Scientific and technological understanding

Learning in this area should include an appropriate balance of focused subject teaching and well-planned opportunities to use, apply and develop knowledge and skills across the whole curriculum.

Curriculum aims

Learning and undertaking activities in this area of learning contribute to achievement of the curriculum aims for all young people to become:

- successful learners who enjoy learning, make progress and achieve
- confident individuals who are able to live safe, healthy and fulfilling lives
- responsible citizens who make a positive contribution to society.

Why is this area of learning important?

This area of learning develops children’s ability to explore and understand the natural and made worlds. It builds on their natural curiosity, inventiveness and wonder and helps them make sense of the world around them. They learn to appreciate how science supports the development of technology and how technological needs lead to new scientific discoveries, shaping how we live in our rapidly changing society.

Children learn to frame and answer questions and solve problems using experimental methods and other practical techniques, drawing on their scientific understanding to inform their designing and making. They develop valuable skills, such as generating and testing ideas, gathering and making sense of evidence, developing possible solutions, and evaluating processes and outcomes. They learn to distinguish evidence from opinion and communicate their findings in a variety of ways.

As their understanding grows, children gain awareness of the ways that learning in science and design and technology inform other areas of learning, including historical, geographical and social understanding. This will help them to make informed choices about the way they want to live in and shape the natural and made worlds.
1. **Essential knowledge**

Children should build secure knowledge of the following:

a. the power of creative ideas and approaches in science and technology to explore and explain our world, solve problems and bring about positive change

b. how information and valid evidence underpin ideas and practice in science and technology

c. how science and human needs interact to create new knowledge, technologies and products

d. how the natural and made worlds are interdependent and interrelated so that actions in one may have consequences in the other.

2. **Key skills**

These are the skills that children need to learn to make progress:

a. observe and explore\textsuperscript{1} to generate ideas, define problems and pose questions in order to develop investigations and products

b. engage safely in practical investigations and experiments\textsuperscript{2} and gather and record evidence by observation and measurement\textsuperscript{3}

c. apply practical skills to design, make and improve products safely\textsuperscript{2}, taking account of users and purposes

d. communicate\textsuperscript{4} and model in order to explain and develop ideas and share findings and conclusions

e. continually make systematic evaluations when designing and making, to bring about improvements in processes and outcomes\textsuperscript{5}.

3. **Breadth of learning**

a. Children should be encouraged to investigate science and design and technology, sharing their expertise in subjects that interest them and responding to relevant and current issues, locally and in the national media. They should apply their knowledge and understanding in real life contexts, relating it to the world around them and visiting places\textsuperscript{6} to learn about science and design. Children should also work with experts and enthusiasts to find out how science and design and technology are used and applied in day-to-day life.

---

**Explanatory text:**

1. This includes obtaining information from a range of different primary and secondary sources, including the internet, and using simulations to predict outcomes of experiments and explore environments, parts and products that are hard to access in reality.

2. This includes selecting suitable tools, equipment and components and controlling risks to themselves and others.

3. This includes using ICT for data logging.

4. This includes using appropriate language to name, describe, explain or evaluate designs, living things, materials, processes and products.

5. This includes reviewing ideas, information and existing products; plans, methods and processes; conclusions and solutions; and includes using ICT for organising information.

6. This includes exploring remote or imaginary locations through the use of ICT in order to encounter environments, products, people and places beyond the immediate locality.
b. Children should explore a range of familiar and less familiar contexts, environments and products in experiments and designing and making activities. They should develop practical skills that will help them to carry out investigations and to make functional products from their design ideas.

c. Children should be encouraged to think creatively and inventively about how things work, identify patterns and establish links between causes and effects. They should test their ideas through practical activities, applying their knowledge and understanding to review their own and others’ ideas and investigations. They should also use design and technology contexts to develop scientific understanding and apply their scientific knowledge to inform their designing and making.

d. Children should carry out their own investigations, using their scientific knowledge and understanding to decide what kind of evidence to collect and what equipment and materials to use. They should suggest the results they expect and explain their observations and the significance and limitations of the conclusions they draw.

e. Children should also develop their own design ideas, creating and improving designs for products, mechanisms, structures, systems and control. They should explore and investigate different materials, and use them to provide functional solutions to meet user needs, evaluating and refining their products as they work.

