

# The NSW syllabus and citizen science

## Introduction

The aim of this document is to accompany teachers in their citizen science journey. As the number of citizen science opportunities grow, and their multifold benefits become apparent, there is an increasing interest in citizen science as a tool to make science education more relevant and engaging. But how to find the right citizen science project? One which is engaging for students, supports a school's values and aligns with the required curriculum?

To get teachers started with citizen science in the classroom, we have handpicked a range of projects which vary in nature and scope. We aligned these projects to the four knowledge and understanding themes of the NSW syllabus [Physical World (PW), Earth and Space (ES), Living World (LW), Chemical World (CW)] across their learning outcomes and content descriptions. This is the first step of the Learning By Doing '*mapping citizen science to the curriculum*' initiative. Future steps will include: 1) more detailed curriculum mapping; 2) the expansion of this work to additional stages and 3) curriculum mapping to syllabi in other Australian states and territories.

This document contains:

1. Background information on citizen science and the NSW curriculum.
2. Examples of citizen science projects that map to the stage 4 knowledge and understanding themes of the NSW syllabus.
3. Overview of citizen science contribution to skill development across all working scientifically processes.
4. Overview of citizen science potential for learning across the curriculum.

## Background information

### What is citizen science?

Citizen science is '*the collection and analysis of scientific data in relation to the natural world, performed predominantly by citizens, usually in collaboration with scientists and field experts*' (Australian Citizen Science Association). It presents an opportunity for people of all ages and backgrounds to participate in real scientific research and to engage with hands-on experiments, while learning about science and nature.

### Why include citizen science in classrooms?

Citizen science in the classroom will enable students to experience what it is like to be a real scientist; conducting observations, recording measurements and communicating their

findings. Students will develop scientific literacy, critical thinking, and social and environmental awareness; all skills to assist them throughout their school education and beyond.

## About Learning By Doing

Learning By Doing is a research project led by an interdisciplinary group of researchers from The University of Sydney and Taronga Conservation Society Australia. We are passionate about citizen science and its benefits for education and are researching ways to bring citizen science into schools. Learning By Doing aims to inform efforts to embed citizen science into the Australian Science Curriculum and will support its goal *‘to develop an understanding of important science concepts and processes, the practices used to develop scientific knowledge, of science’s contribution to our culture and society, and its applications in our lives.’*

## Additional information

For more information on Learning By Doing research projects and ongoing communications, go to the [Learning By Doing](#) website. For an overview of citizen science and its implementation in Australia see the [Australian Citizen Science Association](#) (ACSA) website.

Further useful links:

- [Australian citizen science project finder](#)
- Global platforms for citizen science projects - [Scistarter](#), [Zooniverse](#)
- New Zealand science learning-hub on citizen science - [Learning hub](#)
- Teacher lesson plans for science curriculum implementation (non-specific to citizen science) - ASTA (Australian Science Teachers Associations) [SciWeb Australia](#)

## The NSW science syllabus

The NSW K-10 syllabus was developed by the NSW Education Standards Authority (NESA) based on the Australian Curriculum and additional content clarifying the scope, breadth, and depth of expected learning. This document refers to the [Science Years 7–10 Syllabus](#), and in particular to Stage 4 (SC4) outcomes and content.

The content of the Science Years 7–10 Syllabus is organised into two strands: Skills (working scientifically) and Knowledge and Understanding, which are further detailed below. Additional learning outcomes across the whole curriculum are detailed as well.

### Knowledge and Understanding

This strand specifies the disciplinary content across four themes: Physical World (PW), Earth and Space (ES), Living World (LW), Chemical World (CW). It includes the integration of content

related to understanding of the nature, development, use and influence of science with knowledge of scientific concepts, principles, models, theories, and laws.

## **Skills**

This strand specifies the skills students should develop to apply processes for Working Scientifically (WS). These include: Questioning and Predicting, Planning Investigations, Conducting Investigations, Processing and Analysing Data and Information, Problem Solving, Communicating.

## **Learning Across the Curriculum**

These specify additional content to be learned across the whole school curriculum – not just the science curriculum. These include the cross-curriculum priorities, general capabilities, and other important areas of learning.

