

STEM By Nature: #13 Climate Action

STEM By Nature: *STEM teaching & learning in nature settings, using Outdoor Learning approaches*

Guidance for a 2-3-hour training session with a UN Sustainable Development Goal #13 Climate Action focus

This session introduces and explores what is meant by ‘STEM By Nature’ and how it can be applied in relation to UN Sustainable Development Goal #13 Climate Action. It can be adapted to suit a range of locations and group/learner needs. Its audience is teachers and educators, including youth workers, outdoor instructors, and Countryside Rangers. Whilst some facilitation and group management skills are needed, it is designed to be delivered by non-specialists – you don’t need to be an expert in STEM learning or the outdoors.

STEM By Nature: #13 Climate Action – Aims

- Build STEM skills and confidence through the use of nature settings and Outdoor Learning approaches.
- Introduce and explore the concept of STEM By Nature through information, resources and activities around the theme of #13 Climate Action, including impacts on nature, nature-based climate solutions and collective action.
- Highlight Curriculum for Excellence and STEM connections, including examples and opportunities for Interdisciplinary Learning and the process of enquiry.

Structure and Context

Information, resources and activities relating to UN Sustainable Development Goal #13 Climate Action are signposted throughout. Connections can be made with other [UN Sustainable Development Goals](#) or themes such as biodiversity and sustainability.

This STEM By Nature: #13 Climate Action session is part of a growing portfolio of STEM By Nature session guidance, hosted on the John Muir Trust website [here](#). Other sessions in the STEM By Nature series include - An Introduction, Citizen Science: #14 Life Below Water, Citizen Science: #15 Life on Land and UN Sustainable Development Goals. Explore the STEM By Nature [Resources and Links padet](#) which has useful links relating to each relevant UN Sustainable Development Goal.

See [here](#) for session guidance for STEM By Nature: Trees, Woods and Forests, created by Rob Bushby for Scottish Forestry.

Timings for a 2-3 hour session

Introduction	10-20 mins
Outdoor session	1-2 hours
Review session	20-30 mins
Signposting & wrap up	10 mins

Introduction

(10–20 mins)

As participants gather set an ice-breaker (relating to Climate Action) with an open, leading question or two e.g. “What word/s would you use to describe your level of awareness and knowledge of climate change? How do you feel about climate change? What are you already doing to help tackle climate change as an individual? Collate responses, share with group.

Objectives

By the end of the session, participants will:

- understand what’s meant by ‘STEM By Nature’, and be confident to make use of nature settings for STEM teaching
- be able to access a range of information, resources and activities relating #13 Climate Action, through a nature lens to support STEM-related teaching.

Including:

- Understanding what we mean by ‘**climate change**’ and recognise the effect climate change is having on nature in the UK
- Recognising how **nature is part of the solution** and that we can build nature connection to encourage pro- environmental behaviours,
- **Identifying actions** that we can take **locally** which act to reduce climate change and reduce the impacts of climate change. How we can amplify these actions through **collective action**.

Introduction to STEM By Nature, its origins and rationale

Confirm ‘STEM By Nature’ as: ‘STEM teaching & learning in nature settings, using Outdoor Learning approaches’. Outline session aims and objectives, as above.

Note any relevant local links to Outdoor Learning, STEM, Citizen Science, #13 Climate Action resources; acknowledge any relevant expertise within group (and incorporate as appropriate).

Note the inclusive ‘educator’ audience; the session and associated guidance can have relevance to a wide range of ages and backgrounds, not just schools/teachers.

Background information: Climate Change and impacts on nature

Climate change- the long – term shift in weather patterns, including rising average temperatures around the world, caused mostly by human activities is playing havoc with the natural world. Some human activities, like burning fossil fuels (such as coal, oil and natural gas), release carbon dioxide and other gasses into the atmosphere. These gasses form a layer in the atmosphere that allows heat from the sun in but does not allow it to escape, and so causes the planet to warm. Some other human activities, like cutting down forests, also reduces natural stores for carbon and increases the problem.

Species are adapted to specific climatic conditions and relationships with other species. Climate change is altering these intricate ecological balances that let plants and animals thrive together as healthy ecosystems. The rapid pace of changes threatens the ability of habitats and wildlife to adapt.

