

Sunprints: The Art and Science of Cyanotypes

LESSON PLAN

ALSO FOR
SCIENCE
LESSON PLAN

GRADE AND SUBJECTS (STEAM CROSS-CURRICULAR): Grade 9 Visual Arts OR Grade 9 Science Strands (Scientific Investigation Skills and Career Exploration, Biology) - Academic and Applied

LESSON(S) TOPIC: Using sunprint art with citizen science projects to document nature

DURATION: 245 minutes (3 periods)

INTRODUCTION

Students study cyanotype (also called shadowgraph, blue print, or sunprint) photography techniques for school ground citizen science with inspiration from historical and contemporary artists. Using cyanotypes and digital photography, they document natural features of their school ground for local and online nature study. In a culminating independent project, they use cyanotypes for empirical design, environmental journalism, or community wellbeing.

In Activity 1, students **discover** historical and contemporary artist-scientists using camera-less cyanotype (blue print) nature photography, exploring the artists' work and biographies. Activity 2 is outdoors, where they take **action** as citizen scientists by using digital photography with iNaturalist and creating their own cyanotypes to document species and plant structures from the natural habitat of their school ground. In Activity 3, students build on their cyanotype practice to design, create, and share a meaningful capstone project to inspire positive **change** in their communities.



Tulip tree leaves
by Ansel Oommen

CURRICULUM EXPECTATIONS

GRADE 9 VISUAL ARTS

Strands

1. **Creating and Presenting:** Applying the creative process is a necessary part of designing and producing original art works. Students use the stages of the creative process to generate ideas for, plan, produce, and present works of art. They explore technologies and the elements and principles of design to create art works for a variety of purposes. Throughout, they document their approach in a portfolio, which they can use to reflect on the effectiveness of their use of the creative process.
2. **Reflecting, Responding, and Analysing:** Through the critical analysis process, students interpret and assess the effectiveness of their own and others' art works. By learning how art works reflect both social and personal values, students develop a deeper understanding of themselves, past and present societies, and the communities in which they live.

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3. Foundations: In this strand, students develop their understanding of conventions, techniques, and processes that people use to produce visual art works. They develop the vocabulary necessary for describing and evaluating their own and others' art works. This strand also introduces students to responsible practices associated with visual arts such as the importance of health and safety practices and respect for their environment.

Specific Expectations

- A1.1** Use a variety of strategies, individually and/or collaboratively, to generate ideas and to develop plans for the creation of art works.
- A1.2** Use exploration/experimentation, reflection, and revision when producing a variety of art works in...printmaking.
- A2.2** Apply elements and principles of design to create art works that communicate ideas and information.
- A3.1** Explore and experiment with a variety of media/materials and traditional and/or emerging technologies, tools, and techniques, and apply them to produce art works.
- A3.3** Demonstrate an understanding of some of the ways in which art works can be presented to reach a variety of audiences.
- B1.3** Interpret a variety of historical and/or contemporary art works.

LEARNING GOALS

Students will be able to:

- » Demonstrate appropriate techniques for creating cyanotype artworks using natural and found materials.
- » Demonstrate improvements in their use of materials, technique, composition, layering, and/or negative space to achieve desired effects with cyanotype.
- » Describe techniques used by historical and contemporary artist-scientists for cyanotypes and relate their artwork to the artists' biographical information.
- » Contribute digital photography nature observations to an online citizen science database for environmental monitoring.
- » Compare and contrast different technologies and techniques for documenting natural objects, including digital photography and cyanotypes.
- » Define environmental journalism, empirical design, and mental wellbeing and describe how art can be used to support each.
- » Contribute to environmental stewardship of their school ground, community wellbeing, and positive environmental attitudes by sharing their projects with others.



Peacock by Atkins and Dixon

- B1.4** Use a variety of strategies to identify and reflect on the qualities of their own art works and the works of others, and evaluate the effectiveness of these works.
- B3.3** Identify, on the basis of exploration, a variety of personal opportunities in their community in cultural or other fields related to visual arts.

- C2.1** Demonstrate an understanding of some techniques that artists use to achieve specific effects.
- C3.3** Demonstrate an understanding of how the production and presentation of art works can affect the environment, and apply environmentally responsible practices when creating and presenting art works.

