

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 Citizen Science and Social 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, 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 & Citizen Science – Aims

- Build STEM skills and confidence through use of nature settings and Outdoor Learning approaches.
- Introduce the concept of STEM By Nature.
- Highlight Curriculum for Excellence and STEM connections.
- Make engaging with Citizen Science accessible, making links to STEM skills.
- Demonstrate methods of pupil/learner enquiry.
- Highlight examples and opportunities for Interdisciplinary Learning.

Structure and Content

Citizen Science activities and projects are signposted throughout this guidance. The session can be set up to focus on a particular theme e.g. land-based surveys or trees and woodland. It can be set in a context of one or more UN Sustainable Development Goals e.g. #15 Life on Land, or other relevant Goals relating to ecological and sustainability issues.

See the STEM By Nature Introductory session for more information on context and themes.

Reference: [Citizen Science & Curriculum for Excellence](#)

Reference: FSC Scotland, Citizen Science & STEM [link tbc]

Reference: [Sustainable Development Goals](#)

Welcome and context setting

As participants gather set an ice-breaking task with an open, leading question such as:

- 'How familiar are you with 'Citizen Science'?'
- 'Do you do anything you'd describe as 'Citizen Science' or 'Social Action'?'

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.

Note the inclusive 'educator' audience; session has relevance to a wide range of ages and backgrounds, not just schools/teachers.

Citizen Science and Social Action

Explain what is meant by Citizen Science (using the [Education Scotland](#) and/or FSC resource), and that it can include Social Action (relevant for youth work) and field work/field studies.

Citizen Science is "getting everyone, from experts to amateur biologists, school children to enthusiastic beginners, involved in science" (TCV). More formally, it involves the gathering, recording and analysis of scientific data by members of the public.

[Youth social action](#) refers to activities that young people do to make a positive difference to others and/or the environment. It can take place in a range of contexts and include formal or informal activities such as volunteering, fundraising, campaigning supporting peers – and Citizen Science. Signpost to any relevant local links to Outdoor Learning, STEM, Citizen Science; acknowledge any relevant expertise within group (and incorporate as appropriate).

Reference [STEM employability skills](#) and their relevance to Citizen Science.

Ask participants to consider how progression in these skills can be observed/developed through the activities delivered in this session. Review upon return indoors.

Interdisciplinary learning

Citizen Science covers a range of activities including:

- observing and monitoring e.g. gathering data to find out about wildlife populations
- informing action e.g. providing data to organisations about floods or pollution
- promoting learning e.g. informing learners with information about climate change
- testing hypotheses e.g. using science activities to test a specific question
- crowd-sourcing e.g. online activities to gather or analyse data to achieve a common goal
- helping communities learn about their local environment e.g. with a Bioblitz

STEM By Nature provides opportunities for deepening learning, for example through asking big questions, exploring an issue, solving problems or completing a project – and offers rich potential for Interdisciplinary Learning.

Pupil/learner enquiry

Pupil enquiry refers to learners deciding for themselves, carrying out their own independent investigations, with teachers adopting a facilitator role to develop skills and nurture inquiring attitudes.



A *Spectrum of Enquiry*, drawn from fieldwork practice, relates to a range of STEM skills and be used to set up, deliver and review Citizen Science experiences:

Sensing - Framing - Questioning - Observing - Analysing/Interpreting - Concluding

Consider the relative importance of each of these elements in your activities/session, and in wider education settings. How do these elements inter-connect? How do they relate to STEM subjects? Which are you/your pupils good at?

Outdoor Activities – Citizen Science focus

Present activities as introductions and ‘tasters’ rather than fully delivered, to keep within a limited timeframe, to share a wide variety of ideas, and to give space to integrate and discuss elements noted above. Monitor opportunities to consider STEM Skills, methods of pupil/learner enquiry and interdisciplinary learning as they arise.

Selected activities to demonstrate ways to build confidence and skills in delivering Citizen Science with young people, and to highlight resources available to support this.

Icebreaker - Outdoor Learning journey

Ask participants to arrange themselves in a ‘scale of experience’ semi-circle, based on where they are in their own Outdoor Learning journey (using the outdoors frequently/ infrequently). Discuss briefly.

