, moon, or star.

Key Skills: application; critical evaluation; explanation; demonstrate understanding using models.

Lesson Guide:

- Begin by asking pupils what they know about gravity and how it affects everyday life (e.g., objects falling, people staying on the ground).
- Introduce gravity as a force of attraction between objects that have mass.
- **Discussion Points:**
 - Explain that gravity is the reason objects fall to the ground and that it keeps planets in orbit around the Sun.

Gravity on Earth and in Space

- Describe how gravity pulls objects towards the centre of the Earth, giving them weight.
- Explain that the force of gravity depends on the mass of the objects and the distance between them, the more massive an object, the stronger its gravitational pull.
- **Visual Aid:**
 - Use diagrams to illustrate how Earth's gravity pulls objects downward and how gravity acts between celestial bodies like the Earth and Moon.

Gravity in the Solar System

- Discuss how gravity keeps planets orbiting the Sun and moons orbiting planets.
- Introduce the concept of orbits as a balance between the gravitational pull of the Sun and the forward motion of planets.
- **Activity:**

- Ask pupils to imagine and discuss what would happen to the planets if there were no gravity. Have them consider the importance of gravity in maintaining the structure of the solar system.
- **Reflection:**
 - Discuss how gravity influences the motion of celestial bodies and is fundamental to the stability of our solar system.

Real-World Applications of Gravity Knowledge

- Briefly discuss how understanding gravity is essential in real-world applications:
 - **Space Exploration:** Knowledge of gravity helps in calculating trajectories for spacecraft and landing on other planets.
 - **Astronomy:** Understanding gravity allows scientists to study the orbits of planets, stars, and galaxies.
- Emphasise that gravity is a key concept in fields such as physics, engineering, and space science.
- **Activity:**
 - Ask pupils to think about how gravity affects daily life (e.g., sports, transportation) and share their thoughts.

Plenary: Reviewing Key Concepts

- Summarise the nature of gravity as a force, its effects on Earth, and its importance in the solar system.
- **Reflection Activity:** Ask pupils to complete an 'review your learning' activity by answering, "Why is gravity important in our solar system, and how does it affect our everyday life?"

Resources: <https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/solar-system-and-beyond/lessons/gravity>

Lesson Title: Stars, galaxies, and the universe

Learning Intention: I can describe what stars and galaxies are and explain how they look when seen from Earth.

Key Skills: classification; identification; analysis; critical thinking

Lesson Guide:

- Begin with a question: What do you think exists beyond our solar system? Encourage pupils to share their ideas about stars and galaxies.
- Introduce the concept of the **universe** as the vast expanse that includes all stars, galaxies, and cosmic structures.
- **Discussion Points:**
 - Explain that the universe is made up of billions of stars, grouped into galaxies, and that our solar system is part of the Milky Way galaxy.

Understanding Stars and Galaxies

- Describe stars as massive, glowing spheres of gas that produce light and heat through nuclear fusion.
- Introduce galaxies as enormous systems of stars, gas, dust, and dark matter, held together by gravity.
- Explain that galaxies come in various shapes (e.g., spiral, elliptical, irregular) and that the Milky Way is a spiral galaxy.
- **Visual Aid:**
 - Show images of different types of galaxies and a diagram of the Milky Way to help pupils visualise Earth's position within it.

The Scale of the Universe

- Discuss the vast distances between stars and galaxies, introducing light-years as a measure of distance in space.
- Explain that the universe contains billions of galaxies, each with billions of stars, illustrating the immense scale and structure of the cosmos.
- **Activity:**

- Ask pupils to compare the sizes and distances of objects in the universe (e.g., solar system, galaxy, universe) and discuss the scale in relation to Earth.
- **Reflection:**
 - Discuss how learning about stars, galaxies, and the universe helps us understand the vastness of space and our place within it.

