WORKING TOGETHER TO PROMOTE EDUCATION FOR SUSTAINABLE DEVELOPMENT

INSPIRATION FROM NATURE

SCIENCE, DESIGN AND TECHNOLOGY

KS2 activity handbook for teachers

INSPIRATION FROM NATURE

Front cover photo and above: Kingfisher / iStock

Introduction

Nature provides us with everything we need to live; from the air we breathe, to the water we drink, the food we eat and all the resources we use to make things, and to power our homes, cars and factories. But over the past 50 years, the rapid growth of the world's population and growth in consumption, has led to a massive increase in the demand for land, energy and water. As a result, we are now using the Earth's resources faster than nature can renew them. We are also creating more waste than our planet can absorb.

We are constantly reminded of the negative impact of human activity on the planet, whether it is how we are affecting the climate or the alarming rate of biodiversity loss. As a result, introducing these sustainability issues into the classroom can be challenging, particularly finding an approach that presents a positive vision of the future. As educators, how can we prepare pupils to face these challenges in a rapidly changing world and empower them to make a difference?

WWF and TES are developing a series of Education for Sustainable Development (ESD) materials designed to help young people build their knowledge and understanding of sustainability issues, explore solutions and develop key skills so that they feel empowered to take action. This resource has been produced to help primary schools engage with sustainable development through the innovative approach of biomimicry.

Helping children to value nature through biomimicry

How have a kingfisher's beak, a sticky burr and shark skin inspired amazing inventions? Scientists and engineers have discovered all kinds of creative solutions to problems by imitating plants and animals. When it comes to sustainability, studying how life has survived and thrived on the planet for 3.8 billion years can offer pupils a really exciting approach to innovative solutions. Animals build amazing constructions, create incredible substances and develop body shapes that allow them to glide smoothly through air and water. In nature, materials are used and reused in an endless loop and there's no waste.

N700 series Shinkansen bullet train / iStock

Read the article 'Biomimicry: Inspire the next generation of green inventors' on the WWF content hub www.tes.com/wwf

Biomimicry is an exciting way to inspire pupils to observe the natural world and to develop a creative approach to problem solving by looking at nature for sustainable solutions. 'Bio' means life and 'mimicry' means to imitate. It involves learning from nature to improve the design of products, processes and systems. For example, scientists are studying the patterns and functions of a leaf to try to make better solar panels and looking at how butterflies reflect light to produce vibrant colours.

Introducing biomimicry in primary education provides an opportunity to take the learning outdoors and to instill in pupils a sense of curiosity and wonder about the natural world. It encourages them to think critically about future solutions to sustainability issues. It also helps them to understand that we are part of nature, dependent on and interconnected with natural systems, so they can make informed decisions on using and protecting the Earth's resources, now and in the future.

In this short video, Janine Benyus, co-founder of the Biomimicry Institute, explains how we can learn from nature to create a healthier planet.

www.youtube.com/watch?v=FBUpnG1G4yQ

> "A tree is not just a source of fuel, or wood to build a house, but also an amazing technology in its own right – one that stores energy from the sun, moves gallons of water a day without motorized pumps, creates materials out of carbon in the air, and provides countless ecosystem services. When we learn to see technology in nature this way, our eyes are opened to the sustainable world that already exists, embodied in the plants, animals and other organisms all around us."
>
> From *Sharing biomimicry with young people. An orientation for K-12 Teachers* by the Biomimicry Institute. 2017


Solar panel © Global Warming Images / WWF

How to use this resource

The aim of this resource is to encourage 7 to 11 year olds to develop their curiosity about the natural world and work together to explore creative solutions to sustainability, by looking at nature's own designs. Simple activities and resource sheets are provided to help them think about how we can learn from nature in the way we make, use and dispose of our stuff to eliminate waste.

The suite of activities encourages a 'systems thinking' approach, which is about fostering children's natural curiosity and encouraging them to make connections and recognise relationships, trends and patterns in our increasingly complex world.

