STEM By Nature & UN Sustainable Development Goals

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

Guidance for a 2-3-hour training session

This session introduces and explores what is meant by 'STEM By Nature' and how it can be applied in relation to the United Nations Sustainable Development Goals (also known as Global Goals).
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, Countryside Rangers.
Whilst some facilitation and group management skills are needed, it's designed to be delivered by non-specialists – you do not need to be an expert in STEM learning or the outdoors.

STEM By Nature & UN Sustainable Development Goals – Aims

- Build STEM skills and confidence through use of nature settings and Outdoor Learning approaches.
- Introduce the concept of STEM By Nature.
- Engage with UN Sustainable Development Goals through nature-based and outdoor activities, making links to STEM skills and related themes.
- Consider how the pupil entitlement to Learning for Sustainability can be used as a framework for exploring learning topics including those captured in the Sustainable Development Goals.
- Demonstrate methods of pupil/learner enquiry and highlight examples and opportunities for Interdisciplinary Learning.

Structure and Content

Deliver a practical, informative (mainly) outdoor-based session highlighting links between STEM skills, UN Sustainable Development Goals and connection with nature.
A range of activities and projects are signposted throughout this guidance. The session can be set up to focus on a particular Goal or a combination of relevant Goals relating to ecological and sustainability issues (# 2 Zero Hunger, #11 Sustainable Cities and Communities and #12 Responsible Consumption and Production).

This Sustainable Development Goals 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 #13 Climate Action. Explore the STEM By Nature Resources and Links padet which has useful links relating to each relevant UN Sustainable Development Goal.
See here for a session guidance for STEM By Nature: Trees, Woods and Forests, created by Rob Bushby for Scottish Forestry.

Introduction

As participants gather set an ice-breaking exercise with an open or leading question such as:

- 'How familiar are you with 'Sustainable Development Goals'?'
- 'Do you use them in your work/volunteering'?'

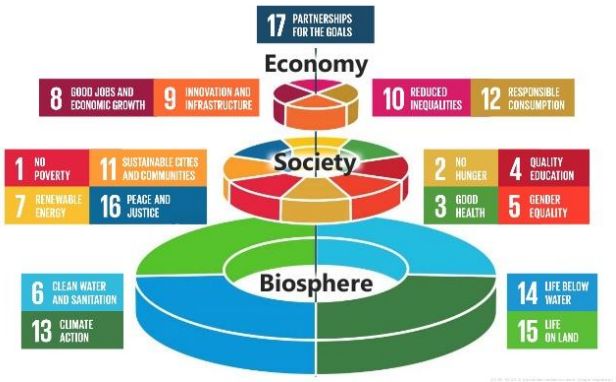
Collate responses on flip chart, share with group.

Introduce STEM By Nature, its origins and rationale. Confirm STEM By Nature as 'STEM teaching & learning in nature settings, using Outdoor Learning approaches'. Note that it's a broad concept and an approach, not just a Professional Learning session or specific subject.

Outline session aims.
Briefly explain the rationale for a session theme of UN Sustainable Development Goals and the contexts of STEM learning, Curriculum for Excellence and Learning for Sustainability.
Note the inclusive 'educator' audience; the session has relevance to a wide range of ages and backgrounds, not just schools/teachers.

UN Sustainable Development Goals

Introduce the Goals to inform discussions. Use the Biosphere model to show the underpinning nature of Goals with an overt ecological aspect whilst referencing the suite of 17 Goals.
Ask whether practitioners use or aware of the Sustainable Development Goals in their work.
Adapt this String Activity to assist introduction.
Reference: Sustainable Development Goals
Reference the Good Life Goals.



Learning for Sustainability

Learning for Sustainability is aligned to the UN Sustainable Development Goals, offering a starting point to explore local issues within a global context and vice versa.
Learning for Sustainability can encourage the development of critical thinking skills. It can help young people to uncover and unpick complex issues. It can also support creativity, allowing learners to imagine solutions to existing and emerging issues. Learning for Sustainability can therefore offer an opportunity to develop and practice skills necessary to thrive in an increasingly fast-paced, uncertain world.

Reference: Impact of Learning for Sustainability on Educational Outcomes: A Summary of Findings
Reference: A summary of Learning for Sustainability resources
Learning for Sustainability Word Cloud

'Big Issues', Pupil enquiry, STEM & Nature

The most urgent, challenging issues for individuals and society, locally and globally, have STEM and Nature at their core for both their understanding and their potential solutions.
Introduce ways to explore 'big issues' with children and young people (with the context of Sustainable Development Goal themes in mind).
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…).
Move on to actions, solutions and positive approaches, including empowerment, creating narrative, and young people's voices being heard. Reflect on feelings, and ways to build emotional resilience.
Consider how Learning for Sustainability and Pupil/Learner Enquiry approaches might help (see below and Skills and Enquiry Handout).
References: Climate Psychology Alliance podcasts, Climate Outreach, Framing Covid-19

Outdoor Session

Line ups

"How sustainable are you?" Ask participants to position themselves on a spectrum of where they consider they are. Participants might explain a sustainable action they regularly take to the person next to them. This opens up considerations around the breadth of 'sustainability', and related perceptions.
Then ask participants to arrange themselves according to their establishment's Learning for Sustainability journey. What are their next steps?

