LOtC in the new science curriculum

With the roll out of the new national curriculum imminent, we continue our look at what the new curriculum means for learning outside the classroom. In this article we identify the opportunities for learning outside the classroom that exist in the draft programme of study and give you some practical ideas for curriculum delivery.

Despite concern that some areas of the draft national curriculum are too focused on the acquisition of knowledge rather than skills, the new science curriculum bucks the trend with a firm emphasis on the real world application of scientific understanding.

The programme of study for science states that “foundational understanding should be consolidated through their appreciation of the specific applications of science in society and the economy.”

The National Curriculum for science aims to ensure that all pupils:
- develop scientific knowledge and conceptual understanding through the specific disciplines of biology, chemistry and physics
- develop understanding of the nature, processes and methods of science through different types of science enquiries that help them to answer scientific questions about the world around them
- are equipped with the scientific knowledge required to understand the uses and implications of science, today and for the future.

Clearly LOtC experiences have an important role to play in giving pupils the opportunity to gain an understanding of how science can be applied in the real world and helping them to develop an understanding of nature.

The draft programme of study acknowledges this by stating that: “The social and economic implications of science are important but, generally, they are taught most appropriately within the wider school curriculum: teachers will wish to use different contexts to maximise their pupils’ engagement and motivation in science.”

There is an emphasis on working scientifically with a specific attainment target relating to this at every key stage. This is underpinned with examples in the guidance notes relating to the hands on teaching of science, including LOtC opportunities.

As a result, the opportunities for using LOtC to deliver the science curriculum are extensive. Indeed the entire key stage 1 science curriculum and a large percentage of the key stage 2 & 3 science curriculum can be delivered outside the classroom walls. Here we have highlighted just a few examples from the unlimited opportunities which exist.
Key stage 1

There is a strong emphasis on the use of first hand practical experiences, which creates countless opportunities for LOtC. The draft science curriculum states that:

“The principal focus of science teaching in Key Stage 1 is to enable pupils to experience and observe phenomena, looking more closely at the natural and humanly-constructed world around them. They should be encouraged to be curious and ask questions about what they notice. They should be helped to develop their understanding of scientific ideas by using different types of scientific enquiry to answer their own questions, including observing changes over a period of time, noticing patterns, grouping and classifying things, carrying out simple comparative tests and finding things out using secondary sources of information. Most of the learning about science should be done through the use of first-hand practical experiences, but there should also be some use of appropriate secondary sources, such as books, photographs and videos.”

Specific opportunities set out in the attainment targets and guidance notes are as follows:

Year 1

Plants

“Pupils should use the local environment throughout the year to study plants growing in their habitat. Where possible, they should observe the growth of flowers and vegetables that they have planted.”

“They should become familiar with common names of flowers, examples of deciduous and evergreen trees, and plant structures (trees: trunk, roots, branches, leaves, fruit; garden and wild plants: flower, petals, stem, leaves, roots, fruit, bulb and seed).”

“Pupils might keep records of how plants have changed over time, for example the leaves falling off trees and buds opening; and compare and contrast how different plants change.”

There are many links that can be made with the key stage 1 maths curriculum, from measuring runner beans or sunflowers to using tally charts and graphs to record results such as the number of different kinds of flowers or trees in the park or school grounds, or using Venn diagrams to classify objects.

Animals

“Pupils should use the local environment throughout the year to study animals in their habitat. They should understand how to take care of animals taken from their local environment and the need to return them safely after study.”

Ideas include watching the development of frog spawn or caterpillars in a suitable indoor habitat, which links nicely to work on life cycles.

Everyday materials

“Pupils should explore, name and discuss everyday materials so that they become familiar with the names of materials and properties such as: hard/soft; stretchy/stiff; shiny/dull; rough/smooth;
bendy/not bendy; waterproof/not waterproof; absorbent/not absorbent. Pupils should explore and experiment with a wide variety of materials, not only those listed in the programme of study, but including for example: brick, paper, fabrics, elastic, foil.”