ONLINE COURSE

This resource supports the TES/WWF free online course on Education for Sustainable Development (ESD)

www.tes.com/institute/wwf-cpd-course


Leaf © Global Warming Images / WWF

Humpback whale's flippers © John Van Den Hende

ACTIVITIES

ACTIVITY 1

Nature's smart designs: A fun interactive game of matching cards to explore inventions inspired by nature.

ACTIVITY 2

Inspired by nature: gathering ideas: A visit of your local woodland, park, beach or school grounds to look at patterns, shapes and textures that work well in the natural world.

ACTIVITY 3

From idea to product: Pupils investigate how an everyday object could be redesigned so it would never end up as waste.

ACTIVITY 4

Designs that work: Pupils take on the challenge of designing their own invention and create a 3D model of their product.

ACTIVITY 5

Inspiration from natural systems: Photo activity to explore how we can produce food the way nature does, without creating any waste.

CURRICULUM LINKS

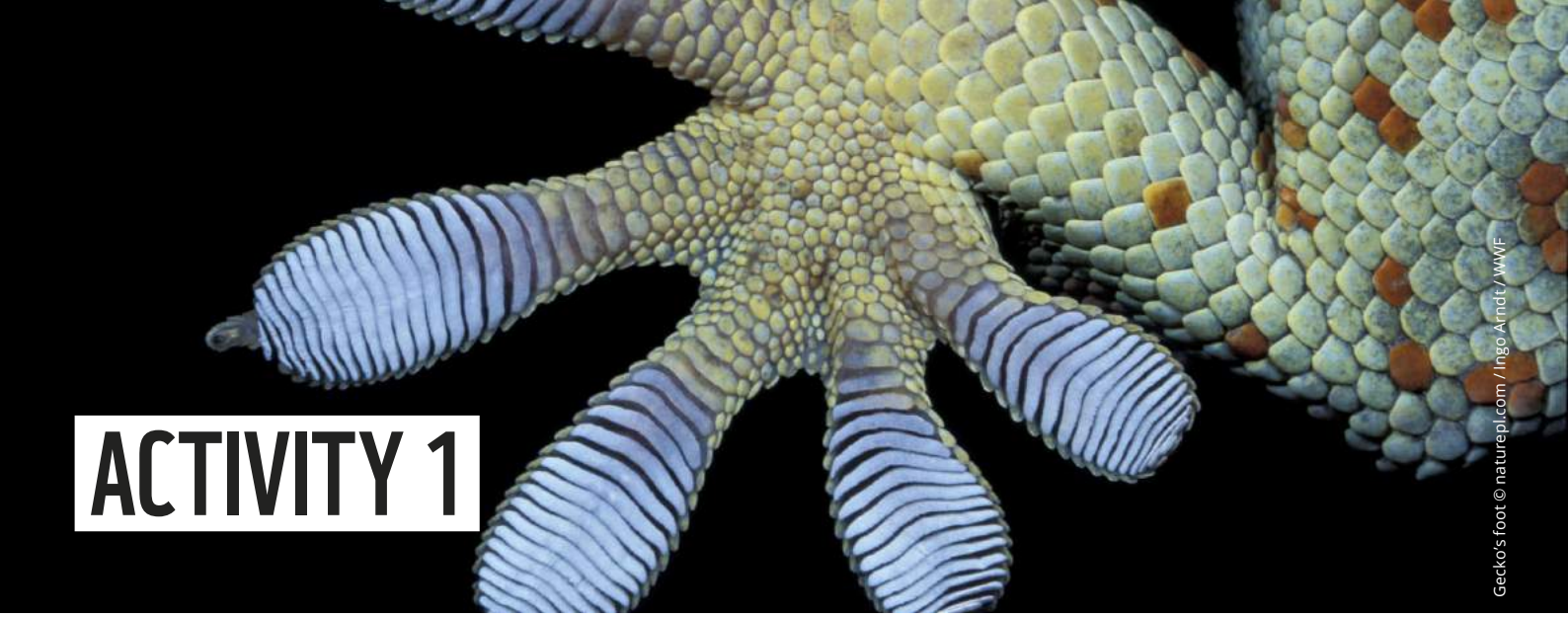
The activities in this handbook can be used in a cross-curricular way and are linked to the national curricula of England, Northern Ireland, Scotland and Wales. They can also be adapted for use with different ages and abilities.