Real-World Applications of Astronomy Knowledge

- Briefly discuss the importance of studying stars and galaxies:
 - **Astronomy and Space Exploration:** Knowledge of stars and galaxies informs the study of cosmic phenomena and helps locate potential habitable planets.
 - **Physics and Cosmology:** Understanding the universe's structure aids in studying the origin, evolution, and future of the cosmos.
- Emphasise that learning about stars and galaxies expands our knowledge of existence and the nature of matter.
- **Activity:**
 - Ask pupils to consider how studying stars and galaxies can inspire questions about life beyond Earth and share their thoughts.

Plenary: Reviewing Key Concepts

- Summarise the main concepts of stars, galaxies, and the scale of the universe, highlighting the Milky Way's role in housing our solar system.
- **Reflection Activity:** Ask pupils to complete an 'review your learning' activity by answering, "What is one thing you learned about the universe, and why is it interesting to study stars and galaxies?"

Resources: <https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/solar-system-and-beyond/lessons/stars-galaxies-and-the-universe>

Lesson Title: Heating by the Sun

Learning Intention: I can explain why the heating effect of the Sun is greater at midday than at sunrise.

Key Skills: practical investigation; measuring; recording and interpreting; evaluation.

Lesson Guide:

- Begin with a question: How does sunlight warm different surfaces, like sand, water, or grass? Encourage pupils to think about their experiences with sunlight on various surfaces.
- Introduce the Sun as the primary source of energy for Earth, responsible for heating its surface and atmosphere.
- **Discussion Points:**
 - Explain that solar energy travels through space and reaches Earth as light and heat, warming everything it touches.

Absorption and Emission of Solar Energy

- Describe how different surfaces absorb and emit solar energy at varying rates. Dark and rough surfaces (e.g., soil) absorb more heat, while light and reflective surfaces (e.g., snow) reflect more sunlight.
- Explain that this uneven heating influences the temperature of different areas on Earth.
- **Visual Aid:**
 - Show a diagram illustrating how sunlight interacts with various surfaces, highlighting how some surfaces absorb more heat than others.

Factors Affecting Solar Heating

- Discuss factors that impact how much solar energy is absorbed, including:
 - **Surface Colour:** Dark colours absorb more heat than light colours.
 - **Surface Texture:** Rough surfaces absorb more energy than smooth, reflective surfaces.
 - **Angle of Sunlight:** Areas near the equator receive more direct sunlight than those closer to the poles.

- **Activity:**
 - Ask pupils to predict which surfaces (e.g., water, sand, grass) will heat up the most when exposed to sunlight, based on their colour and texture.
- **Reflection:**
 - Discuss how these principles help explain temperature differences across Earth's surface and the role of solar energy in climate and weather patterns.

Real-World Applications of Solar Heating Knowledge

- Briefly discuss the importance of understanding solar heating:
 - **Climate and Weather:** Solar heating impacts weather patterns, ocean currents, and seasonal changes.
 - **Renewable Energy:** Knowledge of solar energy absorption is essential for developing solar panels and other renewable energy technologies.
- Emphasise that understanding solar heating is crucial for fields like environmental science, meteorology, and renewable energy engineering.
- **Activity:**
 - Ask pupils to consider how solar heating affects their daily lives, such as choosing light or dark clothing in different weather and share their ideas.

Plenary: Reviewing Key Concepts

- Summarise how the Sun heats the Earth and the factors influencing absorption and emission of solar energy.
- **Reflection Activity:** Ask pupils to complete an 'review your learning' activity by answering, "What factors affect how much heat a surface absorbs from the Sun, and why is this important?"

Resources: <https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/solar-system-and-beyond/lessons/heating-by-the-sun>

Lesson Title: Earth's tilt

Learning Intention: I can explain why it is winter in the southern hemisphere when it is summer in the northern hemisphere.