Some of the impacts that we are seeing in the UK include increasing temperatures, extreme weather and disruptions in the season. See Appendix 1 for more information about these impacts.

Nature as a solution

Frame nature as part of the solution in its ability to store carbon (sinks) and draw down carbon from the atmosphere e.g. peatland, soil, trees and forests, oceans. Talk about how nature's recovery is essential for tackling the climate crisis.

Ref: [Natural Climate Solutions](#) and the Wildlife Trust's [Let Nature Help](#)

Nature connection & practical action

One of the most important ways in which we support action for climate change, is helping people to develop a love, appreciation and wonder for the natural world. Professor Dave Sobel describes this wonderfully in this quote "If we want children to flourish, to become truly empowered, then let us allow them to love the earth before we ask them to save it". Share examples of how connection with nature leads to pro-environmental behaviours and taking personal action. The John Muir Award helps people to connect with nature and care for wild places. The Conserve Challenge of the Award, encourages participants to carry out practical conservation, consider personal impacts and advocate for environmental issues.

How to talk about climate Change:

Introduce ways to explore 'big issues' with children and young people (with the context of Climate Action).

- Focus on encouraging honest conversations in classrooms that give hope, whilst not ignoring the reality and scale of the problem.
- Consider how Learning for Sustainability and Pupil/Learner Enquiry approaches might help
- Enable discussion about a broad range of thoughts and feelings children might have in relation to questions relating to nature, biodiversity, health, climate (including confusion, anger, grief, frustration, fear, as well as joy, contentment, peace...).
- Role model emotional intelligence- all feelings have a place, find common ground, intergenerational understanding.
- Reflect on feelings, and ways to build emotional resilience.
- Move on to actions we can all take, solutions and positive approaches, including empowerment, creating narrative, and young people's voices being heard. Self-efficacy- possible to make meaningful changes if you act and having the capacity to act.

See the STEM By Nature [Resources padlet](#) for examples of talking about climate change.

Ref: Worlds Largest Lesson's: [Talking to young people about climate change](#) educators guide; [Climate Psychology Alliance podcasts](#), [Climate Outreach](#), [Framing Covid-19](#)

Outdoor Session

(1-2 hours – adapt inputs/activities for time available)

Activities are presented as introductions, options and ‘tasters’ rather than fully delivered. This is to keep within a limited timeframe, to share a wide variety of ideas, and to keep things punchy.

Select, plan and frame activities to include and demonstrate, as far as possible:

- ways to build confidence and skills in **STEM** teaching and learning
- active, cognitive, creative approaches
- opportunities to consider methods of Pupil Enquiry, sustainability themes, and Interdisciplinary Learning
- resources available to support participants beyond this session.

Care labels (Geography, Biodiversity)

Read a clothing care label; what does it need to be kept in good condition?

Discussion prompt: What would your own care label look like? (“Me: 2 cups of tea in morning...”).

What would a care label look like for a particular wild place? For the planet?

Issues Tree (Creativity, Literacy, Process of Enquiry) see Appendix 2.

A useful way of structuring an enquiry to encourage learners to explore the causes, effects and solutions of a given issue. You could do this outdoors using a real tree, drawing a large tree in the school grounds or making a tree outline out of natural materials. You could then use labels for young people to fill out with their ideas. Once you have your tree/ outline, label the trunk with the chosen issue, the roots with the causes of the issue, the branches with the effects of the issue, and the leaves with possible solutions/ actions. Use this to prompt discussion about what is already being done internationally and in UK to combat climate change. Add these actions to the issues tree and consider how you can make a difference. See example [Climate Action Issues Tree](#) mini film.

Ref: [Scotdec resources](#), ‘Explore the Global Goals’ for [Primary](#) & [Secondary](#) schools and [Action cards](#).

Seasonal changes & Climate change (Science, Biodiversity, Process of Enquiry)

Introduce **Phenology**, the study of phenomena or happenings, applied to the recording and study of the dates of recurrent natural events (such as the flowering of a plant or the first or last appearance of a migrant bird) in relation to seasonal climatic changes. Showcase Citizen Science project: the Woodland Trust’s [‘Nature’s Calendar’](#) and look for signs of spring and Autumn.

Ref: The Princes Foundation film [‘Exploring the Science of the seasons’](#): includes tree id, how to take part in Nature’s Calendar and information on climate change impact and wildlife adaptations.