England KS2 – Science Plants, animals including humans, living things and their habitats; **Geography** Human and physical geography; **Design & technology** Design, make and evaluate; **Computing**; **Art & Design**; **English** Language and literacy.

Northern Ireland KS2 – Curriculum objectives Personal health, citizenship, Education for Sustainable Development; **The world around us** Interdependence, movement and energy, place, change over time; **The Arts**; **Language and Literacy.**

Scotland Curriculum for Excellence P4-P7 – Sciences Planet Earth, biodiversity and interdependence, energy sources and sustainability; **Social Studies** People, place and environment; **Expressive Arts** Art and design; **Technologies** ICT to enhance learning; **Languages** Literacy and English.

Wales KS2 2015 – Science Interdependence; **Geography**, Understanding places, environments and processes; **Art & Design**; **Information and Communication Technology**; **English** Language and literacy.



ACTIVITY 1

Nature's smart designs

Overview

Through a short introduction to biomimicry and a fun interactive game of matching cards, pupils explore inventions inspired by nature and are encouraged to think about how nature can help find solutions to the sustainability challenges we face today.

Objectives

- To learn about biomimicry and discover products that were inspired by nature
- To reflect on how learning from nature can help us find solutions to sustainability challenges

What you need

- 'WWF PowerPoint presentation' – an introduction to biomimicry
  www.tes.com/teaching-resources/shop/WWF
- Two mystery boxes – cardboard boxes with a hole at the top and one object in each box (optional)

  Mystery box 1: pinecone

  Mystery box 2: environmentally friendly lizard toy made of fabric or wood

- Fun props (optional): Velcro pad, tennis ball and sports top
- 'Resource sheet: Matching cards' – one set of cards per group cut up
  www.tes.com/teaching-resources/shop/WWF
- A large sheet of paper for a mural
- Coloured pens, paint and art materials

Tweet it: **@wwf_uk #GreenAmbassadors**

What to do

- Introduce the topic of biomimicry in a fun, accessible way using the 'WWF PowerPoint presentation', props and mystery boxes.
- Divide the class into groups of four and using the 'Resource sheet: Matching cards', give each group a set of the cut up cards. Pupils place the cards face down and take turns to find the matching pairs – living things and inventions.
- Follow with a class discussion on what we can learn from nature to solve sustainability challenges.
  In nature, resources are used in an endless loop and there is no waste. What invention inspired by nature impressed pupils most and why?
- Pupils can then create a 'Nature thought of it first' mural or a tapestry (each pupil producing a square with real images, art work or fact) to show how plants and animals have inspired so many inventions and everyday objects. They can share a photo of their nature-inspired mural with us and send it to **schools@wwf.org.uk** We'd love to see it! They might also like to tweet it **@wwf_uk #GreenAmbassadors**

Inspiration from nature mural at WWF Living Planet Centre © Tristan Fewings

Termite mound © Wim van Passel / WWF

ACTIVITY 2

Inspired by nature: gathering ideas

Overview

Nature is filled with amazing designs and characteristics that help living things adapt to their environment and survive. This activity involves stepping out of the classroom and investigating your local woodland, park, beach or the school grounds to discover patterns, shapes and textures that work well in nature.

Objectives

- To experience nature first-hand
- To observe and describe how plants and animals are perfectly adapted to their environment
- To introduce pupils to the idea that the natural world can be a source of inspiration for product innovation
- To encourage pupils' curiosity and creative thinking

What you need

- Access to a local woodland, park, beach or school grounds

INTERESTING FACT – LEARNING FROM NATURE IS NOT NEW!