Much of this exploration can take place outside the classroom, both in an urban or natural setting or in a museum or historic house. Using novel settings will help to make the learning experience more memorable, engage active learners and provides opportunities to cover more than one part of the curriculum in the same visit.

Seasonal changes
“Pupils should observe and talk about the weather, the seasons and how the sun seems to move during the day.”

“Pupils might work scientifically by: observing and recording the apparent movement of the sun during the day, for example in a sequence of photographs or moving Teddy so he stays in the sunshine; making tables and charts about the weather and displays of what happens in the world around them, including day length, as the seasons change.”

Year 2

All living things

“Pupils should be introduced to the idea that all living things have certain characteristics that are essential for keeping them alive and healthy. They should become familiar with the life processes that are common to all living things.”

“Pupils might work scientifically by: sorting and classifying things according to whether they are living, dead or were never alive, and recording their findings using charts. They should describe how they knew where to place things, exploring questions such as: ‘Is a flame alive? Is a deciduous tree dead in winter?’ and talk about ways of answering their questions.”

To promote engagement and enjoyment in learning, such this investigation can happen outside the classroom as part of an autumn nature walk or using a museum natural history collection for example.

Plants

“Pupils should use the local environment throughout the year to observe how plants grow (including seeds, bulbs, fruit and vegetables, deciduous and evergreen bushes and trees). Pupils should be introduced to the requirements of plants for growth and survival, as well as the process of reproduction and growth in plants.”

“Pupils might work scientifically by: observing and recording, with some accuracy, the growth of a variety of plants as they change over time from a seed or bulb, or observing similar plants at different stages of growth; setting up a comparative test to show that plants need light and water to stay healthy.”

Many children will be fascinated by these experiments and the progress of the seeds they have planted. Why not extend the work by setting maths problems around the number of plants which thrived or died during these experiments?
Animals, including humans

“Pupils should be introduced to the process of reproduction and growth in animals. The focus at this stage should be on helping pupils to recognise growth; they should not be expected to understand how reproduction occurs. The following examples might be used: egg, chick, chicken; egg, caterpillar, pupa, butterfly; spawn, tadpole, frog; lamb, sheep.”

“Pupils might work scientifically by: observing, through video or first-hand observation and measurement, how different animals, including humans, grow; asking questions about what things animals need for survival and what humans need to stay healthy; and suggesting ways to find answers to their questions”.

This area of work lends itself nicely to a springtime visit to a local farm, to observe animals at different stages of growth and learn how they are cared for.

Habitats

“Pupils should be introduced to the terms ‘habitat’ (a natural environment or home of a variety of plants and animals) and ‘micro-habitat’ (a very small habitat, for example for woodlice under stones, logs or leaf litter). They should use the local environment to identify and study a variety of plants and animals within their habitat and observe how living things depend on each other, for example plants serving as a source of food and shelter for animals. Pupils should compare animals in familiar habitats with animals found in less familiar habitats, for example, on the seashore, in woodland, in the ocean, in the rainforest.”

“Pupils might work scientifically by: constructing a simple food chain that includes humans (e.g. grass, cow, human); describing the conditions in different habitats and micro-habitats (under log, on stony path, under bushes); finding out how the conditions affect the number and type(s) of plants and animals that live there.”

As well as the obvious visits to a farm (to help children understand the process of food production) or natural environment setting, this work could be linked to a trip to a local supermarket to link animals in the human food chain with the products the children see in their fridge at home. This could then be linked to the design technology curriculum, using the foods in cookery.

Uses of everyday materials

“Pupils should identify and discuss the uses of different everyday materials so that they become familiar with how some materials are used for more than one thing (metal can be used for coins, cans, cars and table legs; wood can be used for matches, floors, and telegraph poles) or different materials are used for the same thing (spoons can be made from plastic, wood, metal, but not glass; tables can be made from plastic, wood, metal, but not paper).”

“Pupils might work scientifically by: comparing the uses of everyday materials in and around the school with materials found in other places (at home, the journey to school, on visits, and in stories, rhymes and songs); observing closely, identifying and classifying the uses of different materials, and recording their observations. Pupils should be encouraged to think about unusual and creative uses for everyday materials.”