GRADE 9, SCIENTIFIC INVESTIGATION SKILLS AND CAREER EXPLORATION OR ACADEMIC - BIOLOGY: SUSTAINABLE ECOSYSTEMS OR GRADE 9, APPLIED - BIOLOGY: SUSTAINABLE ECOSYSTEMS AND HUMAN ACTIVITY

Overall Expectations

- A1.** Demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating).
- A1.5** Conduct inquiries, controlling some variables, adapting or extending procedures as required, and using standard equipment and materials safely, accurately, and effectively, to collect observations and data.
- A2.** Identify and describe a variety of careers related to the fields of science under study, and identify scientists, including Canadians, who have made contributions to those fields.
- B2.** Investigate factors related to human activity that affect terrestrial and aquatic ecosystems, and explain how they affect the sustainability of these ecosystems.
- B3.** Demonstrate an understanding of the dynamic nature of ecosystems, particularly in terms of ecological balance and the impact of human activity on the sustainability of terrestrial and aquatic ecosystems.

Specific Expectations

- A1.2** Select appropriate instruments and materials for particular inquiries.
- A2.2** Identify scientists, including Canadians, who have made a contribution to the fields of science under study.
- B2.1** Use appropriate terminology related to sustainable ecosystems, including, but not limited to: bioaccumulation, biosphere, diversity, ecosystem, equilibrium, sustainability, sustainable use, protection, and watershed.
- B2.2** Investigate the characteristics and interactions of biotic and abiotic components of a terrestrial or aquatic ecosystem, and describe the importance of these components in a sustainable ecosystem.
- B2.5** Analyze the effects of human activity on the populations of terrestrial and aquatic ecosystems by interpreting data and generating graphs.
- B3.1** Compare and contrast biotic and abiotic characteristics of sustainable and unsustainable terrestrial and aquatic ecosystems.
- B3.5** Identify various factors related to human activity that have an impact on ecosystems, and explain how these factors affect the equilibrium and survival of ecosystems.

ENVIRONMENTAL EDUCATION CONNECTIONS

KNOWLEDGE

- The nature of ecosystems and biomes, their health, and their interdependence within the biosphere.
- The dependence of humans on environmental resources for life and sustenance.
- The role of science and technology in the development of societies and the impact of different technologies on the environment.
- The process of urbanization and the implications of deruralization.
- The interconnectedness of political, economic, environmental, and social issues in the present world.
- Cooperative national and international efforts to find solutions to common environmental issues and to implement strategies for a more sustainable future.

SKILLS

- Define such fundamental concepts as environment, community, development, and technology, and apply these definitions in local, national, and global contexts.
- Use a range of resources, communications skills, and technologies in addressing environmental questions.
- Develop problem-solving skills and critical and creative thinking skills, including the ability to reason and apply logic, to recognize and apply abstract patterns, to identify connections and relationships between ideas and issues, and to test ideas against new information and against personal experience and beliefs.
- Recognize the need to incorporate an environmental perspective in decision making models.

ATTITUDES

- Appreciate the resilience, fragility, and beauty of nature and develop respect for the place and function of all living things in the overall planetary ecosystem.
- Appreciate the role of human ingenuity and individual creativity in ensuring survival and achieving sustainable progress.
- Maintain a sense of hope and a positive perspective on the future.

MATERIALS:

- Sunprint (prepared) cyanotype paper, at least 2 sheets per student, more suggested (*NOTE: Using prepared paper avoids the use of chemicals that require safety equipment and special lab techniques. See note on do-it-yourself options in the extension, which should only be considered with experienced practitioners and safety protocols in place.*)
- Shallow pan of water
- 2 pieces of cardboard for each student, larger than the paper
- Found natural materials (gathered during Activity 2) such as leaves (pine needles, grass, fallen leaves), twigs, vines, seeds (acorns, maple keys, milkweed fluff, nuts), bark, etc.
- Optional: plexiglass cover (often comes with the kit), preferably 1 per student
- Optional: flat or 3D objects that make interesting shadows, such as lace, paper clips, magnet letters, beads, buttons, etc.
- Optional: Framing mats sized to fit sunprint paper, at least 1 for each student
- Optional: Non-acidic art glue for framing
- Whiteboard or similar for group discussion
- Tablet or other device for submitting iNaturalist observations. At least 1 for the class. Must be able to take photographs. Data is optional (the Seek app by iNaturalist can be used without data and observations submitted later.)

