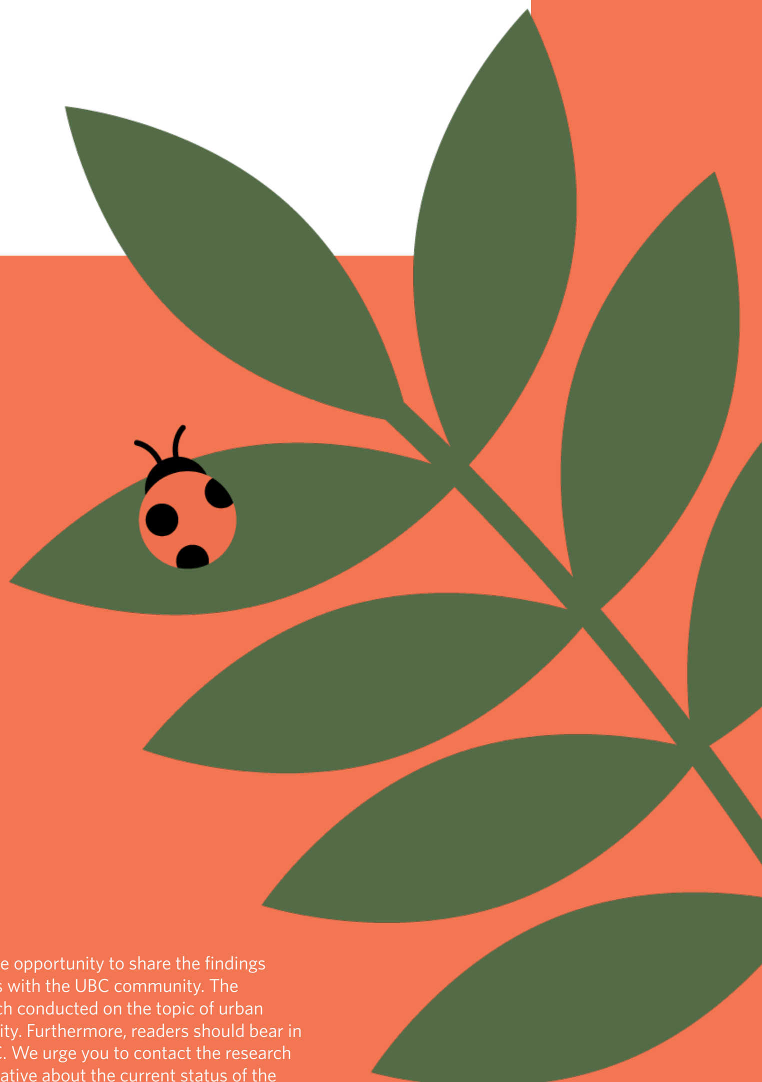
SEEDS KNOWLEDGE EXCHANGE:

Community Science Toolkit

Toolkit Guide



Acknowledgements

Report Compiled By:

Alex Wong
Senior Biology Student | UBC Faculty of Science

Laura Arango
Climate Crisis in Urban Biodiversity (CCUB) Coordinator
SEEDS Sustainability Program

Ben Scheufler
Urban Biodiversity Coordinator |SEEDS Sustainability Program

Zachary Johnston
Urban Biodiversity Coordinator |SEEDS Sustainability Program

Christine Kuo
Urban Biodiversity Coordinator |SEEDS Sustainability Program

Tara Moreau
Associate Director of Sustainability and Community Programs | UBC Botanical Garden

Douglas Justice
Associate Director of Horticulture & Collections | UBC Botanical Garden

SEEDS Sustainability Program*[1] student researchers**, Climate Crisis in Urban Biodiversity (CCUB) Initiative[2] Steering Committee***UBC Botanical Garden[3]

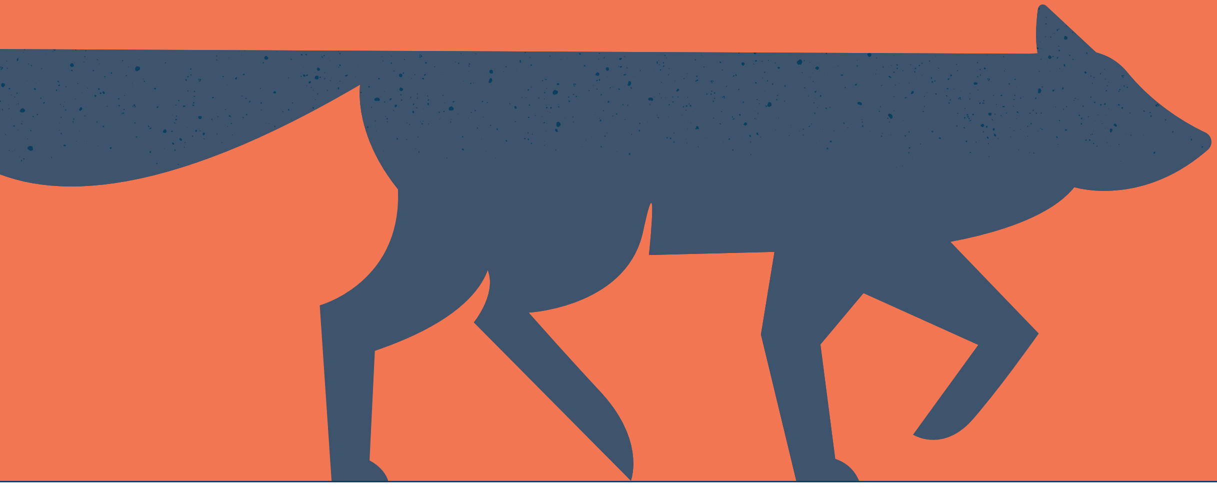
1. *The UBC SEEDS Sustainability Program is an internationally recognized Campus as Living Laboratory initiative, that advances UBC's sustainability and wellbeing commitments through applied student-led research and interdisciplinary partnerships between students, faculty, staff and community partners.

2. ***Climate Crisis in Urban Biodiversity (CCUB) is an initiative aimed towards co-creating interdisciplinary, demand-driven, diverse, and inclusive student-led research that informs urban solutions to the climate and biodiversity crises simultaneously. CCUB was launched as a PURE (Program for Undergraduate Research Experiences) funded pilot as part of the SEEDS Sustainability Program in partnership with the Faculties of Arts, Forestry, Science, and others.

3 The UBC Botanical Garden is Canadas oldest university botanicl garden, its mission is to provide a place for education, research, conservation, and community outreach.

Table of Contents

About this Community Science Toolkit



Toolkit Purpose

Each Toolkit in the **Urban Biodiversity in a Changing Climate ToolTree** aims to support applied student-led research projects in partnership with UBC faculty and staff in ways that can help advance UBC's sustainability and wellbeing commitments. This Toolkit helps to mobilize the findings of a research project conducted by student researcher Alex Wong (2021), who developed a framework for community science at UBC. It consists of resources that support the development of community science initiatives — including a review of the principles behind community science, the generalized steps to a community science project, and a review of key tools that can help community science initiatives that conduct inventories of urban biodiversity!

Who is this Toolkit for?

UBC STUDENTS:
Tools can be used to support student applied research to inform UBC's guiding sustainability policies and commitments, and professional skills development related to the complex challenges connected to climate change and its impacts on biodiversity.

UBC OPERATIONAL STAFF:
Serve as a collection of summarised knowledge and lessons learned from student-led research, to continue and inform UBC's guiding sustainability policies and commitments and the areas of work that have inspired and guided the direction of SEEDS research.

UBC FACULTY:
Serve as a resource to integrate biodiversity and climate topics into curriculum, and support student research and professional skills development.