Explanatory text:

7. This includes investigating functional products to find out how they work, how they are made, and how they meet the needs of the intended user and purpose.

8. Practical skills when making purposeful products include choosing equipment, measuring, marking out, cutting and shaping a range of materials, and assembling, joining and combining components and materials accurately and finishing techniques that help to improve the appearance of their product.

9. This includes living things and products.

10. Such as computer aided design (CAD).

11. This includes making observations in a variety of ways, including electrical and mechanical components, mouldable materials, stiff and flexible sheet materials, and textiles.
### 4. Curriculum progression

The overall breadth of learning should be used when planning curriculum progression. Children should be taught:

#### Early

- **E1.** to explore and observe in order to collect data and describe and compare their observations and findings
- **E2.** to use their knowledge and understanding in their practical work and when evaluating their findings and products
- **E3.** to sort and group information using ICT to inform investigations and designs
- **E4.** to sort, group and identify familiar living things and materials according to observable features and properties
- **E5.** to investigate the properties of everyday materials, find out where they come from, how and why they are used, how they can be changed and how they can be disposed of or recycled
- **E6.** to take account of simple properties of materials when deciding how to cut, shape, combine and join them, and consider users and purposes when designing
- **E7.** to explore changes in the way things move by using push and pull forces.

#### Middle

- **M1.** to explore and investigate in order to collect data, analyse it and identify patterns
- **M2.** to use their knowledge and research to inform designs for functional products and plans for investigations
- **M3.** to capture, record and analyse data using a range of instruments, including sensors
- **M4.** to offer simple explanations for their findings
- **M5.** to evaluate their skills, findings and outcomes using given criteria.

#### Later

- **L1.** to ask questions that can be answered by different types of investigative activity and decide the best approach to use
- **L2.** to choose equipment and tools, including ICT, to make their work more effective and efficient, and explain the reasons for their choices
- **L3.** to make and record accurate measurements and detailed observations, presenting them appropriately, and analyse and interpret them
- **L4.** to devise simple criteria to evaluate their approaches, products and outcomes
- **L5.** to explore and explain how significant innovations and inventions have come about and how they have changed the way people live
- **L6.** to use ideas from other cultures and times to inform their own experiments, investigations and designs.

---

**Explanatory text:**

12. Each area of learning should build on children's experiences and development in the Early Years Foundation Stage to ensure continuity of curriculum provision and their continuing progress.
13. Including showing interest and curiosity, noticing changes, asking questions, saying what they think might happen and using secondary sources.
14. This includes recording and communicating using talk, drawings, photographs, prepared tables and pictorial representations of data such as sorting circles, pictograms and scattergrams.
15. This includes decision making when collecting data, making products, comparing observations and giving their opinion.
16. This includes 'living and never-lived', the main external body parts of plants and animals and sensory properties of materials.
17. Including construction materials, components, textiles and ingredients.
18. Including simple product investigation – manipulating, heating and cooling.

---

**Explanatory text:**

23. This includes using equipment to observe and measure, predicting different things that might happen, using secondary sources where appropriate, drawing their own tables for straightforward data and completing prepared bar charts.

36. This includes selecting equipment, including ICT such as sensors and data logging devices, to make appropriate observations and measurements, deciding how many measurements and repeats to use and how to record them, and using secondary sources where appropriate.
37. This includes using scientific and technical language, together with bar charts and prepared line graphs to present results.
38. This includes exploring the contributions of historically significant scientists, technologists and engineers.
### Across the area of learning

**E8.** to explore simple mechanisms and structures to investigate how they work

**E9.** to give instructions to make things happen using programmable devices

**E10.** to explore simple electrical circuits and find out how electricity is used in the home, at school and in some products

**E11.** to explore sources of light and sound and how we sense them

**E12.** to explore ways of keeping living things alive and healthy, treating them with care and sensitivity

**E13.** to investigate their local environment and use their findings to inform actions to care for and improve it.

---

### Design and technology

**M6.** to apply knowledge, skills and understanding when designing and making products using construction materials, textiles and ingredients

**M7.** to use a variety of methods to explore design alternatives and to test fitness for purpose of materials, components and techniques

**M8.** to apply knowledge of mechanical and electrical control when designing and making functional products

**M9.** to refine sequences of instructions to control events or make things happen using ICT.

---

### Science

**M10.** to investigate how light and sound travel and how shadows and sounds are made

**M11.** to investigate the effects of different forces and how they can use these to move mechanical parts or objects in specific ways

**M12.** to identify, group and select materials using properties and behaviours that can be tested, and identify and group living things using observable features and other characteristics.