Museums/historic houses may be able meet this attainment target using items from their collections, or could you visit a furniture or hardware store to explore objects and the variety of
materials they are made from? Why not link this to an art or design technology project to make and furnish a model house from different materials, or design an invention and consider which materials to use?

Movement

“Pupils should observe closely some things moving. Pupils should discuss, describe and compare the movement of a variety of objects and, where appropriate, themselves, through actions such as sliding, rolling, falling, flying, walking and running. They can explore the movements through games, songs and rhymes, including work in physical education.”

“Pupils might work scientifically by: asking questions about the movement of objects such as parachutes, toy cars and balloon rockets; comparing them, by measuring how far they go; ordering their findings and recording their observations and measurements, for example by constructing tables and charts, and drawing on their results to answer their questions.”

Take the children to a local park to investigate how different objects move when they are rolled, dropped or thrown, or compare how they run with the way dogs, cats and birds move in the park.

Key stage 2

Years 3 & 4

“The principal focus of science teaching in lower Key Stage 2 is to enable pupils to broaden their scientific view of the world around them. They should do this through exploring, talking about, testing and developing ideas about everyday phenomena and the relationships between living things and familiar environments, and by beginning to develop their ideas about functions, relationships and interactions.”

“Pupils in Years 3 and 4 should use practical science to raise their own questions about the world around them.”

Year 3

Plants

“Pupils should be introduced to the relationship between structure and function: the idea that every part has a job to do. This teaching should focus on the role of the roots and stem in nutrition and support, leaves for nutrition and flowers for reproduction.”

“Pupils might work scientifically by: comparing the effect of different factors on plant growth, for example the amount of light, the amount of fertiliser; discovering how seeds are formed by observing the different stages of plant cycles over a period of time; looking for patterns in the structure of seeds that relate to how they are dispersed. They might observe how water is transported in plants, for example by putting cut, white carnations into coloured water and observing how water travels up the stem to the flowers.”
Animals, including humans

“Pupils should continue to learn about the importance of nutrition (including a balanced diet) and should be introduced to the main body parts associated with the skeletal and muscular system, finding out how different parts of the body have special functions.”

“Pupils might work scientifically by: identifying and grouping animals with and without skeletons and observing and comparing their movement; exploring ideas about what would happen if humans did not have skeletons. They might compare and contrast the diets of different animals (including their pets) and decide ways of grouping them according to what they eat. They might research different food groups and how they keep us healthy and design meals based on what they find out.”

This could link to the attainment target around cookery in the design technology curriculum as well as healthy eating.

Rocks  **Note links to geography curriculum**

“Linked with work in geography, pupils should explore different kinds of rocks and soils, including those in the local environment.”

“Pupils might work scientifically by: observing rocks, including those used in buildings and gravestones, and exploring how and why they might have changed over time; using a hand lens or microscope to help them to identify and classify rocks according to whether they have grains or crystals, and whether they have fossils in them. Pupils might research and discuss the different kinds of living things whose fossils are found in sedimentary rock and explore how fossils are formed.”

This observation can happen via fieldwork in a range of natural or urban environments from the local churchyard or interesting buildings within the local community through to a museum or a pebble beach.

Light

“Pupils should explore materials to help them to understand the differences between the meaning of transparent, translucent and opaque. Pupils should observe shadows being formed in everyday contexts, such as when they play outside or shine torches indoors.”

“Pupils might work scientifically by: looking for patterns in what happens to shadows when the light source moves or the distance between the light source and the object changes; investigating the suitability of materials for different purposes, such as blackout curtains; exploring whether shiny things shine in the dark.”

Why not camp in the school grounds or further afield and experiment with shadows in daylight, dusk and at night. As well as working with shadows for scientific observation why not ask the children to create a shadow theatre to tell a story with shadows - perhaps the children could make puppets from wire to tell their story?
Year 4

All living things

“Pupils should use the local environment throughout the year to identify and study plants and animals in their habitat; and how the habitat changes throughout the year. Pupils should classify animals into the major groups such as: vertebrates (animals with backbones) into fish, amphibians, reptiles, birds, and mammals; invertebrates into snails and slugs, worms, spiders, and insects. Pupils should explore examples of human impact (both positive and negative) on environments such as the effect of population and development, litter or deforestation.”