Pathways to nature connection

A route for closer, healthier and more sustainable relationships with nature can arise through noticing, feeling, beauty, celebration and care. See Pathways to Nature Connectedness postcard for the framework and some suggested outdoor activities.
Consider connections to nature and how they relate to Sustainable Development Goals.
Reference: Noticing Nature Report page 41 for a summary of benefits of nature connection.

Care labels

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?

Sticky Questions

A playful way for pupils, parents and staff to embrace ways of talking and critical thinking. (E.g. "What has nature ever done for us?" "Do slugs deserve to eat?").

Development Compass Rose Frame *(Process of enquiry)*
This framework for raising questions encourages various angles of enquiry about development issues in any place or situation. Look at a real landscape and ask questions around 'What has this got to do with me?' - personally, locally, globally. See below for Compass Rose sheets to run this activity outdoors. Cut out the middle square so that you can see a view of your surroundings to prompts questions. Quick review: ask what came up in discussions e.g. view of a car in the landscape might prompt a discussion around accessibility, pollution and air quality.

Outdoor Journeys *(Process of Enquiry)*
Learners generate questions and answers about their local landscape, prompted by going on outdoor journeys outside the classroom. Outdoor Journeys involves three phases that can repeated over and over:

- Questioning: Pupils begin by going on a journey outside the classroom. The purpose of this journey is to generate questions about the socio-cultural, physical and environmental nature of their schoolgrounds and local surroundings. Jotters and digital cameras are useful for making notes and taking photos about items to be researched. The questions can be posted on the classroom walls.
- Researching: Pupils search for answers to their questions. They can use a variety of sources, such as the internet, books, historical documents, museum catalogues, and photographs. They can invite local experts into the school to provide first-hand knowledge. Quite often, pupils may need to go on another journey to answer their questions.
- Sharing: Pupils share the knowledge they have gained in a variety of creative ways. Examples include drama, dance, song, art, poetry, podcasts, presentations, and posters. They can share with their peers, whole-school or local community.

Ref: Outdoor Journeys in Secondary Schools

Issues Tree: (Link to 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.

Outdoor STEM Challenge
Exercise/Discussion (recommended 30 mins; preparation needed)
Give participants the opportunity to create their own outdoor STEM Challenge, taking learning outdoors and linking to nature. Split into groups to explore one of these Global Goals: #2 Zero Hunger, #11 Sustainable Cities and Communities, **#** 12 Responsible Consumption and Production or #6 Clean Water and Sanitation. Nb Goals: #13 Climate Acton, #14 Life Below Water and #15 Life on Land) are considered in other STEM By Nature sessions.

Steps

- Show the film **Land use: 'The UK in 100 Seconds'** (view via this tweet) to stimulate discussion on nature & land use help inform discussions.
- Look at the resources available (Padlet columns) for background and ideas (see Appendix 1 for **nature-based** ideas, activities and resources for exploring the Goals).
- Create an **issues tree** for one of the Goals (see Appendix 2).
- Discuss how you can create an **outdoor STEM By Nature Challenge**, linking nature, STEM skills and the Global Goals. Note: using an **enquiry process** makes this a STEM Challenge. Consider a simple enquiry process of: **Investigate** (e.g. carry out a survey, find out more, explore an environment); **Design** (what can be done to improve/solve issue e.g. make a change to school/centre grounds, plan an event within community, design own investigation, build a model of….) and **Share** (ideas for sharing and engaging more people). See STEM Steps to Success below.

STEM Step to Success from start to finish, including lots of prompting questions (appropriate for Primary and secondary ages Little Bins for Little Hands)

Review Session

Activity Review

Brief round robin with each group outlining what they have developed, how they've gone about it, challenges, connections made etc.

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).
Share your STEM By Nature experiences using #STEMByNature

Signposting & wrap up

Local Learning Task suggestions

Explore the Sustainable Development Goals with your class/group, and how they link to STEM, nature and outdoor contexts.
Create a STEM By Nature Challenge – using your existing planning tools or see 5-minute lesson plan
Make a pledge: #iWill4Nature.
Take a look at the Learning for Sustainability Self-Evaluation and Improvement Framework.

