	Science	Year 6
	Term 6	Topic Title: Evolution and Inheritance

Key Question: How have animals and plants evolved over time and how do scientists know?

National Curriculum Objectives:

- Recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago.
- Recognise that living things produce offspring of same kind, but normally offspring vary and are not identical to parents.
- Identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution.

Vocabulary:

Offspring, sexual reproduction, vary, variation, characteristics, suited, adapted, environment, inherited, species, fossils, natural selection, bacteria, antibiotics, resistant.

National Curriculum requirement: Pupils should read and spell scientific vocabulary correctly and with confidence, using their growing word reading and spelling knowledge

Prior Learning: Identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other.
Notice that animals, including humans, have offspring which grow into adults. (**Y2 - Animals, incl. humans**)
Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal. (**Y3 - Plants**)
Describe in simple terms how fossils are formed when things that have lived are trapped within rock. (**Y3 - Rocks**)
Recognise that environments can change and that this can sometimes pose dangers to living things. (**Y4 - Living things & and their habitats**)
- Describe life process of reproduction in some plants/animals. (**Living things & their habitats - Y5**)

Common misconceptions:

- adaptation occurs during an animal's lifetime: giraffes' necks stretch during their lifetime to reach higher leaves and animals living in cold environments grow thick fur during their life
- offspring most resemble their parents of the same sex, so that sons look like fathers
- all characteristics, including those that are due to actions during the parent's life such as dyed hair or footballing skills, can be inherited
- cavemen and dinosaurs were alive at the same time.

Knowledge: All living things have offspring of the same kind, as features in the offspring are inherited from the parents. Due to sexual reproduction, the offspring are not identical to their parents and vary from each other.
Plants and animals have characteristics that make them suited (adapted) to their environment. If the environment changes rapidly, some variations of a species may not suit the new environment and will die. If the environment changes slowly, animals and plants with variations that are best suited survive in greater numbers to reproduce and pass their characteristics on to their young. Over time, these inherited characteristics become more dominant within the population. Over a very long period of time, these characteristics may be so different to how they were originally that a new species is created. This is evolution. Fossils give us evidence of what lived on the Earth millions of year ago and provide evidence to support the theory of evolution. More recently, scientists such as Darwin and Wallace observed how living things adapt to different environments to become distinct varieties with their own characteristics.

Investigative skills

Fair/comparative testing	Identifying and classifying	Observations	Pattern seeking	Research
Which "beak" is best suited for picking up specific food items? Plan scientific enquiries to answer questions, controlling variables where necessary. Take measurements with increasing accuracy and precision (timing and counting) Report and present findings from enquiries, including conclusions, causal relationships and explanations of results. *The variation between*	*What similarities and differences can you see between these family members?* *Can you classify observations into evidence for the idea of evolution, and evidence against?* Generate comparative statements based on evidence & observations. Identify patterns and causal relationships.	*What can a fossil tell us about the diet, habitat, features and sizes of living things in the past?* Answer own and others' questions based on their scientific understanding, observations made and information they have gained from secondary sources to support and refute ideas. *Changes in the environment may leave individuals within a*	*What similarities and differences between parents/offspring/ siblings can you spot?* *(link to inherited characteristics from parent)* *Is there a pattern between the size/ shape of a bird's beak & the food it will eat?* In conclusions, identify causal relationships and patterns in the natural world from evidence. Identify results that do not fit the overall pattern and explain using	*What evidence is there that animals adapt and evolve to suit their habitats?* *How can bacteria adapt and cause problems when we try to treat infections?* Identify scientific evidence that has been used to support or refute ideas or arguments. *A simple model of chromosomes, genes and*

species and between individuals of the same species means some organisms compete more successfully, which can drive natural selection. (KS3)	*Heredity as the process by which genetic information is transmitted from one generation to the next. (KS3)*	*species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction. (KS3)*	subject knowledge. *Heredity as the process by which genetic information is transmitted from one generation to the next. (KS3)*	*DNA in heredity, including the part played by Watson, Crick, Wilkins and Franklin in the development of the DNA model. (KS3)*

Significant Scientists:

Charles Darwin- evolution
Alfred Wallace- theory of evolution through natural selection.
Mary Leakey- her fossil discoveries of our ancient ancestors changed our understanding of man's evolution.

