Integrating Citizen Science into accredited courses and awards in Scotland

1. Project Summary

Citizen science is the involvement of volunteers in the collection and/or analysis of data of value to science. It is also a powerful tool to engage new audiences with nature and suits environmental education through outdoor learning with its multidisciplinary approach. Outdoor Learning in school grounds and community settings can engender greater learner confidence, renewed pride in community, stronger motivation toward learning, and greater sense of belonging and responsibility. If the Citizen Science activities can be rewarded with an award or accreditation certificate it adds value to the activity of data collection, providing an opportunity for Citizen Scientists to demonstrate achievement and gain recognition for activity and progress, particularly useful for young people. This report identifies some of the available routes for volunteers to achieve recognition through curricular and extracurricular Citizen Science activities and also identifies further research options for wider inclusion of Citizen Science in courses.

2. Introduction

This report examines the possible awards and accreditation available which could incorporate recognition of participation in citizen science activity. This report is undertaken at the request of the Scotland Counts Steering Group in order to ascertain the potential to increase Citizen Science activity through linking it more effectively with recognised awards and accreditation. An initial study of conservation organisation undertaken in 2011 found an even split in opinion on the merits of accreditation and awards for citizen science activities. However, the ongoing integration of Citizen Science into learning through the Scotland Counts and other projects raises a need to identify and explore the potential for achievement of awards and accreditation through participation in Citizen Science activity.

3. Methodology

Research:

Online research was carried out into existing awards and links with outdoor learning and Citizen Science. Of particular use were the websites of the Scottish Qualification Authority, Youth Scotland and their "Amazing Things" report.

Interviews:

In order to gain an insight into the flexibility of existing courses and schemes whose syllabus fit with the direct and indirect learning achievements gained from participation in Citizen Science, consultation was carried out with members of the Scotland Counts Schools Citizen Science Working Group (who have extensive knowledge in education and awards), Education Scotland staff, TCV staff, NGO staff, University and Education professionals.

4. Awards and accreditation in Scotland

We distinguish an award as recognition of the achievement of an individual or group, against a criteria set out by an organisation.

Governing bodies such as Scottish Qualification Authority (SQA) give accreditation to institutes or organisations to deliver a particular course that conforms to a syllabus set out by SQA.

Therefore, any organisation can give an award, but not all awards are accredited. For simplicity below we have listed separately:
Section 5: Awards - named awards (some may be from accredited organisation) and;
Section 6: Accredited Qualifications – Vocational and subject certificates more traditionally delivered through schools and colleges, accredited by SQA.

5. Awards and Citizen Science opportunities

Through internet searches and study of Youth Scotland and their "Amazing Things" report a summary of awards available in Scotland that have a fit with the activities of Citizen Science has been set out in the table below (see Table 1)

Table 1 - Awards and Citizen Science opportunities

Org and Award	**Area(s) of work**	**Citizen Science Opportunities**
ASDAN Awards Certificate of Personal Effectiveness (CoPE)	• Working with others • Improving own learning • Problem solving • Research • Discussion • Oral presentation	Offers the young people a great opportunity to gain additional qualifications and learn a wide range of transferable skills through the diverse variety of CS activities. Team working and planning, new skills and scientific engagement from the OPAL surveys and full list of other CS activities on Scotland Counts website.
The Boys' Brigade Queen's Badge	• Learn a new skill or develop an existing one	Boys can learn to do a biological survey of their local area, church grounds or school. The information can then be used to develop an environmental improvement plan or tackle (using the rest of the troop) INNS affecting the local community area.
Girlguiding Scotland Queen's Guide Award	• Teamwork • Time management • Organisational skills • Planning and evaluation • Community skills • Communication	Girls can organise a community project to monitor a local greenspace area's biodiversity. Bringing the community together to value and take responsibility for that greenspace and develop/improve the site through conservation work led by ongoing biological monitoring.
The Girls' Brigade Queen's Award	• Voluntary Service • Initiative Tasks • A Project	Girls can learn to do a biological survey of their local area, church grounds or school. The information can then be used to develop an environmental improvement plan or tackle (using the rest of the troop) INNS affecting the local community area.