The first major underwater tunnel under the River Thames in London was designed by Isambard Brunel during the mid-19th century. Attempts had already been made to dig a tunnel but the walls kept collapsing. Brunel was inspired by how shipworms burrow into wood immersed in water. Using the hard shell on their head to scrape away the wood, the worms deposit materials around the hole they dig to hold the soil in place. Brunel realized this was the best way to build a tunnel, by protecting his diggers from falling soil with an iron sheet and laying down bricks, as soon as a section was dug to stop the walls from collapsing.

Source: Lee, D. *Biomimicry - Inventions inspired by nature*. Kids Can Press, 2011

Shipworms and tiled underground tunnel / iStock

- ‘Resource sheet 1: Gathering ideas’ www.tes.com/teaching-resources/shop/WWF
- ‘Resource sheet 2: What animals and plants can do’ – copy of functions cut up from the resource sheet www.tes.com/teaching-resources/shop/WWF
- A large, old hat to hold the cut up pieces of paper from ‘Resource sheet 2: What animals and plants can do’

Spiderweb / iStock

What to do

- Identify a local woodland, park or beach where you could take your class on a biomimicry journey. Alternatively, you can also look for inspiration around the school grounds.
- In pairs, pupils look for amazing materials, shapes and patterns in nature, recording their observations on ‘Resource sheet 1: Gathering ideas’.
- Come back as a group and discuss their findings. What is their most amazing discovery? What can we learn from nature’s designs? Allow pupils plenty of time to reflect on and discuss what they have observed.
- Explain that you are now going to identify functions in the natural world and relate them to challenges in design and technology. Invite pupils to pick a piece of paper from ‘Resource sheet 2: What animals and plants can do’ out of a hat: each piece contains a single function, eg climbing, clinging to things, flying. In pairs, they look for examples in nature that achieve this function (e.g. squirrel climbing trees or geckos climbing walls).
- Start exploring ideas of what we can learn from nature and how the design and functions of plants and animals could be the springboard for an innovative product. For example, could we create a machine that climbs walls like a squirrel or a gecko?

Pupil on field trip / iStockphoto

From idea to product

Overview

In pairs, pupils investigate an everyday object of their choice and discuss how the same object could be redesigned, so it would never end up as waste. They can either bring in their favourite object or investigate one that can be easily dismantled (e.g. torch).


Bicycle helmet / iStock

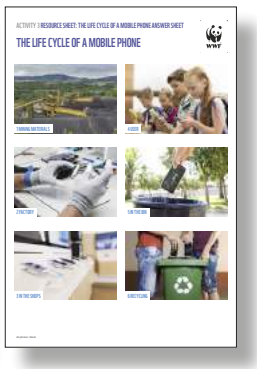

Trainers / iStock


Torch / iStock

Objectives

- To develop an understanding that all objects start with a design
- To explore the link between waste and how products are designed and made

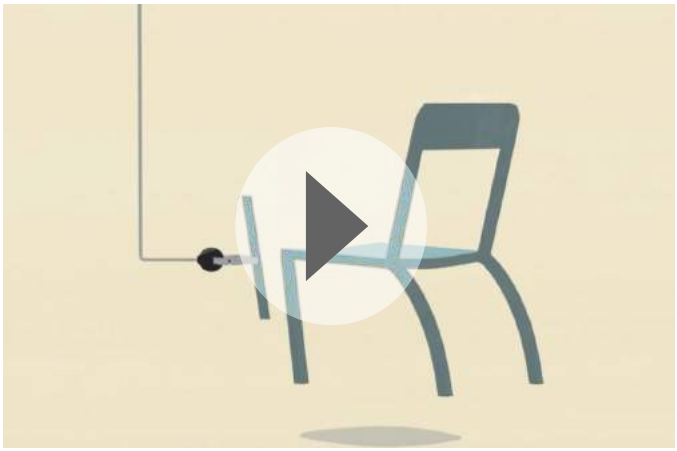
What you need



- A collection of everyday objects (e.g. mobile phone, torch, bicycle helmet, trainer, toy car, cuddly toy, football, bag, etc).
- 'Resource sheet: The life cycle of a mobile phone' www.tes.com/teaching-resources/shop/WWF

