Hampshire County Council
Improvement and Advisory Service

HIAS MOODLE OPEN RESOURCE

Mathematics

Sustainability

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Final version

Overview

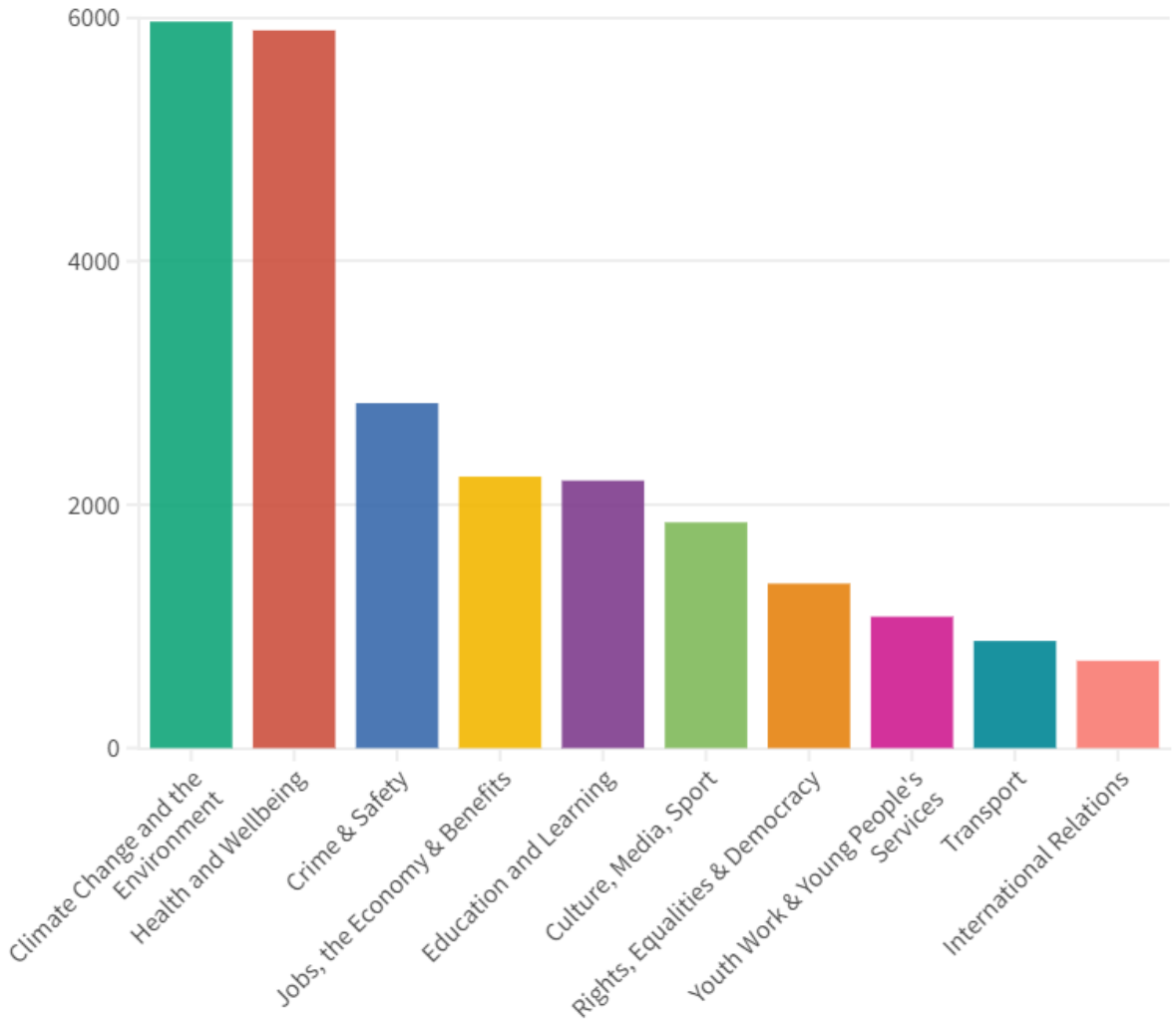
This document contains guidance to support further embedding climate education in the mathematics curriculum.