UBC COMMUNITY:
Promote community engagement and collaboration on biodiversity and climate change challenges and opportunities at UBC and beyond.

What will you Learn?

This toolkit covers a number of topics related to community science. Learning outcomes include:

1

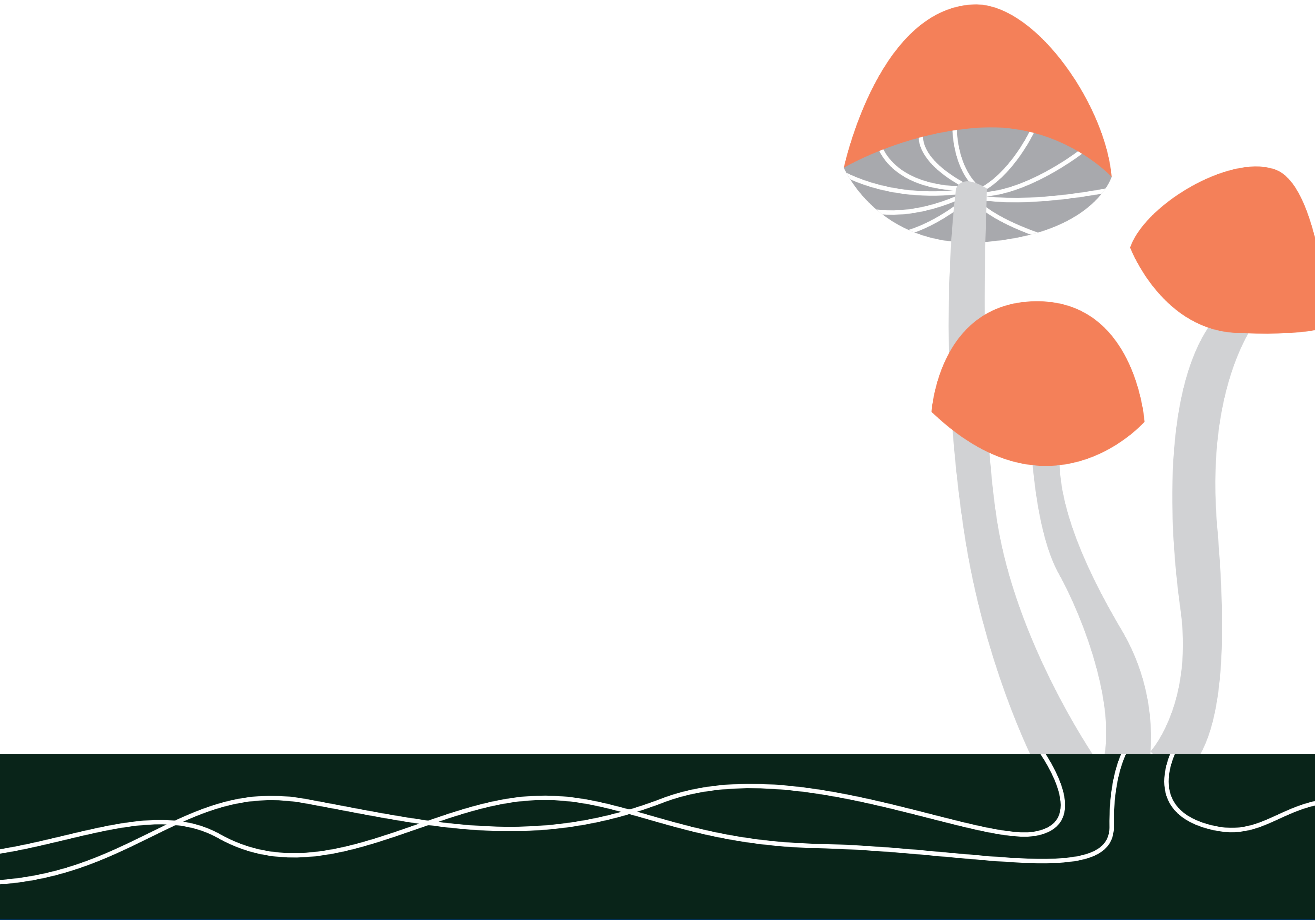
Learn about **community science for urban biodiversity**, why these initiatives are important, and how they relate to urban biodiversity in a changing climate.

2

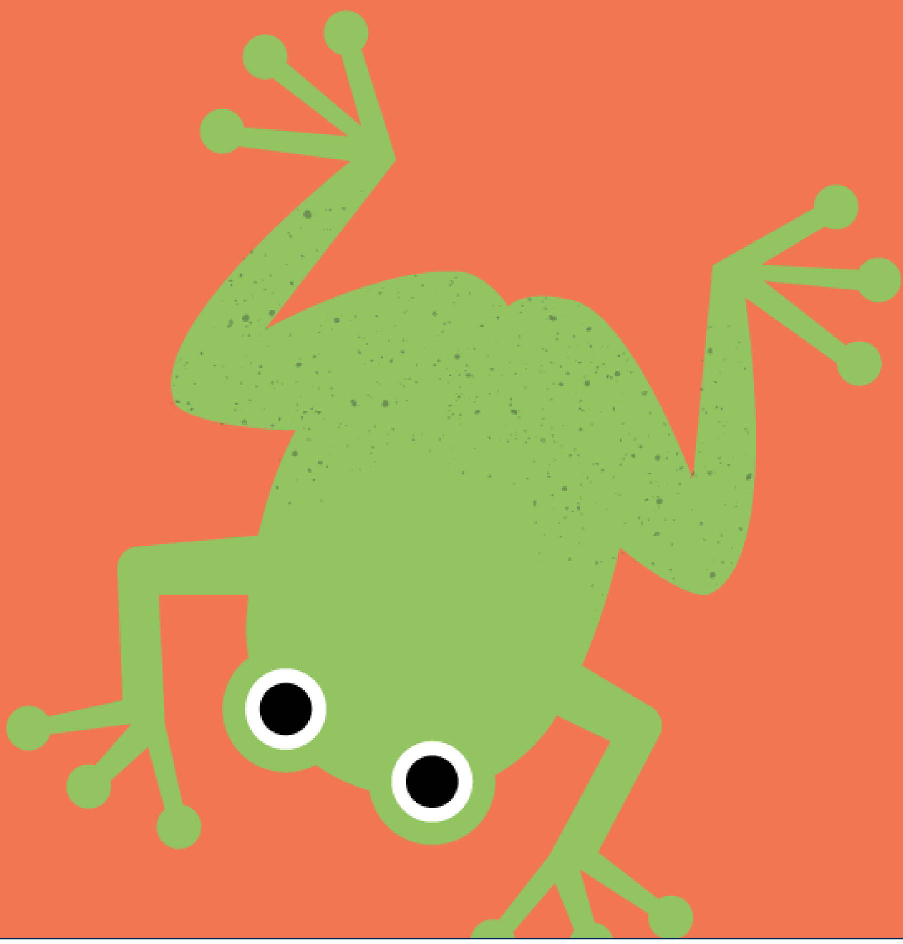
Learn about **key takeaways from applied student-led research on community science** at UBC, and how it can apply to landscape planning & design.

3

Learn about the **steps and principles to develop or participate in a community science project.**



About Community Science



What is Community (and Citizen) Science?

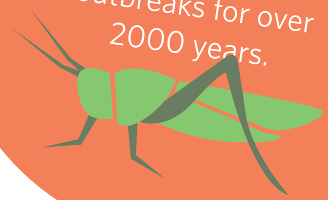
Research was developed by Alex Wong, a senior biology student in the UBC Faculty of Science. Read his full report here.

ommunity science, a practice where the public participates in scientific research in collaboration with scientists, has existed in many fields such as medicine, astronomy, and agriculture for a few millennia. More recently, community science has been a growing practice in climate and biodiversity research due to growing concerns about biodiversity loss.

