Patterns in Nature

A Toolkit to Assist Art & Science Integration In Adult Programming

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BOTANIC GARDENS

Table of Contents

Chapter One:

Introduction, Toolkit Audience & Goals

In this chapter we will...

- Introduce this toolkit and identify its intended audience.
- Identify the goals of this toolkit.
- Frame the benefits of STEAM/art & science intergrated programming in science organizations.

Introduction & Goals of This Toolkit

Introduction and Audience:

Adult learners have different motivations, goals, and needs than child learners. Many resources in both informal & formal education address child learners and STEAM, but for adult learners this practice is under-reported in both literature and informal science programming. This toolkit is being created to address this gap and blend STEAM/arts integration pedagogy with best practices of adult education.

This toolkit is for anyone in a science education organization (museums, zoos, aquariums, public gardens, etc) who wants to commit to doing STEAM or arts integrated programming, but doesn't know where to start. While it may be particularly useful to program managers and educators, this toolkit can serve many audiences working in science education organizations.

The goals of this toolkit are to:

- **Provide a grounding in best practices for art & science integrated adult programming.**
- **Give practical advice and work plan for developing STEAM/arts & science integrated programs.**
- **Share resources and templates to make this toolkit useful.**

In this toolkit you will find:

- Background on how STEAM/arts integration can benefit both your organization and program participants.
- Definitions and best practices from STEAM, art integration, and adult programming.
- How to apply theory from adult programming and STEAM literature to practice.
- Practical tips and templates for program development.
- Program evaluation resources to make your programming even better!
- An example of an art integrated pilot program at the University of Washington (UW) Botanic Gardens including: program activities, handout, and survey.

Background & Framing

Background

Trends from formal science education like STEAM (Science, Technology, Engineering, Arts and Maths) & arts integration in science learning, place an emphasis on interdisciplinary learning practices. The benefits from these practices to learners are clear: they boost creativity & critical thinking (Grant & Patterson, 2016; Bowen et al, 2014), and connect learners to science topics (Lesen et al, 2016). Further, the arts are a tool to promote better mental health & community connection (Eising, 2019).

Science organizations like museums, zoos, botanical gardens, and aquaria are uniquely positioned to advance informal science learning through these integrated learning practices because of their connection to scientists, science collections, and expertise in delivering science programming. Additionally, through STEAM & art integrated science programs, science organizations can provide an entryway to science through the arts and creativity. These programs can help reach new audiences, help organizations build connections with artists and art educators, connect artistic topics with science or specimen collections, and build positive experiences with both the organization and the collections.

Benefits of STEAM/Art & Science Integrated programming to learners:

- **Boosting creativity** (Grant & Patterson, 2016)
- **Building critical thinking skills** (Bowen et al, 2014)
- **Connecting learners emotionally to science topics** (Lesen et al, 2016)
- **Arts promote mental health and community connection** (Eising, 2019)

Benefits of STEAM/Art & Science Integrated programming to Science Educational Organizations:

- **Reach new audiences**
- **Build connections with art & science educators**
- **Connect arts practices with science collections**
- **Build emotional connections to STEM collections, exhibits, or topics**

Chapter Two:

STEAM/Art Integration- Definition & Best Practices

In this chapter we will...

- Define STEAM/Art Integration as it pertains to informal science learning.
- Identify best practices from formal education.
- Identify best practices from adult education to integrate into STEAM/arts integrated programming when creating it for adults.

A Brief Overview of Terminology & Definitions

STEAM

STEAM is an acronym for "Science, Technology, Engineering, Arts, & Math." You may have heard of this term before in reference to students in formal education. It is a derivative of STEM (Science, Technology, Engineering, & Math), and functions as a description for interdisciplinary or transdisciplinary education. STEAM in formal education often refers to **real-world/issues-based problem solving using all 5 disciplines** (Quiggly et al, 2017; Constantino, 2018; Kline & Areepattamannil, 2019). The impetus for providing this kind of interdisciplinary education is to ensure that students are well-rounded and prepared for an ever-evolving workplace (Kline & Areepattamannil, 2019; Rolling, 2016).