Points to consider when using this resource
It was created during February 2025 and all website links were active at this time. The organisations signposted are national ones that teachers are likely to be familiar with such as MEI (Mathematics Education Innovation) but it is always recommended to quality assure any online sources you use in the classroom with your colleagues.

Sustainability in Mathematics

Sustainability in Schools

In recent years, the growing concern over climate change has become a defining issue of our time. From unprecedented heatwaves and devastating wildfires to rising sea levels and severe storms, the impacts of a warming planet are becoming increasingly evident. The biggest ever standalone public opinion survey on climate change, the Peoples' Climate Vote 2024, shows 80 percent – or four out of five - people globally want their governments to take stronger action to tackle the climate crisis. (Source: United Nations Development Programme)
This heightened awareness is not just confined to scientists and environmentalists; it has permeated all sectors, including the education sector. School leaders and our students are increasingly alert to the need to support and promote climate education and to mitigate the impact our school buildings and community have on our environment. Earlier this year Hampshire's young people voted climate change and the environment as their top concern. More than 25,000 young people across Hampshire took part in 'Make Your Mark', the UK's biggest youth consultation.



The Make Your Mark 2024 Hampshire Survey Results
Source: Make Your Mark | Hampshire Youth Parliament (hampshireyp.org)

DFE Sustainability and Climate Change for Schools Guidance

The 2022 policy paper from the Department for Education (DfE) set an ambitious vision of the UK becoming the world's leading education sector in sustainability and climate change by 2030 (DfE, 2022) as outlined in below:

***Vision**: **the United Kingdom is the world-leading education sector in sustainability and climate change by 2030**.*
In England, we will achieve this through the following strategic aims:

1. *Excellence in education and skills for a changing world: preparing all young people for a world impacted by climate change through learning and practical experience.*
2. *Net zero: reducing direct and indirect emissions from education and care buildings, driving innovation to meet legislative targets and providing opportunities for children and young people to engage practically in the transition to net zero.*
3. *Resilience to climate change: adapting our education and care buildings and system to prepare for the effects of climate change.*
4. *A better environment for future generations: enhancing biodiversity, improving air quality and increasing access to, and connection with, nature in and around education and care settings.*

***Source:** Sustainability and climate change: a strategy for the education and children's services systems - GOV.UK (www.gov.uk)*

This guidance is not statutory. Instead, it set out a key initiative for all schools to have a **nominated sustainability lead and a climate action plan in place for 2025**. The guidance breaks down the vision to provide **five areas** where schools and educators should focus:

1. **Climate education**
2. Green skills and careers
3. Educational estate and digital infrastructure
4. Operation and supply chains
5. International

Climate education and sustainability in mathematics.
Climate change and sustainability as context in maths teaching - MEI

If you want to help solve many of the big problems facing the world, including climate change, you can really help if you start with a good understanding of maths. The science and engineering needed cannot progress without it. I know this from my own experience of working on climate modelling for many years….
Professor Vicky Pope, Chair of MEI

Mathematical insight is key to understanding the world around us and our impact on it. A good maths education is vital to begin solving some the problems our world faces. Following the publication of the Department for Education's **Sustainability and climate change strategy** in April 2022, schools are increasingly including climate and sustainability within their development plans and looking for ways to engage students with those issues.

What do we mean by sustainability in mathematics?

In mathematics, sustainability is best described as the use of mathematical models and methods to address and understand sustainability issues. Mathematics can help people make decisions about sustainability by providing quantitative reasoning skills.

- **Mathematical models** can describe environmental and social realities using abstract equations, graphing, diagrammatic prompts and real-life manipulatives. Mathematical

modelling can link across the curriculum to many areas such as science and geography, enabling predictions and hypotheses to form around the cause and effect of climate change.

- **Quantitative reasoning skills** such as logical thinking, statistics and calculation linked to problem solving enable us to understand sustainability concepts and make sense of the world around us.
- **Evaluating sustainability** in quantitative terms can be achieved through mathematical modelling. This involves considering the indicators and processes concerned with climate change and the interrelations between these factors.

What should a mathematics curriculum with sustainability integrated look like?