Mobile phone users / iStock

- ‘PPT resource slide: The life cycle of a mobile phone’ (optional). www.tes.com/teaching-resources/shop/WWF
- For reference, download a copy of the answer sheet for the ‘Resource sheet: The life cycle of a mobile phone’ www.tes.com/teaching-resources/shop/WWF
- Video ‘Imagine a chair’ www.youtube.com/watch?v=FKjJyus6WOg



What to do

- As a starting point, introduce the life cycle of a mobile phone to the class. What is it made of? How is it powered? What happens when we don’t need it anymore? This can be done using the ‘PPT resource slide: The life cycle of a mobile phone’ with the whole class or asking pupils in pairs to place the images from ‘Resource sheet: The life cycle of a mobile phone’ in the right order. Discuss the idea that millions of phones – and all the valuable materials they contain – are thrown away every year, creating waste. What can we do to make sure they don’t end up as waste in order to save energy and resources (e.g. questioning whether the next upgrade is really necessary, recycling, recovering materials)?
- In pairs, pupils investigate the design of an object of their choice. What is it for? What materials are used? How is it powered? If broken, could it be repaired or reused? In their view, is it a good or bad design and why?
- What can we learn from nature to eliminate waste in the way we design and make all our stuff? As a class, watch the video ‘Imagine a chair’ and discuss how their object could be redesigned so it would never end up as waste. Could broken parts be repaired? Could materials be recovered and used again in an endless loop, as nature does? What if an old t-shirt could be composted to enrich the soil or a mobile phone dismantled easily to make new phones?
- Back in pairs, pupils discuss and sketch how their product could be redesigned. They could illustrate the life cycle of their improved product in an endless loop, where materials are recovered, reused or composted.
- Each pair then share their ideas with the whole class. What have they learned through this activity?

Wind turbine / WWF

ACTIVITY 4

Designs that work

Overview

Using what they have learned in previous activities, pupils take on the challenge of designing their own invention inspired by nature to solve a sustainability issue and create a 3D or digital model of their product. They can select their own way of presenting their new product idea, using their prototype or putting together a short presentation on an iPad.

WWF Digital Geniuses workshops © Tristan Fewings

www.wwf.org.uk/Inspirationfromnature

Gecko's foot © naturepl.com / Ingo Arndt / WWF

Objectives

- To explore how we can mimic nature in the way we make, use and dispose of our stuff
- To develop an idea for a new product inspired by nature
- To develop creativity, teamwork and problem-solving skills

What you need

- 'Resource sheet: Our design for the future' **www.tes.com/teaching-resources/shop/WWF**

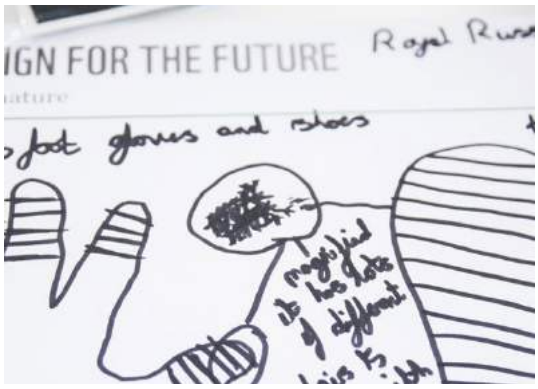
WWF Digital Geniuses workshops © Tristan Fewings

- A collection of recycled materials (e.g. milk bottles and lids, foil paper, cardboard, plastic containers, yogurt pots etc.)
- iPads - one between two pupils – and the Book Creator app to present their ideas (optional)

