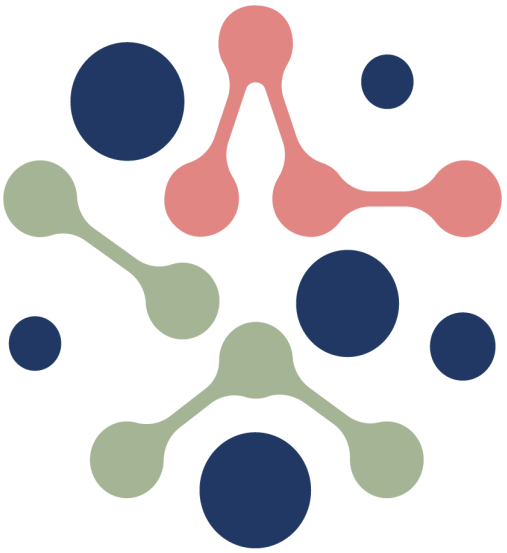

eu-citizen.science

The Platform for Sharing, Initiating and Learning Citizen Science in Europe

Deliverable 5.3: Report on trainings

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Please cite this work as:

Sheppard, A., Herrera, A., Haklay, M., 2021. EU-Citizen.Science, D5.3. Production of training modules, UCL, London.

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Acknowledgement

EU-Citizen.Science has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement no. 824580

Document Identification Sheet

Project Ref. No.	824580
Project acronym	EU-Citizen.Science
Project Full Name	The Platform for Sharing, Initiating and Learning Citizen Science in Europe
Document Name	D5.3 Report on trainings
Security	Public
Contractual Date of Delivery	Month 36, 31.12.2021
Actual Date of Delivery	21.12.2021
Type	Report
Deliverable number	D5.3
Deliverable name	Report on trainings
WP / Task	WP 5 (UCL)
Number of pages	174
Authors	Alice Sheppard (UCL), Abril Herrera (UCL), Muki Haklay (UCL)
Contributors	None
Review	Lucie Steigleder, Marie Cours
Project Officer	Niamh Delaney
Abstract	This Deliverable is based on Task 5.3, and includes the production of specific training modules within the consortium and the call and process

	of including training modules from external contributors. Each module was created to provide between 1 to 2 hours of training. This Deliverable was based on the identification of specific training needs provided by Task 5.1 (Assessment of training needs and desired formats).
Keywords	EU-Citizen.Science, Citizen Science, Training

Version Log

Version	Date	Released by	Nature of Change
V0.1 Draft	01/12/2021	Alice Sheppard (UCL)	
V0.2 Draft	08/12/2021	Alice Sheppard (UCL)	Review by Lucie Steigleder (ECSITE) and Marie Cours (RBISN)
V0.3 Draft	13/12/2021	Alice Sheppard (UCL)	Updated with Lucie Steigleder (ECSITE) and Marie Cours (RBISN)' s comments
V0.4 Draft	13/12/2021	Alice Sheppard (UCL)	Sent to Antonella Raddichi (MfN) for review
V1	21/12/2021	Alice Sheppard (UCL)	Final document prepared for submission

Definitions and Acronyms

CA	Consortium Agreement
CC	Creative Commons
CSA	Coordination and Support Action
Data	Information, in particular facts or numbers, collected to be examined and considered as a basis for reasoning, discussion, or calculation. In a research context, examples of data

	include statistics, results of experiments, measurements, observations resulting from fieldwork, survey results, interview recordings and images. The focus is on research data that is available in digital form. (European Commission, 2016)
Dataset	A grouping of data
Digital Curation	Selection, preservation, maintenance and archiving of electronically stored data
DMP	Data Management Plan
DoA	Description of Action
DS	Data Set
EB	Executive Board
EC	European Commission
ECSA	European Citizen Science Association
FAIR	Findable, Accessible, Interoperable and Reusable
GA	Grant Agreement
GD	Google Drive
GDPR	General Data Protection Regulation
GPF	Grant Preparation Forms
H2020	Horizon 2020
IPR	Intellectual Property Rights
Metadata	A description of data
MoRRI	Monitoring the evolution and benefits of responsible research and innovation
Open Access	Access that is free to all and free of any restrictions
Open Data	Data that can be freely used, shared and built on by anyone for any purpose
OpenAIRE	Open Access Infrastructure for Research in Europe
PPSR	Public Participation in Scientific Research

Repository	A location in which data is stored or managed
RIA	Research and Innovation Action
RRI	Responsible Research and Innovation
SDGs	Sustainable Development Goals
WP	Work Package
WPL	Work Package Leader

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Executive Summary

The vision for the EU-Citizen.Science platform is to aid in the mainstreaming of citizen science, by building a sustainable platform as a learning space for citizen science in Europe for researchers, citizen science practitioners, policy makers, journalists, citizen scientists and other stakeholder groups. To achieve this aim, the project supports the development of ~20 training modules on a wide variety of CS-related subjects, aimed at this range of stakeholder groups. This Deliverable presents 24 training modules, 17 of which are from various Consortium partners and not the promised 3 but 10 modules developed by Cascading Grants awardees, drawing on the expertise from 10 institutions or individuals outside the Consortium. We describe the Moodle platform and the structure and topics of these training modules, the training and evaluation processes used in creating them, and the protocol created for future users of the eu-citizen.science platform who may choose to create their own training modules during the years 2022-2027. We also report how we built on our earlier work identifying specific training gaps in the field of CS, using a survey and a workshop to select the topics of the modules and widening the scope of topics and available languages with the call for Cascading Grants. Finally, this Deliverable concludes with some recommendations for maintaining the sustainability of this platform, highlights potential topics for further training modules to be written in the future and provides some recommendations based on lessons learned for other CS Projects who may wish to provide CS training in the future.

1. Introduction

1.1 The EU-Citizen.Science Project

Citizen science (CS) actively involves the public in scientific research that generates new knowledge or understanding, and thus has the potential to bring together science, society and policy makers in an impactful way. As a core dimension of Open Science, it opens up the opportunity for all members of society to take an active role in research, innovation and the development of evidence-based policy, at local, national and EU levels.

It is the ambition of the EU-Citizen.Science project ("the Project") to build on the growing impact of citizens participating in research across the full range of scientific enquiry, by developing a sustainable platform to act as a mutual learning space for CS, focusing on Europe but relevant globally.

The overall vision for the EU-Citizen.science platform ("the Platform") is to aid the mainstreaming of CS in Europe, such that it becomes an appreciated and widely established means for the democratisation of science in Europe, as shown in Figure 1 below.

Figure 1: The vision, mission and objectives of the EU-Citizen.Science project

The building of the Platform is being pursued through three interconnected lines of activity:

1. Coordinating CS actions, and creating a curated list of existing CS resources;
2. Engaging quadruple helix stakeholders at local, national and European levels, and
3. Creating a mutual learning space, including a set of co-designed short course style training modules.

In keeping with our mission, we aim to engage with CS participants, practitioners, researchers, policy makers, teachers and schools and society generally. One of the many methods for doing so is by creating training modules with learning outcomes across a wide range of CS aspects and aimed at a range of target audiences.

1.2 The Platform

The Platform can be reached at https://eu-citizen.science/. The vision is for it to become a central hub for knowledge sharing, coordination, and action at the European level. As shown in the diagram of work packages for the project in Figure 2 below, the Platform will include:

- a mutual learning hub hosting a wide variety of CS and training resources;

- a projects and networks hub to help practitioners find each other outside the platform;
- training modules on a range of CS topics;
- a CS events calendar;
- community forums for conversations and collaboration to take place amongst the community of practitioners on the Platform itself.

The Platform is visible to any visitor, but to access certain features you need to create an account. These features include, for example, access to training modules and the ability to submit resources to the curated list. The last item is an example of a cocreation approach, in which any stakeholder in the field of CS may share examples of useful material into a curated collection available to anyone.

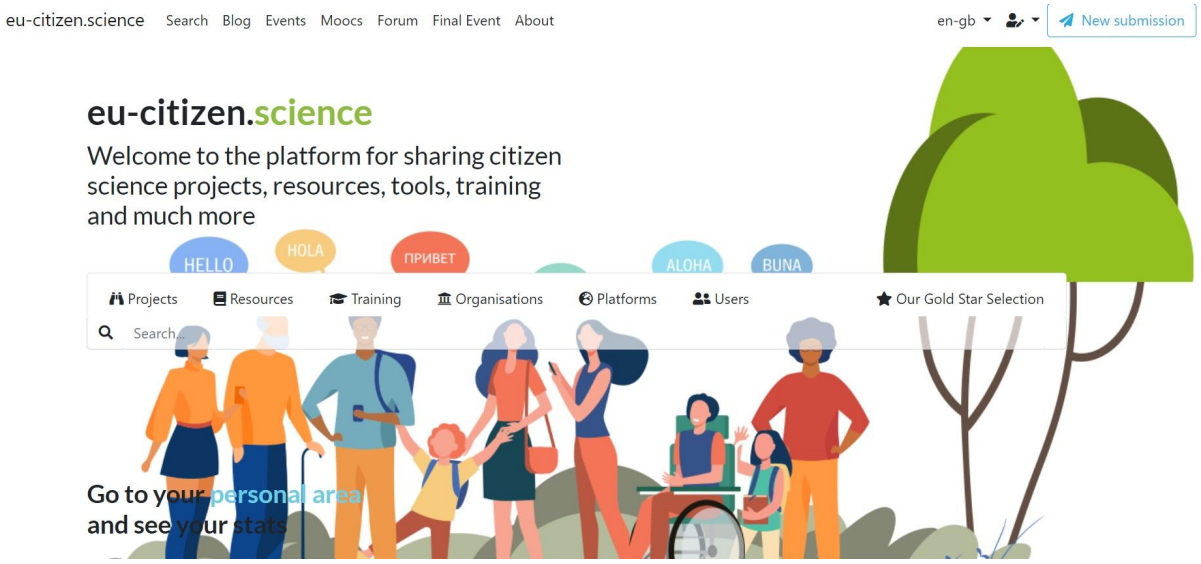

Figure 2: a screenshot of the eu-citizen.science platform as of December 2021. Note buttons such as "Go to your personal area and see your stats" and "New Submission", which allows the site to be interactive and unique to each individual with an account.

Such Resources are existing materials which increase knowledge and skills on the topic of CS. They may be websites, courses, videos, policy briefs, scientific publications or many more formats. The topics they cover range from introductions to CS to much more specialised topics, such as CS in schools, data quality, empowerment, impact, or project sustainability.

One category of Resources is Training, also known as Training and Educational Material, which refers specifically to "the design and implementation of citizen science as a practice and not for very specific activities such as how to carry out a soil survey or how to identify marine fish" (see D5.2, Section 2.1.1). A further subcategory of Training is the Training Modules, which are short, stand-alone courses created or funded by the eu-citizen.science project. It is this last item, the Training Modules, which are the subject of this Deliverable.

1.3 Purpose of this deliverable

This Deliverable will set out the process of completing Tasks 5.3 and 5.4, which are the creation and evaluation of training modules respectively.

Task 5.2 involved the identification of training gaps; Task 5.3 follows this up by the creation of training modules providing information and skills acquisition on these subjects, as well as the needs of specific stakeholder groups as identified in WP2. Different Consortium partners were responsible for the development of different modules, and there were additional funds allocated for organisations outside the Consortium to produce an additional training module. This Deliverable will set out how the training modules were written and how an additional 10 training modules were sourced through Cascading Grants awards. We will also explain certain changes that had to be made as a result of the Covid-19 crisis, for instance changes to the planned "Train the Trainer" workshops (which were replaced by a training module on this topic).

In accordance with Task 5.4, this Deliverable will explain how we carried out the evaluation of the training modules, including certain changes that had to be made as a result of the Covid-19 crisis; for example, the plan to bring 20 participants from the identified target audience together to test each module could not safely be carried out. We will detail how we created a Quality Assurance process with a standard module evaluation with remote user-tests and reviews with key criteria which had to be met.

Lastly, this Deliverable contains a short set of recommendations for further improving training modules, filing additional identified training gaps and ensuring that the modules will be part of a self-sustaining platform for 5 years following the end of the project, then finally widens the scope to provide recommendations for other potential CS training providers in the future.

1.4 List of modules on the Moodle platform as of December 2021

This is a list of modules currently either completed or very near completion and likely to "go live" in the early months of 2022. At the time of writing, a few may not be visible to a student on the Platform, but this is likely to change very rapidly as reviewers sign off modules as complete. The "Developed By" column may indicate either a Consortium member, a project partner organisation, or a third party for example a Cascading Grants awardee or other outside organisation. All these courses will be available by going to the website URL https://moodle.eu-citizen.science/course/index.php or by clicking on "Moocs" from the main Platform.

Table 1: Overview of Training Modules

Module name	Developed by	Short description
Introduction to Citizen Science	UCL	A basic introduction to CS for someone with no prior knowledge of the subject: the definition, history and typologies.
Introduction to Citizen Science for Journalists	UCL/MfN Berlin/Ecsite	A basic introduction to CS for someone who wishes to communicate about it: examples of CS stories, frequently used terminology and an overview of regularly discussed issues, e.g. data quality.
Citizen Science Typologies	UCL	An introductory course for anyone wishing to learn about ways to classify and describe CS and CS activities, plus the challenges of doing so.
Leading a "Train the Trainer" workshop	Earthwatch	A course for CS practitioners looking to run workshops to train CS leaders in the field, to deliver CS programmes or training as part of their project.
Citizen Science Projects: How to Make a Difference (Parts 1-4)	WeObserve	4 3-hour CS courses for the practitioner or citizen scientist on CS and citizen observatories, best practices, project design, data collection and analysis, and how to use your findings to disseminate results and/or take action .
Storytelling for Citizen Science	ECSA Storytelling Working Group	An introduction to storytelling and tools to shape narratives around CS, in order to connect with different audiences
Volunteer Engagement, Management and Care	UCL	A course for the practitioner or engaged citizen scientist on volunteer motivation and engagement, community building, barriers and vulnerabilities, and the importance of communication with and among citizen scientists
Doing citizen science as open science: What, why, and how	Pen-Yuan Hsing, Rafaella Antoniou, University of Bath	A course on CS as part of Open Science, the necessities of and misconceptions around Open Science, and how to choose tools for and aspects of Open Science in your citizen science project
Citizen science in the classroom: A toolkit	Maria Grau, Escola Universidad'Infermeria i Terapia Ocupational-Terrassa, *et al*	A course on the process of adapting a CS project to the primary or secondary school classroom, relevant community building and deciding what aspects of CS to use, measuring impact and evaluation
Bürger schaffen Klima Wissen	Frank Becker, Science Shop	A course in German which explains how citizens can become involved in scientific activities and also how to make practical

(Citizens Create Climate Knowledge)	kubus, Technische Universität Berlin	equipment for climate monitoring
Začnime si s občianskou vedou (Let's start with Citizen Science).	Zuzana Stožická, Slovak Centre of Scientific and Technical Information/ Centrum Vedecko-Technicky	A course in Slovak which aims to spread the ideas of CS to communities and students who are not yet familiar with the concept, its potential to advance society, good practices, project design, basic terminology and also how active citizens can connect with the scientific community.
Basics on regulations and ethics for citizen scientists	Dimitar Kyosev (independent)	A short introduction to some legal concepts of CS, e.g. privacy and copyright laws, how to ensure compliance with these laws and what to do if one is broken, e.g. a data breach, and some ethical questions e.g. what the citizen scientist is owed for their efforts. It does not provide legal advice.
Kutatóknak a "Citizen Science" megközelítésben rejlő lehetőségekről (Value of citizenscience for the traditional researcher).	Oliver Vaczi, Vadonlesők Közössége Természetvédelmi Egyesület (Nature Conservation Society of WildWatchers' Community)	A course in Hungarian aimed at the scientific researcher to show the value and importance of CS in the scientific field, and to tackle misconceptions about CS. It takes the possibly hesitant scientific researcher through aspects of CS, such as relevant fields and projects and avoiding pitfalls.
Social media management for citizen science projects	Sofia Oliveira, Universidade do Porto	A course to guide the CS practitioner through the uses and advantages of social media for their project, and to help them choose the best form of social media for them
Research integrity, ethics and citizen science	Jacqui Goldin, University of the Western Cape	A course aimed at researchers and practitioners in academia and NGOs on the relationship between research ethics and integrity and the relevance of this to CS, and how to incorporate this into research methods
Engagement and dissemination tools and strategies to implement a citizen science project.	Denisa Gibovic, Marc Melus, Blue Room Innovation SL	A course aimed at the CS practitioner about engaging members of the public and specific stakeholder groups, developing a sustainable community and specific online tools for dissemination and collaboration

Empowerment through co-designed Citizen Science in research and formal university education	Annegret Nicolai, Morgane Herve, Living Lab Clef	A course aimed at educational decision-makers about the potential of CS for empowerment and democracy, practical tools to include CS in higher education, plurality inclusion in teaching activities and training students and citizens to use CS in their personal and professional lives.
Designing for Learning through Citizen Science	NHM	A course aimed at formal and informal educators on the topic of learning opportunities through CS activities, and how to design your CS project to facilitate learning.
Your Right to Privacy Online	Huma Shah, University of Coventry	A course aimed at the citizen scientist to equip them with knowledge about their privacy rights, personal data and how it is collected online, privacy regulations and free online tools that reveal more about websites and tools while turning off tracking technologies.
Introduction to Academic Writing	TCD	A course aimed at citizen scientists interested in publishing their work. It explains how academic publishing works, how to go about writing a paper and working with journals, and how to set up a writing group.
Evaluation and Impact in Citizen Science Projects	ZSI	A course aimed at CS practitioners who will evaluate CS projects, on the difference between evaluation and impact, choosing appropriate strategies, setting up the evaluation process and practical tools, methods and examples.

This is a total of 24 modules. More are being planned for the future, e.g. on CS in museums and CS for Teachers, plus some modules are being considered for translation into other languages, so the total is likely to increase considerably in 2022 and beyond.

2. Introduction to the Moodle platform

The Moodle platform is an integrated part of the eu-citizen.science website on which the training modules are hosted. It is reached by clicking on “Moocs” in the main menu and using your eu-citizen.science credentials (username and password) to log in.

The word “Mooc” stands for Massive Open Online Course. During the Project and in this Deliverable we will use the name “Training Module” or “Module” because these courses are very short and several may be taken together as part of the same learning process.

2.1 Features of the Moodle platform

Moodle is a free and open-source learning platform, ideal for creating distance learning courses. Participants may adopt the role of administrator, teacher, non-editing teacher or student; the former two are able to edit courses, while administrators can create them from scratch. It is well established, having first been developed in 2002[1], and is used by several institutions, including UCL, to host student assignments, lectures, files, discussion forums, course announcements, etc. Usefully, it is also programmed to be readable on a small device such as a smartphone.

Modules appear as a series of "Topic"s, under which subtopics are headings for the course content. 4 Topics per module are mandatory while 4-8 further Topics are specific to each training module.

Moodle has the feature that course content, which appears in the subtopics, may appear in a variety of formats. In the case of eu-citizen.science modules, the most commonly used types of format include the following:

- A "page": the simplest format, a blank space for text which allows the upload of images and the embedding of videos, images or interactive content;
- A "quiz", which can count towards a learner's final assessment (summative assessment) or not (formative assessment);
- Interactive content, also known as H5P, which contains a huge variety of interactive resources. The most commonly used ones by eu-citizen.science module writers are:
    - Accordion: Text panels that can be opened and closed by clicking on their headings. The headings are always visible, but only one panel of text is visible at once. This allows the learner to focus on one topic at a time, rather than being confronted with a "wall of text".
    - Presentation: A format similar to Powerpoint, but more interactive: a slideshow is set up which the learner can go backwards and forwards at their own pace. The slides can contain text, images, videos, quizzes and more. Images on these slides have "hover text" in which the learner's mouse can be moved over the picture and some extra text will appear. Note that a Powerpoint file cannot be uploaded onto Moodle to substitute for this type of presentation; it has to be written in H5P (although individual presentation slides are uploadable as images).
    - Interactive quizzes, such as "drag and drop" or "fill in the blanks" where a paragraph with missing words is shown and learners type or drag in these missing words. These are useful for formative assessment (see section 3.5).
    - Interactive Video: A video which can be paused and the learner participate in an activity such as clicking on or dragging a picture, or doing a quiz.

[1] Reference: https://en.m.wikipedia.org/wiki/Moodle

- Image Hotspots: An image is shown with marked areas where the learner can click for some extra text to appear.
- Turning Cards: An image is shown with some text which the learner can click to "turn over" and see some different text on the other side. This can work as a question and answer, or to see content in two different languages, for example.

It was established very early on in our research on best practices for course writing (see section 3.1) that learners appreciate and learn better with more interactive content, so it was important to use these as much as possible. It was also a significant task to learn to use all these new features, to document how to use them and to teach them to all module writers. This training process is covered in detail in Section 4, "Module Creation".

3. The eu-citizen.science training modules

Each module is designed to be stand-alone, in that a learner will study alone, without tuition or interaction with other students; this allows the modules to be maintained on the website indefinitely and at least for 5 years from after the project's lifetime. Each module is free and aimed to last 1-2 hours, though a few last for 2.5 or 3 hours. Each one covers some aspect of Citizen Science (CS).

3.1 Module presentation and organisation

The modules are presented on the site https://moodle.eu-citizen.science/, which can be accessed alone or via https://eu-citizen.science/ itself. An eu-citizen.science login is required to view the modules.

This page shows the modules' titles and cover pictures. Originally, it also showed the Course Summaries (see section 3.2, Module Structure). However, it was eventually found that these summaries took up too much space and made very few training modules visible at once.

The modules are categorised as "Introductory" or "Generic Citizen Science courses". (There is a third category, "Miscellaneous", but it has not been used so far.) The former are suitable for people with little to no experience of CS. This can be a member of any of the target audiences. The latter are suitable for people with some knowledge and experience of CS, or who have taken some introductory modules. The two categories are on separate pages.

Anyone with an eu-citizen.science login may read most of the contents of a training module without having enrolled. However, they would need to enroll in order to take the quiz and receive a badge (see section 3.5).

3.2 Module structure

The modules follow a standardised structure. Each contains 8-12 main sections (known as "Topics" in the Moodle platform), excluding the course summary; 4 main sections are standardised and 4-8 are unique to each module. The order in which each standard Topic appears is also standardised.

Each module contains the following Topics:

- Course Summary: This was originally placed on the course menu and was designed to be written to optimise SEO searching, with fairly standardised text beginning, for example, "This is a free, 1.5 hour course that provides an introduction to ..." and includes the following information:
    - More details about what to expect in the training module;
    - The knowledge level required (e.g. whether or not the module is suitable for a learner is new to CS);
    - Learning objectives, e.g. "By the end of this course, the learner will be able to ..." followed by bullet points, e.g. "understand what 'Train the Trainer' is and how it can benefit citizen science projects"
    - the intended audience, e.g. "This guidance is aimed primarily at contributory citizen science projects, and provides advice mainly to those who wish to host face-to-face training"
    - an enrolment key, e.g. "Volunteers" or "Introforjurno2CS". Most visible modules allow anyone with an eu-citzen.science login to view the material without enrolling, but the learner must enroll in order to take the quiz, for example.
- Welcome & Introduction: This section provides a welcome from the course leader/s, ideally as a video with a transcript, and elaborates on the learning objectives and the structure of the content. For example, "We will first look at ... We will then go onto ..." It can be a fairly short section, but it is vital that it explains what the learner will find in the module and also what they need to do in order to pass the quiz.
- 4-8 unique sections of course content, which is also arranged as topic headings, under which there are one or more subtopics which contain the course content and activities (e.g. reading a text, watching a video, using interactive content, or mini-quizzes).
- Final Quiz: This is a 10-question quiz, which is marked automatically as part of the stand-alone nature of the modules, so learners cannot write essays to be marked or do group discussions, for example. The quiz questions use Bloom's Taxonomy (knowledge, comprehension, application, analysis, synthesis, and evaluation); this means that while some questions are merely factual (e.g. "CS is a discipline that goes back at least to the days of Charles Darwin: true or false?"), others would require the learner to consider several aspects of the module as a whole (e.g. choosing examples of citizen science to match to a

certain typology or relevant environmental problem). If the learner scores 50% or more in the quiz, they will be e-mailed a badge (see section 3.5).

- Further Reading: A list of books, papers, websites or other sources of information for the learner who wishes to find more information on the topic. It may recommend a closer look at materials already used on the module. This may be fairly short, e.g. recommending another module, or it may be quite extensive, e.g. teasing out various aspects of the module into different headings and writing a little about each potential further source of information.
- Sources & Acknowledgements: The references or bibliography of all materials quoted or used as course material, e.g. image credits. This may have some overlap with the Further Reading section.

3.3 Training gaps and module subjects

Part of our mission, specifically Tasks 5.2 and 5.3, has been to fill knowledge gaps by providing training material on subjects that are not currently covered elsewhere. Individual CS projects generally include tutorials for how to carry out their specific project work, e.g. identifying particular plant or animal species, and these often appear as attractive videos that get shared to the wider community. However, training material on how to design and run a CS project, or the practice of CS in general, is currently less widely available.

Deliverable D5.2 describes our earlier work to identify training gaps (Sections 2.2.1, 2.2.2, 2.2.3, 2.4.1, 2.4.2) via a survey of the CS community and then an online workshop in June 2020, so only a brief overview of this previous work is provided here. Training gaps most mentioned by the survey and the workshop participants were:

- An introduction to CS
- Research design and methods
- Engagement
- Data quality and standards
- Transferability
- Communication

Many other training gaps were mentioned but by fewer numbers of people, e.g. links with formal education, legalities and ethics, or academic writing.

Certain modules developed took into account the need to give priority to these training gaps, including some examples developed by Cascading Grants awardees, which was one of the focuses of the call (we will address the Cascading Grants call in section 4.3). Some examples of such modules are:

- Introduction to Citizen Science (for a general audience)

- Introduction to Citizen Science for Journalists
- Two introductory CS modules in Slovak and Hungarian
- Volunteer engagement, management and care
- Social media management
- Engagement and dissemination tools
- Storytelling for Citizen Science
- Evaluation and Impact Assessment

3.4 Training for specific stakeholder groups

The original grant agreement proposed that, of 20 modules developed, "Of these modules, 10 will be aimed at citizen scientists, 6 for practitioners, 2 for policy makers and civil servants, and 2 for journalists (exact details will be agreed as the project evolves)." A variety of stakeholder groups or audiences is thus the plan, while most training gaps identified implicitly target an audience of researchers and citizen science practitioners.

Table 2: Target audiences of training modules

	Target Audiences				
Module name	**Citizen Scientists**	**Practitioners / scientists**	**Journalists**	**Educators**	**Policy makers / civil servants**
Introduction to Citizen Science		✓			
Introduction to Citizen Science for Journalists			✓		
Citizen Science Typologies	✓	✓		✓	✓
Leading a "Train the Trainer" workshop		✓			
Citizen Science Projects: How to Make a Difference (Parts 1-4)	✓	✓			
Storytelling for Citizen Science	✓	✓	✓	✓	
Volunteer Engagement, Management and Care	✓	✓			
Doing citizen science as open science: What, why, and how	✓	✓			✓

Citizen science in the classroom: A toolkit				✓	
Bürger schaffen Klima Wissen (Citizens Create Climate Knowledge)	✓	✓			
Začnime si s občianskou vedou (Let's start with Citizen Science).	✓	✓	✓	✓	✓
Basics on regulations and ethics for citizen scientists	✓				
Kutatóknak a "Citizen Science" megközelítésben rejlő lehetőségekről (Value of citizenscience for the traditional researcher).		✓			
Social media management for citizen science projects		✓			
Research integrity, ethics and citizen science	✓	✓	✓	✓	
Engagement and dissemination tools and strategies to implement a citizen science project.		✓			
Empowerment through co-designed Citizen Science in research and formal university education		✓		✓	
Designing for Learning through Citizen Science		✓		✓	✓
Your Right to Privacy Online	✓				✓
Introduction to Academic Writing	✓			✓	
Evaluation and Impact in Citizen Science Projects		✓			✓

Some modules, such as “Introduction to Citizen Science for Journalists” and “Kutatóknak a ‘Citizen Science’ megközelítésben rejlő lehetőségekről (“The Potential of Citizen Science for Researchers”) have a very explicit target audience. Others may be suitable for various audiences; for example, “Volunteer Engagement, Management and Care” is directed both at CS practitioners and at very engaged citizen scientists who may have found themselves in the position of community leader (e.g. a moderator for online discussion forum or a representative of other participants); and “Začnime si s občianskou vedou (Let’s start with Citizen Science)” is explicitly aimed at all audiences.

Modules such as “Citizen Science Typologies” and “Measuring the Impact of Citizen Science”, plus all those with a school education component such as “Citizen Science in the Classroom”, have various target audiences, but all are also suitable for policy makers who wish to know the wider implications, or the relevant terminology, of CS.

3.5 Studying a module: the learner’s experience

A learner might come across a training module through a search engine or by seeing it listed as a Mooc or Training Resource on the eu-citizen.science platform. They would usually go to the Moocs page to view the list of modules and would click on the training module’s name to see the summary and enrolment key.

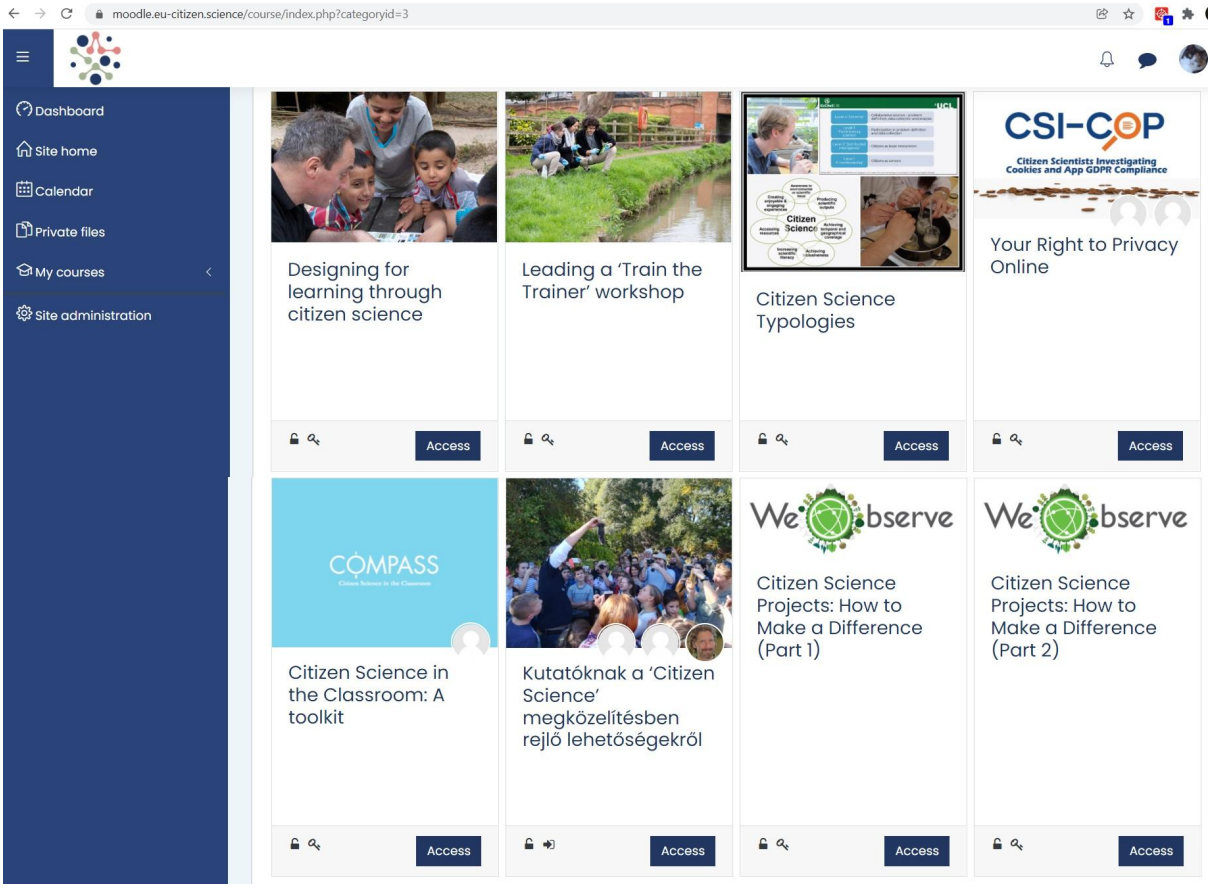

Figure 3: A screenshot of the Moodle platform with some of the training modules. The learner would be able to view the Course Description and enrol by clicking the "Access" button.

Each course summary would indicate the learning objectives, a rough sketch of the module content, the knowledge level required, the time taken and an enrolment key. The learner might immediately enter this enrolment key, or they may choose to enter it later, for example, when they wish to take the quiz.

The Moodle platform allows two methods of navigation along a course. As we have seen, it is set up as headings and subheadings, so a learner could simply click these one at a time. Alternatively, there are back-and-forth arrows that allow them to move between sections in chronological order. The Moodle interface allows the learner to tick a "completed" box for each activity or section, but user-testers have reported that these do not yet fully function in all training modules and it is never possible to use them prior to enrolment.

In general, the learner would spend 1-3 hours on each module, not necessarily all in one sitting.

The learner would have the opportunity for formative assessment in the form of small activities such as mini-quizzes as they go along. The summative assessment always comes at the last topic but two: the Quiz.

When the learner reaches the quiz, they may make multiple attempts. (The quiz is also of course the equivalent of an "open book" examination. They can go back to sections of the module to check their understanding if they wish.) The quiz is always 10 questions long. If they score 50% or more, they will be e-mailed a badge. An example of such a badge (for the Citizen Science and Open Science module) is shown below. The badge reflects the institution of the module writer, ECSA and eu-citizen.science.

Figure 4: An example of a Course Badge, which would be e-mailed to a learner who had enrolled and completed the 10-question Quiz of the Storytelling for Citizen Science training module.

Following the quiz, the learner could then browse the Further Reading and Sources & Acknowledgements topic sections, which of course are optional. If they have gained a great deal of inspiration from the module, they might go on to read further. Some modules, such as Introduction to Citizen Science for Journalists, make the entire course material available as a PDF[2] which the learner can then download and keep as a resource.

4. Module Creation

As the modules were written by many different individuals and organisations, and as the plan is that modules will continue to be written by an increasingly diverse community from 2022-2027, it was vital to develop not only a standardised module format but also a standardised training process and documentation to guide module writers.

An early version of module creation instructions can be found in Section 4 of D5.2. In this section, we provide an overview of the entire process from planning a module, through the uploading of content onto the Moodle platform, to the quality assurance procedures.

[2] Haklay, M., Fabó Cartas, C., Troncoso, A., and Steigleder, L., 2021, Introduction to Citizen Science for Journalists, EU-Citizen.Science project (EU grant agreement No. 824580).

In this section, we focus on the process of creating a module and the needs of and assistance provided to module writers. We also report the changes to the module creation and quality assurance process that resulted from the Covid-19 crisis, namely the reduction of travel and the ability to meet face-to-face.

4.1 Preparation for module writing

During the year 2020, UCL Consortium members Alice Sheppard and Muki Haklay undertook training to develop a set of best practices for module creation. This involved the studying of a 15-hour OpenLearn course: "How to make an open online course"[3], and a Google document was created to take extensive notes from this course for future reference. The course emphasised thinking about who the target audience was and reflecting on what assumptions were being made about this target audience.

A set of best practices were developed, such as:

- Learners greatly appreciate interactive content, such as quizzes and videos, so these should be used where possible;
- Each topic and subtopic should show an estimated time required to complete it;
- Videos should not last longer than 5 minutes, and ideally be around 2.5 minutes;
- Transcripts of videos should be provided, e.g. as PDFs which the learner can click on;
- Images should be credited and also an image description should be added;
- Use Niram or a similar resource to estimate reading time for text, and avoid chunks of text which are too long;
- Do a literature review of the area of your course, even if you are an expert on the subject. This will not only provide the learner with a more comprehensive overview of the field, but also provide you as the course writer with resources you can re-use instead of developing your own.