In informal education, this definition can become more "squishy." Museums and other informal learning organizations have been relied on to provide STEAM programs & resources, but because this education practice is relatively new, informal learning organizations have **ranged in their interpretation** of this concept. These different interpretations span from the all 5 interdisciplinary issues-based problem solving to teaching science concepts through the use of art or art-making. It is also important to note that most museum STEAM programming reported in informal learning literature focuses on young students already in formal education, rather than expanding that programming to adult participants.

Arts Integration

Arts integration refers to the blending of arts practices into another discipline's teachings (Green et al, 2018). This term is normally used to describe the combination of art and science in school lessons. Similarities between art and science disciplines include observation and inquiry, and arts-integrated programming usually relies on these shared traits to merge the two disciplines (Green et al, 2018). There are several different styles of art integration but the most effective ways of integrating art are when the art topics, medium, and creative process are just as emphasized as the science learning (Green et al, 2018). Fully integrating art and science learning can take many forms. A few examples of arts-integration are inviting an art expert into the room to co-teach a science class or reaching out to art institutions to host arts-integrated programming.

For more information about the four different modalities of art integration see Green et al, 2018.

Informal Learning & STEAM

After reading the above definitions of STEAM and art integration, you may still be a little confused about the difference between these two concepts. The main difference is that (for classrooms) STEAM learning specifically refers to problems given to students that require the use of trans/interdisciplinary solutions. During the problem-solving period, students are given free rein to experiment across disciplines to find their solutions. They may be using archival research skills, physics, graphic design, mathematics, etc to find and communicate their solution to a real-world problem. Arts integration still relies on more traditional teaching practices, without using problem-solving as the teaching tool. Arts integration is facilitator-led, with one or more experts explaining concepts before giving space to learners to experiment with these new ideas.

So what's the difference?

For informal science organizations, these differences in pedagogical practice may not make such a difference when creating interdisciplinary programming. The most important thing to emphasize if you are doing STEAM-based or arts integration-based programming is to ***make sure that the "art" is fully integrated into the programming and that the science learning doesn't dominate the experience.***

What does this mean for informal learning programs?

This may mean:

- Finding science and art topics that easily relate to each other and build off each other.
- Inviting an outside expert to co-facilitate the experience.
- Bridging the gap between disciplines by using basic principles of observation, inquiry, and experimentation.
- Building a "making" phase into your program design and creating space for participants to experiment with the art medium.
- Creating an environment where participants feel comfortable trying new things, having new experiences, socializing with their peers, and experiencing "failure" (meaning that the final artistic result doesn't align with their expectations).

HOT TIP!

If you are having trouble thinking of ways art and STEM can relate, a good place to start is with mathematics! Art uses mathematics in patterns, motifs, weaving/sewing arts, tiling practices...the list goes on! Mathematical patterns are a good starting place for art-making and exploration. These mathematical patterns can also be easily branched out to other branches of STEM (ex: Fibonacci series in plants).

Adult Programming

Six Principles of Adult Learning (Knowles, 2005)

Adult learners have different motivations, goals, and needs than child learners. Each adult participant will have unique contexts and prior experiences that they are bringing to your program. There are six principles to keep in mind when creating programming from Malcolm Knowles' theory of adult learning:

1) Emphasize why a concept is relevant to the learner before they engage with it.

2) Affirm the learner's independence in the learning process and create environments where adult learners can make choices about what or how they are learning.

3) Acknowledge the prior knowledge and experience of the learner. Adult learners often have their own past experiences with program topics.

4) Give examples of how the program topics are relevant to everyday life. This principle could also be addressed by describing how the program adds value to daily life through creative practices.

5) Add specificity to your program topics and design. Adult learners tend to prefer specific practical skills or knowledge over broad teachings.

6) Recognize that adult learners have a wide range of internal motivations for attending your program. These motivations vary from skills acquisition from socializing with others to leisure & enjoyment (Sachatello-Sawer & Fellenz, 2000). To address this range in motivations, adult programming should be somewhat challenging, create a personal connection with the place or topic, include sensory experiences, and prioritize interactive relationships between facilitator and participants (Sachatello-Sawyer & Fellenz, 2000; Smirgalia, 2016).

Outdoor Spaces & Adult Programming

Outdoor spaces can be a great resource for adult programming. According to Sachetello-Sawyer & Fellenz, the most impactful adult programs "occur outdoors over an extended period of time and helped adults reconnect with the natural world in some way" (2000). Science organizations that have access to outdoors spaces are uniquely positioned to provide these outdoor experiences that reflect some of the best qualities of art integrated programming - observation, inquiry, and curiosity. If your organization doesn't have access to the outdoors, then don't worry! There may be other ways of connecting your participants to the outside world through the topics that you choose to deliver in your programming.