The term ommunity cience has its roots in the term "Citizen Science," which was first recorded in the mid-1990s by social scientist **Alan Irwin**. Its definition has gone through many evolutions without a definitive consensus by the scientific community and the general public.

Fun Fact:

In ancient China, residents recorded migratory locusts to track outbreaks for over 2000 years.



Alan Irwin's Definition: Dr. Irwin defines citizen science holistically, suggesting it is "science which assists the needs and concerns of citizens" and is "a form of science developed and enacted by the citizens themselves".

Oxford English Dictionary definition: citizen science is "scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions."

Both definitions ultimately describe the same concept: Concerned individuals collaborate with scientists to address a pressing concern through scientific research.

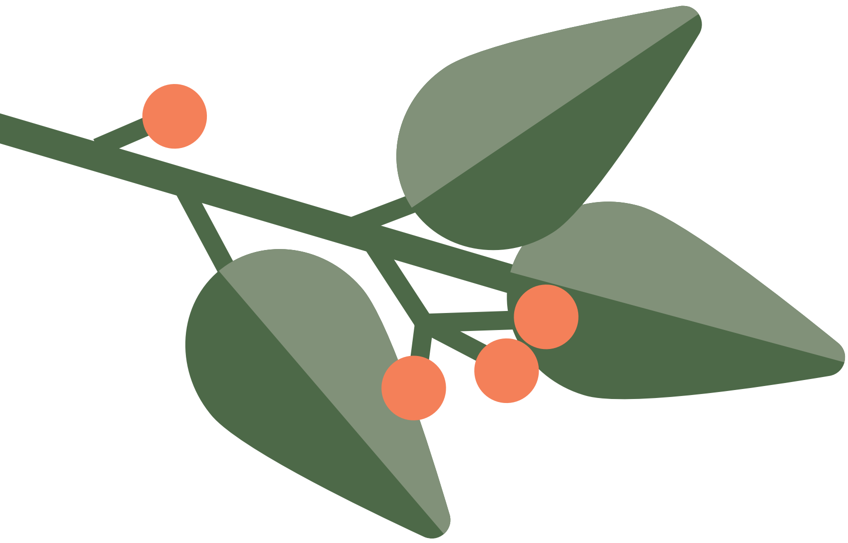
"Citizen Science" or "Community Science"?

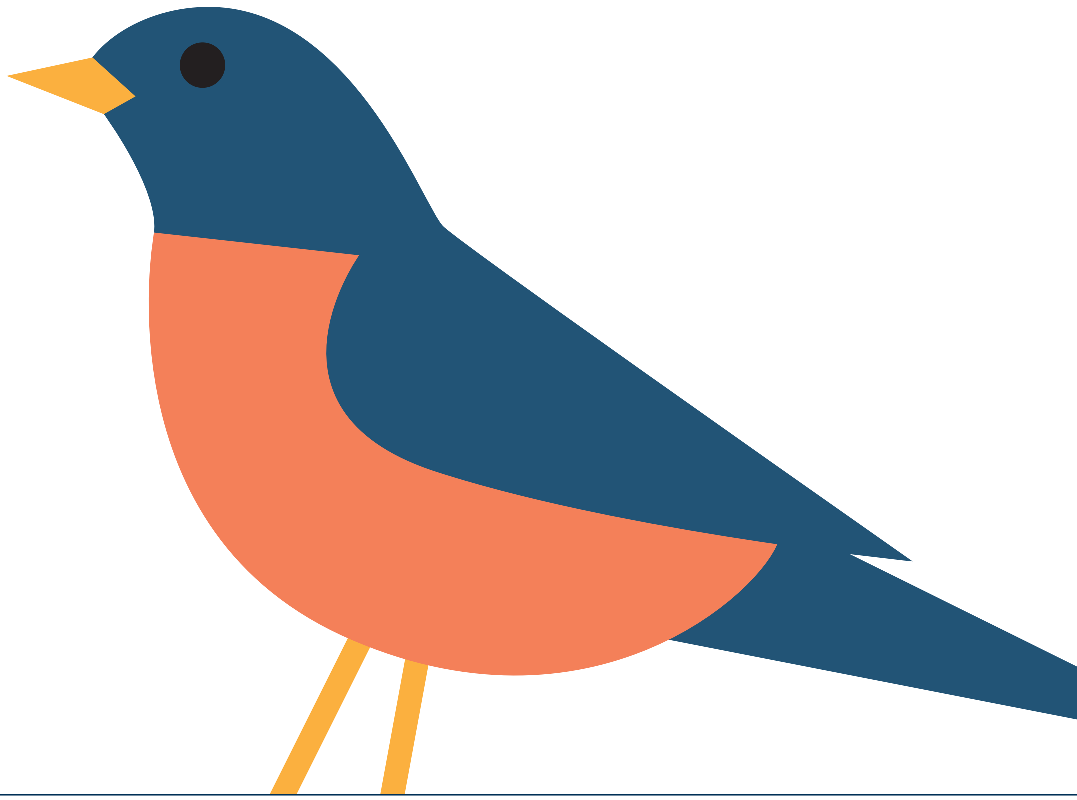
In recent years, there has been a movement to formally change the word "Citizen" to "Community" to increase the inclusivity of those who may participate in these types of projects to be more inclusive of those who— may not be citizens of a country. For the purpose of this Toolkit, the term "Citizen Science" will be used since it is a more familiar term, with the acknowledgement that citizenship in a country is not a prerequisite for participation in these types of projects.

The following definition will be used in this toolkit:

> *"[Community] science is the practice of conducting scientific research in collaboration between members of the scientific community and interested public stakeholders to increase scientific knowledge, education and outreach, while contributing to addressing societal concerns."*
>
> Illinois Sustainable Technology Center

This definition avoids the use of words like "amateur scientists" or "non-experts" in the participation of community science research, which may limit the value of the plurality in ways of knowing, including who holds knowledge and how it is valued. We acknowledge that "expertise" can be based on a myriad of factors, including a plurality of lived individual and community experiences, informal and formal education, and learning with a plurality of senses. The term "scientific knowledge" is used here to encompass contributions to the scientific process including institutionally accredited professional scientists and various interested public stakeholders who play a role in the conduct of science, contributions to scientific inquiry and societal issues.