Exploring Landscape – Re-photography (Geography and Technology)

The act of repeat photography of the same site, with a time lag between the two images; a "then and now" view of a particular area. Some are casual, usually taken from the same viewpoint but without regard to season, lens coverage or framing. Find a local example such as the [Cairngorm Photo Posts](#) to compare an old picture and recent pictures of landscapes or task participants with finding the current location of an old photograph. Ask leading questions: What changes do you notice? Which landscape is

more sustainable? What will it look like in 10 years, 1000 years? These comparisons can help unpack climate change issues through using landscape e.g. habitat loss, glaciers retreating, coastal erosion, sea level rising (ref [Google time lapse](#)). For street level use [Digimaps for Schools](#) – an online mapping service for use by teachers and pupils, which covers towns and communities. Refer to practical action and wildlife surveys - carrying out surveys before and after making improvements and importance of big data sets for comparisons over time.

Carbon Storage in Trees (Science, Geography, Numeracy, Data Handling and Collection)

The carbon cycle is dominated by uptake of CO₂ from the atmosphere by plant photosynthesis.

Trees are unique in their ability to lock up large amounts of carbon in their wood, and forests can be significant stores of carbon. On average, carbon makes up 50% of a tree's total mass. This means that if we can work out the mass of trees, we can work out how much carbon they are storing by:

- Identifying tree species – different species have different densities, grow at different rates, and support different habitats.
- Measuring the size of a tree – this can be done in different ways depending on age/stage of pupils.

Ref: OWL Scotland [Tree Measuring](#) resource.

Discuss how activity can be scaffolded to support a range of ages and stages and point out key considerations when planting forestry: How much land is required? Is this the best use of land? What was the land used for previously? How will the woodland/timber be used by people? What types of trees should be planted e.g. mono-culture versus mixed woodland.

Carbon Storage in Peatland (Science, Geography, Numeracy, Data Handling and Collection)

When managed well, peatland can provide excellent carbon storage. When drained or poorly managed, peatland releases carbon into the atmosphere. It is estimated that 1620 million tonnes of carbon are stored in peat in Scotland, which is equivalent to 5942 million tonnes of CO₂ in the atmosphere. It is made of decaying plant material, however due to the lack of oxygen in the waterlogged soil, the organic material doesn't decompose. Peat grows approximate 1mm a year, therefore 1m of peat can be over 1000 years old.

Carry out an investigation into peatland: the depth of peat can be measured using a suitably long probe (such as the poles used for chimney sweeping) but further consideration is needed into the suitability of a site for such data collection and the impact on the habitat if a large group is involved. We suggest an activity based on the Loch Lomond and Trossachs resource – [Building a Model Peat Bog](#).

Climate Action Discussion

(1 hour)

Invite discussion: *What actions are you taking to tackle climate change- individually/ collectively? What works well with your group?* Explore some of the solutions identified from your Issues Trees and see actions suggested below. Highlight where there are other benefits beyond carbon e.g. health, biodiversity.

Actions which cut carbon emissions

Mainly through themes of Food, Energy and Transport. See below for some examples that you can talk through (*#1 numbers refer to actions identified in [‘How you can save the planet’](#) by Hendrikus van Hensbergen*). Emphasize that you could build on these with a group and campaign around these as an issue.

Food: Reduce waste (compost); grow your own food (*#13 Peat free, companion plant for pollinators*); buy seasonal and local; eat less meat and dairy (*#14 design a guide to sustainable food choices. And #33 persuade your school to provide more meat free options or days*). Food miles are important but are much less significant than *how food is grown* (i.e. hothouse, soy-fed, artificial fertiliser, factory farmed). See chapter on food in [There is no Planet B](#) by Mike Berners-Lee.

Energy: This is as much about consumerism as about what type of energy we buy (our energy use is minor relative to that used to make all the products we buy, and we can't dictate what energy producers use). Actions: use renewable; buy second-hand (*#15 organise a swap shop*); less but better stuff (ref natural resource use around consumerism); refuse, reduce, reuse, recycle (*#16 make stuff from recycled product – upcycling*); mend and make; use less plastic (*#17 try plastic free*)

Ref: [The Story of Stuff](#) and [The Story of Plastics](#)

Transport: Actions: stay local UK (*#27 let's not fly*); active travel – walk or bike (*#10, start a school walk or cycle club, and #28 campaign to reduce car use in your local area*); use public transport.