Land-based surveys

Carry out a terrestrial/land-based survey as appropriate for the time of year and the habitat – see below for examples including bug hunts, tree and woodland based surveys and Bioblitz.

Introduce tools to help with identification: [iSpot](#), [FSC guides](#), and other free apps.

Reference: John Muir Award [Surveys Resource Guide](#)

Reference: [FSC Field Work Live](#)

Activity examples include:

Bug Hunt

Demonstrate a range of techniques to collect/observe organisms e.g. taking photographs, tree beating, sweep nets, paint brush etc. The [OPAL Bug Count can](#) help with the survey process and includes identification guides. Submit findings to [iSpot/iRecord](#) to inform ongoing research, or collect on an app such as [Seek](#) (which gives badges according to how many species are found), or create your own monitoring process.

Give participants the opportunity to trial techniques and explore use of tools, apps.

Re-group and review, highlighting opportunities to develop STEM skills (observation, description, measuring, recording etc.).

Trees and Woodland surveys

If access to woodland or a single tree is available, a range of surveys can be used.

[OPAL Tree Health Survey](#) can help to introduce the process of tree identification and use of scientific language; survey data can then be uploaded to [Observatree](#).

Showcase [Observatree](#), an early warning system for monitoring tree health. Anyone can look out for unusual [pests and diseases](#), or for symptoms that look worrying, and report unusual sightings through [Tree Alert](#). Website includes a poster of priority pest and diseases.

Reference: [OWL Tree Measuring resource](#)

Bioblitz

“**Bioblitz**: capturing a snapshot of an area’s biodiversity before the clock runs out!”

Introduce the concept. An ‘official’ Bioblitz event lasts 24hrs, but observations from a scaled-down version (e.g. school grounds in an afternoon, or on a walk) can be effective.

Set up a short illustrative Bioblitz e.g. see how many of which species in a defined area can be found in 20 minutes.

Discuss which plants you can collect - reference Plantlife wild flower [code of conduct](#).

Demonstrate a range of techniques to collect/observe organisms e.g. taking photographs, tree beating, sweep nets, paint brush etc. Have a selection of [FSC field guides](#) available to help with identification and signpost to [iSpot](#), an online tool of experts for support.

Give participants the opportunity to trial techniques and explore use of tools, apps.

Re-group and review, highlighting opportunities to develop STEM skills (observation, description, measuring, recording etc.).

Submit findings to [iSpot/iRecord](#) to inform ongoing research, or collect on an app such as [Seek](#) which also gives badges according to how many species are found.

Highlight the free training provided by Open Learn: [Citizen Science and Global Biodiversity](#).

Review Activities

STEM Skills

Review each of the session’s outdoor activities using the STEM Employability skills map (as above) to highlight particular skills used and/or developed.

(Add review comments to large display on board/flip chart as participants return indoors.)

Consider which aspects of the *Spectrum of Enquiry* have featured in activities, and how they relate to STEM skills: **Sensing - Framing - Questioning - Observing - Analysing/Interpreting - Concluding**

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 and 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

Use local settings outside to try out some of the Citizen Science examples encountered.

Encourage sharing of photos/quotes/tweets/social media.

Discuss ways to make use of the STEM Self-evaluation and Improvement Framework with colleagues.

Citizen Science Resources – links and signposting

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

Education Scotland [Citizen Science & Curriculum for Excellence](#) Overview (great starting point)

FSC [Field guides](#) and [FSC Field Work Live](#)

[OPAL surveys](#) (the x-Polli:Nation survey is still open for data collection 2020)

[iRecord](#) - collate wildlife sightings to support research at local and national levels

[Digimap](#) - data collections, including OS, historical, geological, marine maps and spatial data

[TCV's Citizen Science](#) pages

[Nature's Calendar](#) - Phenology - the study of cyclic and seasonal natural phenomena - in action.

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

John Muir Award [Surveys Resource Guide](#)

John Muir Award [Sustainability Resource Guide](#)

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

Leaders' Notes

Equipment (suggested)

Any equipment available to help with wildlife observation e.g. magnifying glasses, binoculars, nets, pots for collecting creatures, paint brushes, old white sheet for tree beating.

Identification guides e.g. FSC publications, tablets/devices for taking photos.

Print-out or hard copies of OPAL Tree Health Survey, Observatree pest and diseases poster.

Clip boards, paper, pencils.

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