What to do

- Working in pairs and using the examples introduced in 'Activity 1 -Nature's smart designs', pupils explore different ideas and are encouraged to design an object inspired by nature. Make sure you allow enough time for them to think and discuss their ideas. They might need prompting to use the observations gathered in 'Activity 2 - Inspired by nature: gathering ideas' and focus on how it could provide a solution to a real environmental or social issue.
- First they sketch their ideas on the 'Resource sheet: Our design for the future'. Some suggestions may be impossible or too broad but let pupils test their ideas by sketching them, helping them to improve on their design.
- They then build a prototype, using natural and recycled materials.
- Pupils can use the Book Creator app on iPads to present their invention and explain how it provides a solution to a real sustainable issue. They can think of a cool name for their invention. Which plants or animals have inspired them? How does it work? How is it powered?
- The class could vote for the best invention and this could be the start of an interesting D&T project, improving the winning product design and building a prototype. Experts from the community – engineers or designers – could be invited to feedback on the best products.

WWF Digital Geniuses workshops © Tristan Fewings



WWF Digital Geniuses workshops © Tristan Fewings

Inspiration from natural systems

Overview

Through the use of photos and an inspiring case study, pupils explore how food production can mimic natural systems, without creating any waste. They are encouraged to take a questioning approach.


Grazing cows / iStock


Grazing pigs / iStock

Objectives

- To encourage a joined-up 'systems thinking' approach to solving problems
- To use photos to explore the connections between different aspects of food production
- To develop critical thinking and problem-solving skills

What you need

- 'Resource sheet: Farming as nature does' – a set of photos for each group
  www.tes.com/teaching-resources/shop/WWF
- Large sheet of paper
- Eco-friendly glue
- Coloured pens

What to do

- Working in small groups, pupils stick the four photos from 'Resource sheet: Farming as nature does' onto a large sheet of paper and write down their own questions about each photograph (e.g. How does grass grow? What do chickens eat? What do cattle need to survive? What are pigs looking for in the soil?). They are then encouraged to think about what the link between these photographs could be.
- Ask the groups to volunteer their ideas and then introduce the 'Case study: Farming as nature does', which provides an innovative model of producing food by mimicking nature – using the sun's energy to grow plants, capturing and reusing nutrients and turning waste into a resource.
- In pairs, pupils could design an exciting label for a food product, using something from the farm in the case study, that has been grown as nature does, without creating any waste.

CASE STUDY - FARMING AS NATURE DOES

At Polyface, the Salatin family farms by mimicking natural systems to produce food. They keep cows, pigs and chickens. They use renewable energy from the sun and everything is recycled, as nature does. The food they produce is sold locally.

Most of the year, the cows feed on fresh grass in the fields. They are kept in barns, feeding on hay, only during the cold winter months.

Then the chickens come along. A specially designed 'eggmobile' is brought into the field where the cows have just been and the hens graze the area around it and lay their eggs in the nesting boxes. They scratch and peck the cowpats to find insect larvae to eat. This means fewer flies on the farm – a good thing for animals and people! They also ensure that nitrogen from the cows' manure gets evenly spread, enriching the soil.

The farmers also rotate their pigs every week. Pigs are very good at aerating and turning the soil. They forage the soil for plants and roots and are also fed on grain bought from a local mill.

There is no need for chemical fertilizers at Polyface farm. Compost and manure help to feed the soil.


Screenshot from video

vimeo.com/125404937


Eggmobile / permaculturenews.org


Millenium Feathernet © Joel Salatin, Polyface farm

ADDITIONAL RESOURCES

Here are some additional resources to support your exploration of sustainability issues through the approach of biomimicry.

Biomimicry for kids – ask Nature

A selection of resources by the Biomimicry Institute for introducing biomimicry to young people.

asknature.org/collections/biomimicry-for-kids/#.W5paS5NKiek

Sharing biomimicry with young people. An orientation for K-12 Teachers

A resource produced by the Biomimicry Institute to help educators establish a general foundation in biomimicry and provide ideas for introducing this new way of thinking and problem solving to your pupils.

cdn.naaee.org/sites/default/files/eepro/resource/files/sharing_biomimicry_k12_20170201_tpt_excerpt.pdf

Biomimicry in youth education: a resource toolkit for K-12 educators*

A toolkit produced by the Biomimicry Institute providing a variety of activities and resources.

asknature.org/resource/biomimicry-in-youth-education-a-resource-toolkit-for-k-12-educators/#.W6jLvRNKiek

*K-12, is a term used in education and educational technology in the United States, Canada, and possibly other countries, and is a short form for the publicly-supported school grades prior to college.