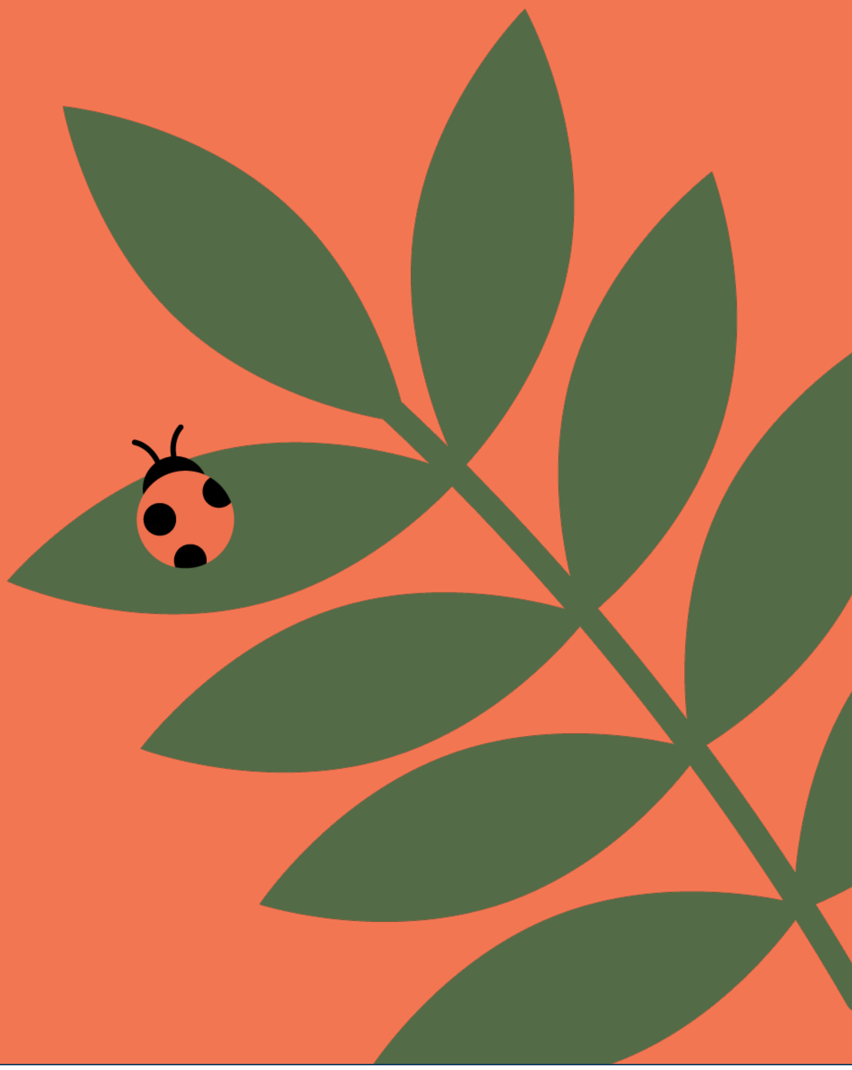
Ten Principles of Community Science

The foundation of community science builds on collaboration between researchers and community members. For a project to find success, it is vital to have guidelines that everyone can follow, adapt and build on. An international community of scientists created the **Ten Principles of Citizen Science** a list of principles that can guide researchers and their projects, which we have adapted to our definition of community science.

1. **Actively involve community members in scientific endeavours that generate new knowledge and understanding.** ommunity members may act as contributors, collaborators, or project leaders and have a meaningful role in the project.
2. **Community science projects have a genuine science outcome.** For example, answering a research question or informing conservation action, management decisions or environmental planning and policies.
3. **Both professional scientists and community scientists benefit from taking part.** Benefits may include the publication of research outputs, learning opportunities, personal enjoyment, social benefits, satisfaction through contributing to scientific evidence, and more. Other examples of benefits include the potential to influence policy to address local, national and international issues.
4. **Community scientists engage in multiple stages of the scientific process.** This may include developing the research question, designing methods, organizing materials, gathering, cleaning and analyzing data, and communicating the results through publications and presentations.
5. **Community scientists receive feedback from the project.** For example, providing feedback on how data will be used and on the ways in which the data can contribute to research, policy or societal outcomes.
6. **Community science is considered a research approach like any other,** with limitations and biases that should be considered and controlled for. Unlike conventional research approaches, community science provides opportunity for greater public engagement and democratization of science.
7. **Community science data and metadata are publicly available.** Where possible, results benefit from being published in an open-access format. Data sharing may occur during or after the project, unless there are security or privacy concerns that prevent this.
8. **Community scientists are acknowledged in project results and publications.**
9. **Community science programmes are evaluated** for their scientific output, data quality, participant experience and wider societal, conservation or policy impact.
10. **The leaders of community science projects take into consideration legal and ethical issues** surrounding copyright, intellectual property, data-sharing agreements, confidentiality, attribution and the environmental impact of any activities.

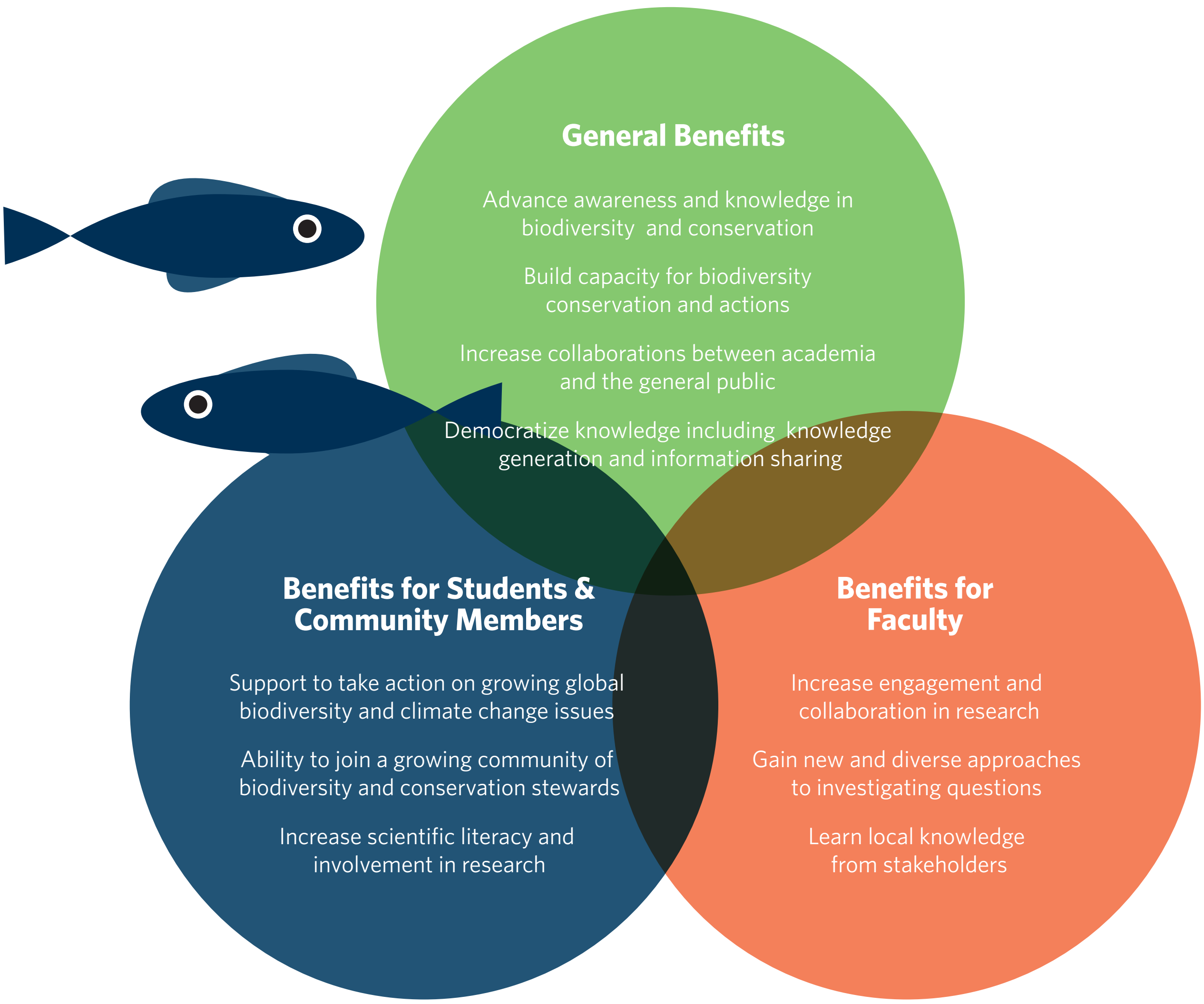
To read more about the "Ten Principles Citizen Science" refer to Robinson et. al's 2018 paper Ten Principals of Citizen Science:

Why Community Science?