Org and Award	**Area(s) of work**	**Citizen Science Opportunities**
British Red Cross The Humanitarian Citizen Awards	● Volunteering - Whatever they do, they give up their time for others. ● Community action – A young person makes an outstanding positive contribution to their community either at home or further afield.	Young people can plan and undertake a project, individually or as part of a group to improve the biodiversity of a local or distant site through encouraging local participation in biological monitoring and managed improvement.
Scottish Government MV Awards	• Personal commitment • Community benefit • Voluntary participation • Inclusiveness • Ownership by young people • Variety • Partnership • Quality • Recognition	Young people could plan and coordinate a project that involves all parts of their community to ensure full access and inclusion. The project could adopting a local amenity site and through biological monitoring and conservation management, improve the biodiversity of the site and the ease of access for the use of all.
The Scout Association Queen's Scout Award	• Take up a skill for 6 or 12 months, show progress and lasting interest. • Following training, provide service to an individual or community for 12 months.	Scouts can organise a community project to monitor a local greenspace area's biodiversity. Bringing the community together to value and take responsibility for that greenspace and develop and improve the site through conservation work led by ongoing biological monitoring.
Quality Scotland Young Quality Scot Award	• Individuals must be actively involved in trying to make a difference in their community, on their own, with friends or through a club or other organisation.	Young people could look towards taking the lead in involving their group or organisation in the evaluation of their site through biological surveying towards structured conservation works and ongoing monitoring.
Young Scot Sunday Mail Young Scot Awards	• Community • Health • Volunteering • Diversity & Citizenship • Heritage • Environment	From these 6 categories out of 15 possible, young people can be awarded recognition for being an outstanding inspiration or benefit their community. They could lead an environmental improvement project, getting the whole community together to improve an area through biological surveying and subsequent conservation work and ongoing monitoring.
Youth Scotland Youth Achievement Awards	• Recognises and accredits the achievements and contributions of young people	4 levels of commitment recognised (bronze to platinum) for involvement and commitment to projects that could include Citizen Science driven engagement.

5.1 Piloted Awards

TCV Scotland, through its Scotland Counts project, already engages with 2 major youth awards using Citizen Science recording. We are highlighting them here because we see them as being particularly suitable for undertaking Citizen Science as part of their accepted criteria for award achievement.

5.1.1 John Muir Award

The **John Muir Award** is a charity based environmental award that encourages people of all backgrounds and ages to connect, enjoy and care for wild places through a structured yet adaptable scheme.

Managed by the John Muir Trust, the John Muir Award:

- Promotes educational, social and personal development through exploration of wild places and involvement in conservation
- Encourages an environmental agenda within youth organisations
- Ensures that social circumstances don't exclude people from opportunities to experience wild places.

At the heart of each John Muir Award lie four challenges;

- Discover a wild place
- Explore its wildness
- Conserve – take some personal responsibility
- Share your experiences

Participants should also show enthusiasm and commitment, and have an awareness of John Muir.

There are 3 levels of the Award, encouraging a progressive involvement. The same 4 challenges above are repeated for each level, with increased involvement in time, activity and ownership.

- **Discovery Award** (introductory level) minimum 4 days (or equivalent)
- **Explorer Award** (intermediate level) minimum 8 days (or equivalent)
- **Conserver Award** (advanced level) minimum 20 days (or equivalent) over 6 months

On discussion with John Muir Award staff, it is seen that Citizen Science fits well with all 4 challenges of the award and at all levels. By getting involved (details on website), interesting and fun Citizen Science activities can be used to gain the Award.