- Consider relevant topics in your existing scheme of work across each key stage. Integrate tasks and skills using mathematical modelling involving number, ratio and proportion, algebra, geometry , probability and statistics.
- As with all real-life maths, sustainability issues need to be introduced in a seamless way, without appearing artificial or contrived. There needs to be a focus on core skills and fluency throughout. The national curriculum for England (2013) has three core aims that support the integration of sustainability and real-life contexts:
    - Fluency ~ become fluent in the fundamentals of mathematics, including through varied and frequent practice with increasingly complex problems over time, so that pupils develop conceptual understanding and the ability to recall and apply knowledge rapidly and accurately
    - Problem-Solving ~ reason mathematically by following a line of enquiry, conjecturing relationships and generalisations, and developing an argument, justification or proof using mathematical language
    - Reasoning ~ can solve problems by applying their mathematics to a variety of routine and non-routine problems with increasing sophistication, including breaking down problems into a series of simpler steps and persevering in seeking solutions

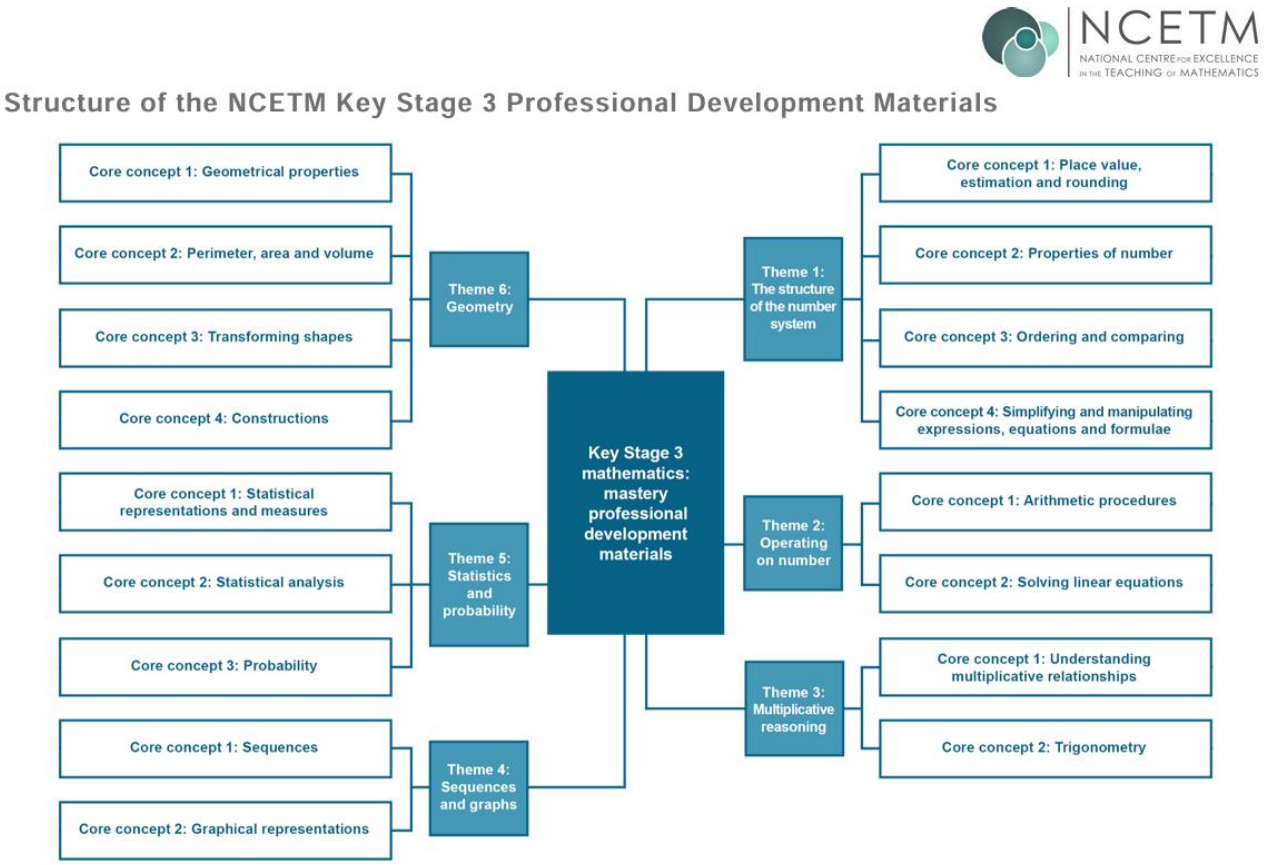
National curriculum in England: mathematics programmes of study - GOV.UK