Signpost to resources (include these in a follow up email to participants)

Have hard copies (or web access and links) of these resources available for participants to view:
Global Goals Lesson Plans
Connecting Classrooms information
John Muir Award Sustainability Resource Guide
Curriculum for Excellence and the John Muir Award

Equipment list (suggested)

String, Photos to illustrate the UN Sustainable Development Goals. Print out of the UN Sustainable Development Goals and Good Life Global Goals. Ipads

Session Guidance produced by:
Rebecca Logsdon for John Muir Trust, Katie Rudge & Rob Bushby for FSC Scotland

Appendix 1: STEM By Nature and UN Sustainable Development Global Goals

See below for some **nature-based** ideas, activities and resources to explore some of the UN Global Goals (#2 Zero Hunger, #6 Clean Water and Sanitation, #11 Sustainable Cities and Communities, #12 Responsible Consumption and Production, # 13 Climate Action, #14 Life Below Water and #15 Life on Land).

#1 numbers in italics refer to actions from 'How you can save the planet' by Hendrikus van Hensbergen

#2 Zero Hunger

Issue: Producing enough food and protecting the environment.
How can we achieve food security and promote sustainable agriculture?
How can we make space for nature?
Learn more: Good Life Goals: Pack of Actions: 'eat better' P4
Make Space for Nature: why Biodiversity is key. See land use in Britain film 'UK in 100 seconds'; Nourish Scotland's Food Atlas; Global Goals Circular economy and modern agriculture lesson plan and Mission: Explore Food: 159 food-related 'missions'
Buy seasonal and local: campaign for planet friendly food and farming see Soil Association, Food Tales (telling the journey that food has taken), Food miles calculator, Garden Organic and Food Cooperatives.
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)*
Grow your own or forage for wild foods– see School Gardening and Foraging wild food
Companion plant for pollinators: see a portfolio of Pollinators in Action
Reduce waste (compost): see The Importance of Earthworms and Spark of Science Food waste
Protect soil and go *(#13*. Peat free) – see The World Beneath our Feet.

#6 Clean Water and Sanitation

Issue: Ensure availability and sustainable management of water and sanitation.
Learn more: Mission:Explore Water you'll find 51 water-related missions, covering rain, using Water and waste. Teachers Notes (example Missions: make rain catchers, Create water cycle in a bottle, collect clouds, impact of rain on wildlife, make a water filter, grow a one litre garden, reduce water at home)
Inform and influence others about the value of water: Scotland's Wetlands and Clean Water for Wildlife
Monitor rainfall: see Rainfall Observers

Create a rain garden 10K Raingardens for Scotland: (areas of plants and vegetation designed to absorb water, reduce flooding and help to protect our rivers and waterways).

#11 Sustainable Cities and Communities

Issue: Inclusive, safe, resilient and sustainable human settlements.
How can we make space for nature in our human settlements? What can we learn from natures adaptability?
Learn more: Good Life Goals: Pack of Actions: 'love where you live ' P13
Make Space for Nature: Tree or hedge plant - *(#4, a tree will soak up 1 ton of carbon in 40 years) – see Tiny Forests*
Create or restore habitats *(#5, plant for pollinators, #6 rewild your green space)* see wildlife gardening;
Remove non-native invasive species.
Campaign to make your city greener- Campaign for National Park Cities
Discover the learning potential of your local greenspace: see Learning in Local Greenspace
Stay local UK *(#27 let's not fly);* active travel *(#10, start a school walk or cycle club)* see Sustrans; *and (#28 campaign to reduce car use in your local area)* see Campaign for Better Transport.
Explore migration (animals/ human): see the RSPB Migratory Birds stories; Open Hearts Open Borders resource; The Moth Migration project and Moths Count and an artist exploring bird and human migration: Derek Robertson exhibition

 # 12 Responsible consumption and production

Issues: Responsible consumption, use and overuse of natural resources.
How can we reduce our impact on the natural world? How can we design for a better world? How can we learn from nature?
Learn more: Good Life Goals: Pack of Actions 'live better' P12
Measure your Ecological footprint
Use less and reduce pollution: *(and try plastic free #17)* - see Practical Action' s Plastics Challenge, Story of Plastics; Redesigning Plastic Packaging lesson plan and technical solutions example
Use renewable, buy second-hand *(#15 organise a swap shop),* by Fairtrade.
Refuse, reduce, reuse, recycle *(#16 make stuff from recycled products – upcycling)* see How We Make Stuff
Take part in litter cleans ups and campaigns – see Keep Britain Tidy and measuring biodegradability
Design for a better world: see Biomimicry, Ask Nature and Design for a better world competition.