- Discover a wild place – The volunteer journey begins with discovering new places (or existing places with fresh eyes) and Citizen Science offers a new perspective on what lives together in a habitat and how they interact together.
- Explore its wildness – By learning to ID species of plant, insect and animals for Citizen Science surveys we can connect with wild places in the spirit of adventure and exploration.
- Conserve – to take Citizen Science further, by showing some personal responsibility, people can become involved in practical conservation work arising from the plans devised through the Citizen Science gathered records.

Share your experiences – To inform and enthuse people about wild places that has been seen and the activities in citizen science that have been undertaken is a great confidence building exercise and also spreads the good word about JMA and Citizen Science.

5.1.2 Duke of Edinburgh Award

The **Duke of Edinburgh Award** (DoE's) Award is a charity based organisation that is the world's leading achievement award for young people. DoEA provide a balanced programme of activities that develops the whole person – mind, body and soul – in an environment of social interaction and teamworking, building confidence and self-esteem.

The DoE's Award is delivered under special licence by over 400 Licenced Partners Organisations) supporting nearly 11,000 DofE centres including youth clubs, voluntary organisations, schools and colleges.

Participants are aged between 14 and 24 and can choose from 3 levels to DoE awards, Bronze – age 14+ for 6 months, Silver – age 15+ for 12 months or Gold – age 16+ for 18 months (the latter 2 shortened by 6 months each if doing awards consecutively. http://www.dofe.org/go/timescales/

Young people complete four different types of activity at Bronze and Silver level and five at Gold level to achieve an Award:

- Volunteering: undertake service to individuals or the community. This develops compassion, commitment and the confidence to make a difference.
- Physical: improve in an area of sport, dance or fitness activities. This develops fitness, enjoyment and, depending on the activity, teamwork.
- Skills: develop practical and social skills and personal interests. This helps young people to realise their unique potential and gain greater self-esteem.
- Expedition: plan, train for, and complete an adventurous journey in the UK or abroad. This develops teamwork and leadership, and challenges young people to push themselves beyond their expectations.
- Residential (Gold level only): stay and work away from home doing a shared activity. Again this challenges young people, who must work with strangers to achieve a positive goal.

On discussion with DoE staff, it is seen that Citizen Science fits well with 2 activities:

Volunteering – there are many NGO environmental charities who take responsibility for a particular site such as a "Friends of" group at a Local Nature Reserve (LNR) or focus their attention on a particular species or group of species such as Buglife.

Along with practical conservation projects that contribute to improved habitat conditions or species protection, these organisation may also undertake site surveys to determine the make up of species as a base line for site condition monitoring. There also needs to be an ongoing program of species recording to show change over time which then feeds into conservation work plans. Organising and taking part in Citizen Science site surveys promote teamwork and would be a fitting Volunteering activity for the DoE Award.

Skills – To undertake species surveys and the survey techniques that are required to improve wild habitats mean the participants need to learn a new set of skills. Species identification is a fun and interesting skill to learn and the practical survey techniques required to undertake the different surveys to improve wild habitats call on a varied range of skill sets.The techniques learned through Citizen Science surveying promote practical thinking and would be a fitting Skills activity for the DoE Award.

6. Overview of accredited qualifications in Scotland

The Scottish Qualification Authority (SQA) accredit vocational qualifications that are offered across Scotland, and approve awarding bodies that wish to award them (such as schools, colleges, universities etc).

For this study, research into SQA accredited courses was undertaken to see where Citizen Science Opportunity (CS Opportunity) could be undertaken individually, in groups or as a class. The list below (and following tables) identify 3 subjects across several National Levels whose Course Structure allows for various Citizen Science activities to be undertaken as part of the assessable and examinable syllabus.