OPTIONAL MATERIALS FOR ACTIVITY 3 PROJECTS, AS NEEDED:

- Lemon juice or vinegar (small bottle)
- Multiple brands/strengths of sunblock
- Found unnatural materials such as litter
- Protective gloves, garbage and recycling bags (if gathering litter)
- Additional sunprint paper and other materials for students to facilitate making cyanotypes with others

(**Appendix EcoSpark iNaturalist Guide**) step-by-step instructions for classroom participation in the iNaturalist citizen science project [EcoSpark Participant Observations](#), including how to photograph and submit nature observations

MATERIALS PREPARATION

Prior to Activity 2, test cyanotype exposure times with a scrap of sunprint paper. The timing will depend on the season and the time of day, as well as weather conditions. The paper should turn very pale blue everywhere it's exposed to the sun. Between 10am and 2pm in summer, this could be in just a few minutes, while midwinter the exposure might take 2-3 hours.

APPENDIX ARTIST PACKETS

- Anna Atkins: Cyanotype pioneer
- Bill Chambers: Environmental journalism
- Ansel Oomman: Art and Science for self expression

ACTIVITY

ACTIVITY 1 ARTIST WORK AND BIOGRAPHIES (SMALL GROUP)

Introduce students to cyanotype examples. (See Appendix Artist Packets.) This is an early camera-less photography technique invented in 1842 by astronomer John Herschel and pioneered by scientist Anna Atkins. Atkins was an innovative female scientist who used the technique to publish the world's first book of photography. Students will be learning about cyanotypes and making their own to explore environmental issues and create an independent STEAM project.

Ask students to share what they know and wonder about cyanotypes and write these on a Know-Wonder-Learn chart.

Introduce the science of cyanotypes, describing the chemical process that creates Prussian Blue in exposure to sunlight. (See Artist Packet: Bill Chambers for info.) Water stops the exposure and captures the image (this stopping of the exposure was actually the most innovative step). Cyanotypes were used historically up till the familiar use of blueprints for architecture, and are now used by artists who have revived the camera-less medium.

Break into small groups. Each group will read one of the Artist Packets in depth on a historical or contemporary artist. After 10 minutes, they will reconvene as a class and share the summary of the info, including a description of the artwork, process/technique info, and biographical info. Presentations should include their group's perspective on the ways in which their artist presented sunprints to reach a variety of audiences, and historical or cultural context for the artworks. How did their artist influence others?

ACTIVITY 2 CITIZEN SCIENCE NATURE WALK (WHOLE CLASS - OUTDOORS)

Explain the significance of nature observation for citizen science to contribute data for environmental monitoring. (See Appendix EcoSpark iNaturalist Guide.) Together, look at some iNaturalist nature observations from the nearby community, using the app.

As a group, walk slowly around the school building or around the entire schoolground perimeter (alternatively, you can visit nearby parks or natural areas). Take at least 5 iNaturalist observation photos of plants, insects, birds, or other wildlife observed during the walk. If using the app, check the scientific observation details (such as sighting time and location) automatically uploaded, or add them in as needed. Focus on observing wild species, even weeds, rather than cultivated species like planted flowers, for the most useful data for nature studies.

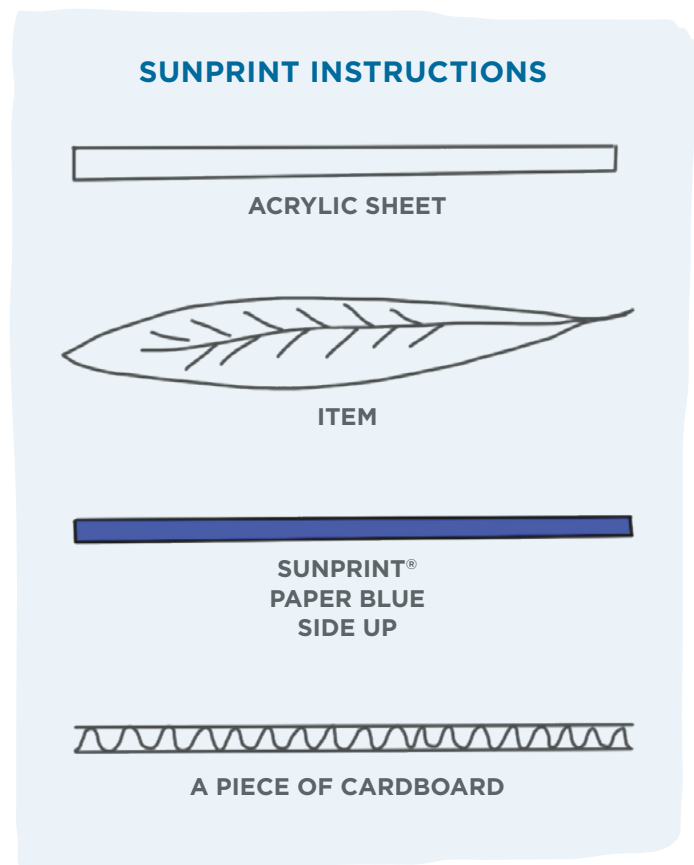
As you walk, each student should gather fallen natural materials for their cyanotypes (note: remind students NOT to remove anything from live plants, as this is harmful to the plant). (Optional): Students can write in a journal where each object was found or indicate the location on a digital or printed map of the school ground with a descriptive label.