Actions which soak up carbon and benefit nature

These are actions where there is also a clear biodiversity benefit, making more space for nature and connectivity. Actions: Tree or hedge planting (*#4, a tree will soak up 1 ton of carbon in 40 years*); habitat creation or restoration (*#5, plant for pollinators, #6 rewild your green space*); anything which encourages native, natural growth e.g. removing non-native invasive species.

Collective Actions

Emphasise the importance of building on practical local action by influencing others to take part in **collective action** (when a group of people comes together to achieve a common goal/objective) and **activism** (efforts to make changes in society for greater good).

We have seen this with Greta Thunberg and young people coming together in the global strike movement [Friday's For the Future](#) and through Youth Social Action [#PowerofYouth](#) campaign ([#Iwill4Nature](#)) where young people are making positive actions for their communities and environment. Share examples of young activists: [Young Climate activist of colour](#); [Global Goals Video part 2](#) and [World's Largest Lesson Youth Climate Activist Film](#).

Ref: World's Largest Lesson: [Think Big: Collective Action for Climate Change](#)

Introduce the idea of **system change** and the need for it. Systems change is about addressing the root causes of social problems and making changes in the structures and processes that lead to current patterns of behaviour. For example - John Muir changed the system of protecting wild places and biodiversity by campaigning for and persuading the US Gov to create National Parks. He also persuaded friends and allies first. What things about our society's structures need to change for the better?

Actions: consider your spheres of influence: family and friends; school or organisation – other year groups, teachers, leaders (#18 get all students at school to use reusable water bottles); wider community – your MP, local Council, the general public (#22 how to write to your MP or council); and challenge actions where they don't take climate into account (#23 take part in peaceful protest).

Actions that educate and inform (see section above How to talk about Climate Change)

Promote hope and 'new stories' (e.g. what you will gain rather than lose) (#24 write a blog or article for an organisation or newspaper); use yourself as an example (#25 approach an organisation and offer to help make information or actions relevant to young people) and invite young people to make a film on climate action (Technology link).

Ref: Keep Scotland Beautiful [Young Reporters for the Environment](#) - a programme that empowers young people aged to take a stand on environmental issues they feel strongly about and to give them a platform to articulate these issues through the media of writing, photography, and video.

How films can help communicate a message:

Invite participants to view a couple of films (during session or in own time) to highlight links with climate, nature and land use.

- ['I wish for you'](#) - short film by climate coalition - letter to the planet written by Michael Morpurgo
- **Land use:** ['The UK in 100 Seconds'](#) 1 second = 1% of the UK. Its key question is: 'Can we find [#MoreSpaceForNature?](#)'
- **Animation:** [How Nature Can Save Us from Climate Breakdown](#)

Create an opportunity to stimulate discussion: *How would you use these films? Would they be suitable for your group? Do they have a good balance in terms of information and giving hope? What other sources of information have you found helpful? Could this prompt young people to make their own Climate Action Film?*

See example films created by young people through the [Youth Climate Film Project](#) – John Muir Award examples include 'Follow the Green Brick Road' created by Citadel Youth Project; 'When Should we Plant Trees' created by Galston Primary School and Levenmouth Academy '[Becoming Beavers in Bat's Wood](#)' a film about flooding, tree planting and climate change.

Review Session

(20 - 30 mins, outdoors or inside)

STEM Skills

Review each of the session's outdoor activities using the STEM employability skills map to highlight skills used and/or developed. Add review comments to large display on board/flip chart as participants return indoors.

Introduce the [STEM Self-evaluation and Improvement Framework](#): "a framework to stimulate dialogue and action towards a whole setting approach STEM". It can be integrated with the quality indicators

within 'How good is our school?' and 'How good is our early learning and childcare?' The framework aligns with expectations within the [STEM Education and Training Strategy](#), Developing the Young Workforce and other priorities in education.

Signposting & wrap up

Open discussion/round robin: "What can you take away with you from this session?"

Introduce STEM By Nature [Information & Resources padlet](#): a place to collate relevant and referenced resources (along with other relevant locations e.g. Glow).