Advice such as this was gradually collated and added to a large live document called the Module Design Guidelines, which is described in more detail in Section 4.2.2.

Before embarking directly on creating modules on the Moodle platform, a few "test modules" were created (obviously not visible to people whose roles did not include module writing - see section 2.1). On these "test modules" it was possible for any module writer to practice uploading content or using new H5P tools to see what worked well and what did not.

[3] The OpenLearn course can be found at https://www.open.edu/openlearncreate/course/view.php?id=2221.

4.2 Documentation

4.2.1 Content Design Template

The Content Design Template is sent to all module writers in the form of a Word document. It is essentially a very large table which asks them to plan each aspect of their module in detail. There are three columns: the first for the module section, the second for an example, and the third for "your text". It asks the module writer to consider each small section in detail, such as the module title, the module image and its accreditation, the number of topic sections, etc. It also contains a detailed Digital Asset Register for outside resources such as images, to ensure that no copyright violations take place when writing a module.

Not all module writers used the Content Design Template because it is extremely structured, which suited some individuals better than others. It is an optional document but extremely useful, and for those who do not use it, it is recommended that they write a planning document using similar headings.

A worked example of the Content Design Template can be found in Appendix 1.

4.2.2 Module Design Guidelines

The Module Design Guidelines is a live document provided to all module writers. During the year 2021 they were written and hosted by UCL, but from the beginning of 2022 they will be handed to ECSA with certain details (e.g. contact names and e-mail addresses) changed.

The Module Design Guidelines are a collection of module writing advice, from planning to style guides to a series of "how-to"s, e.g. how to use H5P, with screenshots from the Moodle platform and very specific instructions. They also contain an FAQ page adapted from the questions most frequently asked in Training Module Surgeries, e.g. "Is there an H5P type that allows me to create a table in Moodle?", "How much text is too much?", etc.

The Module Design Guidelines as they stand in early December 2021 can be found in Appendix 2.

4.3 The Cascading Grants Awards

From its origins, the project stated the intention to provide financial support in the form of grants to be awarded after a call for proposals for the creation of external modules. These external modules were expected to provide between 1 to 2 hours of training responding to the training needs identified through Task 5.1 (Assessment of training needs and desired formats). The selected

institutions, external to the consortium who would receive the grants and therefore provide the required modules would be selected by WP5 leader, UCL, along with the project Executive Board.

Initially, within the context of WP5, Task 5.3 Production of specific Training Modules, UCL set up a budget of 15,000 euros available for 'Financial support to third parties', that was expected to fund three grants of 5,000 euro each, for production of the aforementioned "specific training modules" in the EU-Citizen.Science platform. As part of Task 6.3 Engagement with science journalists/media, one of those grants was expected to be used for the production of a training module helping science journalists to familiarize with and better understand citizen science. However, it was later decided that due to the expertise of some members of the Consortium (Muki Haklay, Andrea Troncosco, Claudia Fabo Cartas and Lucie Steigleder), the production of the module "Introduction to Citizen Science for Journalists" would be done internally. It was also decided that the budget of 15,000 euros could be used to fund ten grants of 1,500 euros each instead of the initially proposed three where expertise was not within the consortium.

4.3.1 The Call and the Selection Process

The call was made public on the EC Funding & Tenders Portal and the EU-Citizen.Science platform[4] and directed to fund 10 projects/ modules up to a maximum of 1.500 € each, providing one grant per individual/organisation and receiving a maximum of one application per organisation. A copy of the call can be found in Appendix 4.1.

[4] https://eu-citizen.science/call/

Figure 5: A short diagram describing the process of the Cascading Grants call.

Applications were asked to convey the Guide for Applicants[5].

19 proposals were received and considered by the reviewer Committee (composed of Nadia Dewhurst-Richman and Muki Haklay [UCL], Antonella Radicchi and Silke Voigt-Heucke [MfN] and Claudia Fabó Cartas [ECSA]). The evaluation followed a screening of the submitted proposals according to the eligibility criteria and a scoring system that evaluated issues such as the relevance of the topic of the training module for the "Scope of the call", the quality of the suggested training module, and the community engagement, just to mention some of the quality controls.

Finally, 10 citizen science training modules proposals that ranked on top were selected:

- Doing citizen science as open science

[5] https://eu-citizen.science/static/site/files/EU-Cit.Sci_Guide_for_Applicants.pdf

- Kutatóknak a "Citizen Science" megközelítésben rejlő lehetőségekről (Value of citizen science for the traditional researcher).
- Citizen science in the classroom: A toolkit.
- Empowerment through co-designed Citizen Science in research and formal university education.
- Research integrity, ethics and citizen science.
- Estrategias y herramientas de comunicación aplicadas a proyectos de ciencia ciudadana (Engagement and dissemination tools and strategies to implement a citizen science project).
- Basics on regulations and ethics for citizen scientists.
- Bürger schaffen Klima Wissen (Citizens Create Climate Knowledge).
- Social media management for citizen science projects.
- Začnime si s občianskou vedou (Let's start with Citizen Science).

The Call and the subsequent blog post announcing the Cascading Grants award winners can be found in Appendices 3.1 and 3.2, respectively.

4.3.2 Cascading Grant Awardees MOOC development process

In order to develop their MOOCs, the Cascading Grant awardees were given a set of procedures and guidelines as follows:

1. Download and fill in the core information table in the Content Design Template and send it back to UCL.
2. Enter your Course information(eg. Module Summary, Audience, Contact, User Testers) into the training module spreadsheet.
3. Finish the design of the first draft using the content design template and send it to your reviewer for the 1st Draft Review.
4. Respond to your reviewer feedback. Remember, you do not need to accept all suggested changes but you do need to document your thoughts on each point.
5. Copy and paste the content into Moodle.
6. Complete 5 user-testings
7. Make sure your course covers ALL aspects of the 2nd Draft Review to your reviewer and UCL contact for final approval
8. Send to UCL no later than two months after signing your contracts your Usability and Accessibility Checklist approved by your reviewer.
9. Receive payment from UCL.

A particular advantage of the Cascading Grants awards was that several awardees were able to write modules in languages other than English, namely German, Spanish, Slovak and Hungarian. Two of these modules (Slovak and Hungarian) were introductory, to broaden the awareness and

accessibility of CS in their countries; and two were more advanced, making a specialist topic available in another language.

4.4 Module Translation

Task 5.2 (described in D2.5) stipulated that "Translation of critical training material to multiple European languages will be directed to the European Citizen Science Translation Hub from the DITOs project." The Citizen Science Translation Hub, a small website created by UCL which invited CS projects to share material for translation, and volunteer translators (e.g. scientific translation students, or multi-lingual citizen scientists) could choose what they wished to translate. However, following discussions between UCL and NHM Berlin, it was decided not to incorporate this website into the EU-Citizen.Science Platform because it lacked a friendly, sophisticated interface allowing for immediate translation or small tasks. Rather, the workflow was explained, and the Consortium developed its own translation interface which did contain these features: the original text and the translated text can appear side by side. There are plans to translate the Introduction to Citizen Science for Journalists into Lithuanian and the Storytelling module into Spanish and/or Portuguese.

4.5 Training Module Surgeries

The practical support given to all module writers was formalised by Nadia Dewhurst-Richman in a weekly "Training Module Surgery" which from April to November 2021 took place every Wednesday at 3pm (European time) over Teams and would last up to an hour. Anyone in the process of writing a module was welcome to attend, and a few members of the Consortium occasionally attended to gain insights into the modules being written. A minutes diary was kept in Google Drive to record the training taking place, such as questions, deadline alerts or other announcements, or the general subjects discussed, and attendees were encouraged to look over this for inspiration.

Some training module surgeries were planned around particular themes, such as "how to insert H5P content" (see section 2.1), and others were kept to announcements and open Q&A. Announcements often included upcoming deadlines or requirements such as what should be included in the Course Summaries. Occasionally, where a live demonstration was given, e.g. of how to insert certain types of H5P content, the session was recorded (with all participants' permission), kept in the WP5 folder and included in the Module Design Guidelines (see section 4.2.2) for module writers to watch at their convenience.

Occasionally, a module writer would ask a practical question, e.g. how to insert a particular object into a Moodle page. The most effective method for dealing with this would be to ask the module

writer to share their screen and the Training Module Surgery leader (Nadia Dewhurst-Richman, Alice Sheppard or Abril Herrera) would explain what to do on the spot. “Learning by doing” was often an easier process than reading long guidelines, no matter how carefully these guidelines were written!

Some module writers also wanted to discuss their course content, including wanting to run ideas past other module writers. In other cases, they had technical questions, e.g. could user-tests and reviews be in the same languages (e.g. Spanish, German, Slovak or Hungarian) as the modules? Cascading Grants awardees often had specific questions relating to their timeframes, e.g. how long they had from signing the contract to finishing their modules; and their reviewers often had questions, especially about their first review, e.g. if some content had only been summarised rather than written in full.

These training module surgeries were halted in November once most Cascading Grants awardees (see section 4.3) had completed their modules and the time came to focus on wrapping up the project.

5 Quality Assurance

Task 5.4 specified that “Each training module will be tested in a face to face situation by three or more partners and through Third Parties, with 20 participants in each location.” This was not possible to carry out due to the Covid-19 crisis making large meet-ups inadvisable. It was thus decided that, on the recommendation that 5 user-testers will find 80% of the problems[6], for each module, 5 user-testers would fill in a thorough user-testing spreadsheet, and each module would be reviewed according to a checklist of criteria prior to release.

The Moodle interface also displays links to an e-mail address and a feedback form, either of which any future learner can use to report bugs or offer recommendations for further improvement.

Due to the timing of the release of the training modules very close to the end of the project, it is unfortunately not possible to provide a realistic report on the success or failure of the training modules, such as uptake by various audiences, as such data is not yet available. We can report that as of December 2021 there are 403 Moodle users, but it is likely that many of these are module writers, user-testers and EU-Citizen.Science administrators.

[6] Nielsen, Jakob. "Guerrilla HCI: Using discount usability engineering to penetrate the intimidation barrier." *Cost-justifying usability* (1994): 245-272.

5.1 Quality assurance documentation

We describe briefly here the two main forms of evaluation used for each module once the content was uploaded onto Moodle.

In cases where the module was written in a language that was not English, the user-tests and reviews were written in the module's language. In most cases, there were Consortium members who spoke the relevant language; in one or two cases, such as the Slovak and Hungarian modules, individuals in the field of CS were found to carry out the reviews.

5.1.1 User tests

Module writers were responsible for selecting 5 user-testers from the target audience of their module where possible. These could be Consortium members, other colleagues, or sometimes students. Each of these individuals would receive a spreadsheet which asked a series of questions about the module content. It was divided up into topic sections, so obviously the compulsory sections e.g. "Welcome and Introduction" were labeled, while the module-specific sections were labeled with "Enter Section Name Here". Some questions were specific to certain sections, e.g. "Do you feel that the course summary provided enough information about the course? If not, what do you feel is missing?" while others were more generic and could be for any section, e.g. "Did all the links/videos work?"

It was required that user-testing forms were sent back to the module writers with the UCL team cc'd for evaluation purposes. It was a policy that user-testers should be thanked in the "Sources and Acknowledgements" section. However, user-testers were entitled to remain anonymous or simply put their initials if they wished.

Before signing off a course as ready, module writers were required to go through these user-tests and make changes according to recommendations, or to explain why they did not feel that a certain recommendation was inappropriate. For example, in the Volunteer Engagement, Management and Care module, four out of five user-testers commented that a video was "very powerful" or "very moving", but a fifth user-tester reported that it added nothing relevant, so it should be replaced with a link to an alternative resource and a picture. The module writer (Alice Sheppard) chose not to remove the video, but used this feedback to improve the explanation of the video's purpose and clarified what the learner should gain from that section. Where user-testing feedback was contradictory, the module writer would simply make a decision about which recommendation to follow!

Module writers who were also user-testers reported that the user-testing experience was extremely beneficial to them in writing their own module, as it highlighted important considerations to them.

An example of a completed user-test form can be found in Appendix 4.

5.1.2 Review checklists

Following the implementation of user-testing feedback, but prior to releasing the module, each module writer in the Consortium completed a checklist. This document was not created by the Consortium but research was done to find a standard template which promoted many best practices and contained the following: "This has been adapted from a checklist created by Matt S. Smith and Anna Trostnikova (Faculty of Engineering Sciences, UCL) for the Connected Learning course. Please use this checklist to help ensure that you have met basic best practice principles for good module navigation, communication, accessibility and legal issues." Following this was a series of sections with tickboxes, on subjects such as the course format and navigation, the clarity of the course, accessibility and legal aspects such as image copyright.

Because the Consortium is responsible for the output of the Cascading Grants awardees, reviews could not be done internally by these awardees but were done by Consortium members. Additionally, two separate Review Checklists were done for modules written by Cascading Grants awardees, a First Review (when the content was uploaded but before user-testing began) and a Second Review (after user-testing feedback was implemented but before the module went live).

Similarly to the user-test forms, if a module writer disagreed with a reviewer's recommendation, they were requested to explain their decision but did not have to implement all feedback.

Examples of First and Second reviews can be found in Appendices 5.1 and 5.2.

5.1.3 Public evaluation form

Members of WP7, working alongside UCL, developed a very short questionnaire to be hosted as a GDPR-compliant Google form on the Platform. This is found at the bottom of the Moodle page through the following notice:

> "Stay in touch
> Give us your feedback ;)
> If you want to tell us how this learning platform is going so far, or you have some suggestions to make, please feel free to fill in our feedback form in this link."

The form first asks whether your feedback is a question, a comment, a bug report or anything else, offers a free text field for the feedback, invites suggestions, and also offers the person filling in the form the option either to remain anonymous or to provide their name and/or e-mail in order that their feedback can be followed up.

A copy of this feedback form can be found in Appendix 5.3.

6 Sustainability of the Platform and future recommendations

At the end of 2021, the Project will come to an end and the Platform will be hosted for at least 5 years by ECSA. In this final section, in accordance with the Grant Agreement's stipulation for this deliverable to contain "recommendation for future development of training in the field of citizen science", we comment on the lessons learned when module writing and training gaps which could be filled further, for the benefit of all CS stakeholders who will use the Platform in years to come and especially those who may wish to write training modules themselves.

There are some identified training gaps which could be filled further by providing modules explicitly on the following topics:

- Research design and methods
- Data quality and standards
- Transferability

(The first two topics are covered in modules such as "Citizen Science Projects: How to Make a Difference", and a module on transferability - namely "Citizen Science in Museums" - is planned; but as of December 2021 no modules are yet explicitly dedicated to these areas.)

For future module writers, we recommend that:

- The Module Design Guidelines are regularly used and added to as necessary;
- Module creators stay in touch with each other to learn from each other, avoid duplicating each other's work, and also to provide "learning by doing" technical support to each other, such as inserting H5P content;
- Ample time is allocated for module production, in case there are problems or delays.

For other individuals or projects who may wish to consider providing training in the field of CS, we recommend that:

- Training is undertaken in course-writing and in CS itself, the former to gather skills and the latter to "think like a student" and gain experience of the student's perspective;

- Knowledge sharing is done as much as possible, to provide mutual support and the exchange of ideas, as well as sharing information about what training gaps still exist;
- A literature review and conversations with colleagues working in similar fields to the training provider, as this will create a broader vision and reading list for their training;
- A repository of useful materials already in existence is created, as this will save a great deal of time when writing a course and also provide a more balanced set of resources;
- Any online platform developed for training has funding allocated for more than one person skilled in code and bug fixes to be present for when problems occur (e.g. someone is having difficulty logging in, or when there is a website error);
- User-testing should be done on as wide an audience as possible, not just (for example) students or colleagues who will already be familiar with the style of the training provider and who are likely to have up-to-date technology;
- The field of CS training is regularly reviewed to identify further training gaps and whether learners tend to have a particular interest in any area of CS.

There are currently 24 modules available on the platform, many of which are in the process of being made visible to learners. Some, such as “Introduction to CS for Teachers” and “CS in Museums” are in preparation and likely to become available during 2022. The creation of some modules were delayed due to constraints on time or other problems encountered by module writers during 2021, so the number of modules visible is likely to continue to increase over the next few months.

Appendix 1: The Content Design Template for the Introduction to Citizen Science for Journalists course

Content Design Template - Introduction to citizen science for journalists

1. Core Information Table

CORE INFORMATION		
COURSE NAME *This field will be copied into the COURSE NAME field in Moodle.*	**EXAMPLE** e.g. Introduction to citizen science for journalists	**YOUR TEXT** Introduction to citizen science for journalists
INTENDED AUDIENCE *It is important to be very clear about who the audience is before you start designing your module content. Once you know who the audience is, engage with them early on in the design process to make sure the content, language, structure is appropriate.*	**EXAMPLE** e.g. journalists - especially in the fields of science, technology, environment, and health that want to learn the basics of citizen science for the purpose of dealing with an assignment.	**YOUR TEXT** Journalists - especially in the fields of science, technology, environment, and health that want to learn the basics of citizen science for the purpose of dealing with an assignment.
COURSE SUMMARY *This field will be copied into the COURSE SUMMARY field in Moodle. Refer to section 2.3.1 of the module design guidelines. Always*	**EXAMPLE** e.g. This is a free course of an hour and a half, that provides an introduction to citizen science, which is a form of active public engagement in science. It is designed to assist journalists who need to understand citizen	**YOUR TEXT** This is a free course of an hour and a half, that provides an introduction to citizen science, which is a form of active public engagement in science. It is designed to assist journalists, who need to understand citizen science in their reporting,

use the following structure: approx 150 words - first part describes length of course "This is a free course of 1.5 hours", second part describes who the course is for and if any prior knowledge is needed. Third part explains the significance of the course, why the learner should take it i.e. learning objectives, and then the topics that are covered in the course. Finally, insert details of a code (enrolment key) that needs to be entered in order to enrol on the course, this can be anything you want it to be and will be configured in Moodle once the course has been created.	science in their reporting. No prior knowledge in science reporting is needed for this course.) The interest in citizen science, the number of projects, and the number of people who participate in such activities have grown significantly over the last decade. By the end of this course, the learner will: - be able to explain the historical background and current activities in citizen science, by identifying key terms and concepts; - identify the major challenges in citizen science projects, including data quality, motivation, working with volunteers, and sharing information; - analyse the contexts in which citizen science can be integrated within news stories. The enrollment key to this course is: CitSciNews.	and no prior knowledge in science reporting is needed for this course. The interest in citizen science, the number of projects, and the number of people who participate in such activities have grown significantly over the last decade. This course will introduce you to the activities that fall under it and major issues that you might encounter when reporting on it (data quality and motivation), and examples of stories and report that are told about citizen science activities. By the end of this course, the learner will: - be able to explain the historical background and current activities in citizen science, by identifying key terms and concepts; - identify the major challenges in citizen science projects, including data quality, motivation, working with volunteers, and sharing information; - analyse the contexts in which citizen science can be integrated within news stories. The enrollment key to this course is: CitSciNews.
COURSE IMAGE *This image will be the main header/ cover image for the course. You will need to complete the image in the third column for all images that you plan to use in the course.*	**EXAMPLE** **File name**: - science bus.jpg **Source (where you found the asset)**: - Unsplash - https://unsplash.com/s/photos/community-science **Location in the course**: - Main course image	**YOUR TEXT** **File name:** Science bus.jpg **Source:** UCL Extreme Citizen Science group **Location in the course:** Main course image **Rights:** CC-By **Attribution:** UCL ExCiteS **Clearance approved to release asset as Creative Commons (CC):** CC-By

	Rights (*who owns the copyright - even if all the assets are owned by you or your organisation it is a good idea to record this in the asset register)*: - CC-By **Attribution** (who to credit for the image): - UCL_Excites **Clearance approved to release asset as Creative Commons** (*you can use this for notes about the clearance and date of clearance*): - Yes, approved by Muki Haklay on the 3rd of March 2020. **Acknowledgement** (*what needs to be listed about this asset on the acknowledgements page if the item belongs to a third party or if the organisation releasing the course wishes to retain 'All rights reserved' rather than use a Creative Commons licence for this asset*): - cc-by 4.0 UCL ExCiteS **Image Alt-Text** (*Alt-text is a description assigned to an image that can be used to describe an image to visitors who are unable to see them or visually impaired*): - White camper van with different science and do-it-yourself symbols parked in front of a high rise building. This is the science bus of the	**Acknowledgement:** cc-by 4.0 UCL ExCiteS **Image Alt-Text:** White camper van with different science and do-it-yourself symbols parked in front of a high rise building. This is the science bus of the Doing-It-Together Science project. 

	Doing-It-Together Science project.	
COURSE LENGTH: *The time it takes to complete the course from the start of the Welcome and Introduction to the end of the final self-assessment quiz.*	**EXAMPLE** e.g. 1.5 hours	**YOUR TEXT** 1.5 hours
TOPICS/ SECTIONS		
NUMBER OF TOPICS/ SECTIONS IN THE MODULE *Refer to section 2.4 of the module design guidelines. Note that there are 4 standard sections that will appear in every module - 'Welcome and introduction', 'Summary and self-assessment', 'Further information and learning', 'Sources and acknowledgements'*]	**EXAMPLE** e.g. 5 + 4 standard sections	**YOUR TEXT** 5 + 4 standard sections

TITLE AND SHORT DESCRIPTION OF EACH SECTION *This information will help you understand broadly the content you want to include in the module.*	EXAMPLE **Welcome and introduction to the course** - introduction to the course from the course tutor. Overview of the content and the learning outcomes. Teaser and a sample story of citizen science achievements. **Section 1**: c*itizen science in five stories:* a description of historical examples of activities that will be called citizen science, and an overview of the type of activities that people engage in citizen science. **Section 2**: *terminology:* to assist the process of learning about citizen science, we introduce common terms that are being used to describe citizen science, and some of the issues with these terms (e.g. the term “citizen” in the US) **Section 3**: *challenges and opportunities in citizen science:* issues that are commonly discussed with citizen science - data quality, engagement with volunteers, motivations, opportunities that citizen science offer in terms of engagement, science literacy, awareness to issues, skills **Section 4**: *Social and political impacts*: an overview of the impacts that participation in citizen science can lead - awareness and science literacy to impacts on policy and	YOUR TEXT **Welcome and introduction to the course** - introduction to the course from the course tutor. Overview of the content and the learning outcomes. Teaser and a sample story of citizen science achievements. **Section 1**: c*itizen science in five stories:* a description of historical examples of activities that will be called citizen science, and an overview of the type of activities that people engage in citizen science. (10-15 minutes) **Section 2**: *terminology:* to assist the process of learning about citizen science, we introduce common terms that are being used to describe citizen science, and some of the issues with these terms (e.g. the term “citizen” in the US) (15 min) **Section 3**: *challenges and opportunities in citizen science:* issues that are commonly discussed with citizen science - data quality, engagement with volunteers, motivations, opportunities that citizen science offer in terms of engagement, EDI equity diversity inclusion, science literacy, awareness to issues, skills. Interpretation - what you should pay attention to when looking into a citizen science story (20 minutes + 30 if all extra material is read) **Section 4**: *Social, economic and political impacts*: an overview of the impacts that participation in citizen science can lead - awareness and science literacy to impacts on policy and information that contribute to research in different areas of science. (20 minute) **Section 5:** *citizen science in the news*: introduction to some of the existing use of citizen science in journalism and examples of narratives that can be used about citizen science activities. Organisations and individuals that can be contacted for commentary on citizen science (15 min)

	information that contribute to climate change studies. **Section 5:** *citizen science in the news*: introduction to some of the existing use of citizen science in journalism and the type of stories that can be told about citizen science activities. Organisations and individuals that can be contacted for commentary on citizen science **Summary and self-assessment** - summary of the course and end-of-course quiz **Further information** - other sources of information and further learning on citizen science **Sources and acknowledgements** - a list of sources that are used in the course.	**Section 6: Summary and self-assessment** - summary of the course and end-of-course quiz, to produce a certificate and a badge of completion. **Section 7: Further information** - other sources of information and further learning on citizen science **Section 8: Sources and acknowledgements** - a list of sources that are used in the course.

Comments from journalists - feedback from 27.04.2021

- It is important that sections of the course can be read/taken without needing to start from the beginning/needing to take all the other sections à hop into the course “laterally” as needed depending on what someone is interested in
- (old-school) journalists like to take notes on paper as they go through the material. It was suggested that we include the possibility to mark things/write notes on the text. I mentioned that we most probably don’t have this function on Moodle, so they suggested that the material is made available for download (as a PDF) that can be marked on the computer but also printed and written on as if they were notes to follow-along. (Here Claudia adds: If we do this, we should make the material available for download for each section for those that just want to read a couple of sections, point above.)
- Put copyright/citation information for written text in the training module, images, text from videos/slides etc. very visibly somewhere so they know how to use it.

2. Detailed Section Plan

Please read section 2 of the module design guidelines before proceeding with your detailed section plan. **You will need to copy and paste some of the template to create additional sections and subsections depending on how many of each you choose to have.**

Welcome and introduction (5 min). In this section, we will provide a brief overview of the course content:

Subsection Number*:* 1.1

Subsection title*:* What can you expect to learn from this course?

Subsection content type: Introduction to the course - structure, content, and who is behind it.

Subsection delivery method: 1 minute video and text below the video, for those who don't want to watch.

Subsection rationale: Welcome the student, provide assurance about the credibility of the course, and set expectations for engagement

Subsection content:

Welcome to the Introduction to citizen science for journalists. This short introductory course will help you to learn some of the important aspects of citizen science. You will see historical and contemporary examples of activities that fall under citizen science; you will be introduced to the major issues that will come up when discussing citizen science - such as data quality or motivations of participants; and you will learn about the broader impacts of citizen science.

Video transcript:

Welcome to the Introduction to Citizen Science course. My name is Muki Haklay and I am a professor at University College London where I co-direct the Extreme Citizen Science group. Together with Claudia Fabó Cartas and Andrea Troncoso from the European Citizen Science Association; and Lucie Steigleder from Ecsite, the European network of science engagement organisations, we have prepared this course for you. The term "citizen science" is probably new to you, and we hope that by the end of this hour and a half training unit, you will feel that you know what it is about. You will learn about its history, the main issues that you might come across when reporting about it, some of the terminologies and their explanation, and where you can find further information. All the material on this course is free for reuse, as long as you provide an attribution, so feel free to use it in your reports. You can find more information on the different sections in the "Sources". We hope that you'll find the course beneficial and interesting!

Script for video

Muki:

Welcome to the Introduction to Citizen Science for journalists course. My name is Muki Haklay and I am a professor at University College London where I co-direct the Extreme Citizen Science group. This course is aimed at introducing you to new forms of public participation in science and research.

Claudia:

Hi and welcome, I am Claudia Fabó Cartas and I work at ECSA, the European Citizen Science Association, as a project officer for the EU-Citizen.Science platform. The term “citizen science” is probably new to you, and we hope that by the end of this hour and a half training unit, you will feel that you know what it is about.

Andrea:

Hi everyone, I am Andrea Troncoso and I too work at ECSA as a project officer for the EU-Citizen.Science platform. During the course, you will learn about the history of citizen science, the main issues that you might come across when reporting about it, some of the terminologies and their explanations, and where you can find further information.

Lucie:

Welcome to the course. I am Lucie Steigleder and I work as a project manager at the European network of science centres and museums. All the material on this course is free for reuse, as long as you provide an attribution, so feel free to use it in your reports. We hope that you’ll find the course beneficial and interesting!

Subsection Number*:* 1.2

Subsection title*:* Course content as a PDF

Subsection content type: a printout of the whole course in a format that can be reused.

Subsection delivery method: PDF file that contains all the material of the course .

Subsection rationale: allowing the learner to have all the content in a way that can be printed and reused

Subsection content:

In addition to the online content, we provide a PDF with the content of the whole course. You can use all the text in this PDF, as long as you provide attribution to the EU-Citizen.Science platform. The material is shared under Creative Common 4.0 international licence. The recommended attribution is:

Haklay, M., Fabó Cartas, C., Troncoso, A., and Steigleder, L., 2021, Introduction to Citizen Science for Journalists, EU-Citizen.Science project (EU grant agreement No. 824580).

Section 1: Citizen science in 5 stories (15 minutes)

A description of historical examples of activities that will be called citizen science, and an overview of the type of activities that people engage in citizen science.

Subsection Number: 2.1

Subsection title: Introduction to the section

Subsection content type*:* an introduction to what the learner can get out of the five stories

Subsection delivery method*:* text and an image

Subsection rationale*:* We want the learner to learn from a few examples on the development of citizen science, the scope of different disciplines, and different use of technologies.

Subsection content*:*

In this section, we introduce you to five stories about citizen science. By using concrete examples, you will be able to see that this is a practice that has been going on for a long time but has a new form due to recent development. The five stories are short, and are introduced to you as an interactive slideshow that you can look through at your own pace.

Subsection Number: 2.2

Subsection title: "Come rain or shine" - the volunteers that make weather forecasting possible (3 minutes)

Subsection content type: A story about weather observer in the outback of Australia and what can we learn from 150 years of weather observation

Subsection delivery method*:* text and an image in a H5P slideshow. About 5 slides with 100 words in each slide and image in the first one

Subsection rationale*:* Using weather observation as an example for an activity that run since the 19th C .

Subsection content*:* (600 words maximum)

Meet Rick Grocke. In 2000, he lived at the Tanami Downs cattle station in the Northern Territory of Australia. Tanami Downs received 204.2 millimetres of rain during an all-time high event in 2009, but usually, it is a fairly dry place.

We probably know these facts about Tanami Downs thanks to Rick and other volunteers in the area that every day check how much water their rain gauge gathered. Every day they check meteorological conditions, such precipitation or temperature, and report to the Australian Bureau of Meteorology.

Rick is part of a global network of weather volunteers that contribute with their observations to their national meteorological service. Observing the weather and reporting it regularly is an activity that is part of citizen science. The people who take the measurements and report them are not trained as scientists. They are people who live in an area and for one reason or another, took over the management of a weather station and got into the habit of collecting and sharing the facts as they find them.

Some people do that for a very long time - for example, an Irish man, age 93, received an award for measuring rainfall daily for 56 years.

The practice of wider participation in weather observation has a long history. In many countries around the world, the regular recording of meteorological information such

as temperature or rainfall using scientific tools and approaches have started in the middle of the 19th century. In many cases, they recorded their observations on cards and diaries, but with the growth of communication means - first the telegraph, then the telephone and the internet - the observations are being shared rapidly.

Knowing what the weather will be like is very important for a whole range of human activities - from putting the washing out to launching a mission to Mars. Weather volunteers solve an important problem for the scientists who create weather forecasts - the need for detailed information from a very large area. Local variations and the inherent unpredictability of the Earth's atmosphere means that regular observations are necessary to be able to create reliable predictions.

Even with automated stations, there is a need for maintenance, so having volunteers that record the data and share it is very effective and increase the accuracy of the system. This is typical of other aspects of environmental monitoring where a large and distributed group of observes is needed.

Weather observation volunteers remain central even today, as they provide crucial information that support the forecasting services. Sometimes, that will include owning an automated weather station and linking it up to the internet, and sharing the observations that the station creates with aggregating bodies. For example, the UK meteorological office collect 13 million observations each month on its Weather Observations Website (WOW).

Subsection Number: 2.3

Subsection title: Observing the first satellites (3 minutes)

Subsection content type: Telling the story of how volunteers spotted the first satellite. Focusing on Fred Whiple and his work at the Smithsonian with Moonwatch volunteers.

Subsection delivery method*:* text and an image in a H5P slideshow. About 5 slides with 100 words in each slide and image in the first one

Subsection rationale*:* A cold war example, which provides an opportunity to mention Big Science and the reduction in the role of volunteers .

Subsection content*:* (600 words maximum)

Our second story is about Fred L. Whipple and how, with a group of volunteers, he helped spot the first human-made satellite - the Sputnik - in 1957. Fred was a professor of Astronomy at Harvard and in charge of the Smithsonian Astrophysical Observatory. We are in the middle of the 20th century, after the Second World War which brought with it a

big change to the way science is run. Science became part of the things that the state is investing in, and there was a new era of “Big Science” - large projects that require very large investment and the involvement of hundreds or even thousands of scientists. One of the symbolic events that introduced this new era of science was the International Geophysical Year.

The International Geophysical Year (IGY) ran from July 1957 to December 1958 (so not exactly a year!) and it was an opportunity for international collaboration between scientists, despite the Cold War - so there was collaboration of East and West countries. During the year, many areas of research were explored: Earth Science, Meteorology, Oceanography, Seismology to name a few. The IGY was very successful and many of its achievements from it continued to shape science, such as the way that Antarctica is shared between countries for peaceful purposes.

One of the most important achievements of the IGY was the launch of a human-made satellite.

The plans for launching satellites had been developed for several years, as a result of the development of rocket technologies. Therefore, there was a need to monitor them and understand their trajectories and paths. Considering that this was during the Cold War, this was a very important task - despite the promises that these satellites will be used only for non-military purposes. While an expensive satellite tracking system was in development, Fred L. Whipple suggested that volunteers can be trained to observe satellite paths and started creating the network in 1955. He called this Operation Moonwatch.

The system worked with amateurs sitting in a row, and when a satellite (or a plane) fly over, they can record the direction and speed of the object. By October 1957, there were 200 teams. When, to the shock of the USA, the Sputnik-1 satellite was launched on 4th October 1957, the more complex system was not ready to use, and it was Moonwatch volunteers who spotted it first. Operation Moonwatch continued until 1975.

Moonwatch is another example of citizen science in which a scientist comes up with an idea and recruits a large and geographically distributed network of observers to record and share information. As with the interest in the weather, there is a long history of amateur astronomers and the concerns over the Cold War, it was possible to recruit people and retain them over a long time.

Subsection Number: 2.4

Subsection title: From buckets of resistance to balloon recording of oil spill (3 minutes)

Subsection content type: From the development of the bucket air sampling in the end of the 1990s to the work of Public Lab in recording the BP Deep Horizon disaster

Subsection delivery method*:* text and an image in a H5P slideshow. About 5 slides with 100 words in each slide and image in the first one

Subsection rationale*:* Gives an example of CS at the opposite end of the spectrum from crowdsourcing and contributory. Including environmental justice issues.

Subsection content*:* (600 words maximum)

Another important activity in which ordinary people use scientific tools are cases where there is an environmental justice problem. For example, when the people living near the fence of a petrochemical factory experience a high level of pollution. How can they monitor pollution events and make sure that the authorities take care of them? Meet Anne Rolfes from the Louisiana Bucket Brigade and Dorothy Jenkins from the Concerned Citizens of New Sarpy. They are using an instrument that is named “the bucket” to collect air samples, which can then be sent to the laboratory and analysed for their chemical composition.

The bucket emerged at the end of the 1990s when the lawyer Ed Masry (who is famous for the Erin Brockovich film) funded the work of an engineer that will transform an air sampling device that cost many thousands of dollars into something that can be used more widely. After some iterations of the original design, the bucket was born and adopted by a range of community science groups who were dealing with locally polluting factories. The quality of the process is high, and the US Environment Protection Agency accepted the results of such studies. The organisations that Anne and Dorothy were running in the early 2000s have successfully used the bucket in their work.

When in 2010 the BP Deep Horizon rig disaster polluted the Louisiana coast, one of the members of the Louisiana Bucket Brigade, Shanon Dosemagen, teamed up with people experienced in photography using helium balloons. They were able to carry out monitoring of the impact of the spill which usually is not be possible for community organisations. This effort led to the creation of "Public Laboratory for Open Science and Technology" (or Public Lab), an organisation that is dedicated to creating low-cost environmental monitoring tools.

The inventiveness of Anne, Dorothy, Shannon and other environmental justice project participants is different from our previous examples. The issue of concern is not coming from scientists but members of the community, but like in the case of weather monitoring or amateur astronomy, there is a need for affordable equipment that can produce high-quality results. The equipment and the data are linked to what the communities care about and their local context.

We can also see this as part of a trend towards "Do-It-Yourself" (DIY) science. Instead of buying expensive scientific equipment, the interested people create the equipment themselves. There are examples of DIY science in environmental monitoring, but also in biology, chemistry, and physics.