As you walk, ask the students to consider artistic and scientific features of the environment. What about this location will shape how they generate ideas and develop plans for the creation of sunprints? (Materials available, local audience, etc.) How much natural area is there vs. paved or human-made objects? How many layers of vegetation are there in different locations? For example, presence of both understory plants and overstory trees offer a more complete, complex habitat than mowed lawn.

How many different species are they able to observe? (Visit ecospark.ca to introduce biodiversity concepts for healthy natural areas.)

In a sunny area outdoors sheltered from wind, each student will design their cyanotype. See “Materials Preparation” note above about exposure time. Manage expectations, emphasizing that the students will be experimenting with a complex material and results may vary depending on weather, paper type, timing, and other factors. Abstract and unexpected designs can be meaningful outcomes, and will look stunning once framed. Opportunities for exploration and reflection will make the sunprinting process itself the goal.

1. Practice arranging the leaves or other items on a flat surface (cardboard or sidewalk) so that their shadows make meaningful patterns.
 - a. Evaluation opportunity: Have students begin writing a short statement on their use of exploration/experimentation to assemble their sunprint.
2. When ready, quickly open the dark bag of solar print paper and remove a single sheet, then reclose the bag.
3. Immediately place the paper on the flat surface, blue side up.
4. Immediately transfer leaves etc. onto the paper and arrange as desired in the sun. Cover the items with the optional clear acrylic sheet to flatten and hold them in place OR if breezy, include a small heavy item like a rock on the corner of the paper to weigh it down. Try to complete this step within 10 seconds because the paper will be exposing in the sun!
5. Immediately start your timer for 1 minute. Do not move the items.
6. After 1 minute, check the color of the exposed paper. A very pale whitish-blue indicates the exposure has completed. Leave the paper and items in place for more minutes if needed.
7. When the paper is whitish-blue and shows darker patterns under the items, quickly remove the items and plunge the entire paper in a water bath.
8. Swirl the paper in the water until completely wet, to stop the exposure.
9. Lay the wet paper out flat to dry. The pattern will turn darker blue as it dries.
10. If the paper curls, flatten it under a book once dry.
 - a. Have students complete their statement by adding reflection on their piece, and their plans for revision if time and materials allow.



ACTIVITY 3 STEAM PROJECT (INDIVIDUAL)

Students will design an independent project using one of the following Options (or suggest another) to explore an art-science concept with cyanotypes. These projects are meant to inspire environmental stewardship and action while highlighting best practices and/or innovative approaches with cyanotypes. They will write out their plan and share it with another student, who should offer constructive feedback. You can also have students workshop their design with you. Once the design is approved, they should gather materials and begin their project with a prototype step as appropriate (trying out a small sample or with a single participant). Then they should get feedback from the participant or a fellow student, reconsider their design, and continue to develop the project. When completed, students can present their project to the class, write about their findings in a scientific report, or create a display, as appropriate, to share the work with others.

Activity 3 Option A: (See *Plant Form and Bioiversity* text box and *Anna Atkins* artist packet): Use an empirical study design to investigate a scientific question using cyanotypes. For example, design a botanical comparison experiment using cyanotype materials, natural plant pieces like leaves, twigs, or seeds, and rulers to investigate the plant form and diversity of your school ground. Investigate solar radiation levels and the effectiveness of various sunscreens by painting with different brands on the plexiglass cover before exposing the sunprint paper to light. Experiment with multiple exposure times, adding vinegar or lemon juice to the water bath, using semi-transparent objects, or invent other physical variables and techniques to create new effects for artists using cyanotypes.