Science stories:

Moth-Isabel Thomas and Daniel Egnéus

Additional texts/ guided reading:
One Smart Fish - Christopher Wormell
Tinga Tinga Tales: Why Giraffe has a Long Neck (synopsis) - Claudia Lloyd

End point:
Can explain the process of evolution using scientific langauge.
Give examples of how plants and animals are suited to an environment.
Can give examples of how an animal or plant has evolved over time e.g. peppered moth.
Give examples of living things that lived millions of years ago and the fossil evidence we have to support this.
Can give examples of fossil evidence that can be used to support the theory of evolution.
Can identify characteristics that will make a plant or animal suited or not suited to a particular habitat
Can link the patterns seen in the model to real examples
Can explain why the dominant colour of the peppered moth changed over a very short period of time

Cross Curricular Links:
English: Poetry- mesostic animal poems, PSA antibiotic resistant bacteria. (persuasion- complete course of antibiotics!)
Maths: Data handling, tally charts, tables, graphs.
Geography: Conservation/human impact on the environment. Why are some habitats endangered? Darwin's voyages
Art/DT: Drawing and sketching wildlife; Using artists such as Franz Marc to inspire animal designs.
Computing: Using video, data logging and digital camera equipment to observe organisms in local environment.
PSHE: Should we protect animals? How will humans evolve in the future? Is genetic screening a good idea? Diversity/variation/endangered species/conservation

Oracy:
Agree/disagree/It depends activity.
PSA

Wider Reading and resources	Enrichment/ Science capital
Who was Darwin? from www.pbslearningmedia.org Plants in their natural environment (download PDF or Zip from www.saps.org.uk Teacher's notes from www.wildwoodtrust.org Animal adaptations from www.sciencemadesimple.co.uk Hamilton Trust resources A creative approach to teaching Science- Nicky Waller Dog breeds STEM- primary evolution resources	Children's own family photos to identify inherited characteristics. Personal code card for their own inherited characteristics. Research antibiotic resistant bacteria and how this can impact own and others' health.

Sequence of Learning

Lesson	Key Question	Key learning/notes
1	What can fossils tell us about how animals and plants evolved and adapted to their environments over time?	• Provide a selection of real fossils as a stimulus to the unit. • Play the evolution and inheritance video on the BP scientists site. • Can children remember how fossils form? When fossils form, why do some parts of the animal or plant get preserved while others do not remain? • Remind chn that fossils provide evidence about living things that inhabited the Earth millions of years ago. Who was Mary Anning? Show ppt. How did the discovery of fossils change the Victorians' thinking about the past? • Discuss the extinction of animals and plants and the adaptations, changes over