Benefits of Community Science

Community science can advance biodiversity and conservation while also providing various benefits for students, staff, faculty and community members. There is potential to build and strengthen relationships between scientists and the general public by facilitating an environment that encourages participation and collaboration in research. The image below provides an overview of the potential benefits of community science



GENERAL BENEFITS

- **Bridge the gap between academia and the public** by increasing transparency and accessibility of the scientific process.
- **Build trust in science** amongst the general public — community science projects can facilitate opportunities to learn about scientific research and provide a skill skill sets to contribute and think critically about research.
- **Address societal concerns** such as climate change and biodiversity loss. Community science has the flexibility to contribute knowledge and actions to advancing critical issues, and help align scientific agendas with the interests of the public.
- **Democratize knowledge and knowledge production** by providing opportunities for people to participate in the production of knowledge and contribute to positively influencing decisions, practices and policies.

BENEFITS FOR FACULTY AND RESEARCHERS

- **Increase engagement and collaboration** with communities. Community science can lead to networking with other experts and interested parties— and can lead to new partnerships with organizations and people that have similar interests. It can help create a sense of community effort, and inform opportunities for future research and collaborations.
- **Investigate questions** by collecting data with many active contributors. Monitoring or surveying an area for species, conducting field observations and data analysis can be labour-intensive for small research teams that can be eased through community science approaches (i.e. including interested local stakeholders).
- **Gain local knowledge** from community participants which can provide unexpected insights leading to new research findings and questions. While professionally accredited scientists contribute their scientific expertise to community science projects, community participants can bring in a variety of information that is not publicly known, such as knowledge of their local community policies, species, environmental to habitat conditions.

BENEFITS FOR STUDENTS AND COMMUNITY MEMBERS

- **Encouragement to take action on growing global issues**. Community science provides an outlet for people to express their interests and concerns through scientific research. It can provide simultaneous learning and knowledge building while also giving people a greater voice in contributing to scientific research and research processes.
- **Join a growing community of biodiversity and conservation**. Community science programs can attract people interested in investigating a research topic, creating a welcoming community of like-minded individuals driven to take action on an issue or opporutnity.
- **Increase scientific literacy and involvement in research.** Community science provides opportunities to gain research experiences, skills and learn about the work that goes into science, an integral step for people who wish to become scientists or professional practitioners.

Using Community Science

Developing a Community Science Project

KEY COMPONENTS:

Who? Establish which parties to engage and educate

Reach out to your community through online platforms or directly drawing on recommendations from established networks. Identify individuals or groups that could join in various capacities whether as contributors, collaborators or project leaders, and who can contribute and have meaningful roles in the project as it progresses. It is likely that there are already many passionate community members, such as avid birders and plant enthusiasts, that will have local knowledge that can help to inform and enhance your project. Understanding your community and the potentially interested parties will help to attract and retain participants as the project continues. In addition, consider the inclusivity of your outreach efforts, so that a diverse group of community scientists might be able to participate.

What? Identify the research scope

Crafting a well formed project goal or research question is critical to inform the scope and overall approach of how you will move your community science project forward. Some project teams may involve participants in all aspects of the research process (e.g. research design, data collection, analysis, sharing), while others will only engage with specific tasks . Moreover, there may be an additional educational initiative that aims to engage the public in the topic of interest. Define and make clear the project's purpose, supporting research questions and intended impact before proceeding, this can serve as a project guide that can help you stay on track and help clarify and manage expectations throughout the process.

When? Determine the research time frame

The project design, goal(s), and resources needed can help inform the project's time frame. For example, short term observations to determine species presence in an area may benefit from applying a bioblitz approach (an event that aims to identify as many species in a given area as possible) and may lend well to be repeated annually (National Geographic Society). Conversely, determining species presence and absence in an area requires constant long-term monitoring. Consider the resources available and the deadline your research must be finished when designing the project's methodology.

Where? Determine the research location

The research location can impact the type of data that is collected and the research questions that can be answered. It is important to consider accessibility when determining research locations. Community researchers may also need to consider site permissions when determining the research location.

How? Develop the research methodology, design and methods

Citizen science projects will differ in the project's methodology depending on the research question. The most common type of citizen science monitoring programs uses bioblitzes and iNaturalist to collect data from participants. However, more detailed project designs may require specific tools and associated training depending on the project goal. Always consider multiple ways to address a research question, as some will be more feasible than others when using community science.

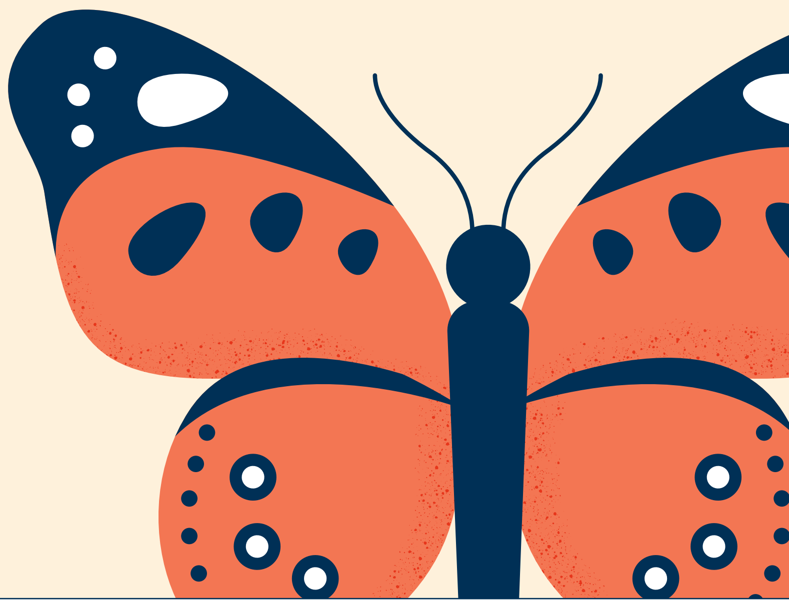
Key Steps to Create a Community Science Project

Considering the components mentioned above, specific steps to create a community science project are outlined in the process (adapted from Bonney et al., 2009) below:

DEVELOP A RESEARCH GOAL AND SUPPORTING RESEARCH QUESTIONS

To begin a community science project, the project leader should explore the problem or topic at hand to determine its priorities, public interests, and the intention of the study. To do this, a research goal should be created that speaks to what the project hopes to achieve. Additionally, at this stage of the project, you should develop a list of research questions to help guide you towards achieving your project goal.

Note: *It is important to also consider whether the application of community science is beneficial to your project. Data from community science platforms such as iNaturalist require data to be verified by other users which can lead to the creation of inaccurate data points (Balázs et al. 2021).*



DESIGN YOUR PROJECT

Project design is an essential step in creating a community science project. Its success, long-term sustainability, and participant recruitment and retention depend on the accessibility and ease of your project. Three main components to consider in your project design:

Component 1: Identify your type of project

There are various established project types to consider when designing a community science framework. Each type will determine the amount of collaboration needed from project participants. Five common project types found in the Bonney et al. and other literature include:

- **Contractual** - The community or individuals approach scientists to investigate a scientific topic and report on the results.
- **Contributory** - Scientists generally are responsible for the design of a project, and community members primarily contribute to the data gathering aspects of the project.
- **Collaborative** - Scientists generally are responsible for the project design and community members primarily contribute to the data collection and also help inform project design, data analysis, and sharing of the research outcomes.
- **Co-created** - Scientists and community members actively work together to create the research design. At least some of the community members are involved in the majority to the entirety of the full life cycle of the research processes.
- **Collegial** - Community members conduct the research independently and receive a varying degree of recognition from scientific and professional peers.