6.1.1 Environmental Science Courses (See Table 2)

National 3 Environmental Science Course (C726 73)
National 4 Environmental Science Course (C726 74)
National 5 Environmental Science Course (C726 75)
Higher Environmental Science (from August 2014)

6.1.2 Chemistry Courses (See Table 3)

National 3 Chemistry Course (C713 73)
National 4 Chemistry Course (C713 74)
National 5 Chemistry Course (C713 75)
Higher Chemistry Course (from August 2014)

6.1.3 Geography Courses (See Table 4)

National 3 Geography Course (C733 73)
National 4 Geography Course (C733 74)
National 5 Geography Course (C733 75)
Higher Geography Course (from August 2014)

Table 2 - Environmental Science Courses

Level + link	Course Structure	CS opportunity
National 3 Environmental Science Course (C726 73)	• Living Environment - Sampling and identifying living things, from different habitats. • Sustainability - The possible impact of atmospheric change on the survival of living things.	• Measure the biodiversity by sweep net invertebrate sampling and bird spotting. • Recording lichen diversity to measure fossil fuel emissions.
National 3 Environmental Science Course (C726 73)	• Living Environment - Sampling and identifying living things, from different habitats. • Sustainability - The possible impact of atmospheric change on the survival of living things.	• Measure the biodiversity by sweep net invertebrate sampling and bird spotting. • Recording lichen diversity to measure fossil fuel emissions.
National 4 Environmental Science Course (C726 74)	• Living Environment - The nitrogen cycle and the environmental impact of fertiliser. • Added Value Unit: Environmental Science Assignment - Sustainability of key natural resources and possible implications for human activity.	• Sample riverfly larvae population changes due to diffuse pollution. • Look at correlation between pollinator numbers decline and habitat loss/monoculture/agro-chemicals
National 5 Environmental Science Course (C726 75)	• Living Environment - Practical fieldwork to sample biodiversity and identify Interdependence and Human influences on biodiversity. • Earth's Resources - Learners will develop skills of scientific inquiry, investigation and analytical reporting/dissemination. • Sustainability – Sustainability of food and water supplies due to climate change.	• Look at correlation between pollinator numbers decline and habitat loss/monoculture/agro-chemicals • Learners can undertake environmental monitoring or biological surveying and write up the project in the style of an academic paper. • Monitoring/recording of weather patterns locally in comparison to historical records.
Higher Environmental Science (from August 2014)	• Living Environment (Higher) - scientific inquiry, investigation and analytical thinking, along with knowledge and understanding in the context of the living environment. Research issues and communicate information related to biodiversity, interdependence, and human influences on biodiversity. • Earth's Resources (Higher) – Research through sampling, scientific inquiry, investigation and analytical thinking in the key areas of the geosphere, the hydrosphere, the biosphere, and the atmosphere. • Sustainability (Higher) - investigate the sustainability of key areas of food, water, energy and waste management.	• Sample biodiversity in a rural (agricultural), and urban environment, compare and report in the style of an academic paper. • Using SEPA data look at issues around air quality from urban emissions and compare to results from report in the style of an academic paper. • Using SEPA data, extract evidence of trends of water usage in agriculture, changes in ammonia/nitrates in water samples and report in the style of an academic paper.

Table 3 - Chemistry Courses

Level + link	Course Structure	CS opportunity
National 3 Chemistry Course (C713 73)	• Natures Chemistry – Air quality through electronic or biological monitoring means.	• Use OPAL air quality survey (lichens) or remote sensing devices (eg Dylos) to monitor air quality in and around your school grounds.
National 4 Chemistry Course (C713 74)	• Natures Chemistry – Air quality specific to fossil fuels, air particulate matter • Added Value Unit: Chemistry Assignment – human health issues around local air quality in school area.	• For both, use OPAL air quality survey (lichens) or remote sensing devices (eg Dylos) to monitor air quality in and around your school grounds.
National 5 Chemistry Course (C713 75)	• Chemistry in Society - Practical investigations of chemical analysis techniques used for monitoring the environment.	• Sample local river quality using AMI techniques and compare to SEPA ecology data sets.
Higher Chemistry Course (from August 2014)	• Researching Chemistry (Higher) - Undertake research in chemistry behind a topical issue, collecting and synthesising information from a number of different sources and communicate the results and conclusions.	• Use OPAL air quality survey (lichens) or remote sensing devices (eg Dylos) to monitor air quality in and around you school grounds and report in the style of an academic paper.