Key Skills: modelling; explanation; hypothesising; observation

Lesson Guide:

- Begin with a question: Why do we experience different seasons, like summer and winter? Encourage pupils to share their ideas.
- Introduce Earth's tilt as a primary factor in the changing seasons.
- **Discussion Points:**
 - Explain that Earth's axis is tilted at an angle of approximately 23.5 degrees, and this tilt causes different parts of the Earth to receive varying amounts of sunlight throughout the year.

How Earth's Tilt Causes Seasonal Changes

- Describe how, as Earth orbits the Sun, its tilt results in one hemisphere receiving more direct sunlight (and warmth) while the other receives less, creating summer and winter.
- Emphasise that when the Northern Hemisphere is tilted towards the Sun, it experiences summer, while the Southern Hemisphere has winter, and vice versa.
- **Visual Aid:**
 - Show a diagram of Earth's orbit around the Sun, highlighting how the tilt changes the angle of sunlight reaching each hemisphere.

Angle of Sunlight and Temperature Variations

- Explain that the tilt also affects the **angle of sunlight**. During summer, sunlight is more direct and concentrated, leading to warmer temperatures. In winter, sunlight is more spread out and less intense, resulting in cooler temperatures.

- Discuss how the length of day also varies with the seasons, affecting the amount of time each hemisphere is exposed to sunlight.
- **Activity:**
 - Ask pupils to observe a diagram or model showing how sunlight angles differ in summer, winter, and discuss how this impacts temperature.
- **Reflection:**
 - Discuss how Earth's tilt and orbit combine to create predictable seasonal patterns, influencing climate and ecosystems.

Real-World Applications of Knowledge about Earth's Tilt

- Briefly discuss the importance of understanding Earth's tilt:
 - **Agriculture:** Farmers rely on seasonal patterns to plant and harvest crops.
 - **Travel and Tourism:** People plan activities around seasons, such as skiing in winter or beach holidays in summer.
- Emphasise that understanding Earth's tilt helps us make informed decisions related to seasonal activities and environmental planning.
- **Activity:**
 - Ask pupils to think about how they adapt their daily activities or clothing choices based on the seasons and share their ideas.

Plenary: Reviewing Key Concepts

- Summarise how Earth's tilt and orbit create seasons, affecting sunlight angles and temperatures.
- **Reflection Activity:** Ask pupils to complete an 'review your learning' activity by answering, "How does Earth's tilt cause the seasons, and why is this important for life on Earth?"

Resources: <https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/solar-system-and-beyond/lessons/earths-tilt>

Lesson Title: Seasons on Earth

Learning Intention: I can explain how and why the seasons change, and why some countries do not have summers and winters.

Key Skills: application; interpretation; prediction; explanation

Lesson Guide:

- Begin by asking pupils why they think we have different seasons. Encourage them to think about how Earth's position relative to the Sun might play a role.
- Introduce Earth's tilt and its orbit around the Sun as key factors causing the seasons.
- **Discussion Points:**
 - Explain that Earth's 23.5-degree tilt means different hemispheres receive varying amounts of sunlight as Earth orbits the Sun, leading to seasonal temperature changes.

The Effect of Earth's Tilt and Orbit on Seasons

- Describe how, during different times of the year, one hemisphere is tilted towards the Sun (experiencing summer) while the other is tilted away (experiencing winter).
- Emphasise that when the Northern Hemisphere has summer, the Southern Hemisphere has winter, and vice versa.
- **Visual Aid:**
 - Use a diagram of Earth's orbit around the Sun, showing how the tilt changes the sunlight angle for each hemisphere, leading to seasonal differences.

Angle of Sunlight and Length of Daylight

- Explain how the tilt affects the **angle of sunlight**. During summer, sunlight hits Earth more directly, creating warmer temperatures. In winter, sunlight is spread over a larger area, resulting in cooler temperatures.
- Discuss how daylight duration changes with seasons, with longer days in summer and shorter days in winter, affecting overall warmth and light.