Component 2: Identify and source project resources needed

Intentional planning in advance of the project inception to identify and secure the resources needed for your project will help ensure its success. Curate a list of readily accessible resources and identify those that need to be obtained. Resources may include budget, research tools, equipment and training materials needed for data collection, and research project incentives to help you recruit participants to participate in the project. If you are unsure if a budgetary, informational or other research resource is available , reach out to on campus or external groups and ask. For a list of community science resources available, see the Helpful Resources section.

Component 3: Methodology and Data Entry

The methodology of a community science project is determined by the research goal and questions. For instance, surveying an area for species presence and absence over the span of five years will require long-term monitoring, while a bioblitz only provides a snapshot of identified species in a specific area.

In addition, consider the tools that participants will use to collect data, and its associated training to mentor project members in appropriate data collection techniques. Proper training is required to provide a fundamental understanding of the project's goals and decrease the variability in data collection and entry. Have a standardized approach and have specific data collection formats, alongside examples, when training project members on the tools that will be used.

ENGAGE THE COMMUNITY

Community science relies on active participation and input from community members. Developing a recruitment plan that identifies who, when and how you plan on recruiting participants is critical to your project's success. There are many ways to attract participants to your project, including collaborating with on campus groups and external organizations to help identify, communicate and recruit your target audiences. For example, engage with one of the many UBC-based student groups engaged with biodiversity and sustainability, or reach out to the Alma Mater Society (AMS) or faculty undergraduate societies to engage the general student body.

A non-exhaustive list of communities (student groups and campus organizations) with initiatives in biodiversity and sustainability can be found here.

4

MANAGE AND ANALYZE YOUR DATA

Since community science has the ability to generate large datasets, managing and analyzing data can become a tedious task, especially for small research teams. The tools used and the methodology determined during project design will also influence how data can be accessed and managed. For example, tools such as iNaturalist or Global Biodiversity Information Facility (GBIF) already have research-grade datasets that have been verified by scientific experts and can be downloaded from their database for analysis. It is important to note that not all community science datasets are validated by members of the scientific community and therefore you may neeed to come up with a framework for validating data in your own project.

Consider providing an opportunity for participants to contribute to data analysis if they are interested. Although data privacy and ownership can be topics of concern in community science, create open datasets if there is unanimous agreement by the project team beforehand to mitigate these issues. **For more information about the tools available to you, see the Helpful Resources section in this toolkit.**

5

SUSTAIN AND IMPROVE YOUR PROJECT BASED ON DATA

Open and steady communication with project members improves engagement and the project's likelihood of success. It is more likely for people to continue with a community science project or program if there are ongoing interactions between the scientists and project participants. It showcases the researcher's dedication and commitment towards the project's goals, which in turn motivates people to uphold their responsibilities as community scientists.

Tips and Tricks for Community Science

ATTRACTING NEW PARTICIPANTS

- Showcase the impact participants have had on the project through data visuals. People who are hesitant to join a community science program may be drawn to it once they see some tangible successes achieved by project members in a visually engaging format.
- Hold workshops and presentations at conferences to engage new audiences. Presenting the project's research and progress at networking events will increase its reach and potentially attract new participants. Some annual conferences at UBC include the Student Leadership Conference, Multidisciplinary Undergraduate Research Conference, and Life Sciences Research Night.
- Provide incentives and educational opportunities for participants. Many who voluntarily join community science projects will look to gain experience in scientific research or knowledge about the research area. Some audiences (i.e. classes, faculty members) may require tangible incentives to appeal to them, which can come in various forms of compensation such as offering academic credit (e.g. through a regularly offered course or directed study), recognition in a paper or website publication that participants can cite, providing and opportunity to recognize people through an event that provides food and networking opportunities, or economic compensation such as a gift card or honorarium.

PARTICIPANT RETENTION

- Provide feedback and regular updates on the data collection to participants. Illustrating the impact people have had on the project can help maintain engagement levels and further empower them to continue.
- Recognize contributors through socials or other types of initiatives that can serve to recognize and celebrate the people involved in the work.

PROJECT IMPROVEMENTS

- Be adaptive and flexible when addressing project design issues. Technical difficulties may arise with participants and the project design may need to be adjusted to accommodate design oversights. Common issues usually arise during data entry due to technological inadequacies. Always have an alternative option for participants to submit their observations and record any design flaws for future improvements.
- Ask for feedback and project improvements. Ask project members for feedback about the project and suggestions for future improvements. Have effective and timely communication with your participants to showcase your dedication.

Special Considerations

Special Considerations

LIMITATIONS:

Community science can be a great way to learn about nature and build community connections. Some considerations that are helpful to consider before implementing your project include:

BIAS

Common Issues: Selection bias and cognitive blindness are often criticisms of community science regarded by many academics (Jordan et al., 2012). For example, participants who lack training and experience when collecting data may skip over critical data because of an interest in a specific species or lack of familiarity with a process or tool.

Opportunities: Creating community science projects based on spatial and temporal constrictions rather than taxa can reduce selection bias amongst participants (Fink & Hochachka, 2012). In turn, there is less emphasis on finding specific species that can lead to species blindness of others. Using an invasive plant species monitoring program as an example, ask participants to survey a transect rather than looking for specific plants. Analyze and identify the data later to sort through invasive and native plants in that area. Additionally, ensure that all participants are familiar with the methodology and tools used in the project to limit bias. Training sessions and in-field help provides a platform for participants to ask questions in advance of the study would also positively impact the community science project.

SAMPLING

Common Issues: Spatial and temporal biases can occur when data collection is not performed consistently across different times (eg. seasons) or locations (eg. data collection in a forest may be centered around areas near hiking trails rather than spread across the entire forest) (Callaghan et al., 2019). This results in a dataset that may not be entirely representative of a given area or species.

Opportunities: Random sampling methods may be used during the data collection phase to help mitigate issues. For example, the University of Minnesota Duluth provides guidance on applying a grid to the study site and randomly choosing cells within that grid to collect data from, or using a random walk technique to locate plot points by walking a random distance in a random direction (University of Minnesota Duluth, n.d.). During the data analysis stage, any sampling or other limitations should be acknowledged, and made clear that the project results may not be entirely representative. Callaghan et al. (2019) also suggest that various statistical approaches can be taken to even out the data during the data analysis phase, for example, by aggregating data in grids or using a subsampling analysis..

DATA ACCURACY

Common Issues: Citizen science projects that are focused on biodiversity often require species identification. A common issue that can arise is inaccurate identification of a species.

Opportunities: Applications such as iNaturalist or eBird are great tools that can help promote accurate data collection through built-in species identification features. For example, iNaturalist generates suggested species identification options that users can choose if they cannot identify the species themselves. The app then relies on a verification system, whereby observations must be verified by two other users to be considered "research grade" (iNaturalist, 2023). Research grade data might then be used in scientific efforts. It is recommended that validation should only be performed by users that are experts in identifying the species in order to ensure that only correctly identified and verified data is marked as research grade.

ETHICS

Common Issues: As with other scientific research, ethical issues arise when implementing community science programs. When designing a project, issues such as data management, legal considerations, and participant benefits need to be considered.

Opportunities: Resnik et al. (2015) go into extensive detail about the topic of ethics in community science and provide suggestions for the project design.

RESOURCES

Common Issues: It is important to consider the investment of resources that are needed to coordinate and conduct citizen science initiatives. For example, the research team will need people with specific expertise to support accurate data collection, and it can take time to recruit participants to engage in the data collection.