## Citizen science projects that map to the science Curriculum

### Knowledge and Understanding strands

In the following section we detail the outcomes and content of each Knowledge and Understanding curriculum strand, followed by suggested citizen science projects which overlap with the content indicated. Projects are either local (within NSW), national or global in scope and provide a range of choices for teachers to engage with.

#### Physical World

<b>Outcomes</b>	<b>Content</b>	<b>Citizen science projects</b>
<b>SC4-10PW</b> <i>Describes the action of unbalanced forces in everyday situations</i>	<b>PW1</b> Change to an object's motion is caused by unbalanced forces acting on the object (ACSSU117)	<a href="#">Quantum Moves 2</a> <a href="#">CREDO</a> <a href="#">New Particle Search at CERN</a>
	<b>PW2</b> The action of forces that act at a distance may be observed and related to everyday situations	<a href="#">Quantum Moves 2</a> <a href="#">Potential Penguin</a> <a href="#">Gravity Spy</a> <a href="#">New Particle Search at CERN</a>
	<b>PW3</b> Energy appears in different forms including movement (kinetic energy), heat and potential energy, and causes change within systems (ACSSU155)	<a href="#">Potential Penguin</a> <a href="#">The NOVA Energy Lab</a> <a href="#">The NOVA Sun Lab</a> <a href="#">SHArK</a>
<b>SC4-11PW</b> <i>discusses how scientific understanding and technological developments have contributed to finding solutions to problems involving energy transfers and transformations</i>	<b>PW4</b> Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations (ACSHE120, ACSHE135)	<a href="#">Quantum Moves 2</a> <a href="#">Potential Penguin</a> <a href="#">The NOVA Energy Lab</a> <a href="#">The NOVA Sun Lab</a> <a href="#">CREDO</a> <a href="#">Gravity Spy</a>

## Earth and Space

<b>Outcomes</b>	<b>Content</b>	<b>Citizen science projects</b>
<b>SC4-12ES</b> <i>Describes the dynamic nature of models, theories and laws in developing scientific understanding of the Earth and solar system</i>	<b>ES1</b> Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales. (ACSSU153)	<a href="#">Landscape Watch</a> <a href="#">NASA Globe Cloud Gaze</a> <a href="#">Did You Feel It?</a>
	<b>ES2</b> Scientific knowledge changes as new evidence becomes available. Some technological developments and scientific discoveries have significantly changed people's understanding of the solar system.	<a href="#">GAVRT Program – Jupiter Quest</a> <a href="#">Black Hole Patrol</a> <a href="#">SETI</a> <a href="#">Solar Petrol</a> <a href="#">Be a Martian</a> <a href="#">Exoplanet Research Workshop</a>
<b>SC4-13ES</b> <i>Explains how advances in scientific understanding of processes that occur within and on the Earth, influence the choices people make about resource use and management SC4-13ES</i>	<b>ES3</b> Scientific knowledge influences the choices people make in regard to the use and management of the Earth's resources.	<a href="#">CanAirIO</a> <a href="#">CITISENS – CITizens as SENSors</a> <a href="#">Geo-Wiki Project</a> <a href="#">Open Litter Map</a>
	<b>ES4</b> Science understanding influences the development of practices in areas of human activity such as industry, agriculture and marine and terrestrial resource management. (ACSHE121, ACSHE136)	<a href="#">GLOBE Observer</a> <a href="#">eOceans</a> <a href="#">Climate Change in Scripted Media</a>