Subsection Number: 2.5

Subsection title: Chris, Kevin, and Hanny and the Galaxies (3 minutes)

Subsection content type: A story about the creation of Galaxy Zoo and the potential of online volunteering

Subsection delivery method*:* text and an image in a H5P slideshow. About 5 slides with 100 words in each slide and image in the first one

Subsection rationale*:* Provides an introduction to large scale online crowdsourcing, astronomy and the potential of discovery by volunteers . Demonstration of the power of the internet within CS and the value of crowdsourcing

Subsection content*:* (600 words maximum)

In July 2007 in a pub in Oxford, Kevin Schawinski, who was doing his PhD in astrophysics met a friend, Christ Lintott for a pint of beer. Kevin had a challenging week. To prove a theory about the formation of galaxies, he needed a very large dataset of galaxies classified according to their shape. He classified 50,000 images of galaxies from the Sloan digital sky survey. To get to the million classifications that he needed, he would need to spend months doing only this, before the analysis can commence. Realising that there is a wide group of people that are interested in galaxies and happy to support scientific efforts, they saw an opportunity.

A year earlier, NASA started a very successful citizen science project called Stardust@home, in which volunteers used a virtual microscope in their web browser to classify images of interstellar dust. Kevin and Chris, who was already an established science communicator, set up a website. The website contained the images of the galaxies that Kevin needed and allowed volunteers to classify an image. Within the first 24 hours of operation, the website received 70,000 classifications in an hour. The classification was also better - each image was classified by multiple people. The Galaxy Zoo website was born. Some volunteers, such as Alice Sheppard, helped by assisting in moderating the discussions among volunteers and community management.

Galaxy Zoo was mostly designed to allow scientists to set up the classification problem that they need to solve, with volunteers helping with the work itself. This can be called crowdsourcing. Yet, Galaxy Zoo provided opportunities for citizen scientists to make discoveries by themselves. For example, when one of the volunteers, Hanny van Arkel, saw a galaxy shape that she hadn't seen before she started asking questions about it. Eventually, it was accepted as a discovery of a new type of observed object. It was published in the academic literature as "Hanny's Voorwerp" (Hanny's object). Other discoveries were made by a group of participants, through sharing and questioning the things that they saw. Maybe volunteers were the first humans that looked at the images, as all the process was automated up to this point.

The success of Galaxy Zoo led to the creation of a range of projects. All of them rely on the sharing of some media - image, audio or video - and asking volunteers to help in carrying out a task or a classification. There are now over a hundred projects on the Zooniverse platform - from clicking on penguins to help polar research to count them, to

looking at historical text on papyrus and transcribing them. Over 1.6 million people have registered and used the system over the years. The Zooniverse platform is also providing an example for potential collaboration between humans and machines by using artificial intelligence. For example, when a classification that is flagged as uncertain by the algorithm, can be passed to the human participant.

Subsection Number: 2.6

Subsection title: Patient, heal yourself! Patients monitoring and self-management (3 minutes)

Subsection content type: A story about the involvement of patients in managing their own condition through self tracking and quantification

Subsection delivery method*:* text and an image in a H5P slideshow. About 5 slides with 100 words in each slide and image in the first one

Subsection rationale*:* Provides an introduction to citizen science in health and and to self quantification

Subsection content*:* (600 words maximum)

Modern medical treatment is complex. It involves multiple medicines and while they are tested individually, their interactions and their relevance to a specific patient can be predicted statistically - but there are variations. Especially in chronic illness and in rare diseases that affect small groups of patients, there is a growing trend of patients and their carers taking an active role in the management of the condition, using scientific tools.

The growth in tools such as smartwatches or activity monitoring of different forms is important here. The patients utilise the abilities of mobile phones to act as sensing devices to record and monitor their condition. This is part of a phenomenon of “self-quantification” where people record, sometimes in a detailed way, their condition, and share the information with other people with the same condition so they can learn from the shared experience. An example for this is provided by Sara Riggare

Sara Riggare’s experience in managing her Parkinson disease is reflected in this short video. (link to video in the slide)

Sara’s story and similar achievements by patients who are using social networks and dedicated websites (such as PatientsLikeMe or OpenHumans) demonstrate an important facet of citizen science. While in the past it was only affluent gentlemen who could afford to be scientists, today the devices, instructions online, and the ability to connect and learn from others allow many more people to do so. The number of people that are involved in “Do It Yourself” (DIY) science is still very small - there are knowledge, time, motivations, and skills barriers. Yet, they lead the way and make it possible for others to join in and manage their conditions.

Subsection Number: 2.7

Subsection title: Summary (1 minutes)

Subsection content type: summarising the stories and providing an explanation of how it all sits in citizen science today

Subsection delivery method*:* text and an image

Subsection rationale*:* Emphasising the learning from the stories

Subsection content*:* (200 words maximum)

The five stories that we have seen in this section provide us with an overview of the activities and forms of participation that citizen science offers. We have seen how the history of non-professional researchers in science goes a long way and predate the development of the modern science system. We also noticed that even within large-scale scientific efforts, such as the International Geophysical Year, there was a space for citizen scientists to join and contribute in a meaningful way to the scientific effort. Galaxy Zoo provides us with a demonstration of large scale crowdsourcing activity that is based on the Web and fast connectivity (to download those beautiful images of galaxies). The stories also show the role of individuals - Hanny van Arkel or Sara Riggare are demonstrating how much people can be involved in research. Personal issues, such as managing your health, and community issues, such as dealing with a polluting factory nearby, are motivators for starting projects. In other cases, it is more about helping scientists and society at large. This wide range of activities is common to citizen science - it can take many shapes.

Subsection Number: 2.8

Subsection title: Optional revision quiz (2 minutes)

Subsection content type: Providing an opportunity to check the learning from the section

Subsection delivery method*:* Drop the words H5P quiz

Subsection rationale*:* Emphasising the learning from the stories

Subsection content*:* (100 words maximum)

A paragraph about citizen science that strings together all the stories with some missing words

Citizen science, a term to describe the participation of members of the public in research, has a very long history and multiple forms. For example, in the area of weather reporting, networks of observers emerged in the middle of the [[19th century]] in different places across the world. Volunteers measure [[rainfall]] and temperature daily and report it to regional or national bodies. There are also examples from observations of animals, birds, and plants that also go back hundreds of years.

Watching the night sky is another human activity with deep roots. This interest is the basis for different citizen science projects - such as in the 1950s the creation of Operation [[Moonwatch]] project to track satellites, or the [[Galaxy Zoo]] project in which volunteers classify millions of images of galaxies online. Citizen science projects are not always started by scientists who ask the public to join, but sometimes when a community lives near a polluting facility, they can use a DIY air sampling tool - [[the bucket]] - to provide evidence to the authorities. DIY is also used by people who monitor their health condition, and this is called [[self-quantification]].

There are also very different instruments and technologies that are used in citizen science - weather monitoring can still be based on using [[rain gauge]] and checking it every day, while monitoring your health can involve building up a DIY instrument.

Section 3: Terminology (15 minutes)

To assist the process of learning about citizen science, we introduce common terms that are being used to describe citizen science, and some of the issues with these terms (e.g. the term “citizen” in the US).

Subsection Number: 3.1

Subsection title: Introduction to the section (2 min)

Subsection content type: Introduction to the section which will first present some main terms in citizen science and then offer an accordion of other terms for more reference, and why we are providing this information to students

Subsection delivery method: text separated into paragraphs

Subsection rationale: introduction to the section (which will assist the process of learning about citizen science, we introduce common terms that are being used to describe citizen science, and some of the issues with these terms, e.g. the term “citizen” in the US)

Subsection content: (250 words)

In this section, we introduce you to common terms used in the field of citizen science to assist the process of learning about it. The content of this section is separated into two segments: In the first one, we will provide you with definitions and explanations of some main terms that are being used to describe citizen science, and some of the issues that

arise with these terms, e.g. the term “citizen” in the US. In this segment you will find the terms that we deem essential to know about to find your way in the field of citizen science. This segment is separated into part A and part B.

In part A we start with some definitions of citizen science focusing on the contribution of citizens, and their role and involvement. Then we move to the "citizen science vs. community science" debate, over to terms used to name participants in citizen science projects before finishing with open science. In part B we introduce many new terms such as volunteer thinking, DIY Science, participatory sensing, and extreme citizen science by looking at three different citizen science typologies.

The second segment is optional and provides a list of other terms for more reference in the form of an accordion so you can click and choose what you would like to expand on. Terms described are citizen observatories, BioBlitz, FabLabs and Science Shops among others.

The used sources will be collected at the end of the course and are also available in the downloadable pdf.

Subsection Number: 3.2

Subsection title: Main terms of citizen science - Part A (8 min)

Subsection content type*:* Definitions of selected main terms in citizen science in text and a couple of pictures (mainly decorative)

Subsection delivery method: Text in form of a slideshow

Subsection rationale: Introduce the student to definitions and explanations of some main terms that are being used to describe citizen science, and some of the issues with these terms. The segment on main terms is broken up into two parts, A and B.

Subsection content: (1400 words)

Citizen science

As the five stories in the last section show, a wide range of activities can be called citizen science – a practice that has been going on for a long time. The Oxford English Dictionary added the term **citizen science** in 2014 defining it as “scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions”. In 1995, the sociologist Alan Irwin coined the term as “developing concepts of scientific citizenship which foregrounds the necessity of opening up science and science policy processes to the public”. At the same time, Rick Bonney, an ornithologist, started using it without knowing of Irwin's definition, and in his use of the term focuses on the contribution of scientific data by citizens. This meaning focuses less on the democratisation of knowledge production and highlights the more participatory strand of the term. The concept of **crowdsourcing** is used within this context to describe finding a way to engage a (very) large number of people in a project.

Since the 2000's, citizen science has become an emerging area of research and practice. Examples of it are found in different scientific disciplines that interpret the term slightly differently. Therefore, citizen science comes with dynamic standards, methodologies, theories and techniques that change over time. Providing a universal definition of what is and is not citizen science proves very challenging.

For example, a chapter on “What is citizen science? The Challenges of Definition” in a recent book, “The Science of Citizen Science”, lists 34 selected definitions of the term. Here are three more definitions from this list that show how citizen science can be interpreted, each highlighting a different aspect of it. Imagine that there are at least 30 more different definitions in this list alone!

- On how citizens contribute: “Citizen Science refers to the general public engagement in scientific research activities when citizens actively contribute to science either with their intellectual effort or surrounding knowledge or with their tools and resources.” (White Paper on Citizen Science for Europe, 2014)
- On what their role is: “Citizen science projects actively involve citizens in scientific endeavour that generates new knowledge or understanding. Citizens may act as contributors, collaborators, or as project leader and have a meaningful role in the project.” (European Citizen Science Association, 10 Principles of Citizen Science)
- On where they are involved: “Citizen science entails the engagement of volunteers in science and research. Volunteers are commonly involved in data collection but can also be involved in initiating questions, designing projects, disseminating results, and interpreting data.” (United Nations Environmental Programme, UNEP, 2019)

From citizen science to community science and back

Not only are there plenty of interpretations of the term citizen science, but the use of the word “citizen” in the term itself might prove problematic. While citizen in citizen science was first used to distinguish professional or trained scientists from untrained scientists, most often the term citizen is used to refer to those that have recognised citizenship status (nationality) of a sovereign state.

Enjoying the legal status of citizenship is in most cases not at all relevant to participate in a citizen science project. However, the term citizen can prove problematic because people that are not citizens of a country might not identify with or feel recognised by this term and, therefore, do not identify with being called a citizen scientist or by doing citizen science – and thus might feel excluded. Especially in the US, many people perceive the term citizen to exclude those without citizenship status.

In an attempt to being more inclusive, a number of organisations and groups in the US have changed the terminology they use to describe their projects and programmes and shifted to calling them *community science*. However, these terms are not a 100% interchangeable; community science has a backstory of its own.

Community science is used to describe projects that are carried out as part of local, everyday settings, to address local concerns and needs, often related to environmental

injustices and public health issues. Activities or projects that fall within community science have a strong bottom-up element and are often initiated by a group or a community rather than by professional scientists.

Examples of community science were introduced in one of the stories in the last section. These are the Louisiana Bucket Brigade and the work of the Public Lab. In the Louisiana Bucket Brigade, the community initiated the project, collected evidence of air pollution incidents, and sent its samples to an accredited laboratory to analyse. Therefore, professional scientists had a role here, but not the primary one.

While some people might feel more comfortable with the term community science than with citizen science or use it to be more inclusive, community science emerged in a certain context as it is linked to social justice. Using the term for something that is not community science – co-opting it – might be doing more harm than good, e.g. community science is already underfunded, so distinct terminology is important to secure funding so community science projects do not fall within the big umbrella of citizen science.

The terms citizen science or citizen scientist are widely spread and you can feel confident using them. Nonetheless, it is good to know that a group of people, based mainly in the US, has raised this issue.

Citizen scientists, volunteers…?

It is important to pay attention to the terminology used in citizen science. The goal of citizen science is to engage the public in science and the words we use, especially the ones that describe those that are involved in it, have an effect on how participants view their contribution and feel about it and themselves. The image on the right taken from an article by Melissa Eitzel and colleagues illustrates examples of how commonly used terms to describe those involved in citizen science can be negatively interpreted. They point out in their article that different terms serve different goals and are appropriate for different audiences, e.g. policy-makers or funders, academics, not yet involved participants in a project, etc. Terminology is also field and country-dependent.

The next slide provides a transcript of the text in the image for those using a screen reader.

Title of the image: “What to call people involved in citizen science projects?”

(The term, its negative interpretation and a description of an image accompanying it are provided.)

- Professional scientists: I just got involved somehow but it is not my principal job. Person with hands in the air.
- Credentialed scientists: You know, I never finished my degree back then. Person next to a crossed out paper symbolising a PhD.
- Academic scientists: Sounds like we have no experience of the real world. Person in a tower (of Babel).
- Citizens: Another thing in which I cannot participate. Person next to three images representing country flags.
- Hobbyists/amateurs: I’ve actually worked in this field longer than you. Person next to a flag or map with footsteps.

- Community members: I don't hold the same values as them. Person with an orange square (representing their values) stands far away from three people all of them with green squares (representing the same values).
- Volunteers: What is my worth? Am I only free labour? Person next to a crossed out money symbol.
- Indigenous people: This is so much more than just science for us. Person next to three abstracts symbols of a sun, a heart, and a leaf.
- Human sensors: I'm not a robot… yet. Person with an antenna on their head holding a mobile phone/smartphone to their ear.

Open science

One of the most discussed topics in research and innovation currently that intersects with citizen science is *open science* (OS). The OECD defines open science as "… efforts to make the output of publicly funded research more widely accessible in digital format to the scientific community, the business sector, or society more generally".

The six principles of open science are: open methodology, open source, open data, open access, open peer review, and open educational resources.

How do citizen science and open science intersect? + Image

Citizen science enables openness by making project generated data available (principles of open data and open access) or by contributing to the development of freely (re)usable research tools and methods (open methodology and open source).

At the same time open science facilitates participation since participation in projects is encouraged and researchers are more accessible allowing a wider audience to suggest possible research topics. In addition, open science promotes citizen science by making existing data and literature behind a paywall accessible to citizens and promoting open source tools (hardware and software).

Subsection Number: 3.3

Subsection title: Main terms of citizen science - Part B (8 min)

Subsection content type*:* Definitions of selected main terms in citizen science in text and a couple of pictures (mainly decorative)

Subsection delivery method: Text in form of a slideshow

Subsection rationale: Introduce the student to definitions and explanations of some main terms that are being used to describe citizen science, and some of the issues with these terms. The segment on main terms is broken up into two parts, A and B.

Subsection content: (1400 words)

Typologies of citizen science

Citizen science is a very broad and diverse field with many different kinds of projects aiming to achieve a variety of goals. In the same way that there is a plethora of definitions of citizen science, there are at least 13 typologies of citizen science that try to make sense of the field, according to a review carried out in 2020. While no typology is perfect, it is useful to look at some of them.

In the following slides, three different typologies of citizen science will be introduced and linked to relevant terms in the field and to some examples.

The first typology was developed by Muki Haklay, Suvodeep Mazumdar and Jessica Wardlaw in 2018. It looks at major types of activities and projects in citizen science and classifies them by their domain, technical needs and level of engagement of participants.

Within **long-running citizen science** fall activities that are well established and that have been going on for a long time. An example of this are ecological observations (also called biological observations in the UK), where people report seeing plants, animals, and fungi. There are many projects of this kind, e.g. bird-watching projects where observations are reported.

Another example is meteorology or weather observation. Several examples of this were introduced in the last section; remember the nearly 13 million monthly observations that the UK meteorological office collects on its Weather Observations Website (WOW), or the Irish man who received an award for measuring rainfall daily for 56 years – that is long running!

The next group of activities or projects relies highly on technology and so are called *Citizen Cyberscience* – a term that Francois Gray coined in 2009. **Citizen Cyberscience** is defined as an activity that completely relies on the use of the internet and computing devices and that could not take place otherwise. These activities are separated into three kinds:

- **Volunteer computing** is a type of participation in a project by downloading software to your computer or smartphone, which allows it to use the devices' processing capacity when you are not using it.
- **Volunteer thinking** is when people participate in a project that sends them information over the internet and asks them to classify or annotate it. For example, identifying animals in an image.
- **Passive sensing** is mostly based on automatic data capture and sharing without the conscious intervention of the volunteer, who simply connects a sensor to their computer or smartphone or uses a built-in sensor, e.g. the integrated movement sensors to enhance observations from existing seismic observation stations.

The last group of projects are those where participants have a wider role in shaping the project, **community science** projects, as described in part A of this section, in which participants are more involved in the project design, analysis and interpretation.

- In **participatory sensing**, the participants in the project have a role to play in deciding where the sensing takes place. In these activities, a group of participants contributes together to a body of information. Importantly, the term is now used to describe a wide range of crowdsourced sensing activities with varying levels of engagement.
- **DIY science** projects are those in which people are using Do It Yourself (DIY) techniques and approaches to address issues that concern them, either in their environment or in a laboratory. Within DIY science fall also projects in which people are exploring aspects of modern biology through an exploration of what they can do with DNA analysis and other sequencing activities – this is called **DIY Bio** or sometimes also **Biohacking**.
- Another area of DIY science is called **civic science**, when the activities are explicitly linked to community goals and question the state of things. While some DIY science also follows this definition, civic science can also include work with indigenous, non-literate communities using smartphones to record community resources and other local features.

The second typology that we will briefly look at was developed by Jennifer Shirk and her colleagues in 2012. Here, citizen science projects are divided into categories depending on the degree of participation, focusing on the role of project designers and owners. This typology focuses on projects within the field of ecology and environmental conservation and management. It can be called "5 Cs" typology as projects are classified into five categories, all starting with "C":

- **Contractual** – communities ask professional researchers to conduct a specific scientific investigation and report on the results, e.g. on possible pollution being emitted from a local power plant;
- **Contributory** – generally designed by scientists and for which members of the public primarily contribute data, e.g. the micro-tasks in Galaxy Zoo where there was also basic analysis;
- **Collaborative** – generally designed by scientists and for which members of the public contribute data but also help to refine project design, analyse data, and/or disseminate findings;
- **Co-Created** – designed by scientists and members of the public working together and for which at least some of the public participants are actively involved in most or all aspects of the research process; and
- **Collegial** – non-credentialed individuals conduct research independently with varying degrees of expected recognition by institutionalized science and/or professionals.

Contrary to the typology just seen at the beginning, this one ignores the domain and the technology that is used, a major benefit since the degree of participation can be quantified and compared. Notice that most citizen science projects are contributory so one class is actually capturing most of the activities.

The last typology that we will look at is Muki Haklay's typology developed in 2013, which is written from the perspective of participatory action research as well as aspects of

geographical crowdsourcing (known as *volunteered geographic information*, VGI). Its aim is to explain different levels of participation in citizen science projects.

This typology is influenced by Arnstein's ladder of participation – created in 1969 by Sherry Arnstein in the context of citizen involvement in planning processes in the US, which is strongly value-based and aims to encourage citizen control over decision-making.

The **crowdsourcing** level is mostly aimed at the provision of resources specific to an activity, which encompasses providing computing resources or the ability to sense different areas and it includes **volunteered computing** and **passive sensing** that we have seen in this section. Most of these projects are contributory. A good example of this level is "Quake catcher" where people are joining with their computer to create a small graphic network and the computer is doing that while they are doing other activities that we have seen a few slides back.

Distributed intelligence is a level that uses the cognitive abilities of the participants, either in micro-tasks such as in the Galaxy Zoo project or through basic observations as is done in different ecological projects. Participants require more training to ensure that the appropriate data collection or analysis has been carried out. These are contributory projects.

Participatory science are projects in which participants are involved in problem definition and in data collection although the experts are involved in the design and in the analysis of the data. Participatory science projects are part of co-created projects. Community noise data collection is a good example of that where the community takes noise meters and uses them under the guidance of a scientist.

The final level is **extreme citizen science** where participants are involved in the project by setting the project goal and carrying out the data collection, analysis and action. Professional scientists – if they are involved – act as facilitators. These projects are equivalent to Shirk and colleagues' collegial project. The work of the Public Lab and the Louisiana Bucket Brigade is an example of this type of activity; they identified the problem, decided on the tools to carry out the analysis, and used the results. Notice that earlier we have associated the same activity with community science. This is common in this area and different terms are used to describe an activity – it depends on what we want to emphasise.

The issue with this typology is that, compared to the typology of Jennifer Shirk and colleagues, it does not include collaborative projects where there is refinement activity by the participant. Also, although contributory projects are now better represented, the typology still includes virtual projects and field observation in the same category – that is something that other typologies have done better. Then, there is the issue with drawing on the Arnstein ladder, which might be misinterpreted as value judgment that suggests that extreme citizen science projects are more valuable than a crowdsourcing project, which was neither the intention nor is this the case.

Subsection Number: 3.4

Subsection title: Further terminology to expand your knowledge (optional)

Subsection content type: Provide students with a list of other terms for more reference in the form of an accordion so they can click and choose what they would like to expand on

Subsection delivery method: Text in the form of an accordion (with the source and often further links of the definition added after each definition)

Subsection rationale: this is more of a non-mandatory section that students can easily skip but is meant to provide them with more terms for further reference

Subsection content: (1500 words without sources and links)

In this list you will find more terms for reference that you may find when reading about citizen science. While we do not deem the following terms essential in an introductory training unit on citizen science (hence why this section is optional), they can broaden your understanding of the field. This list in the form of an accordion allows you to click and choose what you would like to expand on.

Citizen observatories
"Citizen Observatories (COs) are community-based environmental monitoring and information systems, that invite individuals to share observations, typically via mobile phone or the web." (WeObserve)

There are several definitions of citizen observatories. Common to these definitions are that i) citizens participate in environmental monitoring and governance, ii) citizen-generated in-situ observations can strengthen environmental monitoring capabilities, and iii) citizens use their own devices such as smart phones, tablets, laptops or other modern web technologies to generate these observations.

Sources and further links:

- https://www.weobserve.eu/about/citizen-observatories/
- The EU-funded WeObserve project ran from December 2017 to March 2021. It tackled three key challenges that Citizens Observatories (COs) face: awareness, acceptability and sustainability. The project aims to improve the coordination between existing Citizen Observatories and related regional, European and International activities. The WeObserve mission was to create a sustainable ecosystem of Citizen Observatories that can systematically address these identified challenges and help to move citizen science into the mainstream.
- Ground Truth 2.0 was a 3-year EU funded project that set up and validated six citizen observatories in real conditions, in four European and two African demonstration cases. The project demonstrated that such observatories are technologically feasible, can be implemented sustainably and that they have many

societal and economic benefits. The ultimate objective was the global market uptake of the concept and the enabling technologies.
- The Ground Truth 2.0 website provides an overview of six Citizen Observatories in Zambia, Kenys, Sweden, Spain, The Netherlands, and Belgium.

BioBlitz

BioBlitz is composed of 'bio' meaning life and 'blitz' which means quick and intensive. In a BioBlitz event members of the public, scientists, students, and naturalists work together to create a snapshot of the variety of life that can be found in a delimited area (urban or rural) trying to record as many species of plants, animals and fungi as possible over a defined period of time (usually 24 hours).

A BioBlitz provides the public with the opportunity to contribute to a scientific survey at the same time that is breaks down barriers to engagement with science and raises awareness of the role of biological recording. The results of a BioBlitz are datasets able to complement long-term inventories and contribute to reporting progress towards national targets as well as informing decision-making processes.

The term 'BioBlitz' has developed international recognition in the media as an exciting and fun way to get the public to explore natural spaces and discover wildlife.

Sources and further links:

- DITOs consortium, (2017). BioBlitz: Promoting cross border Research and collaborative Practices for Biodiversity Conservation. DITOs policy brief 1. Available at: https://discovery.ucl.ac.uk/id/eprint/1573359/
- Robinson, L.D., Tweddle, J.C., Postles, M.C., West, S.E., & Sewell, J. (2013) Guide to running a BioBlitz. Natural History Museum, Bristol Natural History Consortium, Stockholm Environment Insitute York and Marine Biological Association. Available at (direct download): https://www.nhm.ac.uk/content/dam/nhmwww/take-part/Citizenscience/bioblitz-guide.pdf
- National Geographic has a page called "BioBlitz and iNaturalist. Counting Species Through Citizen Science" available at: https://www.nationalgeographic.org/projects/bioblitz/

Citizen Social Science

"*Citizen social science* is the term most commonly associated with a form of citizen science in the social sciences or alternatively one that has a specific focus on the social aspects of citizen science. It can involve citizens in the design and/or conduct of social research, including engagement in some or all research processes, such as ideation, research design, data collection, analysis, dissemination, and impact."

Citizen social science draws on the tradition of participatory approaches both in participatory action research (PAR) and the co-production of knowledge, and uses tools and concepts that convey scientific rigour and inclusion. Because citizen social science situates social concerns at the centre of research, it gives voice to under-represented or

vulnerable groups and can thus contribute to raising social concerns and to the inclusion and representation of underserved communities in the public sphere.

Source:
Albert A., Balázs B., Butkevičienė E., Mayer K., Perelló J. (2021) Citizen Social Science: New and Established Approaches to Participation in Social Research. In: Vohland K. et al. (eds) The Science of Citizen Science. Springer, Cham. https://doi.org/10.1007/978-3-030-58278-4_7

Co-creation, co-design, co-production
The terms co-creation, co-design, and co-production as used in the field of citizen science describe the collaborative work of professional scientists and citizens in the development and implementation of scientific projects.

Link:

Service design tools website with a collection of tools, resources and materials: https://servicedesigntools.org/tools

FabLabs/Makerspaces
The term FabLab comes from *fabrication laboratory* and refers to small-scale open workshops that offer digital fabrication. Sometimes they are referred to as MakerSpaces.

“A fab lab is typically equipped with an array of flexible computer-controlled tools that cover several different length scales and various materials […]. This includes technology-enabled products generally perceived as limited to mass production.

While fab labs have yet to compete with mass production and its associated economies of scale in fabricating widely distributed products, they have already shown the potential to empower individuals to create smart devices for themselves. These devices can be tailored to local or personal needs in ways that are not practical or economical using mass production.

The fab lab movement is closely aligned with the DIY movement, open-source hardware, maker culture, and the free and open-source movement, and shares philosophy as well as technology with them.” (Wikipedia)

Sources and further links:

- https://en.wikipedia.org/wiki/Fab_lab
- The community maintains a list of all official FabLabs worldwide that was maintained by MIT until 2014 and is available at: https://fablabs.io/

Science shops
"Science Shops are not 'shops' in the traditional sense of the word. They are small entities that carry out scientific research in a wide range of disciplines – usually free of charge and – on behalf of citizens and local civil society. The fact that Science Shops respond to civil society's needs for expertise and knowledge is a key element that distinguishes them from other knowledge transfer mechanisms.

A Science Shop provides independent, participatory research support in response to concerns experienced by civil society." (Living Knowledge Network)

Sources and further links:

- https://www.livingknowledge.org/science-shops/about-science-shops/
- *Living Knowledge* is the international Science Shop network and its webpage contains all about science shops. Here are some links.
- History of Science Shops: https://www.livingknowledge.org/science-shops/about-science-shops/history-of-science-shops/
- FAQ: https://www.livingknowledge.org/science-shops/faq/
- Living Knowledge Toolbox to empower new Science Shops: https://www.livingknowledge.org/resources/toolbox/

Living Labs
"A living lab (LL), in contrast to a traditional laboratory, operates in a real-life context with a user-centric approach. The physical and/or organisational boundaries of a living lab are defined by purpose, scope, and context. The scope, aims, objectives, duration, actor involvement, degree of participation, and boundaries of a living laboratory are open for definition by its participants. A living laboratory could thus be established on a street, in a house, within an organization, or include a whole city or industry, depending on the project. The notion of living laboratory was first proposed by Prof. William Mitchell at MIT Media Lab as:

'a research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real-life contexts.'

However, contemporary definitions of living laboratories are broader and somewhat diffuse. Nevertheless, the following elements tend to be core features of a living laboratory:

- Experimental approaches in real-life context
- Participation and user involvement
- Collaboration and co-production of knowledge"

Source:

http://fissacproject.eu/en/living-labs/

Participatory action research (PAR) and Participatory health research (PHR)

"Participatory action research (PAR) is an approach to action research emphasizing participation and action by members of communities affected by that research. It seeks to understand the world by trying to change it, collaboratively and following reflection. PAR emphasizes collective inquiry and experimentation grounded in experience and social history. […] PAR contrasts with mainstream research methods, which emphasize controlled experimentation, statistical analysis, and reproducibility of findings. PAR practitioners make a concerted effort to integrate three basic aspects of their work: participation (life in society and democracy), action (engagement with experience and history), and research (soundness in thought and the growth of knowledge)."

Source:

https://en.wikipedia.org/wiki/Participatory_action_research

"Participatory Health Research is a research approach. The goal of PHR is maximum participation in the entire research process for the people whose lives or work are being researched. The research process is designed as a partnership between all stakeholders, which include academics; health, social work, and education professionals; decision makers; and engaged citizens from civil society. Through participatory health research, new knowledge can be gained that will help promote health in society. All participants in the research are involved in the entire research process. They participate in formulating the research questions and goals; they jointly develop a research design; and they agree on the research methods, how the research should be evaluated, and how the results should be disseminated."

Source:

http://partkommplus.de/1/forschung/participatory-research/

Community-based Participatory Research (CBPR)

"Community-based participatory research (CBPR) is an approach to research that involves collective, reflective and systematic inquiry in which researchers and community stakeholders engage as equal partners in all steps of the research process with the goals of educating, improving practice or bringing about social change. At its core, CBPR questions the power relationships that are inherently embedded in Western knowledge production, advocates for power to be shared between the researcher and the researched, acknowledges the legitimacy of experiential knowledge, and focuses on research aimed at improving situations and practices. This approach to research is recognized as particularly useful when working with populations that experience marginalization – as is the case for some Indigenous communities—because it supports the establishment of respectful relationships with these groups, and the sharing of control over individual and group health and social conditions."

Source:

Tremblay, MC., Martin, D.H., McComber, A.M. et al. Understanding community-based participatory research through a social movement framework: a case study of the Kahnawake Schools Diabetes Prevention Project. BMC Public Health 18, 487 (2018). https://doi.org/10.1186/s12889-018-5412-y

Public Participation in Scientific Research (PPSR)

The term Public Participation in Scientific Research (PPSR) has been used as an alternative term to citizen science. According to the CAISE report – a very important report that came from the Center for Advancement of Informal Science Education – examples of PPSR projects include citizen science, volunteer monitoring and participatory action research. In this report, PPSR projects were divided into three major categories depending on the degree of involvement of the public. These are:

- Contributory projects: designed by scientists; members of the public contribute data
- Collaborative projects: designed by scientists; members of the public contribute data and participate in refinement tasks
- Co-created projects: designed both by scientists and members of the public working together; some (at least) members of the public participate actively in most or all steps of the scientific process

The CAISE report laid the foundation for the typology developed by Jennifer Shirk and colleagues in 2012 that was presented in part B of this section, the “5 Cs” typology, by adding the categories “contractual” and “collegial”.

Source:

Bonney, R., Ballard, H., Jordan, R., McCallie, E., Phillips, T., Shirk, J., and Wilderman, C. C. 2009. Public Participation in Scientific Research: Defining the Field and Assessing Ist Potential for Informal Science Education. A CAISE Inquiry Group Report. Washington, D.C.: Center for Advancement of Informal Science Education (CAISE). Available at: https://eric.ed.gov/?id=ED519688

Responsible Research and Innovation (RRI)

“Responsible research and innovation is an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation. Responsible Research and Innovation (RRI) implies that societal actors (researchers, citizens, policy makers, business, third sector organisations, etc.) work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of society.

In practice, RRI is implemented as a package that includes multi-actor and public engagement in research and innovation, enabling easier access to scientific results, the take up of gender and ethics in the research and innovation content and process, and formal and informal science education." (European Commission)

Sources and further links:

- https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation
- DITOs consortium, (2019). Research insight on RRI indicators that reflect the practice of public engagement organisations. DITOs policy brief 3. Available at: https://discovery.ucl.ac.uk/id/eprint/10073925/
- RRI tools website: https://rri-tools.eu/

Subsection Number: 3.5

Subsection title: Summary (2 minutes)

Subsection content type: Summary of the learning from the section

Subsection delivery method: text

Subsection rationale*:* Emphasising the learning from the section

Subsection content*:* (240 words)

As illustrated in this section, there are many definitions of citizen science – since citizen science activities and practices are found in different scientific disciplines – and there are also some uncertainties about exactly what the terms that are being used mean in a specific context. Different terms serve different goals and are appropriate for different audiences; it is advisable to check what the people running and involved in a citizen science project exactly mean.

In this section, we have introduced terms such as crowdsourcing, volunteer computing, participatory sensing, and several terms using the word science: DIY science, community science, citizen cyberscience, and civic science.

There are many ways to refer to participants, from citizen scientists (often used) to volunteers or amateurs. In addition, depending on the level or degree of participation of participants in citizen science projects (or, in other words, on the relationship between scientists and participants), projects can be classified in one way or another. For this, we have looked at different typologies and learned that, since most citizen science projects fall within "contributory projects", a way of sub-categorising them makes sense.

We have also learned that typologies and classifications can overlap and the same activity can be called differently depending on what we want to emphasise. In addition, we have

shortly introduced one of the most discussed topics in research and innovation, the wider concept of open science, and seen how it intersects with citizen science.

Subsection Number: 3.6

Subsection title: Self-assessment quiz part 1 (optional - 1 minute)

Subsection content type: Providing an opportunity to check the learning from the section

Subsection delivery method: Drop the words H5P quiz (bold for concepts to be dragged into the boxes)

Subsection rationale*:* Emphasising the learning from the unit

Subsection content*:* (150 words)

There are several **definitions** of the term citizen science, since examples of it are found in different scientific disciplines that interpret the term slightly differently. A universal definition of what is and is not citizen science proves very challenging. Citizen science activities can be classified in different ways, either looking at the type of **activity being performed** or by focusing on the **degree or level of participation**. When looking at three different **typologies** to try to make sense of the field you have been presented with the following terms and explanations:

- Within long-running citizen science fall activities that have been going on for a long time such as weather observations or **bird-watching projects**.
- Activities in **citizen cyberscience** completely rely on the use of the internet and computing, while in **community science projects** participants are more involved in the project design, analysis and interpretation. The latter are carried out as part of local, everyday settings, to address local concerns and needs, often related to environmental injustices and public health issues.

Subsection Number: 3.7

Subsection title: Self-assessment quiz part 2 (optional - 1 minute)

Subsection content type: Providing an opportunity to check the learning from the section

Subsection delivery method: Drop the words H5P quiz (bold for concepts to be dragged into the boxes)

Subsection rationale*:* Emphasising the learning from the unit

Subsection content*:* (150 words)

- The “**5 Cs**” typology classifies citizen science projects into five categories called: contractual, contributory, collaborative, **co-created** and collegial. Contributory projects are generally designed by scientists and for which members of the public primarily **contribute data**, e.g. the micro-tasks in the Galaxy Zoo project. Most citizen science projects fall within this category.