Opportunities: Consider that participants can gain reciprocal benefits by contributing to research — they can connect to local landscapes, learn new skills and make connections to communities of like-minded people. Project organizers can emphasize such benefits to retain participants and attract new ones.

Who is active on the UBC Vancouver Campus in this topic area?

The UBC Campus Biodiversity Knowledge Networks Map provides centralized information about UBC people (practitioners, researchers, instructors, students), networks and initiatives connected to urban biodiversity conservation and stewardship. Using the search feature in the top left corner, users can search for specific departments or people to connect with for a potential or ongoing project. The list is not exhaustive and if you notice a group that is missing or should be added to the map, please contact seeds.info@ubc.ca. It's a tool to help people connect with others, to enable greater collaboration across our campus through bridging efforts across campus operations and academia, helping people connect to work to accelerate action on the ecological crisis, interconnected ecological and climate crises, and eco-human health.

In addition to this Knowledge Network Map, there is the Potential Citizen Science Peoples Network resource containing a list of student groups, UBC departments, and external organisations with initiatives in biodiversity and sustainability. This list is not representative of every group related to UBC with citizen science goals. However, the ones listed were chosen as potentially key players in citizen science at UBC because of their goals and initiatives. To find specific groups within the map, use the search bar in the top left corner to find specific groups to potentially collaborate with.

Policy Alignment with UBC:

UBC's Climate Action Plan 2030 includes "Biodiversity, Adaptation and Resilience among its list of Complementary Action Areas" (p. 44), and associated Actions (p.45-46). Immediate Actions include:

- Increase understanding of the biodiverse ecosystems on campus and the climate adaptation benefits they provide by developing foundational research around biodiversity and climate resilience on the UBC campus. This will include:
- A community-driven process to develop a set of campus biodiversity and climate principles to advance climate change mitigation and adaptation, ecological health, and human health and wellbeing.
- A campus natural asset baseline that quantifies the contributions of UBC's natural assets to the range of ecological and socio-cultural services.

Because citizen science is a great way to understand the natural ecosystem in an urban area while getting the community involved, it could be a great way for UBC to support the goals outlined above!

What Other Community Science Efforts Are Happening in Canada?

- The Government of Canada has a Citizen Science Portal that features current community science efforts.
- The Canadian Council on Invasive Species encourages community scientists to monitor invasive species on various apps; the data is then used to help researchers and land managers manage invasive species before they become widely established.
- The Invasive Species Centre also provides resources such as fact sheets and trainings for community scientists
- The Invasive Species Council of BC provides information on how to report invasive species and learn more about community science
- Birds Canada is an organization that undertakes community science projects in order to monitor bird populations and diversity; it has multiple projects in each province or territory that community members may join.

Case study: Campus-wide Bioblitz with BIOL121

ABOUT:
Over 150 students of BIOL 121 2022S class participated in a campus-wide bioblitz, surveying for all types of biodiversity on the UBC Vancouver campus. Using GIS data from proposed biodiversity corridors, the 60 largest green spaces of the north campus were identified as potential biodiversity hotspots. A biodiversity hotspot is defined as an area with a high amount of biodiversity that is also threatened with destruction.

SCOPE:
This project was proposed as a pilot to test out a novel surveying technique developed by student researcher Alex Wong and UBC Botanical Garden's Associate Director Tara Moreau. The aim of this project is two-fold: 1) Identify potential biodiversity hotspots on campus. 2) Increase the involvement of scientific research in students' curriculum using community science. This novel method is named the Circular Point Method, with design intentions to calculate the density of biodiversity in a given area.

METHOD:
The methodology behind the Circular Point Method was inspired by a combination of methods used in coral surveying transects and bird counts. The surveying technique is detailed below.

CIRCULAR POINT METHOD

Step 1: Students in groups of 3-4 locate two assigned green spaces on campus grounds with a given map. Each green space has five points randomly marked on them.

Step 2: At each point, the students plant a stake into the ground. Then they lay a metre tape five metres out from the stake.

Step 3: For five minutes, students photograph any organisms they see within a one metre circle. If they observe 15 species, they are finished at that point. If five minutes have passed and they do not have 15 species observed, they increase the radius by one metre and observe again for 5 minutes. They repeat this process until they reach 15 species observed or a five-metre radius.

Step 4: Once all the points have been surveyed at each green space, students upload their photos to an iNaturalist project and fill out a sheet detailing information about the field conditions.

FUTURE PLANS

The data collected over the summer will be analyzed by ambassadors in the newly established UBC Sustainability HUB through a SEEDS project. Since the project was established successfully over the summer, the project will be continued and expanded to the entire campus over the course of the 2022/2023 winter terms. It is expected that over 500 first-year students in the BIOL121 class will participate in this project in the fall.

Acknowledgements

This pilot project would not have been success without the help of the instructors Lynn Norman and Dr. Jessica Garzke. They were integral in the delivery of the project to the students and assisted

Helpful Resources

The direction and approach of your community science project in many ways will be informed by the tools you select to inform your data collection methods, data entry, data analysis and data visualization. See Table 1 below for a non-exhaustive list of potential citizen science tools and suggested uses that can inform the development of your project. The tools listed are curated with the following qualities in mind: accessibility, user-friendliness, and open-accessibility to data. The tools have capabilities marked off for convenience and are grouped into four categories: data-entry, analytical tools, visualization tools, and databanks. The horizontal axis refers to the different data types used and capabilities of the Community Science Tools that are listed (i.e. data analysis and visualization).

Community Science Tools	Birds	Bees	Butterflie	Plants	Trees	Database	Data Analysis	Visualization	Reference Material	Description
Data Entry										
iNaturalist	✓	✓	✓	✓	✓	✓				A powerful identification tool used by most project teams. Has a mobile app and browser version to upload observations. Data are marked as research-grade and exported to GBIF once verified by experts. Datasets can also be downloaded locally from the website. **iNaturalist.org**
eBIRD	✓					✓				A documentation project dedicated to birds run by the Cornell Lab of Ornithology. Observations are uploaded onto the website Data are marked as research-grade and exported to GBIF once verified by experts. Data can also be viewed and downloaded locally from the website. **ebird.org**
Bumble Bee Watch	✓					✓				A project dedicated to recording bumblebee sightings. Observations are uploaded onto the website and identified by experts. Data are marked as research-grade and exported to GBIF once verified. Data can also be viewed locally on the website. **bumblebeewatch.org**
i-Tree					✓	✓	✓	✓		A software suite from the USDA Forest Service that provides a variety of tools for forest management, inventories, and health assessments. i-Tree Eco, its flagship software, has been adapted for use in Canada and existing data can be imported into new inventories. **itreetools.org**
Citizen Science Portal						✓			✓	This webpage links to a series of ongoing community science projects that are happening at the community level all over Canada. Users can select and view individual projects to learn how to get involved. **https://www.ic.gc.ca/eic/site/063.nsf/eng/h_97169.html**
UBC Citizen Science GitHub						✓				This GitHub webpage contains links to different community science projects where those interested in joining an ongoing project are able to do so. Users can select and view individual projects to learn how to get involved. **https://ubc-library-rc.github.io/citizen-science-tools/content/citizen-science-projects.html**
Nature-Watch	✓	✓	✓	✓	✓	✓			✓	Nature Watch is an online platform where people can upload observations to Canadian datasets and different community science projects. Users are also able to download data and view data visual-izations. **https://www.naturewatch.ca/**
Analytical Tools										
Github							✓			A for-profit development platform to build and host software. Developers use it to manage and store their code, with many researchers using it to analyze datasets. **github.com**
Jupyter							✓	✓		A non-profit, open-source project containing tools for collaborative programming. Jupyter Notebook and JupyterLab already have many uses, with capabilities to add new modules. **jupyter.org**
Excel							✓	✓		A spreadsheet software with capabilities to write equations and create simple visualizations. **microsoft.com/en-us/microsoft-365/excel**
R							✓			A free software mainly used for statistical computing and graphics. Many use it for its ease with creating publication-quality plots and data visuals. **r-project.org**
Visualization Tools										
QGIS								✓		Open-source and free GIS software run by volunteers. It is used to view and analyze geospatial data and create graphical maps.
Gephi							✓	✓		Open-source and free software to visualize data. It has a variety of analytical tools to display and analyze data patterns. **gephi.org**
Tableau Public								✓		Free software to create and share data visualizations online. It can connect to multiple data formats, such as Excel, CSV, and Google Sheets. Data visuals can be published to their servers and publicly shared at no cost. **public.tableau.com**
UBC GitHub							✓			This GitHub page is a repository for UBC's operational geospatial data. It contains locations (buildings, addresses, campus services, food outlets) and landscape data (soft and hard land-scape, trees, lawns, water features etc.) **https://github.com/UBCGeodata/ubc-geospatial-opendata**