“Pupils might find out about the significance of the work of scientists such as Carl Linnaeus, a pioneer of classification.”

“Pupils might work scientifically by: exploring local small invertebrates and using guides or keys to identify them; making a guide to local living things; raising and answering questions based on their observations of animals and what they have found out about other animals that they have researched.”

Animals, including humans

“Pupils might work scientifically by: comparing the teeth of carnivores and herbivores, and suggesting reasons for differences; finding out what damages teeth and how to look after them. They might draw and discuss their ideas about the digestive system and compare them with models or images.”

Evolution and inheritance **Note strong links to history curriculum**

“Pupils should be introduced to the idea that characteristics are passed from parents to their offspring, for instance by exploring the family trees and family resemblances of historical personalities such as the Tudors or the Hapsburgs”.

“Building on the topic on rocks in Year 3, pupils should be reintroduced to fossils and find out, for example by studying dinosaurs, how things living on the Earth have changed over time. Pupils might find out about the work of palaeontologists such as Mary Anning.”

“Pupils might work scientifically by identifying, comparing and recording similarities and differences among themselves and other animals and looking for patterns; observing and raising questions about local animals and how they are adapted to their environment; finding out about how some other animals and plants, beyond their own locality, adapt to their environments.”

As well as visits to natural history museums or zoos, a visit to an art gallery or historic house with portraits of members of different generations of the same family can enhance understanding of this area of the curriculum.

States of matter

“Pupils should explore a variety of everyday materials and develop simple descriptions of the states of matter (solids can be held in your hands; liquids form a pool not a pile; gases escape from an unsealed container). Pupils should observe water as a solid, a liquid and a gas and should note the changes to water when it is heated or cooled.”
“Pupils might work scientifically by: grouping and classifying a variety of different materials; exploring the effect of temperature on substances such as chocolate, butter, cream (for example, to make food such as biscuits and ice-cream for a party). They might observe and record evaporation over a period of time, such as a puddle in the playground or washing on a line, and investigate the effect of temperature on washing drying or snowmen melting.”

**Sound**  **Note strong links with music curriculum**

“Linked with work in music, pupils should explore various ways of making sounds, for example using a range of musical instruments to make louder and softer, and higher and lower sounds.”

“Pupils might work scientifically by: exploring how the pitch and volume of sounds can be changed in a variety of ways, and finding patterns in the data (for example, blowing across the top of bottles, changing the length and thickness of elastic bands). They might make ear muffs from a variety of different materials to investigate which provides the best insulation against sound.”

**Years 5 & 6**

The draft programme of study states that the principal focus of science teaching in upper Key Stage 2 is to enable pupils to develop a deeper understanding of a wide range of scientific ideas. They should do this through exploring and talking about their ideas; asking their own questions about scientific phenomena; and analysing functions, relationships and interactions more systematically. At upper Key Stage 2, they should encounter more abstract ideas and begin to recognise how these ideas help them to understand and predict how the world operates.

Pupils in Years 5 and 6 should use and develop keys and other information records to identify, classify and describe living things and materials, and identify patterns that might be found in the natural environment.

**Year 5**

**All living things**

“Pupils should study their local environment throughout the year and observe life-cycle changes in a variety of living things, for example plants in the vegetable garden or flower border, and animals in the local environment.”

“Pupils might work scientifically by: observing and comparing the life cycles of plants and animals in their local environment with other plants and animals around the world (the rainforest, under the oceans, desert areas and in prehistoric times), asking pertinent questions and suggesting reasons for similarities and differences.”

**Animals, including humans**

“Pupils should find out how ideas about the circulatory system have changed through studying the work of scientists in the past, such as William Harvey, who described the circulatory system in the seventeenth century, and Galen, the Roman physician of the second century.”