- Haklay’s typology includes **four** levels of participation; level 1 is called **crowdsourcing**, in which citizens are seen as sensors. However, this concept is also used in the context of citizen science to describe finding a way to engage a (very) large number of people in a project. Level 4 is called **extreme citizen science**, where participants are involved in the project by setting the project goal and carrying out the data collection, analysis and action.

Section 4: Challenges and opportunities in citizen science (20 minutes)

issues that are commonly discussed with citizen science - data quality, engagement with volunteers, motivations, opportunities that citizen science offer in terms of engagement, EDI equity diversity inclusion, science literacy, awareness to issues, skills. Interpretation - what you should pay attention to when looking into a citizen science story.

Subsection Number: 4.1

Subsection title: Introduction to the section (2 minutes)

Subsection content type*:* an introduction to what the learner can learn about the field of citizen science by understanding the common challenge

Subsection delivery method*:* text and an image

Subsection rationale*:* Helping the learner to understand the rational for the section.

Subsection content*:*

In this section, you can learn about common issues that are likely to come up when you are reporting or researching citizen science. These are common issues that people ask themselves when they learn about citizen science for the first time - and sometimes well beyond the first time! The questions don’t only come from members of the public, but also from professionals such as scientists, public health officials, and by people in politics and government. By introducing you to these concepts and to the existing discussion points about them, you can be better prepared to ask questions in interviews or find additional material in academic publications and other sources.

In this section we will cover five points. We start with data quality and the ability of people who are not professional scientists to participate in scientific research. Next, we will discuss the issue of engagement with volunteers and how citizen science is different and similar to other volunteering. The issue of motivations and especially the link to activism come up as a way to question the validity of the research; issues of the type of participants and the dimensions of equity diversity and inclusion (EDI); and finally, the claims and evidence for benefits such as science literacy, awareness to issues, improvement in skills.

We will provide a short introduction to each of these topics through a short interactive presentation, and then provide you with additional information that explores it in more detail.

Subsection Number: 4.2

Subsection title: Can non-professionals collect or analyse data as well as professionals? (4 minutes)

Subsection content type: An overview of data quality issues in citizen science

Subsection delivery method*:* text and an image in a H5P slideshow. About 5 slides with 100 words in each slide and image in the first one

Subsection rationale*:* Providing a foundation to why citizen science can provide high quality data.

Subsection content*:* (600 words maximum)

Imagine yourself as a professional surveyor in the early 2000s. Your job is to map in detail roads and buildings for different civil engineering projects. You use equipment worth thousands of Euros - including Global Positioning System (GPS) equipment, laser distance equipment, and rugged field computers. You are told that within less than a decade, ordinary people, equipped with consumer GPS receivers and mobile phones will use them and their home computer to create an accurate map of the world. One of your first reactions will be: no one without my training and equipment is able to create good quality maps. While you are right in terms of creating maps that are precise down to a millimetre. For many users of maps, an accuracy of several centimetres is good enough. In fact, the improved ability of positioning on mobile phones and availability of high-resolution satellite images enabled people with good knowledge of computing and motivation to create such a map within the OpenStreetMap project. These crowdsourced maps are now used by Apple, Microsoft, and the World Bank. It is not surprising that many scientists feel the same about their area, and not noticing the societal changes that enable high-quality citizen science data.

The concern about data quality is understandable. It is common to assume that the people who design and collect scientific data are well-trained experts. It is expected that data collection is carried out only after careful experiment design, selection of locations for data collection, and is done with specialised and expensive equipment. Therefore, the idea that

“anyone” can collect or analyse scientific data with their smartphones and produce high-quality data sounds counterintuitive.

As a result, the question “can volunteers collect data as good as professionals” is very common. There are well over 50 scientific studies that compare the performance of participants in citizen science projects to experts. These studies consistently show that when the process of data collection is designed specifically for a wider audience, high-quality data can be obtained through the effort of volunteers. This requires an approach to quality assurance and data collection that is different from the standard scientific processes, which might explain the concerns. Put simply, scientists are not trained or familiar with how to design high-quality processes for a wide audience as this requires a very different way of thinking.

For example, while it will be too costly to employ 30 scientists who will classify the same picture of million galaxies, such a method is very common in citizen science. The image is shown to different volunteers who are not in contact with one another. The agreement among multiple observers increases the confidence in the classification. Other methods are used in citizen science to ensure high data quality, such as identifying more experienced and accurate volunteers and allocating to them the task of checking the data that was collected by less experienced participants. Another method is to engage experts in verifying the observations that are marked as more uncertain.

Subsection Number: 4.3

Subsection title: additional information on data quality in citizen science (5 minutes)

Subsection content type: Further details and references to major publications in the area of citizen science and data quality

Subsection delivery method*:* text and an image in a H5P accordion. About 50-200 words in each section

Subsection rationale*:* Providing further details on why citizen science can provide high quality data.

Subsection content*:* (800 words maximum)

Evidence for the ability of participants to collect high-quality data:
Multiple studies demonstrate the ability of volunteers to collect high-quality data. Below we provide some links to sources that are discussing how you can ensure high data quality within citizen science projects.
In the paper “Assessing data quality in citizen science” https://doi.org/10.1002/fee.1436, Margaret Kosmala and her colleagues explain the details of ensuring data quality in environmental projects. They explain how it is possible to design a project that will ensure that the quality of the data that is resulting from it is high
Another useful source is Caren Cooper’s blog post from 2016 on Quality and Quantity in Citizen Science

https://www.discovermagazine.com/the-sciences/quality-and-quantity-with-citizen-science. The post is explaining the reasons that we can trust citizen science data and some of the methods that are used to ensure it.

Evidence that the analysis by volunteers is leading to high-quality data

There are also good theoretical reasons why the quality of analysis is high when the public is asked to analyse data, which is based on the multiple observers' concept that we presented above. In a paper by David Watson and Luciano Floridi on" Crowdsourced science: sociotechnical epistemology in the e-research paradigm" https://link.springer.com/article/10.1007/s11229-016-1238-2, they explain that the difference of verification by multiple people is as important as expertise. In some cases, such as the classification of information, the crowdsourcing approach is superior to other methods that are used in science.

There are also studies that demonstrate the high quality of data - for example, in a 2010 study about how many volunteers can map an area well, Muki Haklay and his colleagues show that when you have multiple people working at the same area in OpenStreetMap, the quality of the data does go up https://www.tandfonline.com/doi/abs/10.1179/000870410X12911304958827

The challenges of governmental organisations in integrating citizen science data.

Government organisations, due to their hierarchical and command & control structures, can find it challenging to integrate citizen science and crowdsourcing projects. A good study by Daren Brabham from 2013 explains these challenges and offers a process for integration https://www.cbs.dk/files/cbs.dk/using_crowdsourcing_in_government.pdf. Another study, by the World Bank, shows that government bodies can work in collaboration with non-governmental organisations to integrate such processes in their work.

https://documents.worldbank.org/en/publication/documents-reports/documentdetail/387491563523294272/identifying-success-factors-in-crowdsourced-geographic-information-use-in-government

Subsection Number: 4.4

Subsection title: Why do people participate in citizen science? (4 minutes)

Subsection content type: An overview of the volunteering, activism, and payment aspects in citizen science

Subsection delivery method*:* text and an image in a H5P slideshow. About 5 slides with 100 words in each slide and image in the first one

Subsection rationale*:* Introducing an explanation on the motivation of participants and the discussions around the role of activism and payment.

Subsection content*:* (600 words maximum)

Why do people participate in citizen science? This is a very common question. The question can come up for different reasons. For example, a scientist might want to know what will be the right way to recruit people to join her project, or a government official may wonder if it is appropriate to invest in a citizen science programme "if we build it, will they

come?". From time to time, there will be people who will approach this in an instrumental way that is at risk of becoming unethical exploitation of someone to get them to contribute an effort for free without any gain. Other motivations, especially those that are linked to "activism", are viewed with suspicion.

As with data quality, it will come as no surprise that when scientists have such questions they set off to research them - even when they have little expertise in behaviour and psychology! There are hundreds of academic articles on the issue of motivation in citizen science, and some of them are telling us more about the way that scientists think about the public than explaining motivation. However, there is plenty of good research that is building on psychological and sociological research on volunteering. Overall, the research shows a wide range of motivations.

Motivation is frequently seen as something that is inherently valuable personally (intrinsic motivation) or something that provides an external benefit - such as payment or a job (extrinsic motivation). In citizen science projects it is common to find motivations such as: contributing to science and taking part in scientific discovery. For example, you can help scientists through the identification of galaxies, and you are likely to be the first human that looked at a picture from a space telescope. Similarly, addressing a problem that someone dear to you suffered is a motivation for participation in drug discovery projects. Many citizen science projects also add a game-like element (gamification) and this can encourage people to record more observations to achieve a goal - e.g. getting to 100 pictures during a weekend. However, gamification can lead to unwanted incentives and reduce the quality of the data. Different projects and activities in citizen science are linked to different motivations, and there are no magic levers that will always work.

Activism is the type of motivation that has received special attention. Activism in citizen science is frequently linked to environmental issues. We've seen it in the story about the Louisiana Bucket Brigade, with the community collecting evidence of air pollution incidents. The suspicion towards activism is the result of scientists and officials believing that professional standards and ethos mean that scientific data collection is objective activity. Therefore, activism might lead to bias in the data collection process, so it supports the goal of the activists. The way this challenge is addressed is by paying special attention to data quality and verification in such projects. The Louisiana community was sending its samples to an accredited laboratory that is recognised by the Environment Protection Agency, and this way they could demonstrate an unbiased data analysis.

Finally, an important aspect of participation is the idea that participants in citizen science projects are volunteers. We have seen that some definitions of citizen science explicitly mention volunteers. An indirect assumption here is that volunteering differentiates the lay participant from the research assistants who get paid for their effort to assist the scientists. While this is generally the case, this is not universally true. In some cases, especially when a project includes the participation of a disadvantaged group, some financial compensation for the time that is dedicated to the project can be in place.

Source:

Geoghegan, H., Dyke, A., Pateman, R., West, S. & Everett, G. (2016) Understanding motivations for citizen science. Final report on behalf of UKEOF, University of Reading, Stockholm Environment Institute (University of York) and University of the West of England.

Subsection Number: 4.5

Subsection title: Who participates in citizen science and who is missing? (4 minutes)

Subsection content type: An overview of the people that participate in citizen science and who is missing

Subsection delivery method*:* text and an image in a H5P slideshow. About 5 slides with 100 words in each slide and image in the first one

Subsection rationale*:* Allowing the learner to understand the type of people that they might come across and ask questions about the inclusiveness

Subsection content*:* (600 words maximum)

We answered “why do people participate in citizen science?”, so let’s turn to who participates. Understanding who are the typical participants of citizen science projects is important to the understanding of issues such as diversity and inclusiveness, and, as we will see, also helps in answering how come the data quality is high. Citizen science is a diverse practice that ranges from projects that are run by a single individual who quantifies their health to projects that reach out to millions of participants, so we can expect high variation in the answer to this question, but there are some common patterns.

Let’s first look at how many people participate in citizen science. Currently, the numbers are fairly small out of the total population. For example, in the United Kingdom (UK), every January, the Royal Society for the Protection of Birds runs the “Big Garden Birdwatch” which asks people to identify and report the birds that they see in their gardens for one hour. This is the largest wildlife survey in the world and engaged one million people in 2021. This was a peak year, due to the pandemic lockdown. Even so, they represent 1.5% of the total population. When it comes to projects that require more time involvement, the percentage of participation is much smaller. For example, we can estimate that only 0.1% of the population in the UK regularly contribute to online and offline projects, such as Galaxy Zoo or the weather observations that we mention in our introduction. This is why there is an interest in sharing information about citizen science and welcoming more people — there is plenty of scope for more people to join.

When we look at the profile of the people that participate in different citizen science activities, we can consider a range of characteristics — age, gender, nationality, and so on. One of the interesting aspects is the level of education. For example, while the general level of education across advanced economies in Europe is that about a third of the population attended higher education. Even in the highest attainment countries in Europe like the UK or Luxembourg, only about 45% of the population reached this level. However, in Galaxy Zoo, 65% of participants had tertiary education and 10% had doctoral-level

degrees. In the OpenStreetMap project, 78% of participants hold tertiary education, with 8% holding doctoral-level degrees. Across many projects, people who went to university are overrepresented. This can explain the quality of the data — since such participants understand the requirements of scientific research.

Many projects show a gender bias, but the picture indicates that differences in project design and management can lead to different outcomes. For example, in the OpenStreetMap project surveys show over 95% male participation, while in Transcribe Bentham, a project in which volunteers participate in transcribing the writing of the English philosopher Jeremy Bentham, nearly two thirds of participants are female. In a study in the UK in 2015 of participation in environmental citizen science, there was close participation between male and female. Studies also show higher participation of people over the age of 40s, and white. It is, therefore, not inaccurate to assume that a typical citizen science participant is a male, with a university education, white, and middle-aged. They are also likely to know English, which is the language that is used widely in science. Yet, care should be taken about a specific project — it is a good idea to ask the project coordinators about their effort to be inclusive and what is the profile of the participants.

Source:
https://www.discoverwildlife.com/news/majority-of-garden-bird-species-recorded-in-the-big-garden-birdwatch-2021-suffer-decline/

https://en.wikipedia.org/wiki/List_of_countries_by_tertiary_education_attainment

Pateman, R. M., Dyke, A., & West, S. E. (2021). The Diversity of Participants in Environmental Citizen Science. Citizen Science: Theory and Practice.

Haklay, M. (2018). Participatory citizen science. In Haklay M., Hecker S., Bowser A., Makuch Z., Vogel J., & Bonn A. (Eds.), Citizen Science: Innovation in Open Science, Society and Policy (pp. 52-62). London: UCL Press. Retrieved June 10, 2021, from http://www.jstor.org/stable/j.ctv550cf2.11

Subsection Number: 4.6

Subsection title: What are the benefits of citizen science? (3 minutes)

Subsection content type: An overview of the benefits that people get from participating in citizen science

Subsection delivery method*:* text and an image in a H5P slideshow. About 5 slides with 100 words in each slide and image in the first one

Subsection rationale*:* Allowing the learner to understand the range of benefits that participants can gain in a given project

Subsection content*:* (600 words maximum)

Finally, let's turn to the benefits. What do the participants get out of participating in citizen science? As we've seen in the examples throughout this unit, scientists are getting many benefits: data from places that they can't reach; volunteer effort in collecting and analysing data; and access to resources such as a weather station at someone's home. But what evidence do we have that the people who join such projects also benefit? Here we will look at some of these paybacks. They include multiple aspects, ranging from learning a topic to understanding much more how scientific processes work, but also skills such as engagement with others and even health benefits.

Citizen science has a role at different levels of education. At school, even at a very early age, citizen science provides an opportunity to learn that science is not a solid and unchanged body of knowledge but a process of exploring and understanding the world. For example, children aged 8-10 in Blackawton school in the UK co-design and carried out an experiment that demonstrated that bees can differentiate colour patterns. This is also true for students at universities. Usually, they have little opportunity to participate in active research projects during their undergraduate studies. Citizen science also contributes to learning out of school or college, in what is called "informal learning". This is because it allows people to engage with a scientific issue and learn about it in the outdoors or during a visit to a museum.

Another area where participation in citizen science can provide benefits to the participants is through creativity and innovation. This is especially true with the area of Do-It-Yourself (DIY) science. The development of new measurement instruments or new sensing techniques is an integral part of DIY science. Organisations such as Public Lab, which was mentioned in the balloon mapping case, encourage the people who use the instruments to adjust the blueprints and share the results with other participants. Such online communities have led to the creation of new instruments that can be used for different purposes.

There are also valuable skills that are relevant not only within scientific projects but for other areas in life. For example, we mentioned that in Galaxy Zoo, some participants volunteered to assist with managing the online forum. This provided an opportunity to learn about online community management, keeping the conversation flowing and civilised and so on. Another life skill that citizen science can provide is in managing records of observations and information that was collected and uploading them to shared information systems. Finally, there are also opportunities to develop writing skills — from sharing results on a blog or social media, and potentially learning how to write a scientific paper.

In the projects that are led by communities, such as recording the level of noise in their area or air pollution, the participants gain the ability to provide evidence for the harm that they are experiencing. While these projects are not always leading to a solution to the environmental issues that sparked them, the ability to collect and share the information that demonstrates the issue is valuable by itself.

https://www.bbc.co.uk/news/education-12051883

Subsection Number: 4.7

Subsection title: Summary (1 minutes)

Subsection content type: summarising the the main issues

Subsection delivery method*:* text and an image

Subsection rationale*:* Helping the learner to link the ideas together

Subsection content*:* (200 words maximum)

In this section, we have answered a set of questions about citizen science, which are frequently coming up. The questions were — How can volunteers produce high-quality data? Why do people participate in citizen science? Who participates in citizen science? And What do they get in return for their effort? These questions are, of course, linked. We can now see that because people are motivated to help a scientific effort and are frequently holding higher education, they pay attention to how they collect data. This, in turn, explains the high quality of the resulting data.

These questions are important for different citizen science projects, and within each project, the answers will be different. There can be citizen science projects that are aimed at recruiting volunteers with special expertise — in the same way, that Doctors without Borders seek out volunteers who are medical experts. In such cases, the answers to questions about inclusiveness and diversity will be limited to the pool of available participants and structural inequalities might mean skewed participation. This should not lead to an immediate critique of the project — it needs to be examined holistically, including the benefits from the project to the wider population.

Subsection Number: 4.8

Subsection title: Optional revision quiz (2 minutes)

Subsection content type: Providing an opportunity to check the learning from the section

Subsection delivery method*:*Single Choice H5P quiz

Subsection rationale*:* Emphasising the learning from the unit

Subsection content*:* (100 words maximum)

See if you can answer the following question with the correct statements.

Online citizen science can use the decisions of multiple participants as a way to ensure high quality of data

- Yes, this is correct; by evaluating the degree of agreement among the people that analyse the data, it is possible to reach high quality data

- No, this is not enough and there is a need that professional researchers test the information and the decisions of participants

Is there evidence that the data quality from citizen science is good enough?

- There are over 50-60 scientific publications that compared professionals and amateurs in data collection, and they consistently show that with appropriate training and project design, the quality of the data can be very high
- It is not possible for people without scientific training to collect data that will be at the same quality as professional researchers
- Regardless of project design, citizen science data is always high-quality

People are participating in citizen science mostly for fun, and it is very important to keep them entertained

- While important, it is not the main reason people participate in citizen science. Most participants want to contribute to scientific research and are pleased when their contribution is leading to a scientific discovery
- As a result of this, gamification and the use of leader-boards and other competition is central to activities in citizen science
- The statement is correct, and it is more important to maintain enjoyment - even if the scientific results are not as good as expected

People always participate in citizen science to earn money

- This is incorrect. In most projects, the participants are volunteering in their free time and resources. In some cases, especially when the project is working with marginalised groups, there is a value in some payment for the participants, but if the payment is too high, they are research assistants and not volunteers
- This is a major motivation in citizen science, and the projects are using a lot of money to ensure that they can employ a lot of participants

All citizen science projects are representing society as a whole - you will find people from all backgrounds in all projects.

Unfortunately, this is incorrect. Many projects do have different biases in terms of representation and just like with science in general, there is a need to reach out and include people who are under-represented

Because citizen science is open to the whole public, it is expected that people from all walks of life will join

Section 5: Social, economic and political impacts of citizen science

An overview of the different domains in which citizen science has an impact, either through its outcomes or its implementation.

Subsection Number 5.1

Subsection title Introduction to the section (2 min)

Subsection content type an introduction to what the learner will learn about the impacts of citizen science.

Subsection delivery method text and image

Subsection rationale A short introduction to this chapter

Subsection content

Citizen science, as indicated in its name, is an activity that contributes to science in general. You have now discovered through the previous sections that it can be applied in every domain of science and throughout any step of the scientific process. This section will now provide you with an overview of the benefits that citizen science can bring to other aspects of society, besides the production of science.

With practical examples, we will go through different aspects of our society that can be impacted by citizen science projects or results.

First, of course, scientific studies can take a great benefit from citizen science to gather data or to conduct experiments. Also, society itself and local communities can find in citizen science a tool to improve citizen's lives. Then, interactions between citizen science and policy are mutual, as citizen science brings tools and pieces of evidence that policymakers can use in their activities, and policies are crucial to support citizen science activities. Finally, we will explore together how citizen science raises awareness about environmental or global issues.

Subsection Number 5.2

Subsection title Scientific impact (4min)

Subsection content type Explanation of the scientific impact of citizen science

Subsection delivery method Text + image (800 words)

Subsection rationale Examples of when citizen science has led to a scientific advancement

Subsection content

The core ambition of citizen science, like any branch of science, is to produce knowledge on the world around us. In particular, it is an amazing instrument to overcome barriers that

scientific research faces, such as lack of time to analyse data or lack of resources to gather field data, to name a few.

Citizen science can be especially beneficial as it opens up the scientific process to the whole society and every actor can play a role and can help achieve these objectives.

When one thinks about the different types of impacts that emerge from citizen science, the first one that naturally comes to mind is data collection. Numerous apps or websites are offering a repository platform where citizen scientists can upload their discoveries or the data they have gathered.

The two following examples are both relying on online tools available at a large scale, but many smaller projects have also succeeded in producing high-quality scientific data in a more local setting, not always based on an online platform.

One of the most renowned apps is iNaturalist. In the mobile app, which is also accessible as a website, participants can upload pictures or videos of their natural observations and share them with the whole community. The data collected through this can then be used by various projects and is available to any scientist. The website is described as a "world-leading resource that combines observational data with artificial intelligence and community expertise to bring natural history into the digital age."

After biodiversity, the second scientific domain that is the most represented in citizen science is astronomy and space science, which has a huge potential for citizen participation due to wide public interest in astronomy. With the Galaxy Zoo project, which we came across earlier, participants can be involved in research by helping astronomers to explore the universe and identify particular objects.

Discoveries generated through this mean can have a great impact in the field, as happened with the "Green Peas" galaxies (a special class of galaxies) that have been identified for the first time by Galaxy Zoo participants..

There is a growing trend to give more credit to citizens who have participated and contributed to research in scientific publications. Indeed, for some projects, the majority of the data used for the research comes from citizen science and citizen contribution.

Despite that, the most eminent scientific publications do not integrate yet a possibility to credit other contributors than "official authors" of the study.

This issue is even more relevant when contributors are indigenous citizen scientists, who are already under-represented in science but take part in citizen science projects where they bring a huge contribution.

Subsection Number 5.3

Subsection title Societal impact (4 min)

Subsection content type different examples of citizen science initiatives that have brought impacts on society

Subsection delivery method Text + image (800 words)

Subsection rationale List of examples of when citizen science has had societal benefits

Subsection content

It would be rather reductive to consider citizen science only as a data production tool, that is solely beneficial to scientists. Citizen science is way more than this, and the interest of citizen scientists can not only be based on their motivation to help science but also on the benefits that they can personally or on a community scale, get from it. In history, citizen science has proven to have positive impacts in the localities where it is implemented, bringing a sense of community and offering an activity for the local participants but also through the scientific impacts generated.

As an example of the societal impact, we will describe in detail a case that illustrates this point perfectly: the Making Sense pilot based in Barcelona.

Making Sense was a project that ran from 2015 to 2017 with the aim to engage communities around digital 'maker' culture, open design and environmental sensing.

One of their pilots was based in the Plaça del Sol in Barcelona. This neighbourhood was one of the noisiest of the city, due to the great number of bars and pubs localised in the area and its attractiveness to young people who used to regularly stay until late at night. This situation was no longer to the taste of the inhabitants, tired by these disturbances.

With the help from the local Making Sense branch, the neighbourhood association has been researching and measuring the noise volume.

Concretely, they co-designed and built city sensors called ‘Noisebox’, based on a Smart Citizen Kit, that were able to monitor the noise level in the area. These sensors were placed on the balconies around the square.

In order to raise awareness about this initiative, they have also developed a display to attract curious people with LED strips and a platform to allow visitors to express their feeling about the noise in the square.

Data gathered from this initiative supported the residents' complaints: with peaks of more than 100 decibels in the middle of the night, the level was far higher than World Health Organization recommendations, causing severe disturbances and a possible impact on the inhabitants' health.

With this information, the collective met the local policymakers and exposed the issue. Actions have been taken: the city council made some changes on the square itself, such as more police interventions to move people after a certain hour, or the addition of plant boxes on the steps where the groups were gathering.

In the end, this citizen science project has made a significant change in the neighbourhood and the life of the inhabitants has been truly improved.

Subsection Number 5.4

Subsection title Political impact (4 min)

Subsection content type different examples of citizen science initiatives that have generated impacts on policies

Subsection delivery method Text + image (800 words)

Subsection rationale Citizen science initiatives have the potential to impact policies

Subsection content

The Making Sense provides a smooth transition to the next topic: the impact that citizen science can have on policies and governance.

Being a mix between evidence-based actions and citizen-led initiatives, citizen science has the potential to be of great interest to policymakers and public administrations.

The Making Sense example that we just covered is a good illustration of how citizen science initiatives can have a higher impact on policy decisions and how citizens, through citizen science, can make their voices heard in the governance of their localities.

Various local citizen science projects have been initiated by residents who were looking for a solution to a local problem and who needed concrete pieces of evidence to make their case to policymakers. The production of scientific data, especially coming from monitoring activities (either biodiversity, pollution etc), can inform policymakers of the current situation and help them develop policies in accordance with society's needs.

An example of a European-wide project is provided by WeCount.

The EU-funded project WeCount enables citizens to initiate a policy-making process with fully automated measurement data in the field of mobility and air quality. Based on 5 different pilot projects spread out in Europe (Madrid & Barcelona, Leuven, Ljubljana, Dublin and Cardiff), citizens are invited to count and measure the traffic in their street and use this measurement data to contact the local or regional government in order to devise informed solutions to tackle various road transport challenges.

The 17 Sustainable Development Goals developed by the United Nations in 2017 are common goals that are shared by all members states to promote prosperity while protecting the planet.

In order to measure the progress towards their achievement, several indicators are monitored and followed closely by scientists and experts in every country. To do so, they need reliable and consistent data, and this is where citizen science can once again show its potential: It can provide a great source of data – if correctly coordinated and integrated.

Analysis by Dilek Fraisl and her colleagues (2020) has shown that at the moment, citizen science is already contributing to the monitoring of 5 SDG indicators, and that it could potentially contribute to 76 indicators. Added up, this could represent 33% of the overall number of indexes.

Citizen science could then be a great ally for the achievement of the SDGs, notably the goals linked to nature and environment and society:

- SDG 15 Life on Land
- SDG 11 Sustainable Cities and Communities
- SDG 3 Good Health and Wellbeing
- SDG 6 Clean Water and Sanitation

Subsection Number 5.3

Subsection title Educational impact (4 min)

Subsection content type overview of the other kinds of impacts that citizen science can have, especially on education.

Subsection delivery method Text + image (800 words)

Subsection rationale More than scientific impacts, citizen science is also a way to engage citizens with science through their hobbies and/or activities and engage them with their communities

Subsection content

If we go beyond the classification that we followed until now, which completely separates the three blocks “scientific”, “societal” and “political”, there is a last type of impact that has its roots in each of these categories: the educational impact, or the knowledge and skills that each type of participants can get from a citizen science project. These initiatives can raise awareness about specific challenges, can introduce participants to science in an accessible way and can empower them to choose science, either to solve local issues or even as a career path.

Citizen science is also often used as a tool to reach out to communities that are not familiar with science. Many studies have shown that a significant proportion of the population doesn’t have access to what we call science literacy, due to social-economic reasons. Many citizen science projects have at heart to collaborate with these communities and are even specifically targeting them.

For example, the TROSA project in South Asia is based on voluntary engagement of local communities, mostly women and youth, to collect and analyze river water quality data to build an evidence base which subsequently informs multi-stakeholder dialogues for collective action on water governance.

Several spaces can be used as a vector of science and citizen science projects

First, schools. Formal education is the first means to teach scientific topics to children. Studies have shown that by being familiarised with science from an early age, children have a higher chance to overcome the glass ceiling that could prevent them from choosing scientific paths later in their studies. Citizen science adds the advantage to familiarise students directly with the scientific process, and to offer them a chance to

experiment in a practical setting.
Moreover, citizen science is a means to increase their awareness of societal problems such as air pollution, biodiversity monitoring etc.

Then, science museums. They are already recognised as a space for non-formal learning, and many of them are actually engaged in citizen science projects where their public can take an active part in the scientific research, more than being just passive visitors. For example, the Sparks project that took place from 2015 to 2018 designed a travelling exhibition called “Beyond the lab: the DIY science revolution” that was telling the stories of ‘DIY scientists’.

This exhibition travelled to different locations, always accompanied by a series of public events which related to local scientists and to the topics addressed by the exhibition.

The participatory activities organised were an invitation for the public to dive into the world of citizen science and discover that science was actually at their reach.

SECTION 6: ***Citizen science in the news*** (12 min)

This section provides a series of examples of citizen science stories in different journalistic media. The stories show a variety of topics and formats in English language. A list of examples in other languages is provided at the end of the section.

(This section introduces some of the existing use of citizen science in journalism and examples of narratives about citizen science activities.)

Use as a **guide** for us: articles that Muki has found here and here

- **Classify into:**
  - What kind of media, and within it (combining it)
  - What kind of topic
- **Write 4-5 lines of text** on how the journalists have used the text. Highlight 5 stories in English in 5 different topics and emphasize that we will share examples in other languages in the further resources
  - Campaign CurieuzeNeuzen in Belgium
  - Guardian article on the disappearance of butterflies

    - Specific volunteers (environmental justice cases, Hanny van Arkel)
    - “This is a good story because…”
- **Structure:**
    - Write the 4-5 lines on the story (e.g. print + data quality), and then (maybe in the form of an accordion) provide more resources on the same topic
    - Provide the list as further resources at the end with all the examples that we have not used

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Subsection Number 6.1

Subsection title: Welcome and introduction (1 minute)

Subsection content type: Introduction to the section, which will showcase five examples taken from different types of media and addressing different topics that relate to citizen science

Subsection delivery method*:* Text and picture

Subsection rationale: Brief description of the section’s content, providing the student with an overview of it and inviting her/him to find ideas for future ideas among the examples provided.

Subsection content:

Our final section is dedicated to ***Citizen Science in the news***. We have gathered here some interesting stories that we hope will enrich your ideas about how to integrate citizen science stories into wider media topics. Such ideas can link to different aspects that are meaningful and interesting to diverse audiences. The stories selected are in English and cover a variety of topics and formats used. At the end of the section, you will find a selection of media citizen stories in several languages. We hope this will kindle your interest and provide you with useful ideas!

The examples that we will see include: using citizen science as a vehicle for a major campaign of a newspaper in Belgium, and a way to engage the audience and promote the social engagement of the paper. The second example is for an environmental story on the decline in butterfly population, and the role of citizen science as something that the reader can do about it. The third story comes from a science report programme which reports on a citizen science project as a way to link to the audience at home.

Photo by Good Good Good on Unsplash

Subsection Number 6.2

Subsection title: What happens when 20,000 Belgians turn into air pollution scientists? Curious noses

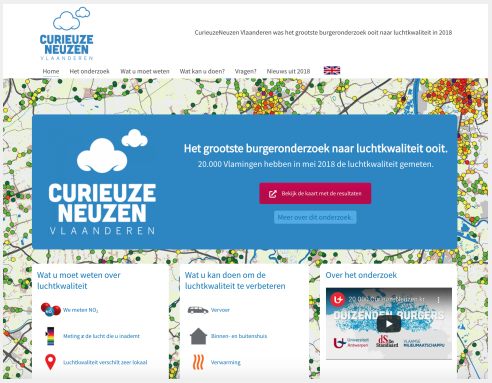
Subsection content type: This is one of the stories that shows with a real example how journalism has showcased stories coming from citizen science projects.

Subsection delivery method: Text, pictures, hyperlinks and Youtube videos (150 words)

Subsection rationale: Providing concrete examples, that vary in format and topic, will enable the learners to see the potential and opportunities that citizen science can offer for their journalistic practice.

Subsection content: Curious noses (“Curieuze Neuzen” in Flemish) is a Belgian citizen science project that has been the biggest European citizen project tackling the problem of air pollution. "Curious noses" is an expression that also means "person who is interested" in Flemish, and this was clearly supported by the high number of adherents that the project had. Using low-cost and uncomplicated instruments, a tube and a cardboard sign, they gathered very valuable data that showed that living in big cities you are exposed to harmful particles. What makes this story a good one? The value of breathing clean air is shared by a large number of people, if not by everyone. Therefore, having a common value and concern, heightened the relevance of and interest in this project. Curious noses is now measuring the impact of dry seasons, especially drought, in their local environment and how this might affect inhabitants in the short term.

Picture source: Screenshot of the home webpage of the Curious Noses.



->3-minute video about Curious Noses

https://www.youtube.com/watch?v=oQwzB91llBI

->Curious noses in local media

https://www.vrt.be/vrtnws/nl/2021/01/21/curieuzeneuzen-in-de-tuin-nieuw-onderzoek-naar-droogte-in-tuine/

->Curious noses in specialised magazines:

https://meta.eeb.org/2018/10/04/five-things-we-learnt-when-20000-belgians-became-air-pollution-scientists/

https://www.nature.com/articles/d41586-018-07106-5

https://panoramatest.tbodev.de/en/solution/citizens-are-encouraged-be-nosy-about-air-quality

Subsection Number 6.3

Subsection title: Where are you, butterflies? The Guardian covering the disappearance of butterflies

Subsection content type: This is one of the stories that shows with a real example how journalism has showcased stories coming from citizen science projects.

Subsection delivery method: Text, pictures, links (130 words)

Subsection rationale: Providing concrete examples, that vary in format and topic, will enable the learners to see the potential and opportunities that citizen science can offer for their journalistic practice.

Subsection content: The lessening of butterflies visiting fields and gardens has been widely documented. Due to pesticides, forest disappearance and industrial agriculture, they are not as common in the countryside. But what are the causes of its decrease in the city?

Picture Source: Screenshot of the webpage, section Cities on The Guardian.

It's the disappearance of butterfly-friendly habitats that appears to be the main cause and this is itself due to several factors and reasons. Some cities are embracing this cause and in a multi-actor coordinated action, they are putting in practice pollination plans. This story is good because it shows the capacity of coordinated communities, including the scientific and political communities, in reversing the pervasive effects of human development.

Accordeon

-> Related content: Saving the monarchy butterfly and by doing so, the planet. 11-min video

https://www.ted.com/talks/mary_ellen_hannibal_how_you_can_help_save_the_monarch_butterfly_and_the_planet?language=en

->Building sites for butterflies downloadable PDF

https://butterfly-conservation.org/sites/default/files/2019-06/building_sites_for_butterflies.pdf

Subsection Number 6.4

Subsection title: Scientific, useful and interesting enough for diverse publics? A BBC podcast showing the hooks of citizen science

Subsection content type: This is one of the stories that aims to show with a real example how journalism has showcased stories coming from citizen science projects.

Subsection delivery method: Audio, hyperlink, text (130) and pictures.

Subsection rationale: Providing concrete examples, that vary in format and topic, will enable the learners to see the potential and opportunities that citizen science can offer for their journalistic practice.

Subsection content: Let's see the case of this audio. This podcast was launched last year, as one of the episodes of the BBC series Inside Science. From around minute 14:45, the listener gets introduced to part of the history of citizen science such as radio-based research from the 1930s. This is followed by a discussion of the Zooniverse platform, which is 10 years old already. The reporter gets on the platform and describes his user experience, while he tells the audience he has chosen a project about penguins, helping scientists get more information about penguin populations. What makes this story interesting? In the episode, a person tries a tool live and tells the listener about his findings, curious facts and how his motivation rises because he is contributing to something he values.

Picture source: Screenshot from the webpage BBC Sounds

Subsection Number 6.5

Subsection title: Personal story that includes the use of citizen science as part of the personal achievement and a journey

Subsection content type: The content will be an article that provides an example of a personal journey that includes citizen science.

Subsection delivery method: Audio, hyperlink and pictures

Subsection rationale: A case that centred on a “hero’s journey” as a narrative story.