Table 4 - Geography Courses

Level + link	Course Structure	CS opportunity
National 3 Geography Course (C733 73)	• Human Environments – Research skills in geographical context.	• Flood mapping, invasive species spread, climate change effects on phenology.
National 4 Geography Course (C733 74)	• Physical Environments - Land use changes and flooding. • Human Environments - World population distribution and change. • Global Issues - Study major global issues and the strategies adopted to manage these. • Added Value Unit: Geography Assignment - Learners will choose an issue for personal study, research and present their findings.	• Look at hard engineering solutions compared to Natural Flood Management techniques and how they change flow levels from SEPA data. • Look at personal measurement of global footprint, food miles, carbon footprint and personal changes to improve your impact. • Compare Scottish climate control efforts compared to other nations. • Use of CS sampling skills, knowledge and understanding acquired in the other three Units of the Course.
National 5 Geography Course (C733 75)	• Geography: Global Issues - The use of numerical and graphical information in the context of significant global geographical issues. Behaviour change; the impact of human activity on the natural environment; environmental.	• Measure and share with your family, their global footprint, food miles, carbon footprint and report the personal behavioural changes that occur from the knowledge to improve their impact.
Higher Geography Course (from August 2014)	• Physical Environments (Higher) – Develop and apply geographical skills and techniques in the context of physical	• Study historical land use changes in local area and understand the improvement or deterioration of

	environments to complex processes and interactions within physical environments on a local, regional and global scale. Key topics include: atmosphere, hydrosphere, lithosphere and biosphere. • Human Environments (Higher) - Develop and apply geographical skills and techniques in the context of human environments in the complex processes and interactions at work within urban and rural environments. Key topics include: population, rural land use change and management, urban change and management. • Global Issues (Higher) - Develop and apply geographical skills and techniques in the context of global geographical issues in the complex global geographical issues. Key topics include: river basin management, development and health, global climate change, trade, aid and geopolitics, energy.	biodiversity as a result. Report in the style of an academic paper. • Using school figures on Waste, Energy and Water use, compare with national guidelines on best practice. Seek ways to affect behaviour change in school to improve the figures. Report in the style of an academic paper. • Measure the global footprint, food miles, carbon footprint etc of your school and investigate the behavioural changes that could improve their impact Report in the style of an academic paper.

There may be some areas of interest in the area of Citizen Science in **National 4 Biology** and in **Higher Biology** - looking at species interdependence and biodiversity. CS Opportunity – could include species sampling but the biology courses seem to mostly focus on the cellular level in organisms

6.2 Existing and developing CS and accreditation links

Links have already been made between Citizen Science and accredited qualifications across the UK through the following programmes:

Field Studies Council

Field Studies Council (FSC) is a UK wide environmental education charity offering day and residential courses at its national network of learning locations. They offer a wide range of professional training and leisure courses as well as fully flexible course accredited school courses. FSC engage with 130,000 school children across the UK (60,000 on 2 day residential courses) at their 17 field centres, supported by their 400 field staff. The Scottish FSC centre at Kindrogan in Perthshire and the new FSC centre at Millport on Great Cumbrae in the First of Clyde, attract 7,000 children to their centres (mostly residential) and hope to expand in the coming years to 10,000 and beyond.

A suite of outdoor learning activities around FSC coursework have been written to fit in with the variety of syllabus formats that are found across the UK including a Scottish educational context of S1 to S3 using OPAL material (ready by March 2014) and S4, S5, Higher and Advanced Higher structures through Curriculum for Excellence for use at their centres.

OPAL

The Open Air Laboratories (OPAL) network (universities and scientific agencies) aims to create and inspire a new generation of nature-lovers by getting people to explore, study, enjoy and protect their local environment. Formed in 2007 OPAL received a grant of £11.75 million from the Big Lottery Fund, it was

mainly focussed in England but is now extending its footprint to cover the rest of the UK. OPAL developed a suite of material that can be used by teachers and families to observe, interact with and record scientific and ecological data and report back to create a huge store of useful records. Working closely with the FSC, OPAL materials were delivers at FSC centres and scools across England. Data from the surveys has been used to create GCSE and A-Level teaching materials and is now being developed to suit Scottish styled education material by FSC (see above).