The Key Take-Aways from the Literature

When designing STEAM/arts integrated programming, the key is to design a holistic experience that **fully integrates art-making** rather than prioritizing the transmission of STEM knowledge. An arts integrated program for adults should be **participant-centered**, emphasize **relationships and interactivity**, and be able to explain **how each part of the program connects** to itself through observation, inquiry, and experimentation.

Chapter Three:

Developing a Workplan

In this chapter we will...

- Explore how to choose program topics based on site-specific contexts and artist skills + expertise.
- Learn how to create program outcomes and learning objectives for STEAM/arts integrated programming.
- List ideas and considerations for program design.
- Share a sample timeline and template.

Identifying Interdisciplinary Program Topics

Determine what your organization is known for

When creating interdisciplinary programming, it is important to consider your organization's strengths as a starting point. Every science organization has unique assets and contexts that they can leverage to build interdisciplinary programming. Maybe your organization has access to the outdoors, a vast research specimen collection, or living collections as part of its assets. What is the "thing" your organization is known for? This will serve as a draw for your existing audience. For example, to create programming with the University of Washington Botanic Gardens, the program designer considered its vast living plant collection, trails, and well-maintained gardens as its primary assets for interdisciplinary programming.

Identify science/STEM topic

After determining your organization's "thing", narrow down the scope of your science/STEM topic. What are you trying to get across to participants? More specificity can be clarified later, but the general topic should be clear to participants before registering for the program. For some organizations with specific collections or missions, the topic might be clear but for others, you may have to narrow it down to one part of your organization's educational mission.

Identifying Interdisciplinary Program Topics

After identifying your science topic, you begin the process of identifying possible arts practices/art mediums. Don't worry if you or or staff don't have this expertise! This is a great time to start reaching out to artists or arts educators in your local area to collaborate on this project if you don't have on-staff expertise. If you choose to partner with an art educator, having the program be co-facilitated by a science expert and an art expert is a great option for integrating science and art topics.

Arts Assets — Building Networks of Community Expertise

When you have found an arts expert, start looking at types of arts mediums and connecting them to your science topics. The artist may have expertise in a specific medium, so it may be clear what medium you work with in your programming. Remember to think about our best practices of integrated/STEAM programming when determining the art medium — think of interactive ways for participants to engage in a creative process while learning and interacting with STEM knowledge, principles, and patterns. Other considerations for this might be cost of materials and expertise, messiness factor, and the appeal of using different mediums for adults. (For example, adults may not be interested in printmaking with potatoes, but they may be more interested in printmaking with 'nicer' materials.)

Connecting science topics to artistic expression

Examples of arts mediums:

- print-making
- wire-wrapping/jewelry making
- clay/sculpture/pottery
- textile arts
- paper-making

Building Program Outcomes & Objectives

Program outcomes & objectives help to identify the **key messaging** of your program and inform your program's design.

After you have identified science and art topics to use in your programming, the next step is to identify program outcomes & objectives. These statements become the key messaging of your program and will assist with program design. What do you want participants to get out of your programming? What experience, messages, and new knowledge do you think they would find interesting?

Program outcomes are *broad statements* that contain the experiences that you want your participants to learn, experience, or feel as a result of your program. For example, an outcome may be: "Participants feel inspired by the program about making connections between science and art." This broad statement helps to identify what is most important to the programming - that participants felt inspired. This helps center the program's design around the participant's experience rather than around knowledge gain.

The second piece of building out programming is creating **learning objectives**. Learning objectives are s*pecific, measurable goals* for your program. They should be observable from your perspective as the facilitator. Objectives will help you build out your program activities and be a starting point for designing your programming. They help you keep your program streamlined and organized, and should connect to your program outcomes. An example of an objective is: "Participants are able to create their own prints from found materials." This suggests that the program should be designed around having a print-making tutorial and time for participants to experiment with the printmaking process.

Don't worry if you fail to meet these learning outcomes and objectives the first time! If you are just starting on creating new programming, there are always ways to improve the program design and direction, so it may be in your best interest to treat the very first program as a pilot program. (See the next chapter about evaluation for resources on how to evaluate your program.)