Subsection content:

Citizen science can also feature in a discussion about community concern over a news issue. For example, the issue of local pollution from fracking activities for the extraction of gas and oil in the US gained attention in the early 2010s. This provided an opportunity for the US National Public Radio (Npr) to develop a story about the involvement of local people in monitoring the impact. Local reporter, Katie Colaneri, focuses her story on Joanne Martin, a resident of Pennsylvania, who has been carrying out water quality monitoring in the Brady Run stream for three years. The reporter uses her story to link the monitoring of environmental quality and the activism about the pollution that oil drilling can cause. In this case, the article focuses on the aspects of citizen science, but in other cases, the personal story takes centre stage.

Picture source: Screenshot from the website State Impact, part of National Public Radio programme.

Another example for such a story is the detailed profile of Hugh Brown and his effort to collect and monitor kissing bugs. The profile puts Hugh in the centre of the story, but also conveys the challenges of the Chagas disease and the wider context.

https://www.statnews.com/2016/08/10/chagas-disease-kissing-bugs-hunt/

Subsection Number 6.6

Subsection title: Stories about the technologies and innovation from citizen science

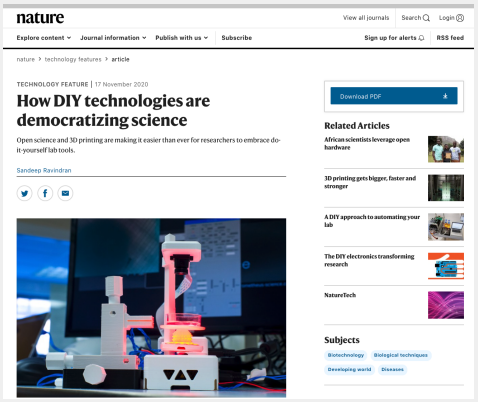
Subsection content type: The content will be an article that provides an example of the innovation that can come out of citizen science activities

Subsection delivery method: Audio, hyperlink and pictures

Subsection rationale: A case that demonstrates how citizen science fits into other science and technology stories.

Subsection content:

The final example that we will use is about the technologies and innovation that are emerging from citizen science. When people get very involved in citizen science projects, a lot of the time they are experiencing limitations in their access to equipment. Since the need is the mother of invention, there are a range of examples of technologies that have been invented by participants. For example, in 2020, the high-level science journal *Nature* reported on the potential benefits of these Do-It-Yourself Science tools and how they can increase access to science. For example, a 3D printed microscope.



Picture source: Screenshot from the website of Nature Magazine.

The story of novel ways of collecting and sharing data can also integrate into stories about a topic, or the achievement of a grassroots campaign, such as this example from the Guardian from 2014 about the use of DIY tools in measuring air quality.

https://www.theguardian.com/cities/2014/jan/31/air-activists-social-media-pollution-city

Subsection Number 6.7

Subsection title: Further example of journalism about citizen science in different languages (optional)

Subsection content type: The content will be a list of resources in different languages and different media, with a short description of the source.

Subsection delivery method: Excel file with hyperlinks and short description

Subsection rationale: Further resources for journalists to explore

Subsection content:

The examples in this list are sorted per language (alphabetically) and within each language per resource type (text, podcast, video, etc.). Each link is accompanied by a short description of the news.

Dutch

Text

- De sneeuw is gesmolten, maar duizenden plastic borstelharen van veegmachines blijven nog jaren liggen

Highlighting the problem of plastic litter, and the Plastic Spotter action that engages Citizen Scientists in not only identifyin types and sources of litter in the canals, but also takes the plastic out of the canals.

- Burgerwetenschap is in opkomst. 'Vergeet niet dat veel wetenschappers vroeger amateurs waren'

Highlighting the problem of plastic litter, and the Plastic Spotter action that engages Citizen Scientists in not only identifyin types and sources of litter in the canals, but also takes the plastic out of the canals.

- Speur mee, tel mee, denk mee - De burgerwetenschap is onmiskenbaar in opkomst

The growth of Citizen Science, with a range of examples, profiled participants, and links to the initiatives to invite readers to also take part

- Vier dingen die jij zelf kunt doen voor biodiversiteit

An article about positive things that you can do for nature to improve biodiversity and support pollinators, that includes examples of being a Citizen Scientist, with links to many initiatives.

- Kinderen onderzoeken tijdens IVN Slootjesdagen hoe gezond de sloot in Utrecht is

Local news about school children engaging with an annual biodiversity initiative, with informationn about what is learned each year.

- Citizen Science: bewoners 'monitoren' biodiversiteit langs fietspad A15

Local news about a CS biodiversity initiative, featuring participants, supporters, and with information about how to get involved yourself

- Amateur wettenschapper

Different projects in The Netherlands

English

Text

- World is home to 50bn wild birds, 'breakthrough' citizen science research estimates

Article about a research carried out by the University of Southern Wales

- The power of people to manage public health

The story of one citizen science project managed to gather and process real-time information and insights faster than most, propelling the power of people-led science combined with technology to the fore.

- The rise of citizen science

Article that enhances how citizen science builds on our very human sense of curiosity.

French

Text

- « Cueilleur de météorites » : Comment les sciences participatives permettent aux citoyens d'aider la recherche

The article shows how astronomers and astrochemist involve citizens and use the data that they provide them.

- Sciences participatives : les Français prêts à participer à la recherche

Article introducing to citizen science, called here participatory science, and how and why people get involved in it.

German

Text

- Wie die Forschung von der Mithilfe der Bürger profitiert

News about how science uses data provided by citizens and how this makes research more inclusive and open.

- Pack die Lupe aus: "Citizen Science" auch in Österreich gefragt

Local news about CS in general and the Austrian platform Österreich forscht and its blog

- Mitmachen bei der Forschung - aber richtig!

National newspaper article on citizen science in general

- Citizen Science: Wiener Wurzeln und Wahrnehmungen

National newspaper article on the history of citizen science in Vienna

- Erdkröte mit Fell

Text on citizen science in general with several examples of citizen science projects

- Die Geschichte der Bürgerwissenschaften

Text on the online portal of the Austrian national broadcasting company ORF about the book "The Science of Citizen Science"

- Citizen Science Erkenntnisgewinn für alle möglich machen

Text on opening research and innovation processes on the page of the (German) Federal Ministry of Education and Research

Hungarian

Text

- How citizens helps researchers → Title changed to: Így segítik a civilek a kutatók munkáját

Article introducing the EU-Citizen.Science platfrom and providing some example from Hungary on how citizens can contribute to scientific research.

Italian

Text

- Una giornata di studio nella Riserva Naturale Orientata Monte Velino di Magliano dei Marsi sui coleotteri

Local news about MIPP (Monitoring of Insects with Public Participation) Life project workshop: presentation of the project and its Citizen Science characteristics (the role of Citizens in Scientific Research and how they can contribute to the monitoring).

- Un raro pipistrello identificato a Trento grazie alla Citizen science

Text on an online scientific portal about a rare Chiroptera species found in the city of Trento (North Italy) by a Citizen. The article focuses on the importance of Citizen Scientists observations for the Scientific community.

- Ambiente, al via “ReATTIVI”: la campagna di monitoraggio partecipato dell’inquinamento di Roma

Local news about ReATTIVI Citizen Science project on urban pollution monitoring carried out thanks to the collaboration between Citizens and Scientists. The monitoring concerns air, soil and water compartments in the city of Rome and the around areas.

- MicroMar: monitorare le microplastiche nel Mediterraneo con la citizen science

National news about MicroMar Citizen Science project: explanation about plastic pollution into the sea and how the Citizens can help Scientists to study this issue through the Citizen Science

Lithuanian

Text

- Lithuanian scientist: about citizen science or "non-professional scientists" → Title changed to: Lietuvė mokslininkė – apie piliečių mokslą arba „mokslininkus neprofesionalus“

Article introducing the concept of citizen science

Spanish

Radio

- ¿Qué será Seró? Proyecto de ciencia ciudadana ‘los vigilantes del aire’

A regional radio channel in Spain talks about a CS project "Los vigilantes del aire" (translated: the guards of the air) in the first half of the transmission.

Text

- Un proyecto de narices en Kampala

The capital of Uganda joins a global network of cities that use co-creation tools and citizen science to alleviate bad odours and improve urban air quality.

- La UNC forma parte del comité asesor de ciencia abierta y ciudadana//National University is part of the Committeee for Open Science for the People

News about an Argentinian university taking part in a local and territorial committee for CitSci.

- Más del 50% de la información científica sobre biodiversidad procede de los ciudadanos

More than 50% of the data collected in the Global Biodiversity Information Facility (GBIF) database comes from citizen science input. Many biodiversity data refer mainly to species distribution

(whether a particular species is present or absent in a location). In this article they mention the Natusfera project.

- Un grupo de niños recopila datos sorprendentes sobre 83especies de animales

Students from USA, India, Mexico and Kenia have participated in the eMammal citizen science project. This project consists of setting camera traps that capture pictures when they sense movement. Children collect the data, upload the pictures to the eMammal software and identify these animals (this identification is verified by a researcher). This data is useful for addressing important scientific and conservation questions, while the pictures provide a unique view into the hidden world of wildlife.

- "La campaña de ciencia ciudadana de LIBERA caracteriza 461 residuos abandonados en entornos fluviales de La Rioja"

The LIBERA citizen science campaign aims to raise awareness about litter and the effects on the environment. Almost 5,000 people have helped collecting debris in fluvial ecosystems. It was possible to collect data on the volume, quantity, and typology of 6.4 tons of abandoned waste.

- Ciencia ciudadana para rastrear la expansión de mosquitos por Europa

In this article they talk about MosquitoAlert. Thanks to the data provided by citizens, scientists were notified about the presence of Japanese mosquitos in the north of Spain, which was rather weird. Tracking mosquito's distribution can help develop environmental strategies and improve policy making against invasive species and the emergence of possible new diseases.

- ¿Cómo colaboran los astrónomos aficionados con la ciencia internacional?

This article refers to the different ways of citizen collaboration in astronomy and encourages non-scientist (or amateur scientists) to engage in scientific research via collecting data in different astronomical related fields, such as astrometry or astrophotography. They mention Zooniverse and some of its citizen science projects related with astronomy, for instance, "Planet Hunter" and "Hubble asteroid Hunter".

- As de guía, ciencia marina inclusiva

The citizen science project 'As de guía', settled in the Balearic Islands, educates participants in the scientific method, showing them how research is carried out and encouraging them to be active protagonists in the promotion of marine science and raising awareness of the importance of conserving biodiversity.

Section 7: Summary and final quiz (10-20 minutes)

Summary of the unit and an opportunity to take the final quiz and get the certificate

Photo by Samuel Clara on Unsplash

Subsection Number: 7.1

Subsection title: Introduction to the section

Subsection content type*:* an introduction to what the learner can see in the summary

Subsection delivery method*:* text and an image

Subsection rationale*:* Help the learner to position the topics that they have covered in the wider context of citizen science and scientific research.

Subsection content*:*

We have now completed the training module. Here, we provide a summary of what we have learned and the main “takeaway” points that we covered in the different parts of the unit. You also have an opportunity to take a final quiz and earn a badge and a certificate that you took this module. This is an opportunity to test your knowledge and see how much you’ve learned in the past hour and a half.

Subsection Number: 7.2

Subsection title: Summary of the topics that we covered (3.5 minutes)

Subsection content type: Main take away points from each of the five sections that were covered in the course

Subsection delivery method*:* text and an image in a H5P accordion. Five sections for the accordion that are based on the topics that were covered.

Subsection rationale*:* Providing the learner with a summary of the material .

Subsection content*:* (800 words maximum)

The purpose of the module was to introduce you to citizen science. We have seen that it is a term with a wide meaning and captures a lot of activities. Here we can summarise the

things that we have learned through the range of examples and stories that were covered. We have set it up, so you can look at each question that the section was addressing.

What is citizen science?

We have seen that citizen science includes activities that are done by individuals or by groups, with a common element of participation in scientific research. An individual might be interested in quantifying their health condition and ask scientific questions about the data that they collect, or might be developing a Do-It-Yourself project. Groups of people can come up with their investigation to address a problem, or they might be joining a project that was designed by scientists with a task that is allocated to participants. It has a long history, with examples from weather observation or recording species that can be traced back over a hundred years ago. In citizen science, it is participation that matters. In some cases, it will involve people putting software on their computers, while in other cases, they will initiate and run a project — all these forms of participation are valuable.

What are the main terms and concepts?

We have seen that there are lots of definitions of citizen science, and there are also some uncertainties about exactly what the terms that are being used mean in a specific context. It is therefore a good idea to consider and check what exactly the people who run the project mean. We have seen terms such as crowdsourcing, community science, and community-based participatory research. We also saw that there are many ways to refer to participants — from citizen scientists to volunteers or human sensors. Likewise, we have also seen that there are links between the wider concept of Open Science and citizen science.

We came across concepts such as volunteer thinking, volunteer computing, citizen cyberscience, and civic science. We noticed that projects can be classified by looking at the relationships between scientists and participants — this is the basis for identifying projects as contractual, contributory, collaborative, co-created, and collegial. Most citizen science, in terms of projects and number of participants, in the contributory area. For a lot of people, when they talk about citizen science they think of contributory projects.

What are the main issues that we will encounter when reporting on citizen science?

When reporting on citizen science, we identified four frequently mentioned issues. These are data quality, motivation, the demographic profile of participants, and the benefits that they gain from participation. We've seen that the data quality can be high, given appropriate planning and design. In terms of motivations, we've seen a wide range of reasons from wanting to help science, to personal growth and interest in a topic. We also discussed the benefits such as science literacy, awareness of issues, and improvement of skills that are relevant beyond citizen science.

What are the impacts of citizen science?

When discussing the impacts of citizen science, we have seen the impacts of scientific research — such as data at locations and scales that would not be possible otherwise.

There are also contributions in ideas and insights. At a societal level, citizen science can help address communal problems and provide evidence that can be used in addressing them. Citizen science can also help in addressing policy challenges — from monitoring an environmental condition to addressing the progression towards the sustainable development goals.

What kind of stories can be written about citizen science?

Finally, we have seen that there is a growing collection of articles, long stories, personal profiles, radio programmes, podcasts, and video reports on citizen science. It is a great topic that can be linked to many issues of interest and concern. It can focus on an individual volunteer and their achievement, on a community struggle, or provide “here is something that you can do” within a campaign that a media outlet adopts.

Subsection Number: 7.3

Subsection title: Final quiz (10 minutes)

Subsection content type: Final quiz.

Subsection delivery method*:* Moodle quiz

Subsection rationale*:* Testing the knowledge of participants .

Subsection content*:* see final quiz section

Subsection Number: 7.4

Subsection title: Conclusion from the course team (1 minutes)

Subsection content type: Saying that we hope that the learner found the material interesting and useful. Reminder about reuse

Subsection delivery method*:* text and an image

Subsection rationale*:* Providing a closure for the learner.

Subsection content*:* (200 words maximum)

We’ve come to the end of this training about citizen science that we have honed thinking in a very specific audience: journalists. We hope that the contents that we put together were clear, compelling, inspiring and will help you to trace projects and people working on the topics that you regularly cover as a journalist. We also hope that as a learner, you are now equipped with the fundamental knowledge of this very broad, complex and expansive field and the overview that we intended to give to has broadened your conceptions and opened room for new ideas. Hope that you’ve enjoyed the course and remember you can reuse all the content of this course. We highly encourage you to

look out in your region and get in contact with people with expertise in citizen science and a local. (137 WORDS)

Indication about additional material and resources.

Section 8: Further information

Subsection Number 8.1

Subsection title Further contact details

Subsection content type further information

Subsection delivery method text

Subsection rationale Providing contact for further information/to enquiry about citizen science.

Subsection content

For more information about citizen science, you can contact the European Citizen Science Association at https://ecsa.citizen-science.net/.

Section 9: Sources and acknowledgments

Subsection Number 9.1

Subsection title Sources for the material in the course

Subsection content type sources used in the course

Subsection delivery method text

Subsection rationale Providing sources to learn more about citizen science or check facts/information.

Subsection content

We have used a wider range of sources for the material in this training unit. The list below is organised according to the sections of the unit.

Section 1: Citizen Science in Five Stories

This section is based on information from multiple sources. The purpose of this section is to provide more details, in case that you would like to learn more about these issues:

Story 1 - Come Rain or Shine

Information and images were provided by the report "Volunteers for Weather, Climate and Water" by the World Meteorological Organization, report WMO-919 from 2001. Further information about the UK Met Office WOW was provided from the Met Office WOW brochure "Get Involved and join our WOW community" (2017).

Story 2 - Observing the first satellites

This section is based on Wikipedia articles about the International Geophysical Year, Fred L. Whipple. , Operation Moonshot, and Sputnik. There is another great source on Moonwatch at

Dickinson, D. 2013. Citizen Science, Old-School Style: The True Tale of Operation Moonwatch https://www.universetoday.com/100744/citizen-science-old-school-style-the-true-tale-of-operation-moonwatch/

And in a more academic version in

McCray, W. 2006. Amateur Scientists, the International Geophysical Year, and the Ambitions of Fred Whipple. *Isis, 97*(4), 634-658. doi:10.1086/509947

Story 3 - From buckets of resistance to balloon recording of oil spill

Sources about Louisiana Bucket Brigade are:

Mack, L. 2013. Anne Rolfes - Interview with the founder of Louisiana Bucket, MyNewOrleans.com https://www.myneworleans.com/anne-rolfes/

Stoll, S.L., 2017. 6 Ways Citizens Across the U.S. Are Using Science to Build a Better World, Yes! Magazine, Spring 2017 https://www.yesmagazine.org/issue/science/2017/02/28/6-ways-citizens-across-the-us-are-using-science-to-build-a-better-world

Louisianna Bucket Brigade, 2021. About the bucket https://labucketbrigade.org/pollution-tools-resources/the-bucket/

Wikipedia 2021. Communities for a Better Environment. https://en.wikipedia.org/wiki/Communities_for_a_Better_Environment

POV, 2002. The Bucket Brigade. http://archive.pov.org/fenceline/the-bucket-brigade/

Public Lab, 2021. About us https://publiclab.org/about

Story 4 - Chris, Kevin, and Hanny and the Galaxies

The sources about Galaxy Zoo are:

Adams, T. 2012. Galaxy Zoo and the new dawn of citizen science https://www.theguardian.com/science/2012/mar/18/galaxy-zoo-crowdsourcing-citizen-scientists

Gray, R. 2017. Galaxy Zoo: Citizen science trailblazer marks tenth birthday https://www.bbc.co.uk/news/science-environment-40558759

Wikipedia 2021. Galaxy Zoo https://en.wikipedia.org/wiki/Galaxy_Zoo

Story 5 - Patient, heal yourself! Patients monitoring and self-management

More about Sara Riggare on her website https://www.riggare.se/about/

Section 2: terminology and classification

Sources – Part A

Citizen Science

Bonney, R. (1996). Citizen science: A lab tradition. *Living Bird* 15(4): 7–15.

Haklay, M., Motion, A., Balázs, B., Kieslinger, B., Greshake Tzovaras, B., Nold, C., … Wehn, U. (2020, April 1). ECSA's Characteristics of Citizen Science. Zenodo. http://doi.org/10.5281/zenodo.3758668

Haklay, M., Dörler, D., Heigl, F., Manzoni, M., Hecker, S., Vohland, K. (2021). What Is Citizen Science? The Challenges of Definition. In K. Vohland, A. Land-Zandstra, L. Ceccaroni, R. Lemmens, J. Perelló, M. Ponti, R. Samson, K. Wagenknecht (Eds.), The Science of Citizen Science (pp. 13–34). Springer. http://doi.org/10.1007/978-3-030-58278-4

Irwin, A. (1995). Citizen Science: A study of people, expertise and sustainable development. London: Routledge.

Oxford English Dictionary. (2014). Citizen science. Oxford: Oxford University Press.

From citizen science to community science and back* and *Citizen scientists, volunteers…?

Cooper, C. B., Hawn, C. L., Larson, L. R., Parrish, J. K., Bowser, G., Cavalier, D., Dunn, R. R., Haklay, M., Gupta, K. K., Jelks, N. O., Johnson, V. A., Katti, M., Leggett, Z., Wilson, O. R., Wilson, S. (2021). Inclusion in citizen science: The conundrum of rebranding. *Science*, 372(6549), 1386-1388. DOI: http://doi.org/10.1126/science.abi6487

Dosemagen, S. (2020) Exploring the Roots: The Evolution of Civic and Community Science. Available at: https://sdosemagen.medium.com/exploring-the-roots-the-evolution-of-civic-and-community-science-80dd899335cb

Eitzel, M. V., Cappadonna, J. L., Santos-Lang, C., Duerr, R. E., Virapongse, A., West, S. E., … Jiang, Q. (2017). Citizen Science Terminology Matters: Exploring Key Terms. *Citizen Science: Theory and Practice*, *2*(1), 1. DOI: http://doi.org/10.5334/cstp.96

Haklay M., Mazumdar S., Wardlaw J. (2018) Citizen Science for Observing and Understanding the Earth. In: Mathieu PP., Aubrecht C. (eds) Earth Observation Open Science and Innovation. ISSI Scientific Report Series, vol 15. Springer, Cham. https://doi.org/10.1007/978-3-319-65633-5_4

Open Science

DITOs consortium, (2017). *Citizen Science and Open Science: Synergies and Future Areas of Work*. DITOs policy brief 3.Available at: https://discovery.ucl.ac.uk/id/eprint/10043574/

OECD (2017) 'Making open science a reality', OECD Science, Technology and Industry Policy Papers. Available at: https://doi.org/10.1787/5jrs2f963zs1-en

Vohland, K. & Göbel, C. (2017). Open Science und Citizen Science als symbiotische Beziehung?. TATuP Zeitschrift für Technikfolgenabschätzung in Theorie und Praxis, [online] 26(1-2), p. 18-24. https://doi.org/10.14512/tatup.26.1-2.18

Wikipedia (2021). Open Science. Available at: https://en.wikipedia.org/wiki/Open_science

Sources – Part B

This part draws heavily on the "Citizen Science Typologies" training module on Moodle that has been designed by members of the Extreme Citizen Science (ExCiteS) research group at University College London (UCL) and is available here: https://moodle.eu-citizen.science/course/view.php?id=12

Haklay M. (2013) Citizen Science and Volunteered Geographic Information: Overview and Typology of Participation. In: Sui D., Elwood S., Goodchild M. (eds) Crowdsourcing Geographic Knowledge. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-4587-2_7

Haklay M., Mazumdar S., Wardlaw J. (2018) Citizen Science for Observing and Understanding the Earth. In: Mathieu PP., Aubrecht C. (eds) Earth Observation Open Science and Innovation. ISSI Scientific Report Series, vol 15. Springer, Cham. https://doi.org/10.1007/978-3-319-65633-5_4

Section 3: Challenges and Opportunities in Citizen Science

This section is based on information from multiple sources. The purpose of this section is to provide more details, in case that you would like to learn more about these issues:

Data Quality

See the section on additional information on data quality where you will find additional information.

Motivation

The main source for this section is a report by Hilary Geoghegan and her colleagues provides a comprehensive analysis of motivation within environmental citizen science.

Geoghegan, H., Dyke, A., Pateman, R., West, S. & Everett, G. (2016) *Understanding motivations for citizen science. Final report on behalf of UKEOF*, University of Reading, Stockholm Environment Institute (University of York) and the University of the West of England.

Benefits of participation

The sources for this section are the following:

For the report on the number of participants in the 2021 Big Garden Birdwatch, see

https://www.discoverwildlife.com/news/majority-of-garden-bird-species-recorded-in-the-big-garden-birdwatch-2021-suffer-decline/

There are many sources about the level of education in different countries, and for the up to date statistics we used https://en.wikipedia.org/wiki/List_of_countries_by_tertiary_education_attainment

The section mentions an analysis of participation in environmental citizen science, and this is available at Pateman, R. M., Dyke, A., & West, S. E. (2021). The Diversity of Participants in Environmental Citizen Science. Citizen Science: Theory and Practice.

The section also used information from Haklay, M. (2018). Participatory citizen science. In Haklay M., Hecker S., Bowser A., Makuch Z., Vogel J., & Bonn A. (Eds.), Citizen Science: Innovation in Open Science, Society and Policy (pp. 52-62). London: UCL Press. Retrieved June 10, 2021, from http://www.jstor.org/stable/j.ctv550cf2.11

Section 4: Social, Economic and Political Impacts

The sources that were used for this section are:

Scientific impact

Jackson, M., & Manning, P. (n.d.). *The next invasion of insect pests will be discovered via social media*. The Conversation. Retrieved 31 May 2021, from http://theconversation.com/the-next-invasion-of-insect-pests-will-be-discovered-via-social-media-143527

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Political impact

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Raising awareness

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Subsection Number 9.2

Subsection title Acknowledgments

Subsection content type acknowledgments

Subsection delivery method text

Subsection rationale The authors' name as well as a thank you to user-testers is provided.

Subsection content

This course has been created by Muki Haklay (UCL), Claudia Fabó Cartas and Andrea Troncoso (ECSA) and Lucie Steigleder (ECSITE).

We would like to give a special thank you to Alice Sheppard (UCL), Karinna Matozinhos (Science for Change), David Borgström (VA) and others for testing the course and giving us valuable feedback.

This work has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement No. 824580 (EU-Citizen.Science project).

The information, documentation and figures in this training module are written by the EU-Citizen.Science project consortium under EC grant agreement No. 824580 and do not necessarily reflect the views of the European Commission. The European Commission is not liable for any use that may be made of the information contained herein.

3. Final Quiz Structure (for the ‘Conclusion and Self-Assessment section)

The final quiz is made up of 10 questions. If the learner passes 50%, they can get a certificate of completion for the course. The questions should use Bloom’s taxonomy, and aim to be 30% on knowledge of issues covered in the course, 30% comprehension, 20% application and 20% analysis/synthesis.

This is a final quiz that contains 10 questions. It is an opportunity to revise and assess the knowledge that you've gained from the unit. The questions are using knowledge from all the parts of the course, and you are allowed to take the quiz more than once. Let's see how much you've learned!

What?	**How? Type of question**	**Why?**
1 Matching the definitions of types of projects from Shirk et al. taxonomy and their description	Matching terms from a drop down-list with a description of the activity.	The typology is one of a central typologies in citizen science, so getting familiar with the main categories is valuable (knowledge question)
2 The five cases that were introduced in part one are related to five common terms that describe similar practices today, can you associate them?	Matching the description of the project to a term from part 2.	This will show an understanding of the stories and how they relate to different concepts and terminologies that are common in citizen science (application question)
3 Match the type of activity to its name	Matching the description of an activity (volunteer computing, participatory sensing, biological recording, DIY science, volunteer thinking)	Recognition and comprehension of the terminologies that describe types of activities (comprehension question)
4 Identify statement as true/false about data quality	A statement about the core issue of data quality	Remembering the main statements about data quality (knowledge question)

5 Multiple choice question about the typical characteristics of participants in citizen science projects	Selection os statements about the typical characteristics of participants in citizen science projects	Recalling information about the type of participants and their background (comprehension question)
6 Select the correct word in a paragraph about the scientific impact of citizen science	Selection of words to complete a paragraph about the scientific impacts - data, new ideas, contribution to open science	Recalling and understanding the information about the scientific impacts (comprehension question)
7 Statement about the making sense project and its policy impact (true/false)	A statement about the policy impacts at a local scale (Barcelona) and global sale (SDG) to link the topic that was covered in the policy impact of citizen science	Linking to different policy scale (knowledge question)
8 Associating projects that were not introduced in the unit	Examples of projects and terms from the first part of the unit. Matching terms to the projects.	Applying the understanding of the terminologies on new cases (application)
9 Associating different things that citizen science achieve with the body that benefits from it	Different outcomes of citizen science and associating them with social, scientific, policy, individual benefit	Ability to analysis and group outcomes from citizen science (analyse)
10 Paragraph about citizen science definition and linking it to projects with missing words	Using the fill the gaps option with a definition of citizen science and terms that require the learner to consider which fits were	Ability to synthesis the material from the course.

4. Equality Impact Assessment

Be sure to carry out an equality impact assessment as part of the design process for your module.

Characteristics	**Issues and mitigation**	**Your response**
Age	e.g. Ensure that material is inclusive for different age groups. This course is aimed at acting journalists, who will be within working ages (25-70) and therefore the material should be presented in a way that is suitable for this group. The font should be readable to older adults.	We need to ensure that the material is inclusive for different age groups. This course is aimed at working journalists who are publishing articles or creating reports in different media (from very short video to TV series, and to podcast and long articles or books), who will be within working ages (25-70) and therefore the material should be presented in a way that is suitable for this group. The font should be readable to older adults. The level of comprehension of the text should be for someone with higher-school education and above. While many science journalist do have advanced degrees, the course is not only aimed at them but to people outside science reporting
Disability	e.g. There is a need to ensure that a learner with disability can access the material. Care will be given for visually impaired learners, and also to those that are having dexterity issue in the selection of questions and options in quizzes and in interactive parts	There is a need to ensure that a learner with a disability can access the material. Care will be given for visually impaired learners, and also to those that are having dexterity issue in the selection of questions and options in quizzes and in interactive parts. The module will rely on the integrated usability and accessibility features of

		Moolde, and will provide alt-text to images.
Race	e.g. Citizen science has underrepresentation of people from Black backgrounds, and the material should include recognition of disparities and the potential for inclusiveness	Citizen science has underrepresentation of people from Black backgrounds, and in many cases ethnic minorities are under-represented. The material should include recognition of disparities and the potential for inclusiveness and that is included in part 3
Religion and Belief	e.g. The text should be written in a way that it recognises differences in religious beliefs	The text should be written in a way that it recognises differences in religious beliefs, and it will be edited to ensure that it does not include terminology that might create offence (e.g. discussion of anti-science sentiments)
Sex (Gender)	e.g. Gender issues in science are well established and the examples that will be used in the unit should balance gender and provide appropriate role models	Gender issues in science are well established as an issue that RRI projects need to take in account. The examples that will be used in the unit should balance gender and provide appropriate role models
Sexual orientation	e.g. The material should not be prejudiced against people with different sexual orientation	The material should not be prejudiced against people with different sexual orientation

5. Digital Assets Register

For each asset that you are planning to use, fill in the below metadata. Copy the below table and delete out the examples and then add your own responses. You will need a separate table per asset.

Image Example	
File name (e.g. *DCN1234.jpg*)	e.g. science bus cover image.jpg
Source of the file	e.g. https://togethersciencebus.eu/
Rights (*who owns the copyright - even if all the assets are owned by you or your organisation it is a good idea to record this in the asset register*)	e.g. CC-By
Attribution for third party asset (*attribution to use with third party asset*)	e.g. UCL ExCiteS
Clearance approved to release asset as Creative Commons (*you can use this for notes about the clearance and date of clearance*)	e.g. Approved by John Smith
Acknowledgement (*what needs to be listed about this asset on the acknowledgements page if the item belongs to a third party or if the organisation releasing the course wishes to retain 'All rights*	e.g. cc-by 4.0 UCL ExCiteS

reserved' rather than use a Creative Commons licence for this asset)	
Describe the image for someone who cannot see it	e.g. this is an image of the Doing it Together Science project's science bus. It is parked outside of the parliament building in London. It is white with large black text and the project logo on the side.

Video Example	
File name	e.g. NSF citizen science video
File name	e.g. *DCN1234.mp4*
Source of the file	e.g. https://youtu.be/5ijSk-QWwjw
Rights (*who owns the copyright - even if all the assets are owned by you or your organisation it is a good idea to record this in the asset register*)	e.g. Copyright, can be freely distributed in its entirety
Attribution for third party asset (*attribution to use with third party asset*)	e.g. US National Science Foundation
Clearance approved to release asset as Creative Commons (*you can use this for notes about the*	e.g. Provided in the video

clearance and date of clearance)	
Acknowledgement (*what needs to be listed about this asset on the acknowledgements page if the item belongs to a third party or if the organisation releasing the course wishes to retain 'All rights reserved' rather than use a Creative Commons licence for this asset*)	E.g. CC-By US National Science Foundation

Appendix 2: the Module Design Guidelines

These are the Module Design Guidelines as they stand in early December 2021. They are a "live" document, continually being updated, with some areas still recommended for completing either by UCL or by ECSA in 2022 at the time of writing this Deliverable.

eu-citizen.science

Guidelines for designing and implementing a training and educational module in Moodle

Table of Contents

PLEASE NOTE THIS WILL BE AN EVOLVING DOCUMENT UNTIL THE END OF THE PROJECT AND SO IS LIKELY TO CONSTANTLY HAVE NEW CONTENT. THEREFORE, KEEP CHECKING BACK FROM TIME TO TIME TO VIEW LATEST REVISIONS/ ADDITIONS.

Key

Orange highlighted text - UCL to amend content/ add content.

Yellow highlighted text - UCL to review this content once the document is finished.

The training modules on the EU-Citizen.Science platform will be developed using the Moodle learning management system[7]. In this section, we provide the guidelines needed to create and design a new module on the Moodle system.

1. Top tips/ key points for creating a training module

We've put together the following top tips based on the partners' experience of creating training modules. Please feel free to add your own tips to this list. The more tips we can accrue, the easier we make it for future module developers.

1.1. Get a sense of what a course could look like in terms of its layout.You don't need to get comfortable with how to use Moodle yet but it definitely makes sense to get a sense of what a Moodle module looks like before you start designing the layout of your material in a Word Template.

1.2. Familiarise yourself with all the different content types you can create in Moodle, specifically the H5P content types. We'd recommend both exploring the existing modules that have been created, and reading section 3.2.1 of this guide. It could really affect how you choose to structure the content you produce so try to do this early on in the design phase.

1.3. Engage with at least 1 or 2 of your intended audience once you've completed Table 1 (i.e. the Core Information Table) and one of the sections in Table 2 (i.e. the Detailed Section Plan) of the Content Design Template. Find out whether the proposed content answers some of their key questions, and how they feel about the writing style. This will save a lot of work when it comes to the user-test phase. Some modules have required large amounts of re-writing because the writing style was not appropriate for the intended audience but this wasn't picked up until the testing phase.

1.4. Wherever you plan to include an image in your module, include it in the word document or a link to it, and fill in the digital assets register (section 5 of the Content Design Template) for each image. For each image you include in a module you will be required to specify the sharing rights, the author of the image, a title for the image and how the image should be described to someone with impaired vision. It can be very laborious trying to gather this data at a later date if the image isn't your own.

1.5. Use a tool like Niram (https://niram.org/read/) to calculate the time it will take for a participant to read through a section. Course designers will typically underestimate the time required.

1.6. The final quiz cannot be developed using H5P.

1.7. Remember, these are self-directed courses and should not require any interaction from a course leader.

1.8. Upload video files to a YouTube account that you know will exist for a while to ensure the sustainability of links.

1.9. Try to provide DOI refs for sustainability.

1.10. Don't make text overly wordy.

[7] https://moodle.org/

1.11. Make sure your learning objectives are clearly defined in the course summary and bullet-pointed. These will be used by the user-testers to assess how well the module achieves its stated objectives.

2. Introduction

The conditions under which the training modules of EU-Citizen.Science need to operate are the most challenging for online learning - they are intended for a student who cannot benefit from a cohort of other students who start the unit at the same time, or from the availability of an instructor who can answer questions and help clarify different issues. Therefore, modules - and each section of them - need to be engaging and interesting, while also providing up-to-date and useful information for the student. Because of these conditions, it is critical that you carefully plan and design your module well before any material is developed.

EU-Citizen.Science **modules should be designed to provide 1-2 hours of self-directed learning**. The aim here is to provide modules that can fit into many people's schedules and time constraints and fill a gap in the training and education for citizen science. The process of developing content for an online module without an instructor is a task that requires significant attention and time investment. The design and development of your module's content will take about 10-20 hours for each hour of online training material.

In Section 2 of this document we will provide guidance on **how to design the content for your Moodle module** which is supported with the use of a design template**,** and in Section 3 on **how to create the framework for a module on the Moodle platform**. The information on how to design the content for your module is based on the University College London (UCL) Connected Learning course material, and more heavily on the UK Open University OpenLearnCreate course 'How to make an open online course'. We highly recommend that you take this course[8]. Additionally, you might want to refer to UCL's Connected Learning material[9] and Coursera[10].