 # 13 Climate Action

Issue: How can nature help combat climate change and its impacts?
What is biodiversity loss? Why should we try to halt it? How?
Learn more: Scotdec: Goal 13 Climate Action resources, Worlds' Largest Lesson Climate Change lesson plan and Biodiversity & Climate Change Education Park,
Campaign against climate change: See Young Reporters for the Environment, Campaign against Climate Change and Show the Love campaign.
Inform and influence others about Natural Climate Change solutions (including wetland/ peatlands, marine permaculture, wave energy) see Project Drawdown
Take part in Citizen Science – see Nature's Calendar (seasons, climate and phenology), The Big Seaweed Search (climate change impacts on the seashore) and Rainfall Observers (observe and record Scotland's rainfall).

Create a raingarden: (area of plants and vegetation designed to absorb water, reduce flooding and help to protect rivers and waterways).
Explore renewable energy: energy, science, sustainability resources: The Pod
Reduce your energy at home, school and work see the Energy Saving Trust.

#14 Life Below Water

Issues: protecting marine habitats, reducing pollution, sustainable use of ocean resources
Learn more: see Marine Conservation Society, World Oceans Day, Global Ocean and Sea change
Reduce plastic pollution: Blue Planet Live, Common Seas and Surfers Against Sewage
Carry out a beach clean: Nurdle Hunt, #2minutebeachclean and Take 3 for the sea
Take part in Citizen Science: see The Seawatch Society and The Big Seaweed Search
Choose sustainable fish to eat: see the Good Fish Guide.

#15 Life on Land

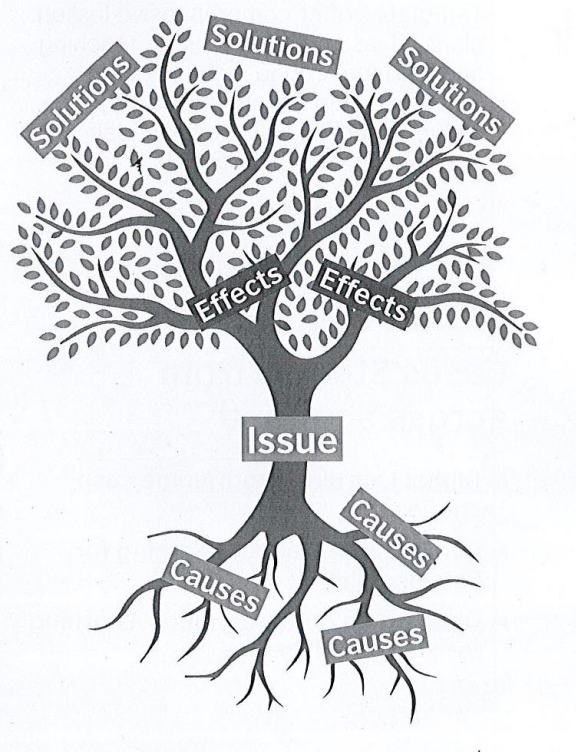
Issue: land use and deforestation.
How can we protect, restore and promote sustainable management of forests?
Learn more: Scotdec: Goal 15 Life on Land resources
Make Space for Nature: Tree or hedge plant - *(#4, a tree will soak up 1 ton of carbon in 40 years) – see Tiny Forests; h*abitat creation or restoration - *(#5, plant for pollinators, #6 rewild your green space); r*emove non-native invasive species.
Campaign to make your city greener- campaign for National Park Cities
Get creative and celebrate biodiversity in woodlands: The Lost Words

Issue: protecting and restoring terrestrial ecosystems including inland freshwater ecosystems and wetlands. Promoting biodiversity and reducing the impacts of invasive alien species
Learn more: Mission:Explore Water you'll find 51 water-related missions Teachers Notes and Freshwater Habitat Trust
Get creative and celebrate biodiversity in freshwater: The Lost Words
Take part in Citizen Science: Kick Sampling and Big Spawn Count
Help fish populations: see Salmon in the Classroom- Ayrshire River's Trust, Mayfly in the Classroom
Make a pond: Pond creation toolkit
Clean up a local waterway: Upstream Battle (Citizen Science project around in land litter – survey guide)

Appendix 2

Issues Tree

Use the space to create your own Issues Tree
(Reference: Connecting Classrooms)



Development Compass Rose

What questions do you have?

Natural – What questions do you have about this environment? Natural resources? Living things and relationships? Include questions about the built and natural environment.

Who decides – What questions do you have about power and choice in this picture? Who decides what will happen? Who benefits and loses and what is the impact of decision making? Think local and global.

Economic – What questions do you have about the economic activities you can see? How are people affected by trade, aid, ownership, buying and selling?

Social – What questions do you have about the relationship to others, traditions, culture, how communities live. Include questions about disability, race, class and age.

Adapted from: https://www.tidegloballearning.net/sites/default/files/uploads/2c.50%20Compass%20rose.pdf

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What's this got to do with me?

Personally...

As a member of a family...

For my nation(s)...

Globally...

Within my local community...

Adapted from: https://www.britishcouncil.org/school-resources

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