The OPAL tree health survey was developed and promoted across Scotland during 2013 in partnership with Forestry Commission Scotland. A guide to Links to the School Curriculum is available (based on the English Curriculum).

7 Citizen Science and the Further Education Sector

As we aim to engage more people to take part in biological recording and environmental monitoring (Citizen Science), we also have an opportunity to increase the acceptance and use of Citizen Science as a data gathering method and of the use of data gathered by Citizen Scientists, by as wide and varied and audience as possible.

Some discussion with staff from Scotland's Rural Colleges (SRUC) was had on whether there is any need or interest within the Further Education Sector (from diploma level up) in the collection of data through the use of Citizen Scientists.

There are undoubtedly already some data sets being used by students that are wholly or in part derived from Citizen Science collected sources. This may be the sole source of data or could be used to back up finer sampling techniques by the student. As always for this type of data there would be a requirement for some way to verify the robustness of the data. Also the timescales for planning, setup, engagement with volunteers and collection of the data may present issues with the timescales available within modular or even 1 year courses, requiring a high degree of organisational skills and time management.

There is nothing formal within known course structures to encourage the use of Citizen Science generated data, but the flexibility of data sources may mean that it has been done in the past but not highlighted as Citizen Science as such.

With the flexibility inherent in course structures there is a definite opportunity to use more Citizen Science generated data in existing course structures. For students to create bespoke Citizen Science data sets to suit particular research aims may not suit modular or 1 year courses but may be suitable for MSc or PhD length projects. What may be suitable for shorter length courses are sets of data collected by Citizen Scientists, perhaps being regularly or annually updated by a recognised group, at a fixed site or through and annual public appeal for records. This would give the student some degree of contact with the Citizen Science engagement process without the need to completely reinvent the whole project.

8. Conclusions

There is potential to incorporate Citizen Science activities into many of the awards that are achieved in Scotland. The DoE Award and John Muir Award programmes indicate that this kind of integration is both appropriate and relatively simple.

For S3, S4, S5, and Higher sciences hold real possibilities for Citizen Science activities within the existing curriculum specifications. Secondary School Teachers would be enthusiastic to explore Citizen Science under new Outdoor Learning and Curriculum for Excellence guidelines.

Secondary School Teachers in Chemistry, Biology, Physics and Geography would be best placed to assess further opportunities to use Citizen Science techniques as part of their course work at secondary level.

Case studies are a valuable tool to disseminate new methods of Citizen Science accreditation trialled by teachers and would be well suited to display on Education Scotland and SERC websites.

There is some interest from Colleges and Universities to use Citizen Science gathered data that could be used in projects and dissertations, but short modules and courses would need strict time limits.

There is an opportunity for TCV through the Scotland Counts project, to engage with a college/university to see whether Citizen Science gathered data can produce sufficient amounts of quality data that can be used by students to produce papers or to back up their own finer data at diploma and above levels.

It is highly likely that some College and University courses already use this type of Citizen Science gathered data or may easily directed towards using it within existing flexible course structures.

9. Recommendations

- Engage a group of Secondary School Chemistry, Biology, Physics and Geography Teachers to assess and trial further opportunities to use Citizen Science techniques as part of their work towards accredited learning at secondary level.
- Display results of teachers' Citizen Science work on Education Scotland and SERC webpages
- Engage with a college/university to test viability of Citizen Science gathered data can produce sufficient amounts of quality data to be used by students.
- Display college/university results of a Citizen Science data viability test on SEWeb.
- Carry out further research on currently run College or University courses that have used or could suit Citizen Science collected data
- Further engagement of coordinators of awards provided in Scotland to promote integration of Citizen Science into awards schemes