		• Activity: ◦ Have pupils observe a model or diagram showing the angle of sunlight during different seasons and discuss how it impacts temperature and daylight hours. • Reflection: ◦ Discuss how these seasonal patterns affect daily life, agriculture, and activities in different regions around the world. Real-World Applications of Seasonal Knowledge • Briefly discuss why understanding seasons is important: ◦ Agriculture: Farmers plan planting and harvesting around seasonal patterns. ◦ Energy Consumption: Knowing seasonal daylight duration helps in planning energy needs for heating and lighting. • Emphasise that understanding seasons allows us to make informed decisions regarding agriculture, energy, and lifestyle. • Activity: ◦ Ask pupils to think about how they adjust their activities or clothing based on the season and share their ideas. Plenary: Reviewing Key Concepts • Summarise how Earth’s tilt and orbit create seasons, influencing sunlight angles, temperatures, and daylight duration. • Reflection Activity: Ask pupils to complete an ‘review your learning’ activity by answering, “How do Earth’s tilt and orbit cause the seasons, and why are these seasonal changes important?” Resources: https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/solar-system-and-beyond/lessons/seasons-on-earth
Less	Mas	Lesson Title: Changing ideas about Earth

Learning Intention: I can describe how and why our understanding of the position and motion of Earth has changed over time.

Key Skills: evaluation; analysis; discussion

Lesson Guide:

- Begin with a question: What do you think people believed about Earth and the universe in ancient times? Encourage pupils to consider how ideas might have changed over time.
- Introduce the concept that early scientists and philosophers had different ideas about Earth's position in the universe, which evolved with new evidence.
- **Discussion Points:**
 - Explain that ancient civilizations believed in the **geocentric model** (Earth at the centre), while later discoveries led to the **heliocentric model** (Sun at the centre).

Geocentric and Heliocentric Models

- Describe the **geocentric model**: An early model, proposed by Ptolemy, which placed Earth at the centre of the universe with the Sun and planets orbiting it.
- Describe the **heliocentric model**: A model introduced by Copernicus and supported by Galileo's observations, placing the Sun at the centre, with Earth and other planets orbiting it.
- **Visual Aid:**
 - Show diagrams comparing the geocentric and heliocentric models to illustrate how our understanding of the universe has shifted.

Role of Evidence and Technological Advancements

- Discuss how advancements in technology, such as the telescope, allowed scientists like Galileo to observe celestial bodies more accurately, providing evidence for the heliocentric model.
- Explain that scientific understanding continues to evolve with new discoveries and improved technology, highlighting the importance of evidence in shaping theories.

- **Activity:**
 - Ask pupils to role-play as ancient astronomers or modern scientists, explaining why they believe in either the geocentric or heliocentric model, and then discuss how they would react to new evidence.
- **Reflection:**
 - Discuss how scientific ideas are not fixed but change over time as new evidence is discovered, leading to more accurate understandings.

Real-World Applications of Changing Scientific Ideas

- Briefly discuss the importance of evolving scientific ideas:
 - **Astronomy and Space Exploration:** Modern understanding of the universe allows for space exploration and satellite technology.
 - **Scientific Method:** The evolution of ideas about Earth's place in the universe demonstrates the scientific process of hypothesis, evidence, and revision.
- Emphasise that changing ideas reflect the nature of science as a field open to growth and revision.
- **Activity:**
 - Ask pupils to think of other scientific ideas or discoveries that have changed over time (e.g., the understanding of atoms or disease), and discuss why flexibility in thinking is essential.

Plenary: Reviewing Key Concepts

- Summarise the shift from geocentric to heliocentric models and the importance of evidence in changing scientific ideas.
- **Reflection Activity:** Ask pupils to complete an 'review your learning' activity by answering, "How did the geocentric and heliocentric models differ, and why did our understanding change?"

Resources: <https://www.thenational.academy/teachers/programmes/science-secondary-ks3/units/solar-system-and-beyond/lessons/changing-ideas-about-earth>