tools	birds	Bees	Butterflie	Plants	Trees	Database	Data Analysis	Visualization	Reference Material	Description
Databanks for Download: Open Access										
GFIB						✓				An international data infrastructure providing open access to biodiversity data. Data is sourced from many sources and goes through a data standard before being published. Datasets are readily available for download. gbif.org
Data. Sustain Repository						✓				An upcoming data repository supported by the CIRS. Open datasets relating to sustainability, biodiversity, and more will be available when finished. It aims to make data more accessible for UBC students, faculty, and staff. data.sustain.ubc.ca
UBC Sustaina-bility Data Portal						✓				A work-in-progress database powered by CKAN. It plans to provide access to open datasets pertaining to sustainability and biodiversity data. dashboard.sustain.ubc.ca/dataset
Abacus Data Net-work						✓				A repository containing open and licensed data hosted by UBC Library. Licensed data is available to those with university login credentials. abacus.library.ubc.ca
Opendata Vancouver						✓				A portal to access all of the City of Vancouver's public data. Datasets are available for download in multiple file formats. Opendata.vancouver.ca
Databanks by Request: Closed Access										
UBC Botanical Gardens						✓				A collection of ~30000 plants from ~8000 accessions representing 5000 taxa from temperate regions around the world. Data is uploaded to GBIF and can be viewed upon request. botanicalgarden.ubc.ca/research-collections/plant-collections/
Beaty Biodiversity Museum						✓				Over two million specimens are organized into six collections that are available to be viewed upon request. Biodiversity researchers often access collections for access to historical data. beatymuseum.ubc.ca/research-2/collections/
E-Fauna BC						✓				An online biogeographic atlas of the wildlife species of BC. Data is collected through community science and is used to provide scientifically accurate information about BC taxa. linnet.geog.ubc.ca/biodiversity/efauna/
E-Flora BC						✓				An online biogeographic atlas of the vascular plants, bryophytes, fungi, and lichens of BC. Combines community and expert data to provide information about BC flora species. linnet.geog.ubc.ca/biodiversity/eflo a/
Additional Resources										
Metro Vancouver Invasive Species List									✓	The link below provides information on key invasive plant species commonly found in the Metro Vancouver area. This webpage provides images of important species as well as removal and eradication information that can help to inform your project. https://iscmv.ca/invasive-species/priority-plants
Soil Classific - tion: British Columbia									✓	This webpage provides a number of resources for soil classification and mapping in British Columbia. The page contains links to different soil classification resources and tools that can be used to inform your own citizen science project. Soil Mapping and classification - Province of British Columbia
UC Davis Centre for Community and Citizen Science									✓	This UC Davis webpage contains information on community science projects, case studies to reference or learn from, and additional resources to help develop your own project. Here, you can access teaching materials, formal training programs, and existing projects to collaborate with or join. https://education.ucdavis.edu/center-community-and-citizen-science
UNESCO Data Charter and Guide for Citizen Science									✓	This document contains recommendations for handling data in community science. It includes information about data publishing, cleaning, and storage, as well as data privacy and ethics. https://www.unesco.org/en/open-science/data-charter-and-guide-citizen-science

References:

Balázs, B., Mooney, P., Nováková, E., Bastin, L., & Jokar Arsanjani, J. (2021). **Data Quality in Citizen Science**. 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. 139–157). Springer International Publishing. https://doi.org/10.1007/978-3-030-58278-4_8

Bonney, R., Cooper, C. B., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K. V., & Shirk, J. (2009). **Citizen Science: A Developing Tool for Expanding Science Knowledge and Scientific Literacy.** BioScience, 59(11), 977–984. https://doi.org/10.1525/bio.2009.59.11.9

Callaghan, C. T., Rowley, J. J. L., Cornwell, W. K., Poore, A. G. B., and Major, R. E. (2019). **Improving big citizen science data: Moving beyond haphazard sampling.** PLOS Biology, 17(6), e3000357. https://doi.org/10.1371/journal.pbio.3000357

Fink, D., & Hochachka, W. M. (2012). 8. **Using Data Mining to Discover Biological Patterns in Citizen Science Observations.** In Citizen Science (pp. 125–138). Cornell University Press. https://www.degruyter.com/document/doi/10.7591/9780801463952-015/html

Illinois Sustainable Technology Center, I. S. T. (n.d.). LibGuides: **Citizen Science: What is Citizen Science**. Retrieved August 2, 2022, from https://guides.library.illinois.edu/c.php?g=348340&p=2347193

Jordan, R., Ehrenfeld, J., Gray, S., Brooks, W., Howe, D., & Hmelo-Silver, C. (2012). **Cognitive Considerations in the Development of Citizen Science Projects.**

National Geographic Society. (n.d.). Bioblitz | **National Geographic Society.** Retrieved August 2, 2022, from https://education.nationalgeographic.org/resource/bioblitz

Resnik, D. B., Elliott, K. C., & Miller, A. K. (2015). **A framework for addressing ethical issues in citizen science.** Environmental Science & Policy, 54, 475–481. https://doi.org/10.1016/j.envsci.2015.05.008

Robinson, L. D., Cawthray, J. L., West, S. E., Bonn, A., & Ansine, J. (2018). **Ten principles of citizen science.** In A. Bonn, S. Hecker, M. Haklay, A. Bowser, Z. Makuch, & J. Vogel (Eds.), Citizen Science (pp. 27–40). UCL Press. https://www.jstor.org/stable/j.ctv550cf2.9

Trinity College, Dublin. (n.d.). **Creating a Citizen Science Project – Parthenos training**. Retrieved August 23, 2022, from https://training.parthenos-project.eu/sample-page/citizen-science-in-the-digital-arts-and-humanities/creating-a-citizen-science-project/

University of Minnesota Duluth. (n.d.). **Randomly locating sample plots.** Retrieved March 2, 2024, from https://wormwatch.d.umn.edu/research/research-methods/randomly-locating-sample-plots

Wong, A. (2021). **Citizen Science at UBC: A Framework and Future Recommendations.** Course Code: VOL 400. https://sustain.ubc.ca/sites/default/files/seedslibrary/VOL_400_Citizen%20Science%20at%20UBC_FinalReport.pdf

Thank you for reading! We hope you found the research summarized in this Toolkit useful.

Please email seeds.info@ubc.ca for any questions or comments.