How we make stuff

The following website based on Christiane Dorion's book 'How we make stuff' and produced by the Ellen MacArthur Foundation, aims to encourage children and primary educators to explore how we can learn from living systems and rethink the way we design, make and use products. It provides a range of activities to stimulate debate.

www.made2bmadeagain.org

Biomimicry - inventions inspired by nature. Lee, D., Kids Can Press, 2011

A beautifully illustrated children's book introducing inventions inspired by nature.

VIDEO LINKS

POLYFACE FARM

At Polyface farm, meet Joel and Daniel Salatin who farm the way nature does.

www.youtube.com/watch?v=KxTfQpv8xGA

THE ELLEN MACARTHUR FOUNDATION

Ellen MacArthur, founder of the Ellen MacArthur Foundation, tells us why she gave up competitive sailing to promote a vision for a sustainable future. She explains how insights from living systems might help us to redesign our future.

www.youtube.com/watch?v=N-cWaRRLh3k

ADDITIONAL RESOURCES

WWF/TES content hub

'Biomimicry: Inspire the next generation of green inventors' an article by Racheal Adams, September 2018.

www.tes.com/wwf-sustainable-development

ABOUT WWF

WWF is the world's leading conservation organisation with offices in over 100 countries. Our mission – to create a world where people and nature can thrive. But this requires some fundamental shifts. We need to make further biodiversity loss socially, politically and economically unacceptable. We need to reverse the decline in nature.

To achieve our mission, WWF is therefore addressing the root causes of nature's decline. We're finding ways to help transform our food system – the biggest current driver of biodiversity loss, pushing for a reduction in carbon emissions to avoid catastrophic climate change, and pressing for measures to help people live sustainably, within the means of our one precious planet.

www.wwf.org.uk

Young people today are amongst the first generation in history to realise what we're doing to our world, and the last who can do something to fix it – before it's too late. Through Education for Sustainable Development (ESD) we can help them build their capacity to do so.

www.wwf.org.uk/schools

It's time to make a choice.

Nature is vital. It provides our life-support system, and we cannot survive without it. But our world is now under threat like never before. Globally we are all using the planet's resources faster than nature can restore itself. So we must all act right now to reverse the damage and restore nature. We have the solutions, we just need the will.

It's time to decide. Are you for your world?

www.youtube.com/watch?time_continue=13&v=3oT4AEJL3yI

VIDEO LINKS

How does a penguin launch itself from the sea?

Get loopy

In this fun video, a mad professor (comedian Steve Punt) questions the way we currently make 'stuff' and asks us instead to get loopy! It is a good introduction to the idea of natural limits and the need for a circular economy.

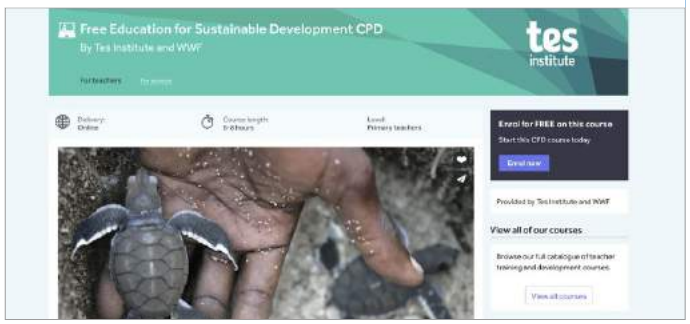
www.youtube.com/watch?v=DGERjaaY40g

CPD EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD) COURSE

This free online programme for educators will help you to:

- Develop a better understanding of ESD and why sustainability is an important part of teaching and learning
- Explore ways of developing a whole school approach to ESD
- Provide strategies, activities and ideas to develop ESD in your school

www.tes.com/institute/wwf-cpd-course



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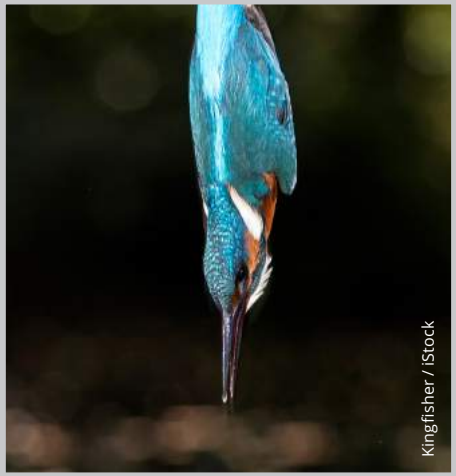
DS2241 2018

ACTIVITY 1 RESOURCE SHEET: MATCHING CARDS

TIP: Print these sheets out single-sided.



Kingfisher

Shinkansen bullet train

Gecko's foot

Adhesive sticky tape

Cocklebur

Velcro

Termite mound

Natural air conditioning

ACTIVITY 1 RESOURCE SHEET: MATCHING CARDS

TIP: Print these sheets out single-sided.

Shark skin

Swimsuit

Humpback whales' flippers

Wind turbine

Birds

Aeroplane

Dolphin

Underwater communication

ACTIVITY 1 RESOURCE SHEET: MATCHING CARDS

TIP: Print these sheets out single-sided.

Leaf

Solar panel

Pine cone

Breathable fabric

GATHERING IDEAS

Our names

Today we went to

SHAPED FOR SURVIVAL

1 Can you find the following shapes in nature?

☐ circle

☐ triangle

☐ spiral

☐ shaped like a trumpet

☐ shaped like a bowl

Other amazing shapes we discovered. Draw them here.

ON A HUNT FOR TEXTURES

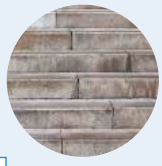
2 Can you see something that is:

☐ rough

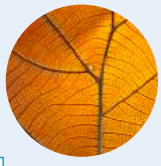
☐ soft

☐ shiny

☐ crumbly



☐ hard



☐ wrinkled

☐ soggy

☐ prickly

A RAINBOW OF COLOURS

3 How many different colours can you see?

☐ red

☐ yellow

☐ orange

☐ white

☐ pink

☐ purple

☐ blue

FUNCTIONS IN NATURE

4 Can you find something that:

☐ flies

☐ glides with the wind

☐ crawls

☐ opens and closes

☐ climbs

☐ produces bright colours

☐ runs

SOUNDS WE CAN HEAR

5

bubbling water

rustling leaves

singing birds

buzzing bee

blowing wind

creaking

OTHER AWESOME THINGS WE SAW

6

Draw them here.

Making materials (e.g. spider's web, conker from horse chestnut tree)

Sticking to things (e.g. cocklebur)

Using the sun's energy (e.g. plants making food)

Recycling waste (e.g. beetles, fungi)

Building a home (e.g. bird's nest)

Flying (e.g. bird)

Moving (e.g. worm burrowing through the soil)

Climbing (e.g. squirrel)

Keeping warm (e.g. furry animal)

Ability to repair (e.g. tree trunk)

THE LIFE CYCLE OF A MOBILE PHONE

All photos: iStock

THE LIFE CYCLE OF A MOBILE PHONE

1 MINING MATERIALS

4 USER

2 FACTORY

5 IN THE BIN

3 IN THE SHOPS

6 RECYCLING

All photos: iStock

OUR DESIGN FOR THE FUTURE

INSPIRED BY NATURE

THINK ABOUT:

What is it for?
What is it made of?
How is it powered?

OUR NAMES .....

FARMING AS NATURE DOES

Millenium Featherner © Joel Salatin, Polyface farm

Cows / iStock

Grass / iStock

Pig / iStock