		time that have been discovered, argued and explored by Scientists. • What can we learn from fossils? (Life on Earth is very old. fossil records provide evidence that life has evolved; fossils provide us with evidence that many life forms have become extinct; fossils help us to understand ancient environments; fossils can show us how ancient organisms lived and evolved. **Complete the BP fossils adaptation and evolution quiz** in groups as a class.
2 & 3	What characteristics can be inherited by an offspring? (Prior to lesson, ask chn to bring in photos of their immediate family to compare characteristics.)	• Living things produce similar but not identical offspring to their parents. Use the Simpsons (TV characters) Chn look for similarities and differences between siblings. Link to inherited characteristics from parents. • Provide pictures of celebrities and their lesser known family members plus photos the chn have brought in of their own family. Can they match family members based on similar characteristics? Ask chn to justify their choices. • A characteristic is a feature of any organism (seen (hair colour) or 'hidden' (blood group)). Do all humans look identical? What about siblings? They do look similar and may share certain characteristics. Why? Explain various combinations of characteristics result in variation. Some characteristics are inherited through our 'genes' (a sort of 'code') (e.g. eye colour/tongue rolling/shape of ear lobes) while other characteristics come from lifestyles such as where we live, food we eat or exercise we take (environmental) These help clarify what is and isn't inherited (e.g. language, religion). • Environmental factors can impact on **all** living things- show chn images of hydrangeas, explaining that different soil types affect the colour of the flowers. Chn create a personal 'code card' for their inherited characteristics (resources). Can they suggest characteristics that might be both inherited and environmental? (e.g. height, weight, intelligence, sporting ability). • Play 'inherited or environmental' sorting game in table groups (see resource) to clarify understanding of inherited characteristics. Explore that while many inherited characteristics are one option or another, some, such as skin colour, are a mix of both parents and may differ to the parents. • **Activity:** Relate variation and inherited characteristics to dogs and cross breeding. Give chn dog cards (resources) chn choose two at a time and predict the features a cross breed might have, (check if time.) Chn to create a labelled drawing of possible cross breeds thinking about which features could be inherited from the parent dogs.
4	What evidence is there that animals adapt and evolve to suit their habitats? **Investigation:** Is there a pattern between the size and shape of a bird's beak and the food it will eat?	• Introduce key scientist Charles Darwin. Tell chn that Alfred Wallace also came up with the idea of natural selection leading to evolution independently. • Look at some background information then focus on Darwin's voyage to the Galapogos islands in 1831. There, he observed that finches on different islands had different shaped beaks- he suggested this was through gradual evolution as their beaks had adapted to the type of food available on each island. If the creatures had not adapted, they may have become extinct. Look at Darwin's finches and later investigations of Gregor Mendel using pea plants, helping to explain why offspring differ from parents. • **Explore Darwin's ideas to carry out and write up a full investigation** using spoons, tweezers, chopsticks, tongs, pegs, nutcrackers etc to represent different bird's beak shapes. Investigate how many of different food types they can pick up with each "bird beak" in an agreed amount of time and record appropriately. (Use pipe cleaners or string as worms bird seed as seeds; rice as insects; raisins as fruit and berries; marshmallows as flesh.) • Children should form conclusions about causal relationships. They should identify the type of food most suited to different beak shapes and which types of birds would be more likely to be found in these environments. • This variation can help survival of species. Darwin described this as theory of evolution by natural selection. Respectfully, compare his ideas with creation story and how there is still controversy over conflictions with religious ideas.
5	What is evolution?	• Watch BBC clip on nocturnal animals. What adaptions can the chn see and why do these creatures have these features? • Show fox pictures (resources.) What environment does it live in? How have its characteristics adapted to this environment? Why do chn think Vulpes (fox) differ? In the Arctic, fur is an obvious difference – colour and length. How would a red fox (UK) fare in the Arctic? (cold/vulnerable to predators.)

		• Adaptation is when certain characteristics become more common because they are more likely to help living things survive. Why do foxes come in so many different 'versions'? They all have a common ancestor and in certain environments certain features would have helped specific foxes to survive and reproduce, passing on genetic characteristics that eventually end up being 'selected' naturally and become the common form of that fox. • Natural selection occurs due to variation to deal with changing environments. Generally, natural selection in the animal world happens over huge time scales. It can happen over decades (in microorganisms it happens much quicker) through favourable mutations (random changes in characteristics). Organisms that reproduce quickly, such as insects, will evolve quickly; those that reproduce slowly, such as humans, will evolve slowly. • Darwin concluded that plants and animals change by chance (genetic mutation) and that some of these changes made the animal or plant better suited to their environment. If plants and animals are well-suited to their environment, they are more likely to survive long enough to pass their changes to their offspring. They have adapted better to their surroundings. • ***Variation game*** – chn to play game with habitat cards and variation scenarios. Chn decide if the variation is potentially positive or negative (resources).
6	How does adaptation lead to evolution? Investigation: Does the colour of a moth affect their vulnerability to predators? Follow up: Does the size of a bird's beak increase its chance of survival?	• Read Tinga Tinga Tales: Why Giraffe has a Long Neck (resources) Ask chn to give their own suggestions to today's key questions to check understanding of evolution so far. Watch BBC bitesize clip Why does the giraffe have a long neck? Compare the two versions and discuss any wonders the chn might have. (Ensure that chn understand that adaption does not occur during an animal's lifetime e.g. a neck extending to reach higher leaves.) • Discuss the dramatic changes in the peppered moth population. Before 1845. the peppered moth population in the city of Manchester, would camouflage against pale birch tree trunks to avoid being eaten be predators and so it was the light grey variety of the moth that was most likely to survive and reproduce. However, due to the industrial revolution, pollution slowly turned the bark of the trees to a darker grey. Now darker moths could hide from predators and grew in numbers. By mid-20th century, the air pollution was reduced, tree trunks became cleaner and the light grey moths thrived again! • **Investigation:** (if possible, use an outdoor setting and natural materials for camouflage) Scatter an equal number of short strands of white, grey and black wool (representing different varieties of peppered moth) across a large piece of light fabric/paper (light tree bark). Discuss fair testing. Chn act as birds and hunt for as many strands that they can find in 30 seconds (use tweezers to represent bird beaks.) Compare the total number of each colour collected. Why do you think different coloured "moths" had a different chance of survival? Rpt by scattering the same strands of wool across a large piece of darker material and link results to the story of the peppered moth population. Extend by switching to the idea of the success of the birds and their survival by considering "beak" size. Test out by using whole hands and compare with just a thumb and forefinger to collect items- do birds with bigger beaks have a better chance of collecting more moths? • **How does adaptation lead to evolution?** Encourage chn to think about the practical exercise plus previous investigation of Darwin's bird beaks. The bigger beaked bird should have more success than others, so will have a higher chance of survival and can reproduce. Think back to ideas about inheritance: What size beak will offspring of the big beaked bird have? (Most often, a big beak). What size beak will offspring of smaller beaked birds have? (Most often, small). The process by which this beneficial trait (big beak) spreads through a population, is called natural selection and over time this leads to evolution. The birds will evolve to have larger beaks over time, because a bigger beak is an adaptation which helped them to survive.
7	How can bacteria adapt and cause problems when we try to treat	• Explain how evolutionary thinking is important not only to understand the past, but it is also very relevant to our current lives. • "Antibiotic resistant bacteria"; has recently become a problem in modern society. It means that the medicines we use to make people better are getting less effective. The occurrence of antibiotic resistant bacteria is caused by evolutionary adaptation – the bacteria are evolving to their environment, which