“Pupils might work scientifically by: discussing and drawing what they think the circulatory system looks like and comparing this with images from other sources; discussing, drawing or creating models
of how the main organs of the body fit together and function; comparing the effect of different types of activity on pulse rate and breathing rate. They might find out about the effects of things that might damage the body’s systems. They might compare the organ systems of the human body with the organ systems of a variety of animals, asking pertinent questions and suggesting reasons for similarities and differences.”

Properties of everyday materials and reversible change

“Pupils should build a more systematic understanding of materials by exploring and comparing the properties of a broad range of materials and relating these to what they learnt about magnetism in Year 3 and about electricity in Year 4. They should experiment with reversible changes, including melting, dissolving, evaporating, filtering and sieving.”

“Pupils might work scientifically by: investigating questions such as ‘Which materials would be the most effective for making a warm jacket, or for wrapping ice cream to stop it melting?’ They might compare materials in order to make a switch in a circuit.”

Earth and space

“Pupils should be introduced to a model of the Sun and Earth that allows the explanation of day and night. Pupils should learn that the Sun is a star at the centre of our solar system and that it has eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune (Pluto was reclassified as a ‘dwarf planet’ in 2006). They should understand that a moon is a celestial body that orbits a planet (Earth has one moon; Jupiter has four large moons and numerous smaller ones).”

“Pupils should find out about the way that ideas about the solar system have developed by studying the work of scientists such as Ptolemy, Alhazen and Copernicus, understanding how the geocentric model of the solar system gave way to the heliocentric model.”

“Pupils might work scientifically by: comparing the time of day at different places on the Earth through internet links and direct communication; creating simple models of the solar system; constructing simple shadow clocks and sundials, calibrated to show midday and the start and end of the school day; working out how places such as Stonehenge were used as astronomical clocks.”

For learning outside, pupils can create large geocentric and heliocentric models of the solar system in the playground using their own bodies or other objects.

The opportunity to observe the night sky (e.g. during a camping trip or a visit to a planetarium) would bring this area of the curriculum to life and ensure a greater depth of understanding. For example, pupils could observe Jupiter’s moons or Saturn’s rings through a telescope. Get in touch with the local astronomy society or join in with local BBC Stargazing Live events. Check out the LOtC Quality Badge website for planetariums holding the LOtC accreditation (www.lotcqualitybadge.org.uk).

Magnetism

“Pupils should be introduced to a predictive model for the way magnets behave. They should explore the behaviour and everyday uses of different magnets (for example, bar, ring, button and horseshoe) and find out about how the Earth acts as a magnet.”
Pupils might work scientifically by: looking for patterns in the way that magnets behave in relation to each other and what might affect this, such as the strength of the magnet or which pole faces another; identifying how these properties make magnets useful in everyday items and suggesting creative uses for different magnets. They might explore what happens if magnets are hung from threads or floated on water and relate this to the development and use of compasses for navigation.

**Year 6**

**All living things**

“Pupils should build on their learning about the classification of all living things in Year 4 by looking at the classification system in more detail. They should be introduced to the term ‘kingdom’ and learn that most scientists classify things into ‘five kingdoms’ (bacteria, protists, animals, plants and fungi). Through direct observations where possible, they should classify animals into vertebrates (reptiles, fish, amphibians, birds and mammals) and invertebrates. They should find out about different types of reproduction, including sexual and asexual reproduction in plants, and sexual reproduction in animals. Pupils should build on what they have learnt in previous years about how the various body systems function. Pupils should learn how to keep their bodies healthy and how their bodies might be damaged – including how some drugs and other substances can be harmful to the human body.”

“Pupils might work scientifically by: devising classification systems and keys to identify some animals and plants in the immediate environment. Pupils might try to grow new plants from different parts of the parent plant, for example seeds, stem and root cuttings, tubers, bulbs. Pupils might observe changes in an animal over a period of time (for example, by hatching and rearing chicks); comparing how different animals reproduce and exploring the work of scientists and scientific research (including historical sources, e.g. the work of John Boyd Orr) about the relationship between diet, exercise, drugs, lifestyle and health. They might collect data by interviewing health professionals and create guidance for younger children about how bodies work and how to keep them healthy.”

There are many cross curricula links which could be explored in LOtC activities, including links to the English curriculum in using interviewing skills, writing information materials or public speaking to younger children during assemblies.