Activity 3 Option B: (See *Environmental Journalism* text box and *Bill Chambers* artist packet): Design an environmental journalism project that frames an environmental issue that is important to you and your school. The project should be visually memorable or offer a unique perspective to draw attention to an issue and inspire others to learn more and take positive actions. Images can be hopeful (inspiring people to understand and protect natural features) and/or awareness raising about a problem (showing impacts of environmental degradation).

Activity 3 Option C: (See *Nature and Art for Mental Wellbeing* text box and *Ansel Oommen* artist packet): Design an activity for others to participate in nature and art appreciation to enhance wellbeing. The activity should have clear examples, step-by-step instructions, inspirational materials, and ways for participants to be able to work in a physically calm environment. For example, consider calm music or quiet art spaces to allow for reflection, work outdoors, and ensure creature comforts like snacks or a walk to recharge. Offer solo time or help a group provide positive support to each other. Include a way to assess or measure outcomes, such as self-checks for heart rate before and after or pre-and post-survey on participant stress levels.

Environmental Journalism: Real Images That Made a Difference

Famous photographs have changed collective understanding about important environmental issues and inspired positive environmental attitudes. Photos raise awareness such as those of Exxon Valdez oil spills and plastic trash in the stomachs of sea birds. Others inspire conservation attitudes, including early photos of Earth from space by astronaut Bill Anders called *Earthrise*: “Earth divulges its true state...warmly welcoming and achingly vulnerable...*Earthrise* was an Earth selfie, taken by earthlings.” – Joe Moran, *The Guardian*, 2018, <https://www.theguardian.com/artanddesign/2018/dec/22/ behold-blue-plant-photograph-earthrise>

Nature and Art for Mental Wellbeing

Spending time in nature supports mental health. In addition, making art provides wellness opportunities, for example through reflection, stress-relief, and self expression. How are school communities supported by enhanced wellbeing? For example, increasing creativity for problem-solving, reducing stress by engaging in art and nature appreciation during school exams, helping the broader community overcome pandemic conditions and feel connected, etc.

Resources: Student Well-Being and Mental Health <https://www.dcp.edu.gov.on.ca/en/program-planning/considerations-for-program-planning/student-well-being-and-mental-health>.

Brain Research Shows Arts Promote Mental Health <https://ucalgary.ca/news/brain-research-shows-arts-promote-mental-health>

Nature Can Have a Nurturing Effect on Your Health <https://www.camh.ca/en/camh-news-and-stories/nature-can-have-a-nurturing-effect-on-your-mental-health>

PLANT FORM AND DIVERSITY

Botanists study the outline and structure of plant parts for species identification, as well as to learn about the function of the plant in an ecosystem. For example: alternate vs. opposite twig structure; toothed vs. smooth leaf edges; leaf size and shape; seed number, size and dispersal method (e.g., windblown willow seed fluff vs. maple keys vs. walnut); vine grasping methods; thorns or other protective structures.



SMOOTH



LOBED



TOOTHED
(SERRATED)

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LESSON PLAN



Bottles by Bill Chambers



Poppy by Anna Atkins



Fern by Anna Atkins

WRAP UP

Revisit Know-Wonder-Learn chart and fill in what we learned about cyanotypes.

Ask students to reflect on cyanotypes and their final projects. What worked well, what would they change for next time?

Ask each student to select a favourite cyanotype print. Flatten under a book. Use the frame and glue a small amount all the way around the inner edge of the frame, then center on the print to mount the print in a frame. Create a display using the prints. Ask students to name and label their prints or type out a short biographical statement about their work in cyanotype (see Artist Packet bios for inspiration), then print them and add to display.

SHARE STUDENT WORK WITH ECOSPARK!

We would love to hear from your class about the projects you designed. Share images of cyanotypes from any of your activities with us by emailing schoolwatch@ecospark.ca. We may invite students to contribute to our blog or share about their work on EcoSpark's social media channels to inspire others in the community!