3. Getting started with designing the module content

3.1. Using the Content Design Template for preparing your module

For the training and educational modules, the Content Design Template will help guide you through the design process. **We recommend that you always use this template when designing a module/ course** as it provides you with a methodical approach to thinking about content and ensures you have accounted for all the data fields. The template is provided with an example of how to design a module. Here, we provide guidance on the process of designing a training unit to ensure that quality assurance standards are maintained.

3.2. What are the style requirements for modules?

[8] https://www.open.edu/openlearncreate/course/view.php?id=2221

[9] https://www.ucl.ac.uk/teaching-learning/education-planning-2020-21/staff-development-prepare-teaching-and-assessment-2020-21/ucl-connected

[10] https://www.coursera.org/

- 1-2 hours long
- Self-directed
- Enrolment key
- Learning objectives
- Image credits on every page
- ***

3.3. Designing the content

3.3.1. What sort of content can I create?

Before designing your content, you'll need to consider the type of content you want to produce. Content types could include:

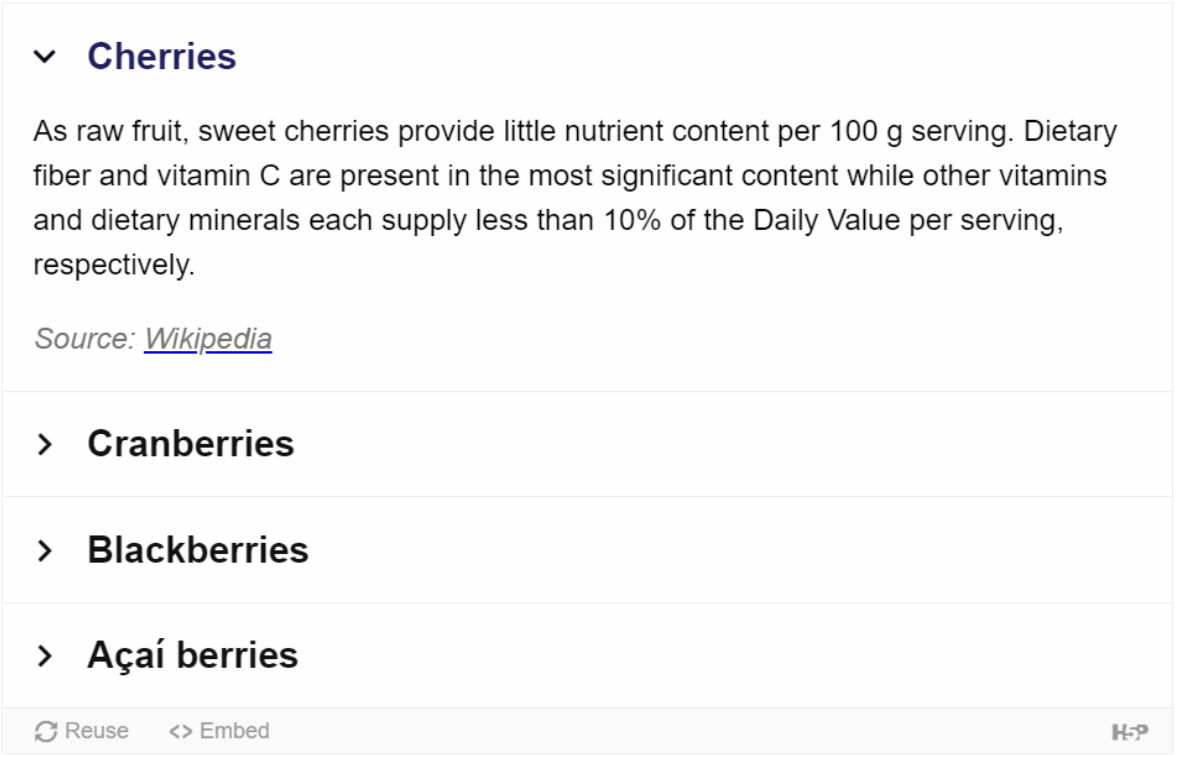
- Text
- Images
- A presentation
- A video
- An interactive video
- An audio file

Add some tips on creating each of these content types

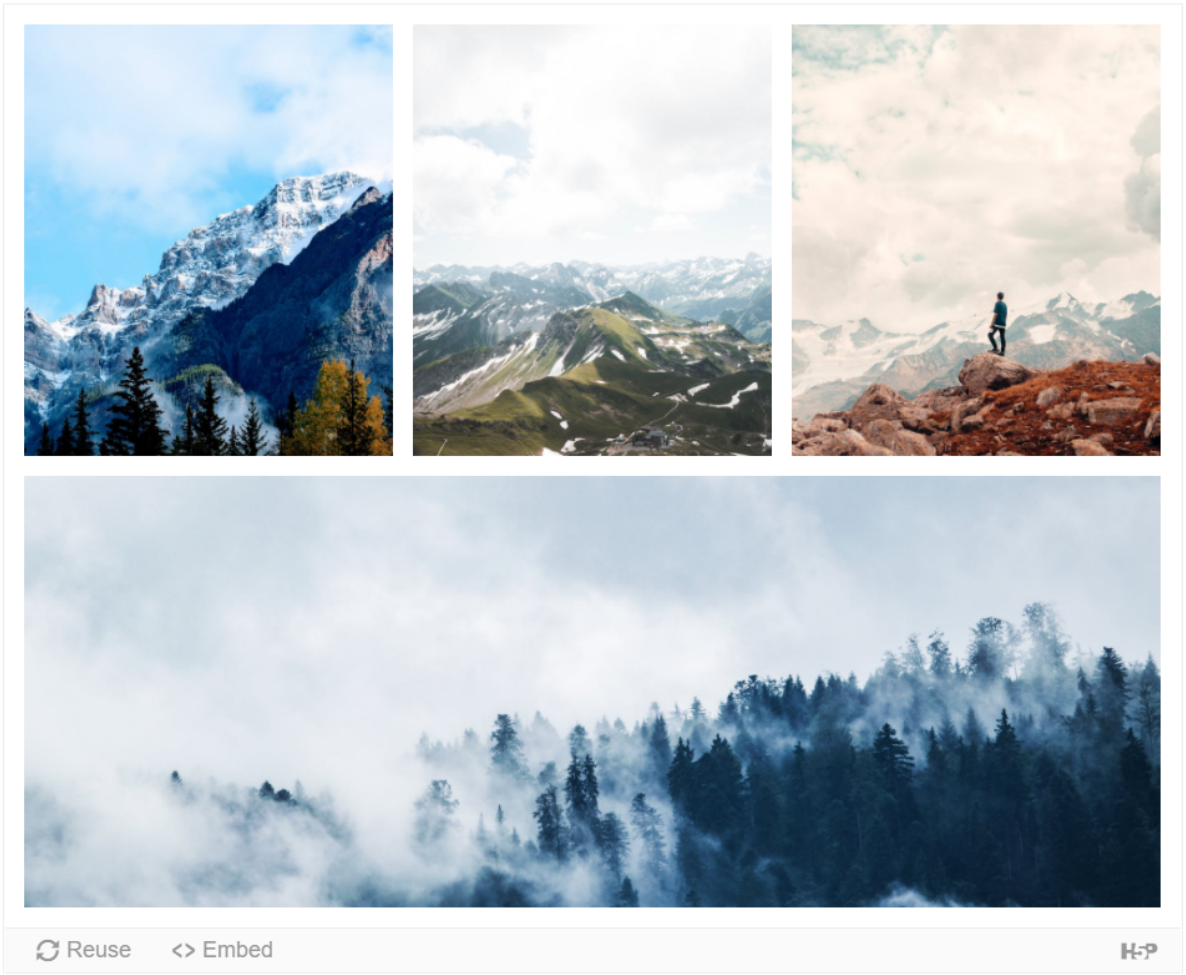
3.3.1.1. H5P

If you choose to create a presentation, a video (interactive or not) or an audio file you may choose to use your own existing software (e.g. MS Powerpoint) but it's worth noting that Moodle has a built-in interactive content creation tool called H5P. There are currently 46 different media types you can create with H5P but below is a short list and explanation of the content types we think would be most useful for the training modules:

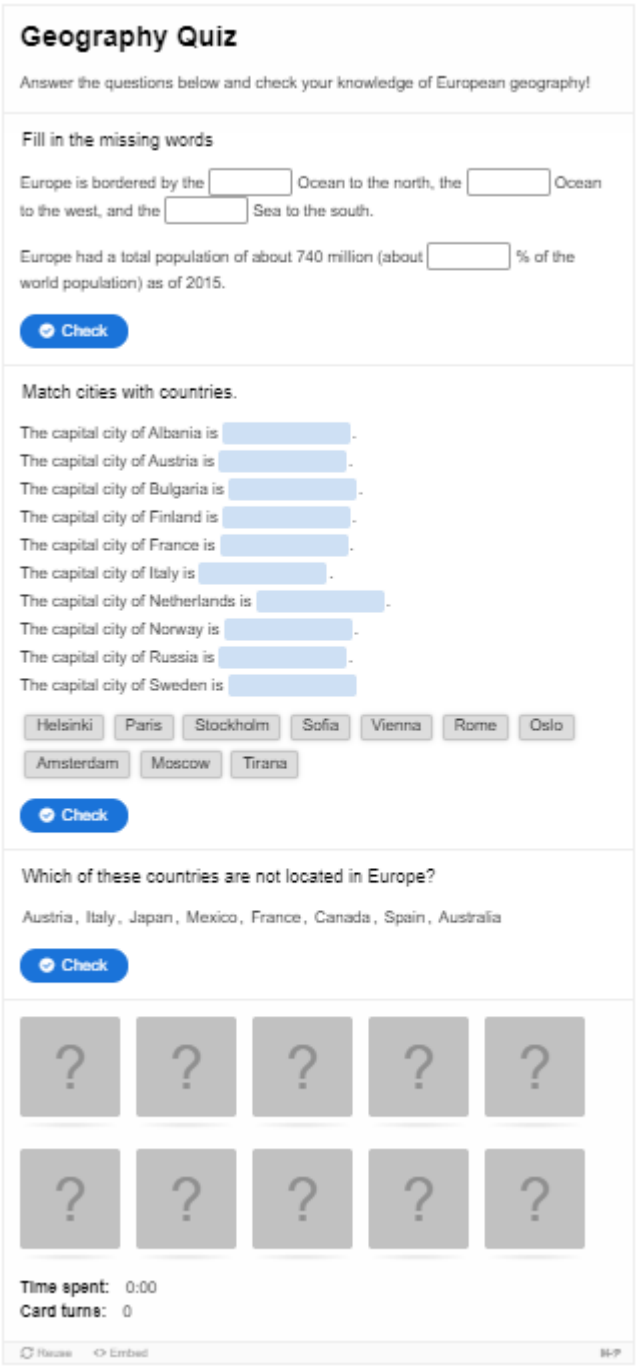
- **Accordion: The** Accordion content type can be used for presenting text when there is a limited amount of vertical space (see image below). The content inside Accordion is shown in collapsible panels with a title. Each panel expands by clicking on the title. To see a demo of the H5P accordion, visit here.



- **Audio recorder**: An HTML5 audio recorder. Record your voice and playback or download a .wav file of your recording. Use the H5P plugin to create the H5P Audio Recorder to your Drupal, Wordpress or Moodle site. For a demo of Audio Recorder, visit here.
- **Audio**: Audio is the tool you need in order to upload your H5P audio file to Moodle. For a demo, visit here.
- **Collage**: You can use the Collage tool to put together images in a nice composition (see image below). There are several layouts to pick from. To see a demo of the H5P collage tool, visit here.

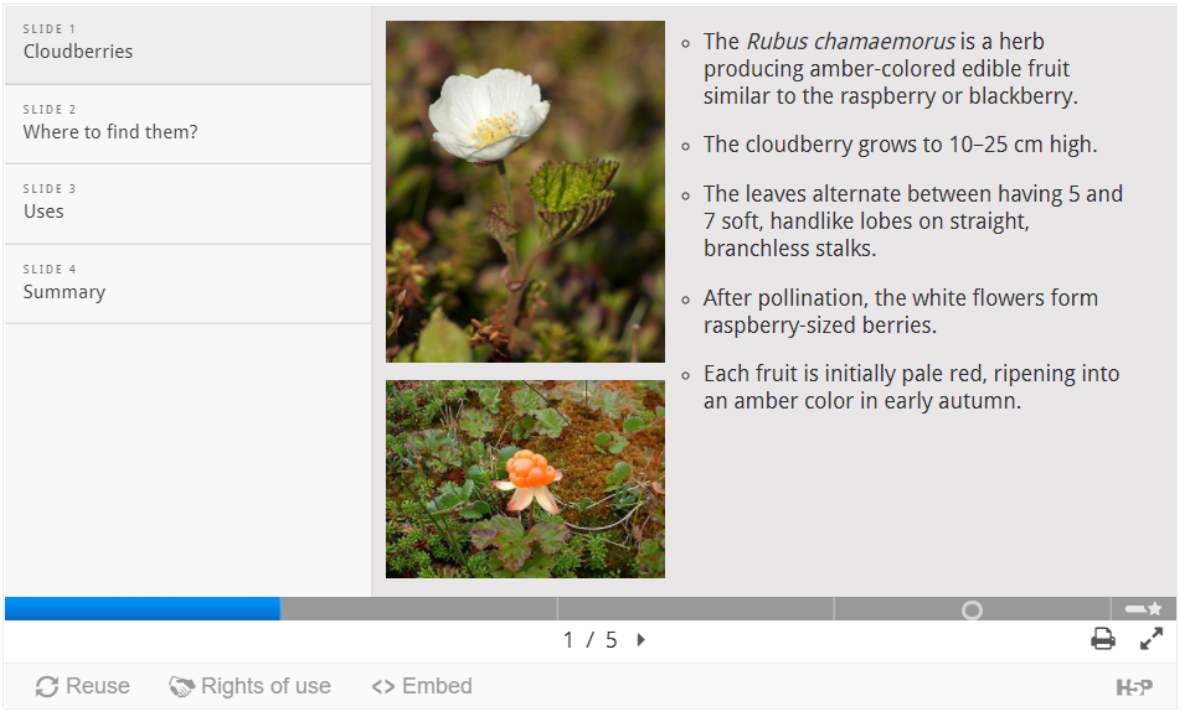


- **Column:** The Column content type could be used to organize your H5P content into a one column layout (see image below).Content types that address similar material or share a common theme can be grouped together using Column to create a coherent learning experience. For example, if you're creating a quiz that's made up of Drag and Drop (see below), Drag the Words (see below), Multiple Choice (see below) content types then you can use this tool to group all these different content types together. To see a demo of the H5P column tool, visit here.



- **Course presentation**: Course presentations consist of slides with multimedia, text, and many different types of interactions like interactive summaries, multiple choice questions and interactive videos (see image below). Learners can experience new interactive learning material and test their knowledge and memory in Course Presentations. As always with H5P, content is editable in web browsers, and the Course Presentation activity type includes a WYSIWYG drag and drop based authoring tool. A typical use of the Course Presentation activity is to use a few slides to introduce a subject and follow these with a few more slides in which the user's knowledge is tested. Course Presentations may however be used in many different ways, including as a presentation tool for use in the classroom, or as a game where the usual navigation is replaced with navigation buttons on top of the slides to let the

user make choices and see the consequences of their choices. To see a demo of an H5P course presentation visit here.



- **Dialog Cards**: The Dialog cards content type enables you to create a set of cards with corresponding words or expressions on either side of the cards (see images below). To see a demo of the dialog cards, visit here.

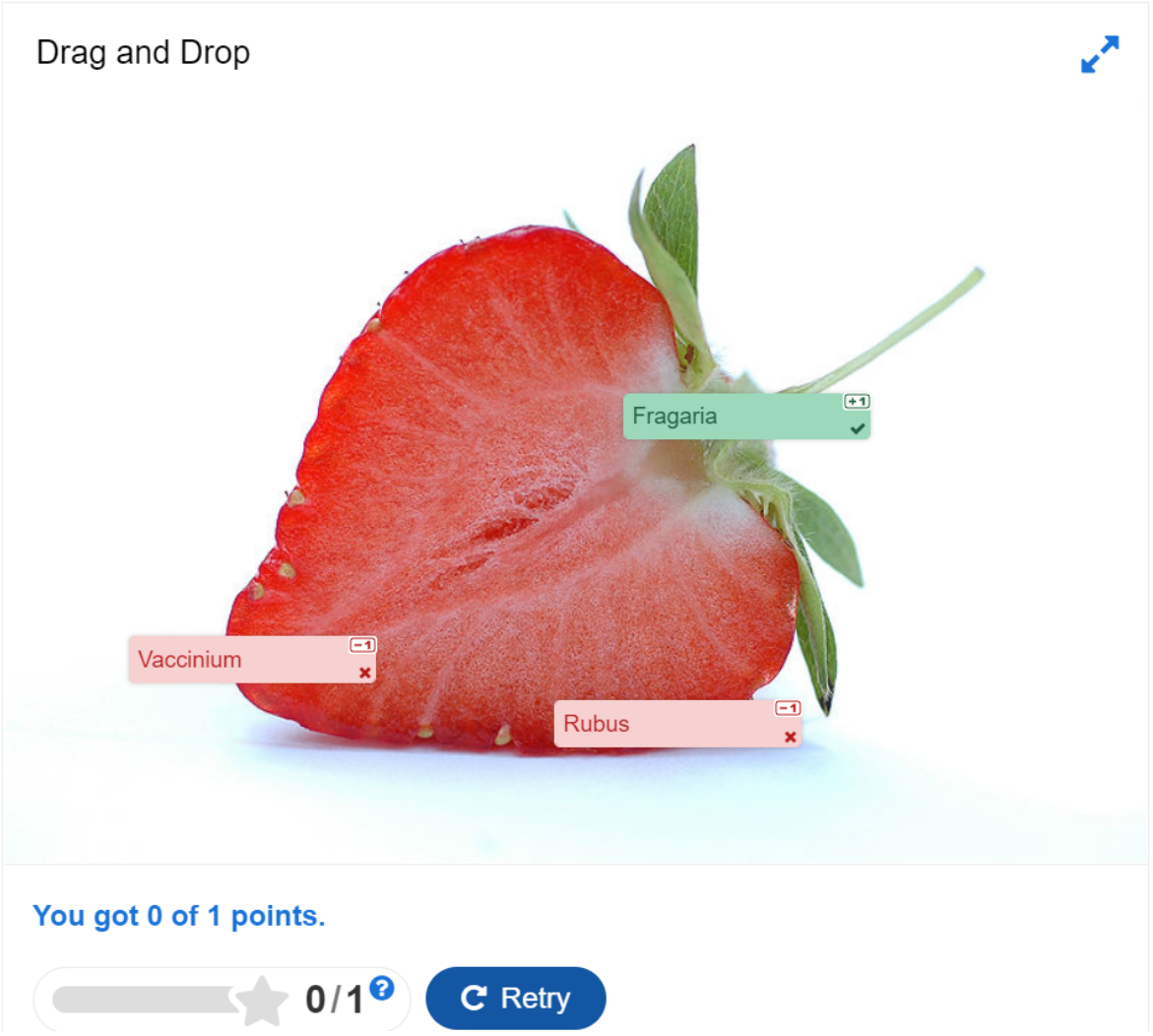
Arándanos azules

Turn

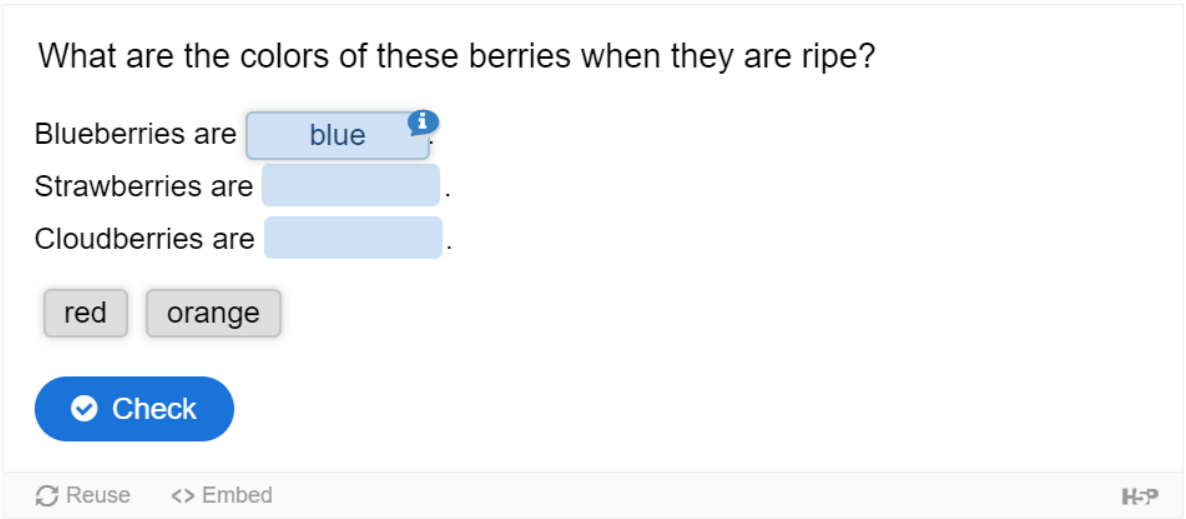
Blueberries

Turn

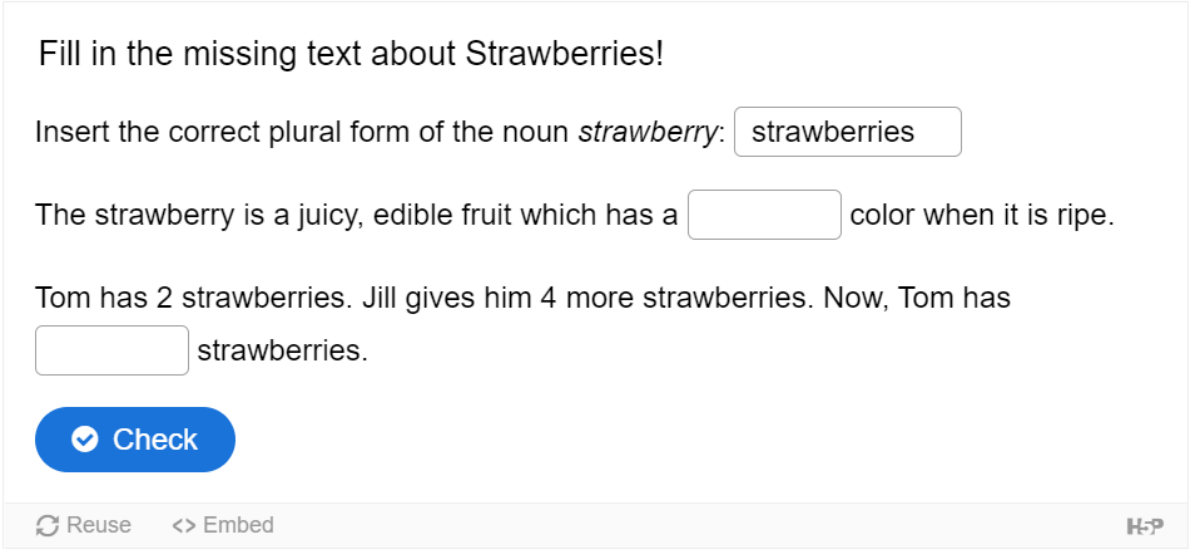
- **Drag and Drop:** Drag and drop enables the learner to associate two or more elements and to make logical connections in a visual way (see image below). Here are some examples: 1) Group elements that belong together or have something in common, 2) Match an object with another object, 3) Put elements in the correct order, 4) Place elements at a correct position. To see a demo of Drag and Drop, visit here.



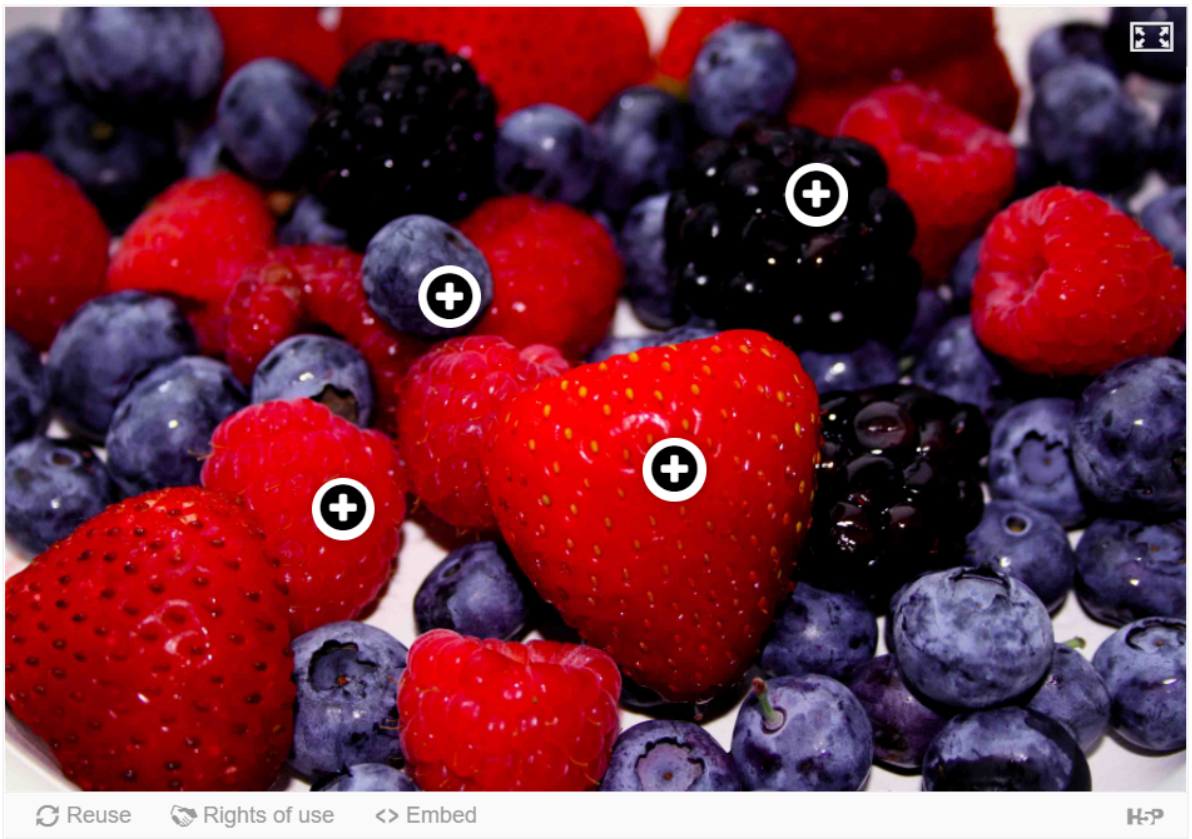
- **Drag the Words:** Drag the Words allows content designers to create textual expressions with missing pieces of text (see image below). The end-user drags a missing piece of text to its correct place, to form a complete expression. To see a demo of Drag the Words, visit here.



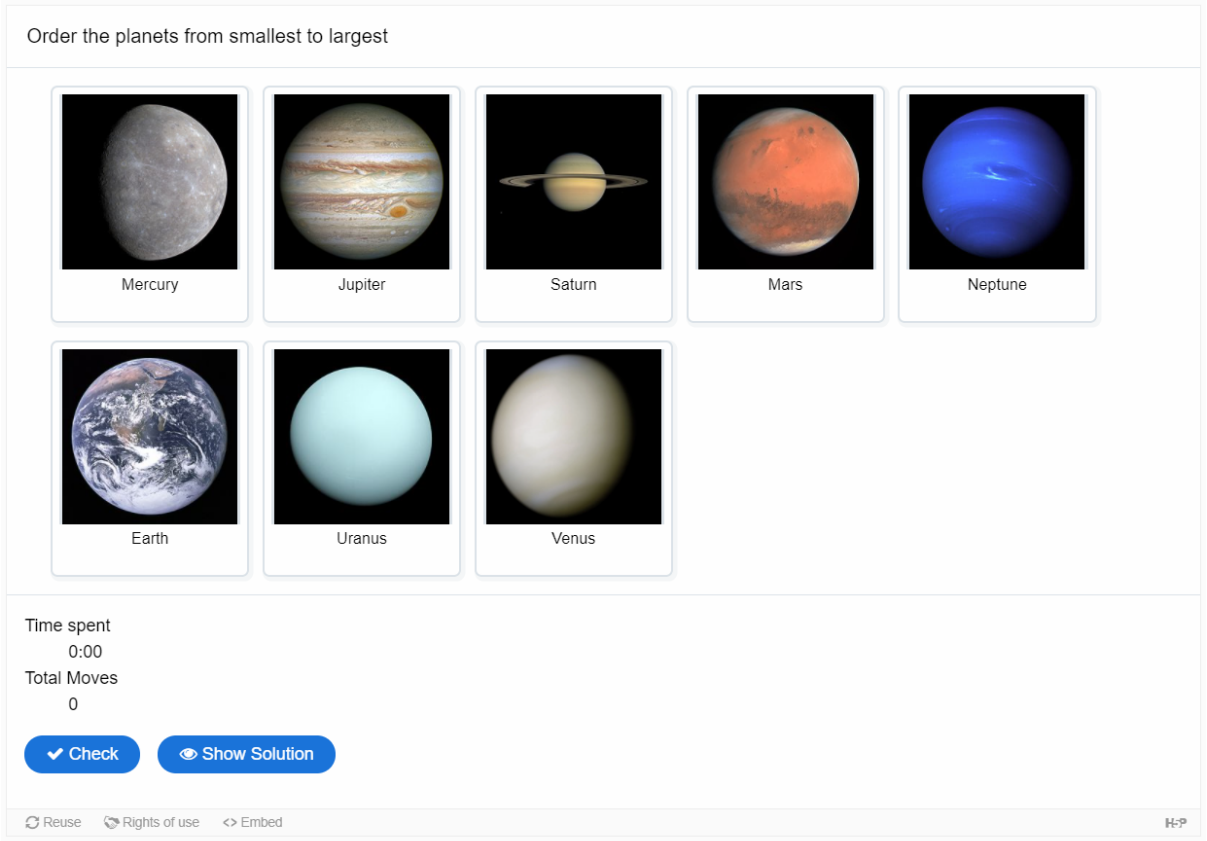
- **Fill in the Blanks**: The fill in the blanks allows eLearning designers to create cloze tests (see image below). Portions of words or sentences are removed from a text and the learner is asked to replace the missing text. For a demo of Fill in the Blanks, visit here.



- **Image Hotspot**: The Image hotspots content type allows you to place an overlay of hotspots on images and graphics (see image below). The user presses the hotspots to reveal an associated text. For a demo of Image Hotspots, visit here.

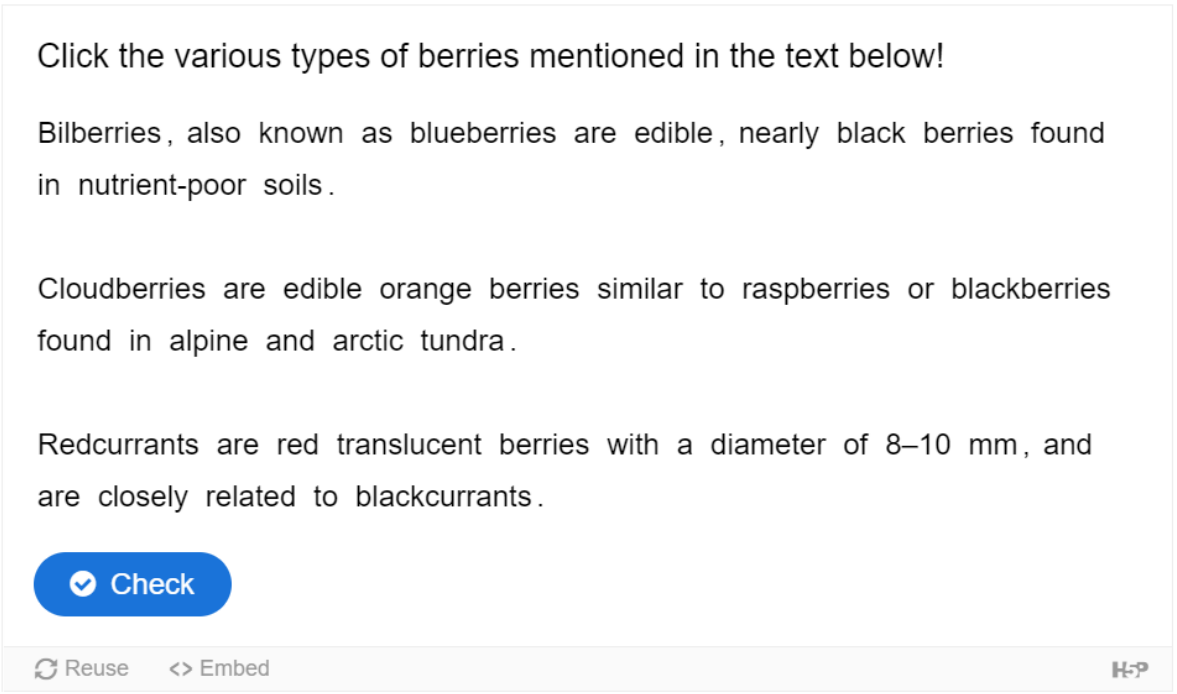


- **Image Sequencing**: A content type that allows authors to add a sequence of their own images (and optional image description) to the game in a particular order (see image below). The order of the images will be randomized and players will have to reorder them based on the task description. For a demo of Image Sequencing, visit here.

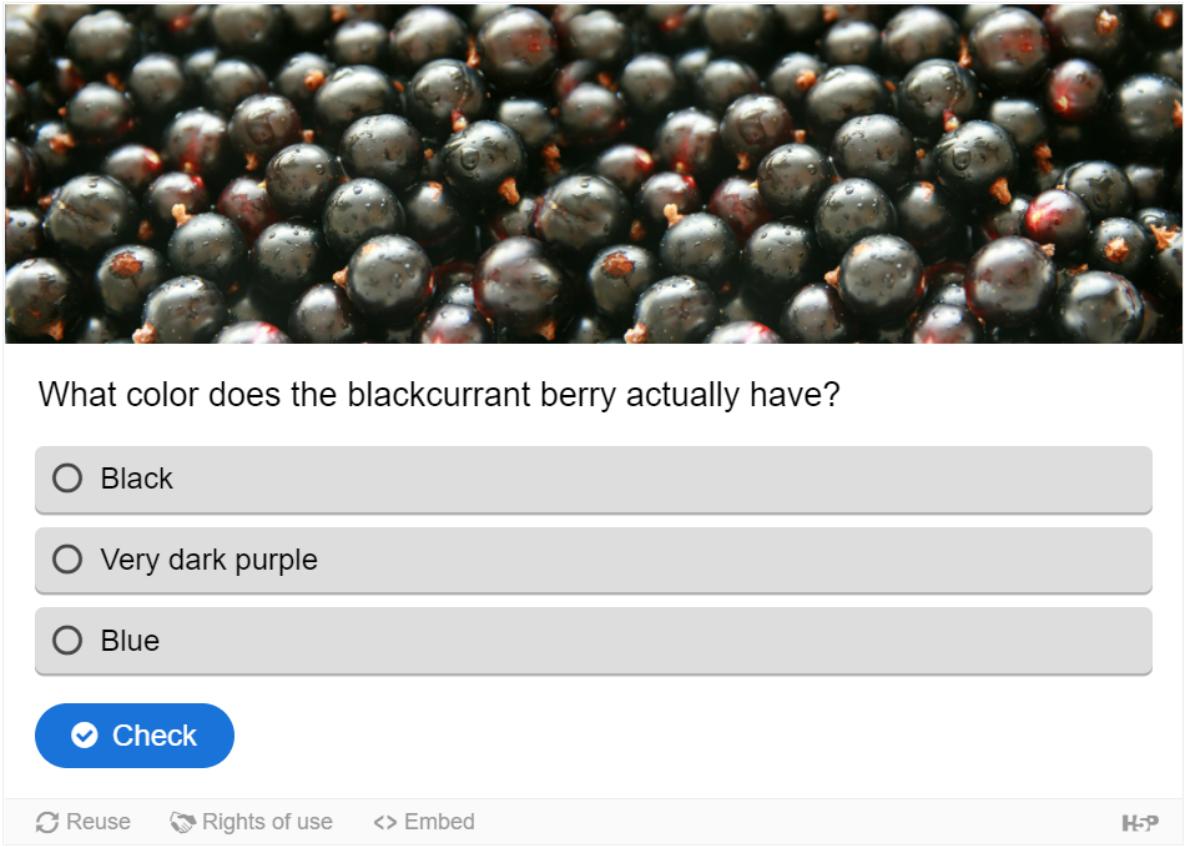


- **Interactive video**: Add interactivity to your video with explanations, extra pictures, tables, Fill in the Blank and multiple choice questions. Quiz questions support adaptivity, meaning that you can jump to another part of the video based on the user's input. Interactive summaries can be added at the end of the video. Interactive videos are created and edited using the H5P authoring tool in a standard web browser. To see a demo of an H5P interactive video, visit here.