Create a padlet to share participant conversations and activities arising from the session.

Note use of relevant hashtags for social media sharing, including [#STEMByNature](#).

Local Learning Task suggestions (if appropriate)

- Try Nature's Calendar survey- looking for signs of the seasons
- Map how your areas greenspaces have changed
- Explore issues around climate change with your group (e.g. outdoor issues tree) and how they link to STEM, nature and outdoor contexts.
- Make a pledge through #iwill4Nature
- Make a climate change film with your group
- Encourage sharing of photos/quotes/tweets/social media.
- Discuss ways to make use of the STEM Self-evaluation and Improvement Framework with colleagues.

Climate Action Resources – links

Have hard copies (or web access and links) of these resources available for participants to view.

Keep Scotland Beautiful:

- [Climate Ready Classrooms](#) – a one day accredited course for Secondary schools for young people aged 14-17.
- [Climate Emergency training for Youthworkers- tool kit](#)

Juliet Robertson's (author of 'Dirty Teaching: a beginners guide to learning outdoors'), comprehensive [Index](#) of ideas and articles.

John Muir Award [Sustainability Resource Guide](#) and [Curriculum for Excellence](#)

Leaders' Notes

Equipment (suggested)

Any equipment available to help with outdoor activities e.g. re-photography example, measuring tapes, hard copies of resources such as OWL Scotland Tree Measuring

Tree Identification guides e.g. [FSC publications](#)

Tablets/devices for taking photos.

Clip boards, paper, pencils.

Session guidance produced by: Rebecca Logsdon for John Muir Trust & Katie Rudge for FSC Scotland, May 2021

Appendix 1: STEM By Nature

Impact of climate change on nature

Climate change- the long – term shift in weather patterns, including rising average temperatures around the world, caused mostly by human activities is playing havoc with the natural world. Some human activities, like burning fossil fuels (such as coal, oil and natural gas), release carbon dioxide and other gasses into the atmosphere. These gasses form a layer in the atmosphere that allows heat from the sun in but does not allow it to escape, and so causes the planet to warm. Some other human activities, like cutting down forests, also reduces natural stores for carbon and increases the problem.

Species are adapted to specific climatic conditions and relationships with other species. Climate change is altering these intricate ecological balances that let plants and animals thrive together as healthy ecosystems. The rapid pace of changes threatens the ability of habitats and wildlife to adapt.

Increasing temperatures

Increasing temperatures are resulting in the loss of habitats such as mountain top habitats. Species are under pressure as a result, especially cold adapted species that are having to move northwards to find suitable habitats to flourish. Not all species have the ability to move (e.g. plants) and there isn't always enough space and connectivity between habitats to support this.

The expected warming of oceanic waters due to climate change could be lethal for many species. Rising sea temperatures have a lasting effect on the whole food chain, which will ultimately impact many marine predators such as seabirds. Zooplankton, microscopic floating animals, struggle to survive in warmer waters, so fish species like sand eels have less to eat and their population declines as well. This domino effect means that seabirds will also have less prey to feed on and their population will also eventually fall.

Extreme weather events

Climate change amplifies weather systems. Places that are drier will become even drier, and areas with high rainfall will get even wetter. The UK (and globally) is already experiences increasing frequency of extreme weather events such as heavy rain and summer droughts. Heavy rain events cause severe spates in rivers which then affect salmon spawning grounds and summer droughts affect survival rates of mammals, birds and plants.

Seasonal changes

Climate change disrupts the seasons – warmer, wetter winters and seasons that start at different times, as the climate warms. More erratic weather and unreliable seasons mean that bees find it harder to nest and feed. There is an increasing unpredictability to our familiar annual cycles such as availability of prey species, causing disruptions in food webs e.g. young birds might not hatch at the same time as their prey. Flowers might not be open when their pollinators are active.

Ref: For a more **accessible** lay persons view see BBC [Climate Change The Facts](#) with David Attenborough (58 Min film). WWF's [UK species affected by climate change](#); Nature Scot's [Climate Changes impacts in Scotland](#) RSPB's [How Climate Changes affects nature](#) [Adaptation Scotland](#)

Appendix 2 Resources: Issues Tree

Use the space to create your own Issues Tree

(Reference: [Connecting Classrooms](#))