- Students can be encouraged to engage with sustainability themes and explore their own questions.
- Students should be given opportunities to record measurements, compare values, and think about how to reduce waste.

KS3 Curriculum Mapping

https://www.ncetm.org.uk/media/oagj2ka2/curriculum-framework-for-ks3-april-2021.pdf

The diagram below exemplifies an appropriate KS3 curriculum structure that can be used as a starting point for integrating sustainability study and tasks across the programme of study for mathematics.



This example has been created by Microsoft Co-Pilot. It adheres to the national curriculum and was asked to ensure that there is progression in complexity of sustainability education over the three years:

	Year 7	Year 8	Year 9
Autumn	**Number and PV**: Understanding large numbers and their impact on resources and sustainability. **FDP:** Calculating percentages related to recycling rates and energy consumption. **Geometry**: Exploring shapes and their properties through the design of sustainable buildings.	**Number and PV**: Calculating the impact of population growth on resource consumption. **FDP:** Analysing the efficiency of different energy sources. **Geometry**: Investigating the use of geometric shapes in sustainable architecture.	**Number and PV**: Evaluating the economic impact of sustainable practices. **FDP:** Calculating the cost savings of renewable energy. **Geometry**: Exploring the role of geometry in environmental engineering.
Spring	**Algebra**: Introduction to algebraic expressions using real-world sustainability problems. **Statistics**: Collecting and analysing data on local environmental issues. **Ratio and Proportion**: Understanding ratios in the context of sustainable resource allocation.	**Algebra**: Solving equations related to environmental data. **Statistics**: Interpreting graphs and charts on global warming and climate change. **Ratio and Proportion**: Applying ratios to understand the distribution of natural resources.	**Algebra**: Modelling environmental data with algebraic equations. **Statistics**: Conducting surveys on public attitudes towards sustainability. **Ratio and Proportion**: Understanding the ratios involved in sustainable agriculture.
Summer	**Measurement**: Measuring and comparing carbon footprints. **Probability**: Exploring the likelihood of environmental events and their impacts. **Geometry**: Designing eco-friendly spaces using geometric principles.	**Measurement**: Comparing the energy efficiency of various appliances. **Probability**: Assessing the risk of natural disasters and their effects on communities. **Geometry**: Planning sustainable urban developments using geometric concepts.	**Measurement**: Analysing the water usage of different households. **Probability**: Predicting the outcomes of environmental policies. **Geometry**: Designing sustainable transportation systems using geometric principles.

The wealth of climate education resources for mathematics:
Once you have conducted your audit and identified opportunities to explore climate education and build in further progression of knowledge over time the sheer volume of organisations offering teaching resources could seem quite daunting. The following organisations are well worth considering as a place to start.

1. **NRICH :** https://nrich.maths.org/ This well-established organisation has an extensive range of tasks and enquiries that support climate change study within the maths curriculum. Put 'Climate Change' into the search facility to find lots of tasks with age guidance.
   For example: Food Web : Food Web | NRICH
   A simple ecosystem consists of ample **grass**, a herd of 50 **deer**, a nest of 2000 **rabbits**, a cast of 10 **hawks** and a sleuth of 5 **bears**. Deer and rabbits are herbivores, hawks only eat rabbits and bears eat both deer and rabbits.
   Draw a food web, showing how the animals in this ecosystem are fed and what the transfer of energy is.

   Discuss what would happen to the ecosystem if...
- The deer began reproducing rapidly.
- Some of the rabbits migrated out of the area.
- The bears were hunted by humans.