ADDITIONAL CONSIDERATIONS

EXTENSION ACTIVITIES

- Have students research women photographers, and artists using cyanotype in Canada.
 - Chelsea Jeffrey <https://www.yukon-news.com/entertainment/jenni-house-artist-uses-cyanotype-to-document-world-around-her/>
 - Lisa Myers (see below)
- Make cyanotypes of various 3D objects on the paper.
- Layer multiple lacey fabrics and other objects to build up a multipart image.
- Use cut-outs of shapes or magnet letters or write on the plexiglass to add shapes and letters.
- Use digital negatives or transparent slides to create photograph-like cyanotype exposures, combining multiple photography types.
- Capturing interesting larger shadows of trees, gates, cars, buildings, etc. cast on the sidewalk by placing the sunprint paper under the shadow when the sun is low in the morning or afternoon.
- Get giant sheets of sunprint paper to make large format art.
- Work with a science lab (and dark room) at school to prepare your own cyanotype coatings for paper or fabric, using appropriate safety techniques (see Bill Chambers art packet for ideas and consult with experienced practitioners).
- Make a class photobook or field guide with cyanotypes collected to share with other classes and the community (e-version or printed).

ADAPTING TO DIFFERENT GRADE LEVELS AND SUBJECTS

Senior Level

- Grade 10 Visual Arts expectations are largely met with the same activities, especially A1. The Creative Process, A2. The Elements and Principles of Design, B3. Connections Beyond the Classroom, and C2. Conventions and Techniques
- Connect this lesson with Photography (AWQ3/4 for Visual Arts and TGP3/4 for Technology) or grade 11 and 12 Visual Arts (AVI3/4 and TGJ3/4) by linking curriculum expectations for environmental impact.
- Have students research more advanced cyanotype processes and plan Activity 3 using these techniques. Refer to *Cyanotype* by Christina Anderson, eBook, 2019, ISBN: 9780429805974, or other online or local library resources.

Junior Level

- Replace Activity 1 with a group exploration of the images included in the Artist Packets and other sources. Display a diverse array of sunprint art that the students can compare and contrast. Ask for students' ideas about how different sunprint techniques were achieved.

- Assist younger students with the materials as they set up and time their sunprints, or work together as a class using a single larger sunprint paper, having each student select 1 or 2 items to include in the class artwork.
- Introduce Anna Atkins with age-appropriate books, such as *The Bluest of Blues: Anna Atkins and the First Book of Photographs* by Fiona Robinson, eBook, 2019, ISBN: 9781683352891.

First Nations, Métis, and Inuit Studies:

- Explore indigenous artist Lisa Myers' Blueprints art, accessed at <https://lisarosemyers.com/section/382323-Blueprints.html>. The artist uses botanical materials (blueberry juice) to print maps and mark trauma and resilience. Essayist Maya Wilson-Sanchez discusses the work as, "an intimate way of relating to land that demonstrates how personal history and cultural memory can be transmitted using new methods" in *On Mapping, Storytelling, and Cooking: A Discussion of Lisa Myers's Berry Works* (accessed at <https://www.otherplaces.mano-ramo.ca/maya-wilson-sanchez-on-mapping-storytelling-and-cooking-a-discussion-of-lisa-myerss-berry-works>, 2021).

REFERENCES

- **The Ontario Curriculum, Grades 9 and 10: The Arts, 2010**
- **The Ontario Curriculum, Grades 9 and 10: Science, 2008 (revised)**
- Ontario Ministry of Education. (2009). *Acting today, shaping tomorrow: A policy framework for environmental education in Ontario schools*. Ontario Ministry of Education. www.edu.gov.on.ca/eng/teachers/enviroed/ShapeTomorrow.pdf

SCHOOL WATCH LESSON PLAN

School Watch introduces students, grades 6 to 12, to the world of citizen science through customized curriculum linked classroom and on-site activities. EcoSpark's School Watch program provides the lesson plans and tools - such as butterfly nets, binoculars, and tree measuring tools - to deliver citizen science projects suitable for most school grounds. EcoSpark staff lead facilitated two-hour outdoor sessions with students, on or near the school grounds, to bring curriculum based concepts to life. In addition to providing the necessary equipment, we supply data sheets and other project materials such as identification keys.

EcoSpark believes strongly in the benefits of outdoor education but also recognizes that since the Covid-19 crisis, not all education will take place in traditional school learning environments. In addition to our in-person programs, we have modified remote learning options available with flexible scheduling and delivery variations based on board, school and teacher needs and requirements.

For more information or questions, please contact:
schoolwatch@ecospark.ca
or 647-258-3280 x 2003