**Evolution and inheritance**

“Building on what they have learnt about evolution and inheritance in Year 4, pupils should look in more detail at how living things evolve. They should be introduced to the idea that variation in offspring over time can make animals more or less able to survive in particular environments and lead to evolutionary change.”

“Pupils might find out about Charles Darwin’s work on evolution.”

“Pupils might work scientifically by: comparing how some living things are adapted to survive in extreme conditions, for example cacti, penguins and camels. They might analyse the advantages and disadvantages of specific adaptations, such as being on two feet rather than four, having a long or a short beak, having gills or lungs, tendrils on climbing plants, brightly coloured and scented flowers.”
Visits to zoos or natural history collections can greatly enhance depth of understanding around this area of the curriculum. There are also lots of opportunities in and around the school grounds to conduct experiments and observe differences.

Changes that form new materials

“Building on their work in Year 5 about changes that are easily reversible, pupils should explore changes that are difficult to reverse, such as burning, rusting (oxidisation) and reactions, for example vinegar with bicarbonate of soda. They should find out about how chemists create new materials, for example Spencer Silver, who invented the glue for sticky notes or Ruth Benerito, who invented wrinkle-free cotton.”

“Pupils might work scientifically by: observing and comparing the changes that take place, for example when burning different materials or baking bread or cakes. They might research and discuss how chemical changes have an impact on our lives, for example cooking, and discuss the creative use of new materials such as polymers, super-sticky and super-thin materials.”

This can link to cookery in the design technology curriculum.

Light

“Pupils should explore the way that light behaves, including light sources, reflection and refraction. They should talk about what happens and make predictions. They should experience a range of examples of interesting aspects of light such as rainbows, colours on soap bubbles, objects looking bent in water and white light being split by prisms.”

“Pupils might work scientifically by: deciding where to place rear-view mirrors on cars; designing and making a periscope and using the idea that light appears to travel in straight lines to explain how it works. They might investigate the relationship between light sources, objects and shadows by using shadow puppets.”

Ask students to create a shadow puppet theatre as a night time activity during their year 6 residential.

Forces

“Pupils should explore falling objects and the effects of air resistance. They should experience forces that make things begin to move, get faster or slow down. Pupils should explore the effects of friction on movement and find out how it slows or stops moving objects, for example by observing the effects of a brake on a bicycle wheel. They should explore the effects of air resistance by observing how different objects such as parachutes and sycamore seeds fall. Pupils should explore the effects of levers, pulleys and simple machines on movement. Pupils might find out how scientists such as Galileo and Isaac Newton helped to develop the theory of gravitation.”

“Pupils might work scientifically by: designing and making a variety of parachutes and carrying out fair tests to determine which designs are the most effective. They might explore resistance in water by making and testing boats of different shapes. They might design and make a simple lever and explore its effects.”
From experimenting with friction in the playground to dropping objects from a 1st floor window, there are many LOtC opportunities around forces. The new science garden at ThinkTank is a fantastic place to experiment with large scale pulleys and levers.

**Electricity**

“Building on their work in Year 4, pupils should construct simple series circuits, trying different components, such as switches, bulbs, buzzers and motors. They should learn how to represent a simple circuit in a diagram using recognised symbols.”

“Pupils might work scientifically by: systematically identifying the effect of changing one component at a time in a circuit; designing and making a set of traffic lights, a burglar alarm or some other useful circuit.”

**Key stage 3**

The most relevant points relating to LOtC have been highlighted here, although LOtC can be used in the teaching of all the attainment targets across all three scientific disciplines.

Pupils should be taught to:

- ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience
- plan and design investigations and experiments to make observations and to test predictions, including identifying independent, dependent and control variables and their intrinsic nature and other factors to be taken into account when collecting evidence and data
- use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety
- understand that scientific methods and theories develop as scientists modify earlier explanations to take account of new evidence and ideas, together with the importance of publishing results and peer review
- evaluate risks.

**Biology**

**The skeletal and muscular systems**

- Biomechanics – the interaction between skeleton and muscles, including the measurement of force exerted by different muscles in the school gym.