The average weight of the animals in this ecosystem is given in the table below:

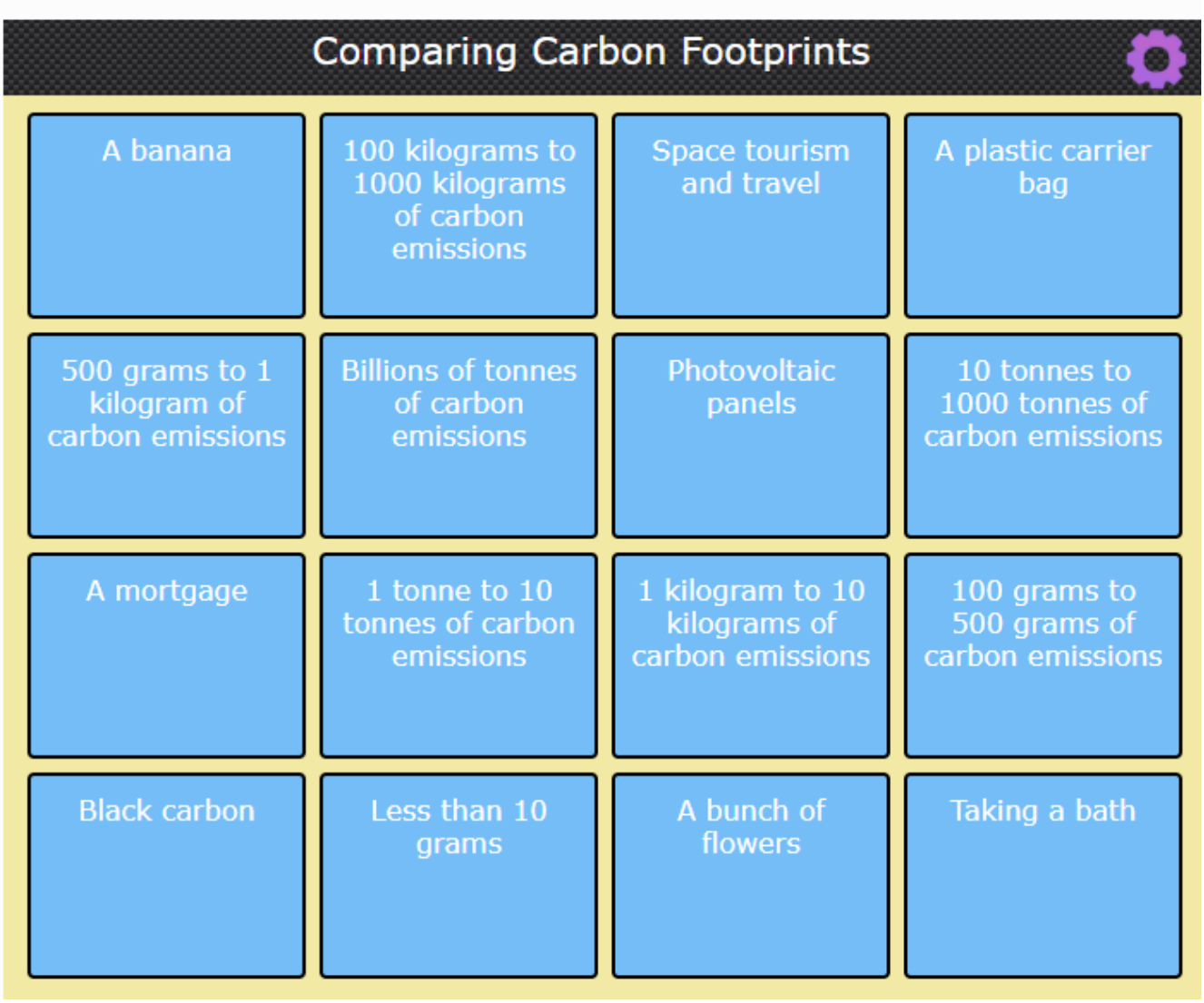
Animal	Weight
Deer	150 kg
Rabbit	1 kg
Hawk	1 kg
Bear	500 kg

In the autumn, a bear needs to consume as much as 40kg of food a day as it prepares for its winter hibernation. A hawk will eat up to 1kg of food at a time, although it can then go without food for a day or two.