- **Mark the Words**: Mark the words allow content designers to create textual expressions with a defined set of correct words (see image below). The end-user highlights words according to the task description and gets a score. For wrong answers, the user gets negative points. To see a demo of Mark the Words, visit here.



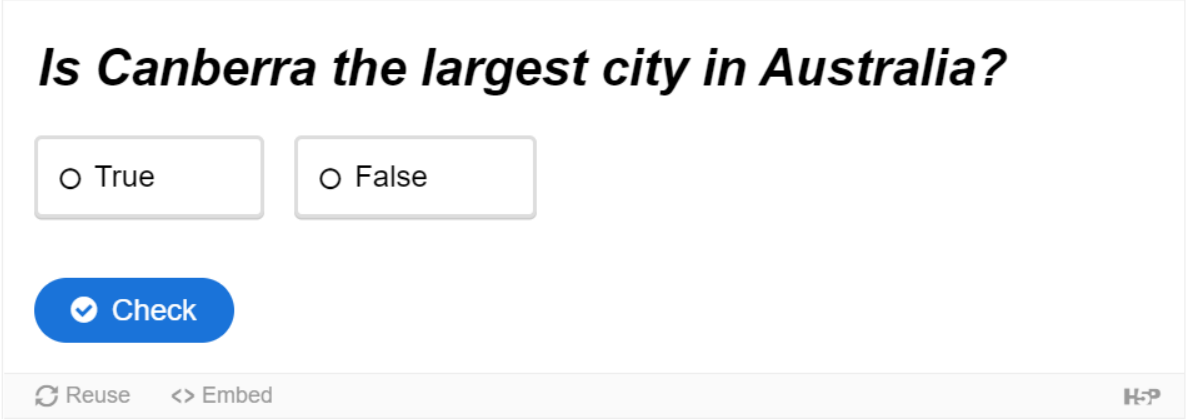
- **Multiple Choice**: The Multiple Choice content type is your staple multiple choice quizzing tool (see image below). Multiple Choice can be used to test the learner's level of knowledge on a given topic. For a demo of Multiple Choice, visit here.



- **Question Set**: The question set allows eLearning designers to create a sequence of various quiz types, including Multichoice questions, Fill in the blanks, and Drag and

drop. The question set supports customized text feedback as well as video feedback to the learner. For a demo of Question Set, visit here.

- **True/ False**: A True/False question is often used in surveys and consists of a statement that demands a true or false answer (see image below). Alternatively, you could change the answers to Yes/No, Agree/Disagree, etc. For a demo of True/ False, visit here.



If you want to learn about the other types of H5P interactive content then visit https://h5p.org/.

3.3.2. How to design a course summary

COURSE SUMMARY is a large textbox for a detailed course description. It is very useful to fill in this section including lots of keywords that accurately describe the content (i.e. learning objectives and outcomes, length of time it takes to complete the course, and the main sections) of the course as this will help the course be more 'visible' when people are searching for it on the internet. Make sure you include terms/ keywords that most people actually use when describing these various elements so it matches what people would naturally be searching for.

Learning objectives describe the *purpose* of the course, while learning outcomes state *what the student should be able to do at the end* and are usually measurable outcomes that can be linked to evaluation. Of these tasks, the most important are the design and the writing of the learning objectives or outcomes. Learning objectives and outcomes are about the expectation of what the learner should know and be able to do at the end of a unit. They are frequently described using Bloom's taxonomy of learning[11] which include:

- Knowledge
- Comprehension
- Application
- Analysis
- Synthesis
- Evaluation

[11] https://en.wikipedia.org/wiki/Bloom%27s_taxonomy

As the units will be short and without the opportunity for the marking of essays, it is most likely that our quizzes/ assessments will focus on **knowledge and comprehension**. For learning objectives, see Writing Good Learning Outcomes by University of California, Davis[12] and for a good vocabulary of learning objectives see the end of Writing and using Learning Outcomes by University of Cardiff[13]. An example of a learning objective is:

“By the end of this course, the student will be able to explain the historical background and current activities in Citizen Science, by identifying key terms and concepts”.

In an EU-Citizen.Science training module, please aim for 2 or 3 objectives.

**

3.3.3. How to design a module topic/ section

As mentioned in section 2.2, your module will be split into approximately 8 - 12 sections (approximately 8 sections for a one hour module, 12 sections for a 2 hour module). Here we describe how to design the content for each of these sections.

For each of the module sections you will need to plan 1) the sub-sections you plan to include within a section (e.g. Introduction to the course learning objectives), 2) how you plan to deliver that content (e.g. a video, audio, text) and 3) why you plan to include that content (e.g. to help situate learners and set expectations for engagement). This planning should be undertaken in part 2 (Detailed Section Plan) of the Content Design Template.

Each module will contain the following sections:

- **Welcome and introduction to the course (5 minutes)** - this section provides an introduction to the module from the course tutor, which must be in video or audio format and lasting about 1 - 2 minutes. It is important that the module students see the face of someone who has helped develop the module, as this can enhance credibility and trust in the module. In this section, please include an overview of the content and the learning outcomes. If relevant, provide a teaser and a sample for something that is central to the course so the learner can assess if the course is for them. The introductory text needs to be clear and enticing. When recording the video (or other videos for the course) be aware that audio clarity is key, and that you can use smartphone quality as long as it is clear.
- **Summary and self-assessment (17 minutes)** - summary of the module and end-of-module quiz. The summary should review the topics and highlight the key messages. Please also include links to the other final sections, though do not make these compulsory for course progression. The final part must be the end-of-course quiz. The end-of-course quiz is critical and standardised in terms of its content, and described in details below. This is because the completion of the quiz with a grade of over 50% correct answers will trigger the provision of completion badge and certificate to the learner.

[12] https://canvas.ucdavis.edu/courses/34528/pages/writing-good-learning-outcomes
[13] https://www.cardiff.ac.uk/learning-hub/view/writing-and-using-learning-outcomes

- **Further information** - other sources of information and further learning on Citizen Science. This can include links to other online courses and Massive Open Online Courses (MOOCs), training resources on the EU-Citizen.Science platform, and further reading, videos, and podcasts that are relevant to the topic.
- **Sources and acknowledgements** - a list of sources that are used in the course, details of the people that created it, and funding sources that funded the work.

You can design the rest of the sections to suit the specific content needs for your module but remember you should not exceed a total of 12 sections for a 2-hour module.

Use a tool like Niram (https://niram.org/read/) to calculate the time it will take for a participant to read through a section. Course designers will typically underestimate the time required.

3.3.4. How to design a module quiz/ assessment

Well-designed online assessment activities such as polls, quizzes, questionnaires, reflective exercises and self-assessment questions can provide very effective consolidation and evidence of learning. In the EU-Citizen.Science training and educational modules we will use two forms of evaluation: formative and summative. Formative evaluation provides the learner with scope for self-reflection as they progress through the module - it can be a short quiz, for example, or a case study to consider and write about, followed by reading a “model answer” which reveals some points to think about. A formative quiz will not count towards the learner’s grade but is aimed at providing the learner with a way to check that they understood the section. The formative quiz should have 2-4 questions, and the time that it takes to carry it out should be counted in the overall course plan. As noted, the end of the course is based on a well-constructed quiz covering material from the whole course is one method of conducting summative assessment in this situation.

The final quiz should be made up of 10 questions. If the learner passes 50%, they will receive a certificate of completion of the course and an ECSA badge. The questions should be written bearing in mind Bloom’s taxonomy (see the section called ‘Course summary’ under ‘Designing the Content’) and aim to be 30% on knowledge of issues covered in the course, 30% comprehension, 20% application and 20% analysis/synthesis. In the final quiz, the results are shown for the whole exam.

When designing the quiz questions, follow the Open University’s checklist for quizzes:

a. Identify the topics you want to cover in the quiz and write them down, you may do this as you are writing the course and the material is fresh in your mind.
b. For each topic, draw up possible ways to ask the question, referring to examples of the different question types in use.
c. Decide on the feedback type for each question.
d. Draft questions for each topic in the question formats you have chosen.
e. Write out some hint text for the interactive with multiple try questions.
f. Write out some feedback text for the deferred feedback and immediate feedback questions.
g. Compile all the questions and organise them into a logical order, grouping the random variant versions together under one question number (e.g. 3a, 3b, 3c each being a variant for question 3).

h. Ask colleagues to review the questions and feedback text. Request that they provide comments on the pedagogical strength of the questions. Tell them about the potential audience for the open online course and the assessment strategy (including if the quiz is summative or formative).
i. Review and, if necessary, revise the questions, feedback text and assessment strategy in light of comments from colleagues.

You will also need to design some quizzes or activities at the end of each section within your module. To help you think about what sorts of quizzes/ activities you'd like to design here is a list of all the options within Moodle:

- Multiple choice - Allows the selection of a single or multiple responses from a pre-defined list
- True/ False - A simple form of multiple choice question with just the two choices 'True' and 'False'.
- Matching - The answer to each of a number of sub-question must be selected from a list of possibilities.
- Short answer - Allows a response of one or a few words that is graded by comparing against various model answers, which may contain wildcards.
- Numerical - Allows a numerical response, possibly with units, that is graded by comparing against various model answers, possibly with tolerances.
- Essay - Allows a response of a file upload and/or online text. This must then be graded manually.
- Calculated - Calculated questions are like numerical questions but with the numbers used selected randomly from a set when the quiz is taken.
- Calculated multiple choice - Calculated multichoice questions are like multichoice questions which choice elements can include formula results from numeric values that are selected randomly from a set when the quiz is taken.
- Calculated simple - A simpler version of calculated questions which are like numerical questions but with the numbers used selected randomly from a set when the quiz is taken.
- Drag and drop into text - Missing words in the question text are filled in using drag and drop.
- Embedded answers (Cloze) - Questions of this type are very flexible, but can only be created by entering text containing special codes that create embedded multiple-choice, short answers and numerical questions.
- Random short-answer matching - Like a Matching question, but created randomly from the short answer questions in a particular category.
- Select missing words - Missing words in the question text are filled in using drop-down menus.

3.3.5. Module sustainability considerations

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3.3.6. Best-practice in module design

Once you've decided on the sections you'll need, use the following tips to guide the design of the content. This list is based on online course design best-practice principles:

1. When designing activities, try to **keep activities to between two to 10 minutes**. If you are planning to record a lecture or a set of slides, be aware that evidence from online learning shows that the people will not watch long videos, and therefore any video that is integrated as an activity should be a maximum of 5 - 6 minutes. Studies suggest that 2.5 minutes is the optimum. Videos can be 'broken down' into sections.
2. When designing activities, **consider using a range of activity types**:
    - Assimilative - reading material, watching a video, or listening to a recording
    - Finding and handling information - asking the learner to look out for information
    - Productive - asking the learner to produce their own ideas or take notes
    - Experiential - provide an opportunity for the learner to apply the knowledge in their own context
    - Interactive/communicative - these are activities where learners can communicate with others, such as a discussion forum. However, this is more difficult to implement in an asynchronous situation so should be optional, if used at all.
3. **Clearly indicate how long each activity should take to complete**.
4. **Ensure that you have a clear structure/learning journey through the materials**.
5. As you develop the details, **regularly check your content against your learning outcomes**. Ask someone else to look at your planning grid before you start writing the content.
6. **Be very clear about what the student should be doing** (e.g. 'write yourself a list of your top priorities when managing data').
7. As you design the course, **consider how you can prevent learners from navigating away from the course where possible**. For instance, if using third-party material, a video from YouTube, embedding these within the course is preferable to linking out and requiring students to leave the course/platform (whilst bearing in mind that this may have copyright implications).
8. **Use imagery - photographs, figures and illustrations**. When designing the section, you can consider the use of decorative images that will represent the context of the specific section but be aware that they may disrupt learners' attention to the studies.
9. **Make sure that each topic/section (apart from the Welcome and introduction, Sources and acknowledgements, Further information) end with a formative quiz to evaluate how well the student is learning the course content** (see the section called 'Quiz/ assessment design').
10. **Consider the following accessibility guidelines for course content and activities in addition to the points covered in Figure 2 (**for more guidance on accessible material development, see the OpenLearn course 'Accessibility of eLearning'[14]):
    a. Each video or audio will require a text script that can be shared for accessibility purposes.

[14] https://www.open.edu/openlearn/education-development/education-careers/accessibility-elearning/content-section-0

b. Ensure diagrams and schemas are explained in the text, and each image must use the alt-image tag to provide an alternative description. Slides and material should be provided in accessible PDFs.
c. The writing style for the material should pay attention to guidelines for writing for the web: use short sentences and style, use a conversational style that guide the reader to the course and remember that generally, each page should not contain more that 250 words to read (for a slow/non-native reader this is about two minutes, while for an average reader it will be about a minute). Do not use more than 500 words in one section. Avoid making sentences too long as this reduces their readability and accessibility, especially in an online setting when long sentences and paragraphs need to be broken into more manageable lengths.
d. In quizzes, use drag and drop questions with care as they can be problematic on some devices and for participants who have dexterity limitations (e.g. tablets).

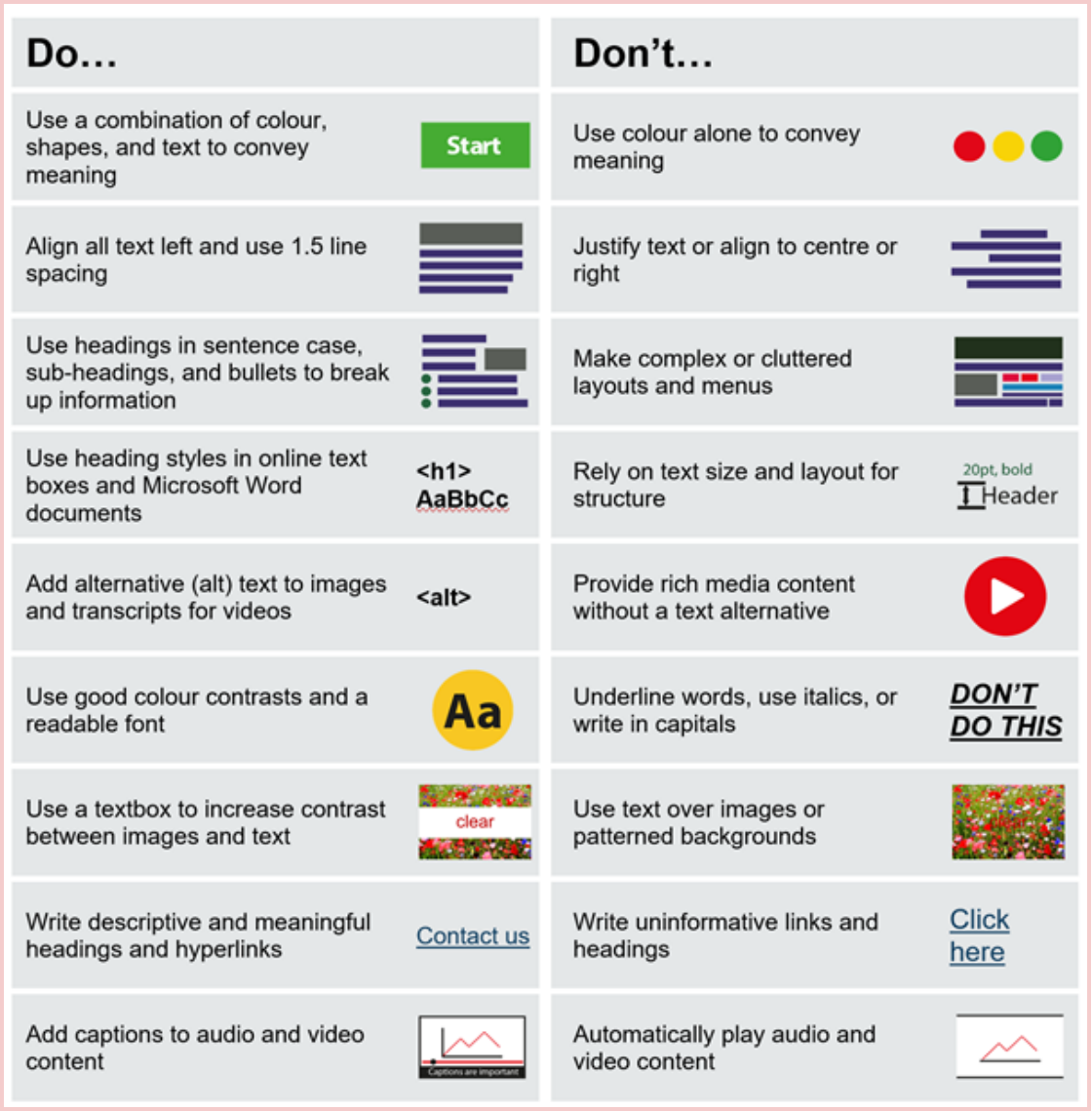


Figure 2: Core accessibility guidelines for the implementation. Source: UCL accessibility team

3.3.7. Using assets (videos, pictures etc) in your module

While developing the module material, you will probably want to use various 'assets' e.g. resources from the EU-Citizen.Science platform, videos on YouTube etc. As long as their copyright status has been clarified and, ideally, unless they are available on a very stable platform such as YouTube, they should be copied and stored on the EU-Citizen.Science Moodle platform to avoid deterioration of the course if the linked website disappears. Where necessary, indicate clearly that an external link is provided. In the template, you will find a space to plan and register the assets that will be used in a training unit. Before adopting an asset, ask yourself the following questions - Is it suitable for the audience? How complex is it? Is it answering your stated learning objective? How? Level of details and explanation? Anything missing that should be explained in text?

The table (see Table 1) in the template for an asset register is taken from the Open University OpenLearnCreate course, and we provide here an explanation on the details you'll need to log.

Table 1: An example of an asset table.

Image Example	
File name (e.g. *DCN1234.jpg*)	e.g. science bus cover image.jpg
Source of the file	e.g. https://togethersciencebus.eu/
Rights (*who owns the copyright - even if all the assets are owned by you or your organisation it is a good idea to record this in the asset register*)	e.g. CC-By
Attribution for third party asset (*attribution to use with third party asset*)	e.g. UCL ExCiteS

Clearance approved to release asset as Creative Commons (*you can use this for notes about the clearance and date of clearance*)	e.g. Approved by John Smith
Acknowledgement (*what needs to be listed about this asset on the acknowledgements page if the item belongs to a third party or if the organisation releasing the course wishes to retain 'All rights reserved' rather than use a Creative Commons licence for this asset*)	e.g. cc-by 4.0 UCL ExCiteS
Describe the image for someone who cannot see it	e.g. this is an image of the Doing it Together Science project's science bus. It is parked outside of the parliament building in London. It is white with large black text and the project logo on the side.

3.4. Module feedback/ monitoring/ evaluation

We recommend that when designing the module, you include a feedback activity in the 'Summary and Self-Assessment' topic/ section to help capture any issues that the students might face and that are missed during the user-testing. We also recommend including a simple survey of demographic information of the students - without asking for a name in order to maintain anonymity. You and other module administrators will need to agree to a standard questionnaire for modules.

4. Creating the module in Moodle

4.1. Getting set-up

To set up a new training module you will need administrative access to Moodle which can be obtained by contacting Nadia Dewhurst-Richman (n.richman@ucl.ac.uk) or Alice Sheppard (a.sheppard@ucl.ac.uk) but please first register yourself here -

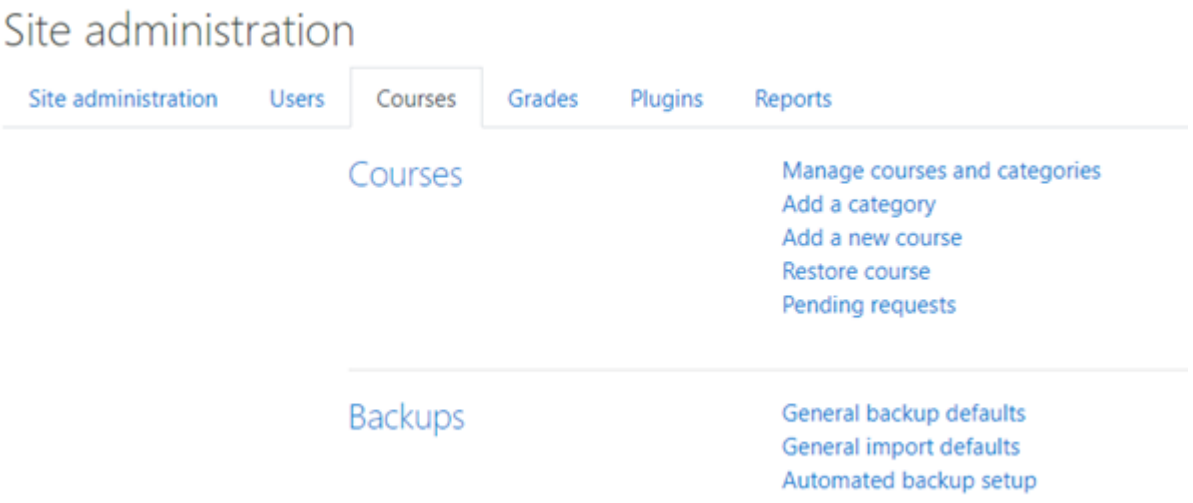
https://moodle.eu-citizen.science/. Once you have are registered one the Moodle section of the EU-Citizen Science platform, you will need to request for a module template to be created for you in Moodle into which you will add all your module content. A module template cannot be created for you until you have completed Section One of the Content Design Template so please complete this and email a copy along with your request for the template.

To familiarise yourself with the Moodle platform, we recommend that you watch the YouTube video *How can I create a course on Moodle?*.

4.2. Creating a module template in Moodle (for administrators only)

You will first need to log-on to Moodle at https://moodle.eu-citizen.science/.

a. Look for SITE ADMINISTRATION which is represented by a cog as shown in this image 
b. Under SITE ADMINISTRATION (see the figure below), choose the COURSES tab, and then ADD A NEW COURSE [15].



Site Administration Interface.

c. For each course, make sure you enter the COURSE FULL NAME and COURSE SHORT NAME.
d. Under COURSE CATEGORY select 'Generic citizen science course'.
e. Under COURSE VISIBILITY, select 'Hide' until the course is ready.
f. Select the course START DATE. This should be the official release date of the course, though students may begin any time after this. Ensure that the course end date is disabled by unticking 'enable' after course END DATE.

[15] Please note Moodle refers to modules as courses, the two terms mean the same thing in this document

4.2.1. Course Summary

a. Start the opening text with ‘This is a free and open course of X [usually 1-2] hours’, then explain the significance of the course and why the learner should take it, and then the topics that are covered in the course.
b. For COURSE IMAGE, use an image size of 800 x 400 to represent the unit.

4.2.2. Course Format

The next step in the design process is the identification of topics/ sections into which the course will be broken into. Each training module will have, as a standard, the following topics: “Welcome and introduction”, “Conclusion and self-assessment”, “Further information and learning” and “Sources and acknowledgements”. Between the introduction and conclusion, there should be 4-8 sections.

a. Under COURSE FORMAT, select ‘Topics’ from the drop-down menu.
b. Under NUMBER OF SECTIONS, select the number of sections you wish to have in your course, this is usually between 8 and 12. After sections for the Welcome and introduction, Conclusion and self-assessment, Further reading and learning, Sources and acknowledgements you will need at least another four sections for the module itself.
c. Under COURSE LAYOUT, select ‘show all sections on one page’.

4.2.3. Appearance

a. Under FORCE LANGUAGE, we recommend selecting ‘do not force language’.

For the other options, select options most appropriate to your course.

4.2.4. Files and uploads

This section allows us to set limits on the size of files that may be uploaded. We will not be expecting students to upload files of their own, but course administrators may wish to upload several items. We encourage course administrators to use a variety of media, e.g. videos, pictures, graphs, animations, quizzes, etc. At present, we anticipate that leaving the size limit for uploads is left as the site default (i.e. 100MB). This can be altered if any problems occur (e.g. many or large files slowing down the Moodle site).

4.2.5. Completion tracking

Under ENABLE COMPLETION TRACKING, select ‘yes’ from the drop-down menu.

4.2.6. Groups

As these modules will be carried out by individuals and without a tutor, so select ‘no’ for all the options **under this heading.**

4.2.7. Role renaming

Unless you specifically want to rename the roles (e.g. course creator, manager, teacher) then we suggest you leave these fields blank.

4.2.8. Tags

There will be a text box saying ENTER TAGS which you can use like a free text box. The tags will appear above the box once you press ‘Enter’. A standard EU-Citizen.Science list of tags will be created, e.g. citizen science, volunteer management, policy etc. but you’re free to add your own.

One box will be called “Course ID number”. It has not yet been decided how to assign course numbers; this will be the subject of future discussion as we create our first ten modules. This guide will be updated when a decision is made.

Once you’re finished with the ‘Tags’ section, click the ‘Save and Display’ button at the bottom of the page.

4.2.9. Participants

After clicking the ‘Save and display’ button you will be asked to complete the following information regarding enrollment to the course. You will need to enrol yourself or another agreed person as a course manager i.e. someone who can edit the course.

a. Click the ENROL USERS button on the right-hand side of the page.
b. Before selecting who you’d like to enrol on the course go to the ASSIGN ROLE box and select the role of the first individual you’d like to enrol. Your options are Teacher, Manager, Student or Non-editing teacher.
c. In the SEARCH box either start typing the name of the person you want to assign as a course manager, or click the down arrow in the SEARCH box and select from the list. To add a person they must already be registered with Moodle. Their name and e-mail address should automatically appear when you click the grey “enrol users” button on the right. N.B. All course designers should be enrolled as ‘Teacher’ NOT ‘Manager’. The manager role gives people the rights to delete and create courses and should only be reserved for project staff.
d. Then click the ENROL USERS button at the bottom right-hand corner of the page.

4.3. Uploading the module content to Moodle (for all course designers)

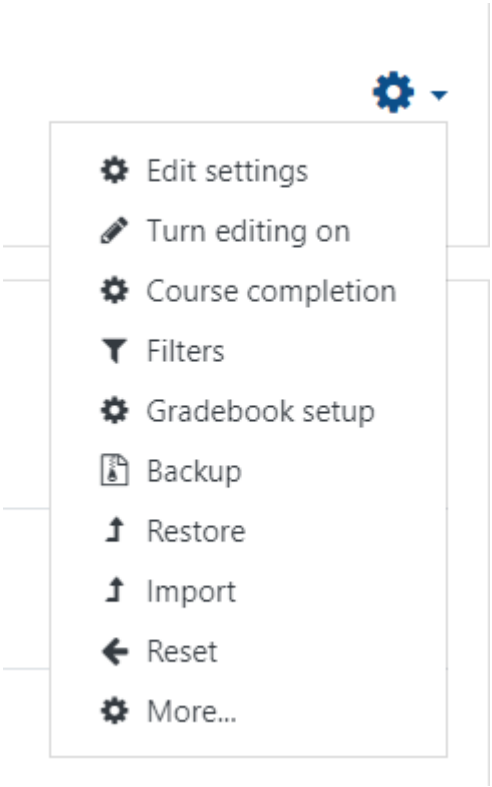
Once the material for the course is ready, you are ready to upload it to Moodle. Follow these steps:

a. Log on to Moodle https://moodle.eu-citizen.science
b. Go to site home as represented by this icon 
c. You should now see your module. Click on it.

d. After clicking on the course, you should see an outline of the course similar to that in the image below.

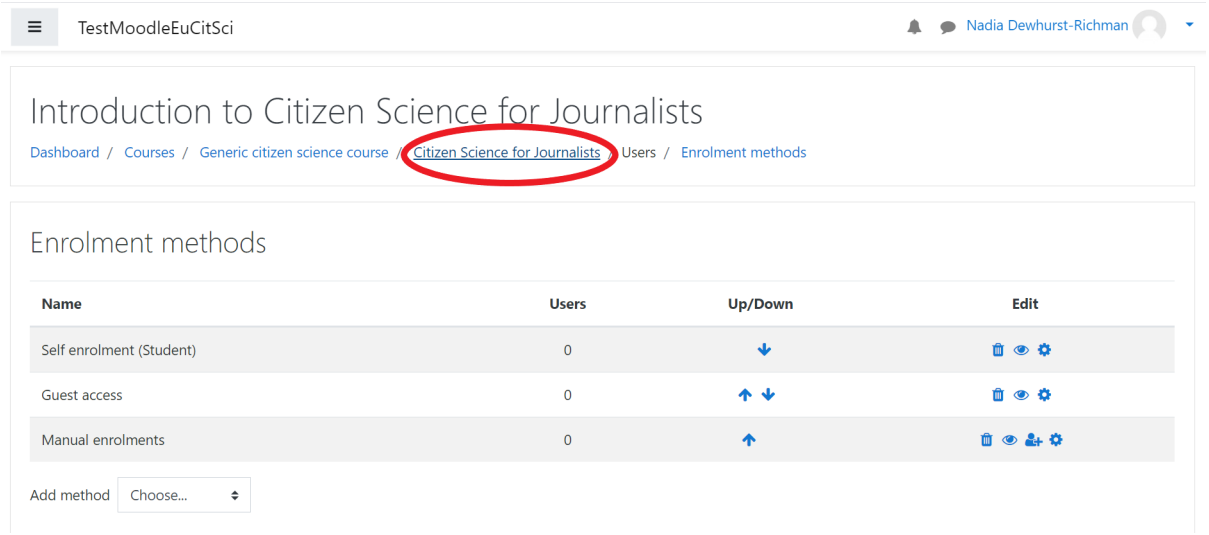
4.3.1. Setting the course enrolment

a. Click on the settings ‘cog’ icon in the top right of the page and select ‘More…’ as shown in the image below.



b. Select the USERS tab, and then select ENROLMENT METHODS. Notice the ‘eye’ icon which indicates if the module is visible or not (see image below). For all EU-Citizen.Science modules, guest and self-enrolment should be visible and manual enrolment should not be visible, these can be amended by clicking on the ‘eye’ icon. The order of enrolment should be set to Self, Guest, and Manual.

c. Now click on the settings ‘cog’ for SELF ENROLMENT and for ENROLMENT KEY enter the enrolment key. Then click on SAVE CHANGES at the bottom of the page.
d. If your Moodle page does not seem to allow students to self-enrol, please use this article[16] for troubleshooting.



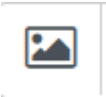
4.3.2. Naming and creating the sections/ topics

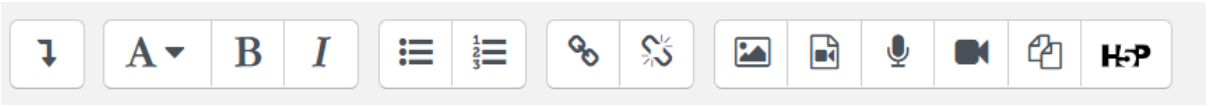
a. Now return to the module’s main page by clicking on the name of the course as shown in the red outline in the figure above.
b. Once again click on the settings ‘cog’ in the top right corner of the page. Select ‘Turn editing on’. This will enable you to start editing the module on Moodle. For a tutorial on how to use Moodle for additional content, see the following resources:
    a. https://www.youtube.com/c/moodle/videos
    b. https://www.youtube.com/watch?v=cEROJvmM5C8&list=PLxcO_MFWQBDfMnwMzFBq0ab9wSPniXEkp
    c. https://www.youtube.com/watch?v=SbAPOjpNUrM
    d. https://docs.moodle.org/39/en/Teacher_quick_guide
c. A pencil icon should appear next to the TOPIC 1 name. Click on this and name it ‘Welcome and Introduction (xx mins)’. Click enter to save.
d. Continue to name all the other topics according to whatever names you have given them. The last three topics should be named ‘Summary and Self-assessment (xx mins)’, ‘Further reading and learning’, ‘Sources and acknowledgements’.
e. Once you’ve named the topics, go to the first topic and click the ADD AN ACTIVITY OR RESOURCE in the bottom right corner.

16 https://www.lmspulse.com/2018/moodle-for-beginners-how-to-enable-self-enrollment-in-your-moodle-course/

f. Start by adding a PAGE. This is the resource type you will need for adding text, video, audio content. You are welcome to browse the Moodle Help website for information on the other resource and activity types but for the purpose of these modules you will principally be using PAGE.
g. You now need to give your page a name. We'd recommend giving the page a name which summarises the key content that the student should expect to cover e.g. The history of citizen science. You do not need to give the page a description.
h. The text you have prepared in your content design template that is to appear under this particular topic is copied into the PAGE CONTENT box. You can simply copy and paste across the text from any other document type.

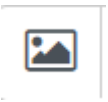
4.3.3. The editing toolbar

You'll notice at the top of the PAGE CONTENT box, and editing toolbar as shown in the image below. If you click the first button (the downward facing arrow) it will expand the toolbar and show a range of other options. You will probably be familiar with the options from other software packages but useful options to note, include  for inserting a link,  for inserting an image,  for inserting a video or audio file and  for clearing formatting.



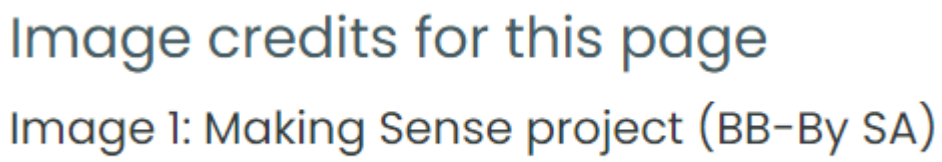
4.3.4. Inserting an image into your content

You have two options for inserting images into page content, adding a single image straight into the page content or adding multiple images as a collage. If you're adding multiple images as a collage then you might choose to use the H5P Collage tool (see section 3.2.1.) which can be inserted using the steps in section 5.5. You might choose to simply add a single image into the text in which case the easiest way to do this is to:

a. **Click on the place in the text where you want to insert the image.**
b. Click on the insert image icon  .
c. Under ENTER URL, select BROWSE REPOSITORIES.
d. You will likely need to select UPLOAD A FILE if you are uploading the file for the first time. Note that once an image has been uploaded, if you wish to use it again somewhere else in the course then you can find it under RECENT FILES.
e. Under ATTACHMENT, select CHOOSE FILE and navigate to where the file is saved. Under SAVE AS give the file a meaningful name.
f. Under AUTHOR, name the person to whom the image should be credited.
g. Under CHOOSE LICENCE, select the sharing rights for the image.
h. Select UPLOAD THIS FILE.

i. Under DESCRIBE THIS IMAGE FOR SOMEONE WHO CANNOT SEE IT, give a description of the image which will be read out for anyone who is visually impaired.
j. Under size, select the dimensions of the image. This may require a bit of playing with i.e. you'll need to select some dimensions then hit save, then hit save and display so you see the finished page. You can return to these settings for an image by double-clicking on the image.
k. Under ALIGNMENT, select the alignment of the image within the text.

Please note that the above information is attached to the stored image file but will not be displayed. Instead, we ask all module designers to create the following image acknowledgement text (see below for an example) at the bottom of the module section that contains the image(s). Your text will need to include the image number (i.e. it's sequence on the page) or could be a description, the author of the image and it's sharing rights.