## Living World

Outcomes	Content	Citizen science projects
<b>SC4-14LW</b> <i>Relates the structure and function of living things to their classification, survival and reproduction</i>	<b>LW1</b> - There are differences within and between groups of organisms; classification helps organise this diversity (ACSSU111)	<a href="#">Big city birds</a> <a href="#">FrogID</a> <a href="#">Questagame</a> <a href="#">Great Southern Bioblitz</a> <a href="#">1 Million Turtles</a> <a href="#">Aussie Backyard Bird Count</a> <a href="#">Wild Pollinator Count</a>
	<b>LW2</b> Cells are the basic units of living things and have specialised structures and functions (ACSSU149)	<a href="#">Etch A Cell</a> <a href="#">eteRNA</a> <a href="#">Foldit</a>
	<b>LW3</b> Multicellular organisms contain systems of organs that carry out specialised functions that enable them to survive and reproduce (ACSSU150)	<a href="#">Stall Catchers</a> <a href="#">Great Southern Bioblitz</a> <a href="#">1 Million Turtles</a> <a href="#">ASU West Global BioBlitz</a>
<b>SC4-15LW</b> <i>Explains how new biological evidence changes people's understanding of the world</i>	<b>LW4</b> Scientific knowledge changes as new evidence becomes available, and some scientific discoveries have significantly changed people's understanding of the world. (ACSHE119, ACSHE134)	<a href="#">FrogID</a> <a href="#">Foldit</a> <a href="#">Wild Pollinator Count</a> <a href="#">Stall Catchers</a>
	<b>LW5</b> - Science and technology contribute to finding solutions to conserving and managing sustainable ecosystems.	<a href="#">Big city birds</a> <a href="#">1 Million Turtles</a> <a href="#">To Save the Wild Mammals of Algeria</a> <a href="#">Instant Wild: Winchester</a> <a href="#">Entangled Wildlife Australia</a>

## Chemical World

<b>Outcomes</b>	<b>Content</b>	<b>Citizen science projects</b>
<b>SC4-16CW</b> <i>Describes the observed properties and behaviour of matter, using scientific models and theories about the motion and arrangement of particles</i>	<b>CW1</b> The properties of the different states of matter can be explained in terms of the motion and arrangement of particles. (ACSSU151)	<a href="#">Breaking Good</a> <a href="#">Soil Collection Program</a> <a href="#">WaterWatch</a>
	<b>CW2</b> Scientific knowledge and developments in technology have changed our understanding of the structure and properties of matter.	<a href="#">E\$SENTIAL MEDICINE\$</a> <a href="#">Soil Collection Program</a>
	<b>CW3</b> Mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques. (ACSSU113)	<a href="#">Breaking Good</a> <a href="#">Eye on Water</a> <a href="#">WaterWatch</a>
<b>SC4-17CW</b> <i>Explains how scientific understanding of, and discoveries about, the properties of elements, compounds and mixtures relate to their uses in everyday life</i>	<b>CW4</b> In a chemical change, new substances are formed, which may have specific properties related to their uses in everyday life.	<a href="#">Breaking Good</a> <a href="#">E\$SENTIAL MEDICINE\$</a> <a href="#">Soil Collection Program</a>

## Citizen science and working scientifically

Engaging students with citizen science provides many opportunities for the development and application of scientific skills across all processes of Working Scientifically (WS). Here we detail the outcomes of each WS strand and explain how citizen science contributes to their realisation. We do not specifically assign projects to content as we have done above, as there are too many to note. Generally speaking, each citizen science project will usually cover between 3-4 of the 6 WS processes.

<b>Strand</b>	<b>Outcome</b>	<b>Citizen science contribution</b>
<b>Questioning and Predicting</b>	<b>SC4-4WS</b> Identifies questions and problems that can be tested or researched and makes predictions based on scientific knowledge	<p>Many citizen science projects will have a pre-defined research question that can be explored by students and used to develop understanding of the relationship between questioning and predicting to following research process.</p> <p>Citizen science supports the process of formulating questions or hypotheses that can be investigated through participation in the project. Although in many of the cases, it is not inherently part of the project, but rather an addition for educational purposes.</p> <p>Predictions can be made based on students' scientific knowledge and information provided from citizen science projects</p>
<b>Planning investigations</b>	<b>SC4-5WS</b> Collaboratively and individually produces a plan to investigate questions and problems	<p>As with the research questions, many citizen science projects will have pre-defined investigations methods of investigation. These can be studied to recognize choices made in method selection and equipment needed including digital technologies to collect and record data systematically and accurately.</p> <p>Within the boundaries of the planned investigation, students can plan and organise their own individual inquiries and identify ways of reducing risks.</p> <p>Example for of choices that can be made by students:</p> <ul style="list-style-type: none"> <li>• Location of the observation/sampling</li> <li>• Type of species/sample to investigate</li> </ul>
<b>Conducting Investigations</b>	<b>SC4-6WS</b> Follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually	<p>Citizen science provides a range of investigation types that students can engage with. These include (but are not limited to):</p> <ul style="list-style-type: none"> <li>• Making observations</li> <li>• Recording measurements</li> <li>• Taking samples</li> <li>• Classifying images/specimens</li> </ul> <p>Engaging in such investigations will requires students to assemble and use appropriate equipment, follow planned procedures, use appropriate measuring units and ensure safety and ethical guidelines are followed.</p>