	infections?	in a sick person might be filled with antibiotics. By understanding how the bacteria are evolving to resist the antibiotics we can be more educated in how and when we give antibiotics out. It also gives an opportunity to discuss hygiene and hand washing, to prevent the spread of bacteria.: • In this lesson we will learn to understand that bacteria are able to adapt just like any other organism (plant or animal) and use a simple doctor/patient scenario to demonstrate how adaptation causes problems when treating a bacterial infection. Use the STEM lesson (resource) and carry out the suggested activities or get chn to plan and deliver a persuasive PSA informing public of the importance of continuing the use of antibiotics (oracy resources) • Discuss with the pupils how adding the antibiotic is changing the *environment* for the bacteria, and they are adapting to this new environment. Random mutations in the population (*variation*) will happen by chance. Because it is random, not all mutations will have resistance – think back at what happened with Pupil 2. However, because there are so many bacteria and they are multiplying so quickly, even though these mutations are random they happen very often and so some will cause resistance. *Natural selection* acts on these mutants when the antibiotic is added and those that are able to survive will multiply more than the bacteria that are not resistant. • "What would happen if another sick pupil needed to be treated and none of the antibiotics worked?" This is what is happening now, and why doctors have to be very careful about not using all the antibiotics they have all the time. • "Pupil 3 went to school when he still was a bit sick, if he stayed at home until he was sure he was better, Pupil 4 would not have got sick.
8	How have animals and plants evolved over time and how do scientists know? Read one smart fish. Assessment lesson	• Is evolution still happening? Yes! As we have learned, bacteria (living things unit) continue to mutate and evade antibiotics and scientists continue to study the evolution of plants and animals. • Read and discuss "one smart fish" (either in this lesson or during guided reading to have time to explore and unpick) • Complete the end of unit quiz and return to KWL pages to add key learning and discoveries/answers to wonders. • How might modern day humans be influencing evolution, both positively and negatively (climate change, destruction of habitats, breeding programmes, introduction of evasive species, etc.)? Finish the unit by using Explorify question to consider "what if humans didn't have thumbs?" Use plus, minus, interesting to explore ideas. • e.g. Which animals have thumbs and which don't? Are they mammals, fish, birds, amphibians? • What do we use our thumbs for? Would not having thumbs limit the things we'd be able to do? • Do your thumbs move differently from your fingers? Why do you think this is useful – would it be good or bad if we lost this? • Would it be difficult to use tools or equipment without thumbs? e.g. throw a ball, skip, use a drill or hammer. Can you think of other things that would be difficult to use? • Use this video to find out more about evolution of hands (resources.)

Further enrichment activities