4.3.5. Inserting a video or audio file into your content

To insert a video file into page content it will first need to be uploaded to YouTube. As ECSA have committed to maintaining the platform for at least 5 years after the end of the project, they are happy to host video content on their YouTube account. If you have a video to upload, send it to claudia.fabocartas@mfn.berlin. Once you have the URL for the YouTube link to your video, follow these steps which will embed the video within your content:

a. Click the location in the content where you want to embed the video.
b. Click on the Insert video/ audio icon  .
c. Simply paste the YouTube URL of the video into the SOURCE URL box.
d. Click INSERT MEDIA. The video will not immediately appear as an embedded item, you will simply see the URL. To see what it looks like, scroll to the bottom of the page and click SAVE AND DISPLAY. To return to editing, you will need to TURN EDITING ON under the cog tab once again.

4.3.6. Inserting H5P content

To insert H5P content you first need to think about where your H5P content is to appear within the course i.e. do you want it to appear within the text or do you want it to have an entirely separate page. Even if you want the H5P item to appear with the page content, you first need to start by creating it on an entirely separate page:

a. If you are still within 'Add a Page', scroll to the bottom of the page and select SAVE AND RETURN TO COURSE.

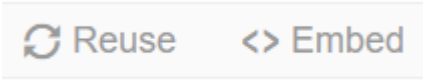
b. Now go to the topic or section in which you want to add the H5P item, and select the ADD AN ACTIVITY OR RESOURCE button

c. Select the INTERACTIVE CONTENT option which is represented by this image

d. Scroll down to EDITOR and select the H5P content type that you wish to create.
e. Create the H5P content item. In most cases the process for creating an H5P item is self-explanatory but if you need any extra help or guidance then please search for the content item on the H5P website (https://h5p.org/content-types-and-applications) where they provide helpful tutorials on how to create these items.
f. Once you've created the H5P item, scroll to the bottom of the page and select SAVE AND RETURN TO THE COURSE. You will now be returned to the main course page and you should see your H5P item appear under the topic/ section.

You now have an entirely separate page that is entirely dedicated to this H5P item. If you want to now embed this item within the text of another page then follow these next steps:

g. Click on the title of the H5P item.



h. Underneath the H5P item, select REUSE
i. Select DOWNLOAD AS AN .H5P FILE.
j. Now go back to the page where you want to insert the H5P item. Once in the page you will need to select EDIT SETTINGS by going to the cog in the top right hand corner.
k. Go to the PAGE CONTENT box and find the place in text where you want to insert the H5P item. Select the Insert H5P button  from the editing toolbar.
l. Select BROWSE REPOSITORIES and then under UPLOAD A FILE select CHOOSE FILE. Find the .h5p file you just created and select.
m. Under SAVE AS give the file a name, then add the AUTHOR of the H5P item and CHOOSE LICENCE.
n. Now select UPLOAD FILE.
o. As with the video content, the H5P item will not appear properly until you go to the bottom of the page and select SAVE AND DISPLAY.

Below are some additional design configurations that you'll need to apply both to standardise the experience across all EU-Citizen.Science modules, and in an effort to apply best practice principles:

a. Of the activities and resources that can be added to a module, we recommend only using the following activities and resources: feedback, glossary, quiz, H5P activities, file, label, page and URL.

b. For quizzes, we suggest you use the ‘Choice’ option. Questionnaires can be used to gather information from learners and then show them other responses (so need seeding with some possible responses).
c. For formative learning quizzes linked to a specific section, we recommend - on the configuration page - setting the grade to ‘out of 10’, setting the layout to ‘never, all questions on one page’, setting question behaviour to ‘interactive with multiple tries’, as well as using encouraging and conversational language in the overall feedback messages. We suggest setting 50% as a grade counter.
d. The summative quiz should use “deferred feedback with CBM”, and in activity completion, set “show activity as complete when conditions are met” and tick “student must receive a grade to complete this activity”.
e. Use labels to indicate different activities within the topic, make the title a label that is medium heading. In labels and sub-headings, ensure that under “Activity Completion” the option “Do Not indicate activity completion”.
f. Where a QUIZ has been added, under the ‘Review Options’ make sure that all the following are ticked: ‘whether correct’, ‘specific feedback’, ‘general feedback’, ‘right answer’ and ‘response history’.
g. We recommend that each module should include a feedback activity at the end, after the final quiz.

4.3.7. Adding a quiz at the end of a section

***

4.3.8. Adding the final ‘Summary and Self-Assessment’ section quiz

Penalty for each incorrect try is 0% - this need to be set for each question in the quiz.

You do that by “edit quiz”. Then, for each question, click on the cog wheel, and at bottom of the page, choose “multiple tries”

4.3.9. Enabling completion tracking throughout the module

Add something here about how to enable completion tracking = Intro to CS > Settings > Course Completion

4.3.10. Setting up the final quiz gradebook

Add something about the course grading to make sure that you’re only being marked on the basis of the last quiz = Intro to CS > Settings > Gradebook set-up

4.3.11. Enabling course badges

The next stage is to add a badge for the course. Badges demonstrate interest in a subject, evidence of professional development or a commitment to studies. Badged courses are

highly engaging and cover a range of core subjects and professional competencies. Badges are awarded once all sections have been completed, and assessments are passed.

a. Go to the burger menu in the top left hand corner and select SITE ADMINISTRATION.
b. Under the SITE ADMINISTRATION tab, scroll down to BADGES and select 'Add a new badge'.
c. You will need to give your badge a name, a description and an image. ECSA is expected to design its own badges; they will work best as JPEG or similar files. If you choose a different one, please ensure that it is not a copyrighted image. If it is your own artwork, please decide on what kind of license you wish to attach to it (e.g. creative commons).

A single glossary of terms will be developed that will apply to all courses. We will encourage our students to highlight any words they feel should be in it.

4.4. Making the course live/ visible

***

5. Quality Assurance

Once you've designed your module, you will need to beta-test the module. First test the module on yourself and work through all the checklists in this document, then test the module on a group of individuals from your target audience.

5.1. User-testing

***

6. FAQs

6.1. Can I create a table in Moodle?

6.2. What tips can you offer for designing video content?

Add section on good tips for designing a video. This is feedback from a training module surgery, feedback from Muki - Q (Carole) on video format recommendations: No recommendations yet. Carole: As it's self-sustaining, we need the occasional video as a substitute for interaction and somebody there explaining! Muki: Recommendations - short (analysis shows 2-3 minutes is what people watch); if they're interactive/telling a story can be a bit longer but no longer than 5-6. Slides and ppts need to be careful - better if there is some activity as people often avoid them! People often download the slides with the texts when designed as lectures. Use ppt animations to give a bit of life to what's happening on the screen. If you're recording someone, e.g. the introductory video, this should show the person who's guiding the course. Make the user background interesting - you can use an image relevant to the course as your background, or a series of backgrounds in additions to slides. There are tools to do better presentations, OBS studio is free but need to learn how to use it. If you use an additional screen, attach it to your laptop before you record. Think

about reflections on glasses etc: reduce brightness on monitor. Nadia has checked the guidelines - **Action: Nadia to expand the video design section**. Muki: we can copy some of UCL's Connected Learning and also OU.

6.3. **How much is too much text?**

6.4. **Do I have to use the Content Design Template if it isn't working for me?**

6.5. **How do I create a credit/ acknowledgement for an image?**

Appendix 3.1: The Cascading Grants call

This is a copy of the Cascading Grants call from the eu-citizen.science blog. It can be referenced at this link: https://eu-citizen.science/blog/2021/03/01/eu-citizenscience-will-fund-10-citizen-science-online-training-courses/

EU-Citizen.Science will fund 10 citizen science online training courses.

Eu-Citizen.Science

1 Mar 2021, 11:54 p.m.

EU-Citizen.Science will fund 10 citizen science online training courses.

10 training modules will be granted up to €1.500 for their development, implementation and testing before their publication on our platform.

If you have ideas to produce a 1-2h online course on any relevant aspect of citizen science, this opportunity is perfect for you!

We are looking for 10 teams or individuals that would be interested in producing training modules to enrich our catalogue and fill the gaps in the global library of citizen science courses or educational materials on Moodle.

We would be particularly interested in supporting the development of training courses on the following topics:

- Co-Creation
- Communication
- Data quality and standards
- Empowerment
- Engagement
- Evaluation
- Impact
- Link with formal education
- Project Management
- Project sustainability
- Regulation and ethics
- Research design and methods
- Transferability
- Why trust citizen science data?

- Achieving policy impact with Citizen Science

The call for applications will be open until 30 April.

You can find more detailed information on our website, and in the guide for applicants carefully developed by our team to help your application.

You can also join one of our "Information for applicants" workshops, organised on Wednesday 10 March and Monday 15 March 2021, from 11:00 to 12:00 (CET). Register via this Google form.

Appendix 3.2: The announcement of the Cascading Grants awards winners

This announcement appeared on the eu-citizen.science blog and can be accessed at this link: https://eu-citizen.science/call/

EU-Citizen.Science call (closed)

The open call ran from 26th February to 30th April 2021 and is now closed.

Winner announcement

Update on 27th of May 2021: The EU-Citizen.Science call for 10 new citizen science training modules has now closed and the following projects have been selected. The new modules will be available on the platform from late summer 2021 so keep an eye out at https://moodle.eu-citizen.science/.

- Doing citizen science as open science: What, why, and how. This module will be available in English and is designed for citizen science practitioners. It will introduce what open science is and why it is mutually complementary with citizen science and will illustrate which tools can enable collaborative and inclusive processes underlying citizen science and open science. The module will be developed by Dr. Pen-Yuan Hsing and Rafaella Antoniou of the MammalWeb project and of the University of Bath, UK.
- Kutatóknak a "Citizen Science" megközelítésben rejlő lehetőségekről (Value of citizen science for the traditional researcher). This module will be available in Hungarian and is designed for Hungarian researchers in traditional citizen science fields such as the natural sciences. It will cover the benefits, opportunities, challenges and barriers of the citizen science method, data quality, fields of interests and the publication potential of citizen science data. The module will be developed by Dr. Oliver Vaczi of the Vadonlesők Közössége Természetvédelmi Egyesület (Nature Conservation Society of WildWatchers' Community), Hungary.

- Citizen science in the classroom: A toolkit. This module will be available in English and is designed for educators, students and their families or guardians, and policy makers seeking to integrate citizen science projects into school curricula. It will cover the basics on the value of citizen science for learning, how to design citizen science projects for a classroom setting and how to access projects that are suitable for the school curriculum. The module will be developed by Dr María Grau of the Universitat de Barcelona, Maria José Aparicio of the Escola La Maquinista Barcelona, Dr. Núria Codern Bové of the Escola Universitària d'Infermeria i Teràpia Ocupacional - Terrassa, Dr. Jorge L. Díaz, of the Parc de Salut Mar - Barcelona and Raul Martínez of the Escola La Maquinista Barcelona.
- Empowerment through co-designed Citizen Science in research and formal university education. This module will be developed in English and is designed for an educational policy/ decision-maker audience i.e. those in charge of designing educational programs from school to university level. It will explore how citizen science can be used as a way to empower people within co-designed research programs and students in formal education. The module will be developed by Dr. Annegret Nicolai and Morgane Herve of the Living Lab CLEF, France.
- Research integrity, ethics and citizen science. This module will be available in English and is designed for researchers and citizen science practitioners working in NGO's, academics, graduate and post-graduate students, journalists and government officials. It will cover research integrity and ethics in the context of selected SDGs, how these topics are relevant when conducting citizen science, what is ethical behaviour and how do we maintain research integrity. The module will be developed by Professor Jacqueline Goldin of the University of the Western Cape, South Africa and Stef Dingemans of the University of Utrecht, Netherlands.
- Estrategias y herramientas de comunicación aplicadas a proyectos de ciencia ciudadana (Engagement and dissemination tools and strategies to implement a citizen science project). This module will be available in Spanish and is designed for citizen science practitioners. It will explore the different approaches for engaging citizens as stakeholders and introduce basic techniques for communication and dissemination. The module will be developed by Blue Room Innovation SL.

- Basics on regulations and ethics for citizen scientists. This module will be available in English and is designed for the aspiring citizen scientist. It will cover introductory information on volunteers' rights and obligations in gathering and analysing data, and co-authoring research papers. A special emphasis will be placed on how to handle sensitive data and ethical requirements in gathering such information. The module will be developed by Dimitar Stoychev Kyosev, Bulgaria.
- Bürger schaffen Klima Wissen (Citizens Create Climate Knowledge). This module will be available in German and is designed for citizen scientists. This module will provide a tutorial on where and how to step into scientific work and become a citizen scientist primarily in the area of climate and environmental science. The module will be developed by Frank Becker, Thomas Hasenauer, Otto Kückmann, Michael Plögert, Antonia Rollwagge of the Science Shop kubus, Technische Universität Berlin, Germany and BANA (Berlin Model: Education for Post-Occupational Activities) course guest lecturers.
- Social media management for citizen science projects. This module will be available in English and is designed for citizen science practitioners. It will explore the ways that citizen science can benefit from social media; choose the social platforms that best suit particular projects; and teach participants how to implement the best strategies to increase engagement and grow a social media following. This module will be developed by Sofia Oliveira and Ruth Pereira (GreenUPorto / Faculty of Sciences - University of Porto), Paulo Santos (CIIMAR / Faculty of Sciences - University of Porto) and Joana Pereira (CESAM - University of Aveiro).
- Začnime si s občianskou vedou (Let's start with Citizen Science). This module will be available in Slovak and is designed for students and researchers (interested in learning about citizen science and ways of making community-driven research), policy-makers (interested in strengthening the science – policy interface), and citizen scientists (interested in learning about how to get involved in citizen science projects). This module is designed for an audience based in the Slovak Republic, where the concept of citizen science is not yet widely familiar or taught at university level. This is an introductory module aimed at helping to spread the idea of citizen science, its society-advancing potential and good practice awareness in and outside of

the scientific community. The module will be developed by Jitka Dobbersteinová, Silvia Horáková and Zuzana Stožická of the Slovak Centre of Scientific and Technical Information, Slovakia (Centrum vedecko-technických informácií Slovenskej republiky).

Task description

The EU-Citizen.Science Call will fund the development, implementation and testing of 10 training modules on the topic of citizen science. These modules will be uploaded to the Moodle integration of the EU-Citizen.Science platform. Please refer to section 3 “Scope of the Call” in the Guide for Applicants to read the themes and the suggested topics of the training modules.

Training modules are self-directed, 1 or 2 hours units that a learner can study at her own pace and receive a badge and a certificate upon completion. The system is based on the education content management system Moodle. We are estimating the effort of designing and developing a training unit at about 7-10 working days.

Module designers are expected to:

- develop the module content using the guidelines of the EU-Citizen.Science platform (see link below);
- create a template for the module on the EU-Citizen.Science platform using Moodle, and upload all the content;
- undertake user-testing of the module and implement changes where necessary with at least five members of the intended audience.

All guidance, templates etc. to help with the design of module content and uploading it to Moodle will be provided upon successful award of the grant. The preliminary module development guidelines document and content template are available for download.

Please refer to section 7 “Requirements” of the Guide for Applicants to see all the requirements for a training module. Some of these requirements are:

- Each module should contain 5-8 sections, which must include the standard “Welcome and introduction”, “Conclusion and self-assessment”, “Further information and learning” and “Sources and acknowledgements”.

- Modules can be prepared in any European language, but the application needs to be in English.
- Each section of the module must end with a short activity or quiz to test student understanding of the section content. This is formative assessment, which allows the student to assess their progression and their understanding of key concepts.

Submission & evaluation process

The call will award 10 projects a maximum of 1.500 € each per project. Only one grant can be awarded per individual/organisation. Therefore, we ask each individual/organisation to submit a maximum of one application.

Applicants can submit their applications (consisting of the completed Application Form, signed Declaration of Honour and a CV) as a single pdf per email to eucitsci.cg@gmail.com before the call deadline. Training modules can be prepared in any European language, but the application should be in English.

The Application Form and the Declaration of Honour are available for download.

The evaluation process and selection criteria are detailed in sections 6 and 10 in the Guide for Applicants. Please, carefully read them before submitting your application. A decision of successful applications will be made no later than 24th May. Complete training modules (i.e. uploaded to Moodle and user-tested) are due for submission by the end of July 2021.

Call publication date: 26.02.2021 at 17:00 CET

Call deadline: 30.04.2021 at 17:00 CET

Further information

Two 'Information for applicants' sessions took place on the 10th and 15th of March 2021 from 11am - 12pm (CET) starting with a short introduction to the EU-Citizen.Science project and training module design followed by a Q&A session. A recording of one of the sessions is available here.

We collected some FAQs during the 'Information for applicants' sessions. We have answered these questions in a document available for download in the list below. The presentation we used during these sessions is also available for download.

Contact person: Nadia Dewhurst-Richman eucitsci.cg (at) gmail.com

Documents for download

- Guide for Applicants
- Application Form (to submit in the application)
- Declaration of Honour (to submit in the application)
- Preliminary module development guidelines document
- Content template
- FAQs from the 'Information for applicants' sessions
- Presentation of the 'Information for applicants' sessions. Also in Spanish
- User-testing protocol template

Acknowledgement

We have used the documents produced by the ACTION project for their open call as a basis to develop the Guide for Applicants including both its annexes and thank the

ACTION project for sharing these useful documents with us. ACTION has received funding from the European Union's Horizon 2020 Framework Programme for Research and Innovation under grant agreement No. 824603

Appendix 4: An example of a completed user-test form for the Introduction to Citizen Science for Journalists course

			Response
Name of the module being tested:			Introduction to citizen science for journalists
User-testers name and email address (you can choose to remain anonymous if you wish):			Karinna Matozinhos - karinna.matozinhos@scienceforchange.eu
Are you happy to be acknowledged in the Sources and Acknowledgements section of the module for your feedback?			Yes.
Section Name	Instruction	Task	**Feedback**
Course Summary	Go to the MOOCS section of the EU-Cit.Sci platform. Find the module you're user-testing and read the COURSE SUMMARY.	Do you feel the summary provides sufficient information on the course? If not, what do you think is missing?	I already entered directly in the main page of the course that looks pretty clear to me.
	Once you've completed the above step, enrol on the course.	Did you encounter any issues with enrolling in the course? If so, please describe.	No, it was really easy to join the course.
Welcome and Introduction	Once you've completed the step above, go to the WELCOME AND INTRODUCTION section of the module.	- Does this section provide sufficient information on the course and its learning outcomes?	
Welcome and Introduction		- Did you encounter any spelling/ grammatical issues?	No.

Welcome and Introduction	If there are links, please click on all the links.	- LINKS: Did they all work?	Yes.
Welcome and Introduction	If there are pictures on the page please hover over each of them.	- PICTURES: Do they all have a credit? If not, which ones don't?	Yes.
Welcome and Introduction		- PICTURES: Are any of the images poor quality, look too big, too small?	Yes.
Welcome and Introduction	If there is a video(s), please watch it/them all the way through.	- VIDEOS: Did the video work?	Yes
Welcome and Introduction		- VIDEOS: What did you think of the video content? Did you find it useful and interesting?	Yes, the video was interesting. I think it would help to let keywords appear in the video connected to what people are talking while presenting the course.
Welcome and Introduction		- VIDEOS: Do you think the video timing was too short, too long or just right?	Just right.
Welcome and Introduction		- Did you find the content in this section useful, engaging, interesting?	Yes, it was useful to know what the course will provide.
Welcome and Introduction		- Do you think the content of this section was presented appropriately for you e.g. was the use of language appropriate, were there any sections you did not understand?	Yes.
Welcome and Introduction		- Do you have any other comments about this section?	The video could appear a bit bigger in the screen.
Citizen science in five stories	Now visit the next section in the module and work through all the content.	- Did you encounter any spelling/ grammatical issues?	No.
Citizen science in five stories	If there are links, please click on all the links.	- LINKS: Did they all work?	Yes.
Citizen science in five stories	If there are pictures on the page please hover over each of them.	- PICTURES: Do they all have a credit? If not, which ones don't?	No credits on images of "Observing the first satellites"
Citizen science in five stories		- PICTURES: Are any of the images poor quality, look too big, too small?	No.
Citizen science in five stories	If there is a video(s), please watch it/them all the way through.	- VIDEOS: Did the video work?	Yes.
Citizen science in five stories		- VIDEOS: What did you think of the video content? Did you find it useful and interesting?	It was a very interesting personal story. I really enjoy having videos in the course to make it more dynamic.
Citizen science in five stories		- VIDEOS: Do you think the video timing was too short, too long or just right?	Just right.
Citizen		- Did you find the content in this section useful, engaging,	Useful.

science in five stories		interesting?	
Citizen science in five stories		- Do you think the content of this section was presented appropriately for you e.g. was the use of language appropriate, were there any sections you did not understand?	Yes.
Citizen science in five stories		- Do you have any other comments about this section?	If you click on the "Operation Moonwatch" the sections with the slide names don't disappear and you can not read the text. You need to refresh the page It happens in other sections too). It would be nice to have the link of Galaxy Zoo: https://www.zooniverse.org/projects/zookeeper/galaxy-zoo/ (It appears later in the course, but it would be nice in the first time too)
Terminology & classification	Now visit the next section in the module and work through all the content.	- Did you encounter any spelling/ grammatical issues?	No.
Terminology & classification	If there are links, please click on all the links.	- LINKS: Did they all work?	Yes.
Terminology & classification	If there are pictures on the page please hover over each of them.	- PICTURES: Do they all have a credit? If not, which ones don't?	Yes.
Terminology & classification		- PICTURES: Are any of the images poor quality, look too big, too small?	No.
Terminology & classification		- Did you find the content in this section useful, engaging, interesting?	Really liked the exercise in the end.
Terminology & classification		- Do you think the content of this section was presented appropriately for you e.g. was the use of language appropriate, were there any sections you did not understand?	Yes.
Terminology & classification		- Do you have any other comments about this section?	It could have the link: https://servicedesigntools.org/tools at Co-creation, co-design, co-production at Further terminology to expand your knowledge. Add the link https://rri-tools.eu/ for RRI.
Challenges & opportunities	Now visit the next section in the module and work through all the content.	- Did you encounter any spelling/ grammatical issues?	It could have the link: https://servicedesigntools.org/tools at Co-creation, co-design, co-production at Further terminology to expand your knowledge. Add the link https://rri-tools.eu/ for RRI.
Challenges & opportunities	If there are links, please click on all the links.	- LINKS: Did they all work?	Yes.
Challenges & opportunitie	If there are pictures on the page please hover over each of them.	- PICTURES: Do they all have a credit? If not, which ones don't?	Yes.

s			
Challenges & opportunities		- PICTURES: Are any of the images poor quality, look too big, too small?	No.
Challenges & opportunities		- Did you find the content in this section useful, engaging, interesting?	Yes.
Challenges & opportunities		- Do you think the content of this section was presented appropriately for you e.g. was the use of language appropriate, were there any sections you did not understand?	Yes.
Challenges & opportunities		- Do you have any other comments about this section?	No.
Social, economic, and political impacts	Now visit the next section in the module and work through all the content.	- Did you encounter any spelling/ grammatical issues?	Include a dote in Slide 3 of "Citizen science also raises awareness"
Social, economic, and political impacts	If there are links, please click on all the links.	- LINKS: Did they all work?	Yes.
Social, economic, and political impacts	If there are pictures on the page please hover over each of them.	- PICTURES: Do they all have a credit? If not, which ones don't?	Yes.
Social, economic, and political impacts		- PICTURES: Are any of the images poor quality, look too big, too small?	No.
Social, economic, and political impacts		- Did you find the content in this section useful, engaging, interesting?	Yes.
Social, economic, and political impacts		- Do you think the content of this section was presented appropriately for you e.g. was the use of language appropriate, were there any sections you did not understand?	Yes.
Social, economic, and political impacts		- Do you have any other comments about this section?	It would be nice to add the link to Dilek's paper: https://link.springer.com/article/10.1007/s11625-020-00833-7
Citizen science in the news	Now visit the next section in the module and work through all the content.	- Did you encounter any spelling/ grammatical issues?	No.
Citizen science in	If there are links, please click on all the links.	- LINKS: Did they all work?	Yes.

the news			
Citizen science in the news	If there are pictures on the page please hover over each of them.	- PICTURES: Do they all have a credit? If not, which ones don't?	Yes.
Citizen science in the news		- PICTURES: Are any of the images poor quality, look too big, too small?	No.
Citizen science in the news	If there is a video(s), please watch it/them all the way through.	- VIDEOS: Did the video work?	Yes.
Citizen science in the news		- VIDEOS: What did you think of the video content? Did you find it useful and interesting?	Yes, really useful.
Citizen science in the news		- VIDEOS: Do you think the video timing was too short, too long or just right?	Too long when you compare with the whole duration of the course, but really interesting.
Citizen science in the news		- Did you find the content in this section useful, engaging, interesting?	Yes, useful.
Citizen science in the news		- Do you think the content of this section was presented appropriately for you e.g. was the use of language appropriate, were there any sections you did not understand?	Yes.
Citizen science in the news		- Do you have any other comments about this section?	At Further examples of journalism about citizen science in different languages (optional) in Spain you can include the article at El Pais about how the population in Kampala is participating in citizen science: https://elpais.com/elpais/2020/07/14/planeta_futuro/1594722510_142922.html And the Heraldo article that was released in June with a compilation about citizen science projects in Spain: https://www.heraldo.es/noticias/aragon/2021/06/20/ruidos-contaminacion-accesibilidad-en-mapas-hechos-entre-todos-1500677.html
Summary and self-assessment	Now visit the SUMMARY AND SELF-ASSESSMENT section	Do you think the summary section provided a sufficient overview of the topics you covered in the module? If not, what do you think was missing?	Yes, straight to the point.
Summary and self-assessment		- Did you find the content in this section useful, engaging, interesting?	
Summary and self-assessment		- Do you think the content of this section was presented appropriately for you e.g. was the use of language appropriate, were there any sections you did not understand?	Yes.

Summary and self-assessment	If there are links, please click on all the links.	- LINKS: Did they all work?	
Summary and self-assessment	If there are pictures on the page please hover over each of them.	- PICTURES: Do they all have a credit? If not, which ones don't?	I did not see pictures.
Summary and self-assessment		- PICTURES: Are any of the images poor quality, look too big, too small?	I did not see pictures.
Summary and self-assessment		Did you encounter any spelling/ grammatical issues?	No.
Summary and self-assessment	Now take the final quiz.	Did it work OK or did you encounter any issues? Was there anything you didn't understand?	The Quizz did not work. It said "You need to enrol in this course before you can attempt this quiz", but I am enrolled.
Summary and self-assessment		Were you offered the chance to re-take the quiz?	No.
Summary and self-assessment		Upon completion of the quiz, did you receive your badge and certificate of completion (this should have arrived by email)?	No.
Further reading and learning	Now visit the FURTHER READING AND LEARNING section.	What do you think about the content on this page? Is it easy to follow?	I did not see much information, just the "Further contact details".
Further reading and learning		Did you encounter any spelling/ grammatical issues?	No.
Further reading and learning	If there were links, please click on all the links.	LINKS: Did they all work?	Yes, but the link https://ecsa.citizen-science.net/ it does not open in a new tab as it was happening before, so you click and leave the course page which is not good for the course.
Acknowledgments	Now visit the ACKNOWLEDGMENTS section.	What do you think about the content on this page? Is it easy to follow?	The sources for the material in the course are good, but the acknowledgments could be longer.
Acknowledgments		Did you encounter any spelling/ grammatical issues?	No.
Acknowledgments	If there are links, please click on all the links.	- LINKS: Did they all work?	Yes.
	Now go back to the COURSE SUMMARY and re-read the learning objectives.	Having completed the course, does the course adequately address all the described learning outcomes? If not, why not and what do you think is	It was not possible to read the PDF about the course, it is not available yet.

		missing?	

Appendix 5.1: An example First Review Checklist for a Cascading Grants Awardee's training module

1st Draft- Checklist

Module name__Basic regulations and ethics for citizen science

A. Navigation

This is how students find and interact with information and resources on the course.

A1. Module is divided by subheadings within sections/topics – There is a consistent heading hierarchy. Main titles – H3, sub-titles – H4, H5, H6.	✓
A2. The module narrative is organised in a meaningful and clearly structured way – This may be chronologically (the order in which to complete tasks), which is highly recommended for wholly online module delivery. Headings should be used to group learning resources and activities.	✓
A3. When relevant, resources and activities should be LABELLED with descriptive titles – eg.. *'Task 1.1. - Your first citizen science experience'*. Titles should at a glance make sense to learners providing them with the information needed to know what the resource or activity is without opening it. Titles such as 'Task 1' are not adequate. The description should provide further details about the resource/activity and how it relates to the intended learning outcomes. Note: Task numbers are optional, as long as overall there is a clear narrative.	✓
A4. Optional activities/resources are clearly labeled – eg. *'Task 3.2 - The life of Mary Anning (optional)'*. For multiple optional resources/tasks, it is advised to place them into their own section provided at the end of the course.	✓
A5. All resources are up-to-date. Check that the materials used are not obsolete but offer a state-of-the-art view of the discussed topics.	✓

1

B. Content

This refers to the available resources of the course.

B1. Check that the module has the following sections - Welcome and Introduction, 4-8 module-specific section, Summary and Self-Assessment, Further Reading and Learning, Sources and Acknowledgements.	✓
B2. Check that the module-specific sections are clear, and their content is appropriate for the module's intended audience (eg. academics/ journalists/ policy makers/ general public).	✓
B3. Check each of the module-specific sections ends with a short activity or quiz (can be as little as one question) to test student understanding of the section content. This activity/ quiz should not be counted towards the overall module score.	Need to add these. They can be very small
B4. Check that the course summary includes: 1) the learning outcomes, 2) an enrollment key, 3) the intended audience of the modules, 4) prior experience needed to participate in the course.	Add part 4
B5. Make sure all learning outcomes are clearly detailed in the course summary and are an accurate reflection of what the learner can expect to gain from undertaking the module.	✓
B6. Check there is a 10-question final quiz.	8 questions. Need to add 2
B7. Proof-read the text for consistency and sense.	✓
B8. Check spelling and grammar.	A few small errors. I can help ☺
B9. Check references and the use of as many open access references as possible.	✓

B10. Check numbering and sequences.	✓

B11. Make sure all images have a credit that details the person to be credited for the image and the sharing rights.	✓
B12. Make sure the module timing is between 1-2 hours of self directed learning.	✓

C. Legal issues

Good copyright practices, data protection issues and ensuring students have a private (password protected) environment to work in.

C1. Check that intellectual property and copyright legislation are observed.	✓

Please add your name and signature below to declare that the module complies with all of the above fields:

(Signature) 

(Name)

Alice Sheppard, 4th October 2021

Appendix 5.2: An example Second Review Checklist for a Cascading Grants Awardee's training module

2nd Draft- Checklist

Module name Basic regulations and ethics for citizen science

This has been adapted from a checklist created by Matt S. Smith and Anna Trostnikova (Faculty of Engineering Sciences, UCL) for the Connected Learning course. Please use this checklist to help ensure that you have met basic best practice principles for good module navigation, communication, accessibility and legal issues.

a. Navigation

This is how students find and interact with information and resources on the course.

A1. The course format is set up as 'Collapsed Topics' – This format is more accessible on mobile devices and for those using screen readers. This can be done in the settings for your course.	☑
A2. Use sub-headings within sections/topics – There is a consistent heading hierarchy. Main titles – H3, sub-titles – H4, H5, H6.	☑
A3. The narrative of the module is organised in a meaningful and clearly structured way – This may be chronologically (the order in which to complete tasks), which is highly recommended for wholly online module delivery. Headings should be used to group learning resources and activities.	☑
A4. When relevant, resources and activities should be LABEL with descriptive titles – eg.. 'Task 1.1. - Your first citizen science experience'. Titles should at a glance make sense to learners providing them with the information needed to know what the resource or activity is without opening it. Titles such as Task 1' are not adequate. The description should provide further details about the resource/activity and how it relates to the intended learning outcomes. Note: Task numbers are optional, as long as overall there is a clear narrative.	☑

A5. Each section/ topic header has its time length – e.g. '*Section 1 - Welcome and Introduction (6m)*'. Timings should be inclusive of videos, word counts for reading and quizzes/ activities. This allows learners to decide whether they have time to undertake a piece of learning before opening it. Each resource / activity should also have an accompanying description. Note: Numbering is optional, as long as overall there is a clear narrative.	☐
A6. Optional activities/resources are clearly labelled – e.g '*Task 3.2 - The life of Mary Anning (optional)*'. When having multiple optional resources/tasks, it is possible to put them into their own section which is provided at the end of the course. Note: Numbering is optional, as long as overall there is a clear narrative.	☑
A7. Check that all broken hyperlinks are removed or fixed(URLs)	☑
A8. Check that all resources are up-to-date before releasing them to the learners.	☑

b. Introduction

These are the elements that will help learners orientate themselves at the beginning of the course.

B1. Measurable module level learning outcomes are included(CLB 2.1) – In order to ensure they are measurable, it has been recommended to use the Bloom's Taxonomy verb table.	☑
B2. There is a Course Summary – The short course summary (which learners see when searching for the module via Moodle Search) should be approximately 150 words and include 1) the learning outcomes, 2) an enrolment key, 3) the intended audience of the modules, 4) prior experience needed to participate in the course.	☐

c. Communication

These are ways to promote effective communication between tutors and students, and students with their peers.

C1. A welcoming and approachable tone is used.	☑

d. Accessibility

This is how to make the course accessible to different learners. This may include those accessing your course using different devices e.g. mobile, as well as those with additional educational needs e.g. dyslexia.

D1. The course provides a level accessibility statement – A brief course-level accessibility statement is provided containing any additional guidance and indicating the availability of an alternative format for any resource.	☑
D2. Accessibility Fundamentals	
D2.1. Fonts are large enough and sans serif – they should be at least pt11.	☑
D2.3. Links are descriptive – (avoiding "click here") and open in the same window.	☑
D2.4. Alt text descriptions for images are used– mentioning the key learning points, for screen-reader users (e.g., alongside the image, as a caption, or as 'alternative text).	☑
D3. Audio and video accessibility pointers - Transcripts and alternative formats are provided.	☑

e. Legal issues

Good copyright practices, data protection issues and ensuring students have a private (password protected) environment to work in.

E1. Observed intellectual property and copyright legislation.	☑

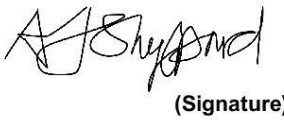
f. Final editorial and style guide checks

F1. The module has been tested across several devices (smartphone, tablet, PC) to ensure there are no compatibility issues.	☑
F2. The text has been proof-read for consistency and sense.	☑
F3. No spelling and grammar mistakes were detected.	☑
F4. References were checked and when possible open access references were used.	☑
F5. There are no navigation issues through the module, it is intuitive and students aren't left questioning 'Where to go next?'	☑
F6. Refer to the accessibility design principles and check for potential accessibility issues (e.g. alt-text, transcripts).	☑
F7. Check that the badges work.	☑

F8. Check cross-references are accurate.	☑
F9. Check numbering and sequences.	☑
F10. Check that students aren't taken away from the module page i.e. videos are embedded in the module or open in another window.	☑
F11. Make sure all user-testers are included in the acknowledgements.	☑
F12. Make sure all images have a credit that details the person to be credited for the image and the sharing rights.	☑
F13. Make sure all learning outcomes are clearly detailed in the course summary and are an accurate reflection of what the learner can expect to gain from undertaking the module.	☑
F14. Make sure the module timing is between 1-2 hours of self-directed learning.	☑
F15. Check that the module has the following sections - Welcome and Introduction, Summary and Self-Assessment, Further Reading and Learning, Sources and Acknowledgements.	☑
F16. Check that the final quiz has 10 questions.	☑
F17. Check that the module has undergone user-testing with at least 5 user-testers and that there is documented feedback.	☑

F18. Check that the final quiz is configured so that it only requires a 50% pass rate.	☑

Please add your name and signature below to declare that the module complies with all of the above fields:



(Signature)

Alice Sheppard, 5th November 2021

(Name)

Appendix 5.3: Public evaluation form on the Platform

On the Moodle page is a link to a Google form inviting all learners to submit feedback on courses. They have the choice whether to do so anonymously or not. This form can be accessed at https://docs.google.com/forms/d/1odOCMz70MHANVQINma_RuSpupYDBWehn-TT8LiMb1JQ/edit.