Rabbits reproduce quickly: a single female can produce up to 800 children, grandchildren and great-grand children over a season (February to October in the northern hemisphere, July to February in the southern hemisphere).

Is this eco-system sustainable over time?

For Example : Carbon Footprints: Comparing Carbon Footprints | NRICH
The data in this interactivity comes from the book How Bad Are Bananas? by Mike Berners-Lee.
Here is a chance to gain a better understanding of how our lifestyle choices affect our carbon footprint.
In this interactivity you will be asked to pair up items or activities with the amount of carbon used when producing or engaging in them. When you have matched a pair correctly you will be able to read some more information about that item/activity.



There are many more cards than appear in a single game, so you may like to play several times so that you have a chance to see all of the cards.

To find out more about carbon footprints you might like to watch Mike Berners-Lee Ted talk "The Carbon Footprint of Everything".

2. **MEI (Mathematics Education Innovation)**

Climate change and sustainability as context in maths teaching - MEI

MEI have produced a range of resources that use climate and sustainability as a context for mathematical learning. They are helpfully organised into 7 sections.

Maths and Climate Change resources

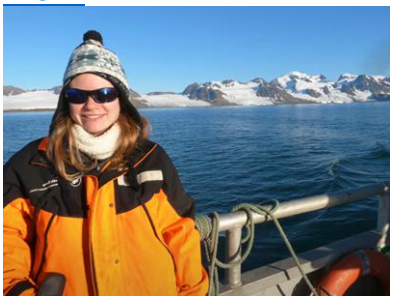
A suite of climate change focused maths resources for both Core Maths and Key Stage 3 students.

View

Where maths meets… Urban regeneration

Meet Susie and discover the mathematical skills that are required to complete an urban regeneration project.

View



Where maths meets… Climate science

In this video you'll hear from Sammie how choosing to study A level Mathematics was essential in enabling her to pursue a career in climate science.

View

Where maths meets… 'green' engineering

In this video, find out how maths helped Ayantika develop a new material that can help fight climate change.

View

Where's the maths in that? Climate edition

The *Where's the maths in that* resources, published by the AMSP, features a special Climate Edition.

View

Your food's carbon footprint

This AMSP-published Desmos activity aims to show how important maths is in understanding and communicating global issues.

View

Visualising the Climate Crisis

These resources, published by the AMSP, highlight the environmental impact of fast fashion with a focus on the annual purchase of a Christmas jumper.

View

For Example : Key Stage 3 – Trees for Net Zero (Extended Resource)

MetLink - Royal Meteorological Society Key Stage 3 - Trees for Net Zero (Extended Resource) –

Brief overview of session 'logic'

- Why trees are good
- People are planting trees – estimates around what the numbers look like in terms of land use
- Some companies encourage you to offset flights by planting trees – how many trees for one flight?
- How much carbon do trees capture and store?
- How does the amount of carbon captured and stored by a tree change during its lifecycle?
- What happens to that carbon when a tree dies?

- Can you plant a tree to offset a flight?
- What is Net Zero?

Mathematical opportunities offered

- Estimation and proportional reasoning
- Developing a sense of scale of large numbers
- Interpretation of data, statistics, graphs, infographics in context
- Critiquing graphs
- Analysing and comparing data in order to develop and present a conclusion
- Making assumptions
- Making predictions
- Reading scales

Download the resources

1. Session Plan
2. Presentation
3. Carbon Storage Graphs
4. Carbon Storage Tables
5. Blank axes

HIAS resources:

Don't forget to take a look on the HIAS Moodle pages for further guidance and lesson inspiration. There is a dedicated page called Climate Unity where you can find further links to resources as well as access all the previous Hampshire wide climate themed events for students such as the annual conference. Course: Climate Unity

"Another world is not only possible, she is on her way. On a quiet day, I can hear her breathing."

Arundhati Roy (Indian Author and Man Booker Prize winner)

In this area you can find resources to support your teaching about the Climate Crisis. Materials will be added to over time here and are especially suitable for KS2 and KS3, but many will also be adaptable for younger children as well as for older young people.

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For further details on the full range of services available please contact us using the following email:

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