<b>Processing and Analysing Data and Information</b>	<b>SC4-7WS</b> Processes and analyses data from a first-hand investigation and secondary sources to identify trends, patterns and relationships, and draw conclusions	<p>Following their investigation, students process the information collected and upload data to the citizen science project through a website or app.</p> <p>Students can use a range of representations to organise data, including graphs, keys, models, maps, diagrams, tables and spreadsheets and extract information from these representations to answer their research questions. Yet, this process is often not inherently part of the project but rather an addition for educational purposes.</p> <p>Many citizen science projects provide detailed representations of project data in the form of graphs, maps, diagrams and tables. Students can use these representations to identify trends patterns or relationships and draw conclusions based on previous scientific knowledge.</p>
<b>Problem Solving</b>	<b>SC4-8WS</b> Selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems	<p>Following participation in a citizen science project, students can consider the relevance of the a project's central scientific issue focus to their own lives. Students can suggest possible solutions, and use cause and effect relationships to explain their ideas and findings.</p> <p>Additionally, students learn about citizen science as a research methodology and describe how it can be used to solve scientific problems from large to local in scale. Students can reflect on the possible use of citizens science in their own communities.</p>
<b>Communicate</b>	<b>SC4-9WS</b> Presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations	<p>Communication is an important aspect of citizen science for both scientists involved and the participants. This is often considered a non-formal activity in terms of the projects, yet crucial for spreading project information and for expanding the project reach and participation rate.</p> <p>Students can take an active role in communicating project information and their own their findings within their local communities and families in creative ways. Students can also take a leading role in training future students within their schools and develop a sense of ownership and leadership.</p> <p>Students can report on their findings from their citizen science involvement using scientific language with appropriate text, data representations and discussions and using digital technologies as appropriate. This can be used for teacher assessment of learning.</p> <p>Students can also read through official project communications and discuss their relevance, representation styles and propose ways to extend these communications.</p>

## Citizen science and learning across the curriculum

In addition to learning science content and skills, rich aspects of additional learning take place through participation in citizen science projects. This relates to many important capabilities, skills and priority areas which have been declared important for graduates living and working in the 21st century. Teachers can expect each citizen science project to cover several of the 'learning across the curriculum' items identified by NESA and detailed below. However, each project is unique, and an exhaustive or generalised list for all citizen science projects would be challenging to construct. We therefore detail below a list of just three 'learning across the curriculum' strands. We believe all items can be covered, through participation in a range of citizen science projects to be chosen carefully by teachers.

### Cross-curriculum priorities

Cross-curriculum priorities relate to contemporary issues faced by students. They enable students to develop understanding and address these issues in relation to topics across the curriculum. These priorities can be addressed to a different extent by various citizen science projects.

- Aboriginal and Torres Strait Islander histories and cultures
- Asia and Australia's engagement with Asia
- Sustainability

### General capabilities

General capabilities embody the knowledge, skills, attitudes and behaviours students need to develop to live and work successfully in the 21st century. Citizen science is particularly powerful in helping students develop many of these skills and capabilities as it is authentic, grounded and community centered.

- Critical and creative thinking
- Ethical understanding
- Information and communication technology capability
- Intercultural understanding
- Literacy
- Numeracy
- Personal and social capability

## Other learning across the curriculum areas

These include additional areas of learning identified as important for all students. These can be addressed to different extents by various citizen science projects.

- Civics and citizenship
- Difference and diversity
- Work and enterprise

This document was assembled by Dr. Yaela Golumbic with assistance from the Learning By Doing team members: A/Prof. Alice Motion and Sinn Phway Thant and Dr. Chris Preston.

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