---

### Science – energy, movement and forces

**L7.** to make controllable systems or models, devising and refining sequences of instructions taking into account users, purposes and needs

**L8.** to consider the implications of familiar designs and products for the environment and different communities.

**L9.** to investigate and explain the effect of changes in electrical circuits

**L10.** to investigate the properties and behaviour of light and sound in order to describe and explain familiar effects

**L11.** to investigate combinations of forces.

---

**Explanatory text:**

19. For example, a wheel and axle in a toy vehicle.
20. This includes light and dark, shadows and reflections and sources of light and sound.
21. This includes movement, reproduction, sensitivity, growth and nutrition in plants, animals and humans.
22. This includes looking at how, for example, the production of some materials can affect our world.
24. Including using different components to improve the function of a product.
25. For example to control events in a lighting sequence or make things happen when controlling a device such as a model vehicle.
26. Different forces include magnetic forces, gravitational attraction, friction and air resistance.
27. This includes those in the human body.
28. This includes rocks and soils, and grouping into solids, liquids and gases.
29. This includes electrical, thermal and magnetic.
30. This includes reversible and non-reversible changes.
31. Including habitat (for example water, land and air) and diet (for example other animals, plants or a combination).
39. Including the use of conditional statements, procedures or subroutines.
40. This includes how we see things, how shadows are formed and how to change the pitch and loudness of sounds produced by musical instruments.
41. This includes opposite forces, more than one force acting on an object and representing them diagrammatically.
32. This includes separating solids from mixtures by sieving and filtering and by magnetic separation.
33. This includes the structure and function of the parts of a plant and the relationship between them.
34. Including the appearance, texture and permeability of rocks and soils.
35. This includes food chains.

Explanatory text:
42. For example the reversible changes that occur when separating soluble solids from liquids and the non-reversible changes of the breakdown of food by micro-organisms.
43. This should also include digestion (teeth and food), circulation (heart and pulse rate), skeleton (muscles and movement) and growth. This should be related to caring for the human body.
44. The benefits include breaking down waste and use in the making of bread, the harm includes causing disease and making food go mouldy.
Explanatory text:

45. This includes looking at how day and night and time measurements (day, month and year) are related to the spin of the Earth and the orbit of the Earth and moon.

46. This includes green plants as producers and animals as consumers; the ways in which plants depend on animals including pollination, seed dispersal and nutrients; fertilisers as plant nutrients and growing plants.

47. Scientific and technological developments that affect the physical and living worlds include the consideration of medicine and health, farming and agriculture, travel, communication and entertainment, pollution and global climate change.
5. Cross-curricular studies

Children should have opportunities:

a. to develop and apply the skills of literacy, numeracy and ICT, in particular by developing and using specialist vocabulary and meaningful contexts for fiction and non-fiction writing, including evaluating their own and others’ products or experiments and writing reports. Within the area of learning children also talk for a range of purposes including evaluating products and experiments in order to test and refine their outcomes and conclusions. Children develop their reading skills through researching on paper and on screen in order to plan investigations and design products. The area of learning also provides purposeful contexts for children to develop and apply mathematical skills, in particular number, measurement, graphing, data handling, interpolation and extrapolation and costing their own products. Children can develop their ICT skills by using ICT for capturing, organising and analysing data and presenting results; and for sequencing instructions to control events and products. Children learn to appreciate the potential ICT simulations have to provide access to things that cannot be experienced directly

b. to extend their personal, emotional and social development, particularly by working collaboratively towards a common goal such as planning and carrying out investigations or developing products. Within the area of learning they share ideas, make compromises, negotiate and offer each other feedback in order to ensure a high-quality outcome

c. to enhance their scientific and technological understanding through making links to other areas of learning and to wider issues of interest and importance, in particular developing understanding of sustainability by assessing the impact on the environment of choices in their designs. Children develop their understanding of how to stay healthy through learning how human body systems work and how microbes cause disease. They also explore the contribution of historically significant scientists and engineers.