**Human nutrition and digestion**

- The consequences of imbalances in the diet, including obesity, starvation and deficiency diseases can be discussed during a visit to the school by a local doctor.

**Cellular respiration**

- Learning about the effects of anaerobic respiration on muscles during exercise on the school sports field.
Relationships in an ecosystem

- The interdependence of organisms, including food webs and the accumulation of toxic materials.
- How organisms affect, and are affected by, their environment.
- Niches and the role of variation in enabling closely-related living things to survive in the same ecosystem.

These can all be observed in natural habitats in and around the school.

Genetics and evolution

There are a myriad of real world opportunities to investigate reproduction in plants, including flower structure, wind and insect pollination, fertilisation, seed and fruit formation and dispersal, including quantitative investigation of some dispersal mechanisms. All schools will have a variety of these examples close by, to enable students to relate their learning to their local environment.

Inheritance, chromosomes, DNA and genes

- The variation between individuals of different species.
- The variation between individuals within a species being continuous or discontinuous, to include measurement and graphical representation of variation.
- The variation between species and between individuals of the same species leading to competition which can drive adaptation.
- Changes in the environment that leave some species less well adapted to compete successfully and reproduce, which might lead to extinction.
- The use of gene banks to preserve hereditary material before a species becomes extinct.

These can all be investigated during a visit to a zoo, aquarium or safari park, on a visit to a field studies centre or nature reserve, or using a bird feeding station set up in the school grounds or local community.

Chemistry

The particulate nature of matter

- The properties of the different states of matter (solid, liquid and gas) in terms of particle kinetics, including gas pressure and diffusion.
- Changes of state in terms of particle kinetics and energy changes.

The above can be demonstrated using our bodies to model how particles move within solids, liquids and gases in an open space or large space in a museum or historic building.

Earth science

- The composition of the Earth and the atmosphere.
- Changes to the Earth’s atmosphere since its formation.
- The production of carbon dioxide by human activity and the impact on climate.
- The efficacy of recycling.

LOtC undertaken in the local community can help provide a practical element to theory lessons.

Physics

Energy changes and transfers

- Examples of processes that cause change, with forces (work = force x distance; levers and gears reducing force by increasing distance, changing motion, dropping an object, turning a dynamo to produce light); with matter (releasing a compressed spring, igniting fuel, putting
hot and cool objects in contact, metabolism of food); with vibrations and waves (warming by radiation); and with electricity (completing an electrical circuit).

Experiments in the school grounds can give some very practical learning opportunities.
- Experiments and observations in real world settings; e.g. working models/engines in a science museum or during a visit to a factory or process plant.

Motion and forces

**Many opportunities for investigation during adventurous activities or a journey undertaken to or from an LOtC visit**

*Describing motion*
- Speed and the quantitative relationship between average speed, distance and time (speed = distance ÷ time).
- The representation of a journey on a distance-time graph.
- Relative motion: trains and cars passing one another; the movement of the sun, moon and Earth.
  Consider using human graphs in the school grounds to represent results.

*Forces*
- Forces as pushes or pulls, arising from the interaction between two objects - observing the mechanisms of the school lift.

*Pressure forces*
- Pressure in liquids, increasing with depth; upthrust effects, floating and sinking - use outdoor water supply to measure the volume of irregular objects using the water displacement method.

We are encouraged by the emphasis on the practical application of knowledge which runs through the proposed new science curriculum and believe the ideas for practical science and learning outside the classroom in the non statutory notes and guidance will prove extremely useful to teachers and providers alike in providing more learning outside the classroom experiences to enhance the delivery of the curriculum.

Whilst, regrettably, the opportunities for learning outside the classroom do not enjoy the same emphasis across all areas of the draft national curriculum programmes of study, there are still unlimited opportunities for these inspiring educational experiences across all areas of the curriculum.

Find out about opportunities for LOtC in the English and maths curriculum [here](#).

Find out about opportunities for LOtC in the geography curriculum [here](#).

We will continue our look at the opportunities for LOtC in the new national curriculum with history in the September newsletter.