For both outcomes and objectives, it is recommended to write 2-3 of them per program to keep your program messaging concise. To see more examples of outcomes and objectives, see Appendix 1 on page 22.

Program Design and Facillitation

After creating program outcomes & objectives, the next step is to design your program. Here are some considerations to make when planning your program design:

- The amount of structure included in your program.
- If/how participants are going to move throughout your organization's space
- Creating enough time for expert(s) facilitation and free exploration.
- Highlighting the most important elements of your program in its design.
- Supports to make your program accessible.

As you are creating your program, another thing to consider is the overall enjoyment of your program participants. Some things to consider are accounting for a variety of physical needs, recognizinge how participants might experience your programming differently, and making sure that participants feel welcomed into your spaces are all ways to be considerate of your program participants. How are you going to ensure that participants have a good time, and might want to come back if you repeat this program?

Finally, when designing STEAM/arts integrated programming for adults remember these tips from best practices:

- Designated free choice/free exploration time or making/creating time - and making sure that there is enough time for this!
- Creating a good & social atmosphere with interaction between participants and facilitator.
- Making science and art relevant to each other in the moment for participants.
- If you have multiple experts or facilitators, making time for each expert.
- Highlighting experiential, senatorial activities over lectures.

Program Design Examples:

- Talk at the beginning with time for free exploration
- Tabling event with multiple arts/science activities
- Nature walk/hike with art activities
- Collections exploration with art activity
- Monthly workshop with different art activities and science experts
- Seasonally themed art exploration event

Sample Planning Timeline

Planning Phase

Programming Bones: Identify What, When, Where & Who

Marketing

- Program description for promotion
- Decide marketing start date & locations
- Start marketing the program

Program Design

- Program outcomes & objectives
- Program activities
- Facilitators
- Materials budget & list
- Accessibility considerations

Evaluation

(optional)

- Write evaluation purpose & questions
- Determine methods (ex: survey, interview)
- Design questions to ask participants

Pre-Program Prep

- **Gather materials**
- **Confirm location & program flow**
- **Communicate with staff about any guests/program happenings**
- **Tech check**
- **Print program handouts/surveys**

Program Day!

Program Planning Template

Science Topic/Expert:_____/_____

Art Topic / Expert:_____/_____

Location:_____

Date(s):_____

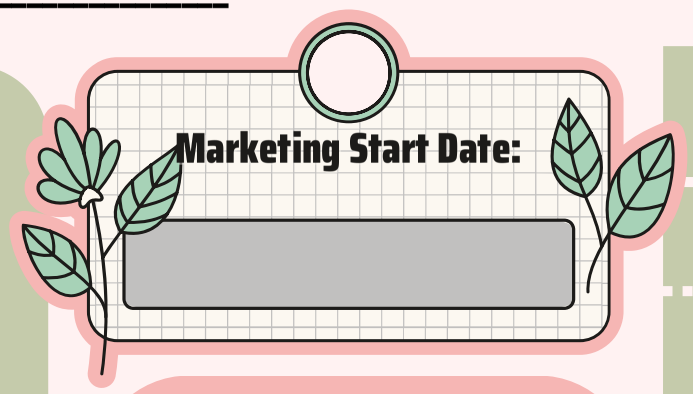
From:_____**to**_____

Program Activities Brainstorm:

Materials List:

What do you already have?

What needs to be purchased?



Advertising Methods?

- Social Media
- Blog Post
- Newsletter
- Send to Community Partners
- Other:_____

Evaluation or Survey? Yes / No

Order of Activities:	Time per Activity:

Chapter Four:

Evaluating & Improving Your Program Over Time

In this chapter we will...

- Explore how evaluation can be a useful tool for making your program even better!
- Provide useful evaluation tools & resources.

Benefits of Incorporating Evaluation into your Program

Evaluation is a great tool to get feedback from program participants. You can use evaluation to get information on how to improve pilot programs, to find out participant reactions/knowledge gain on fully developed programs, or can use it as a tool during program development (especially when creating new types of programming or trying to reach new audiences). Program evaluation can take many forms including:

- surveys (both digital & paper)
- interviews
- focus groups
- observation

Surveys are the most common method to get feedback on programs and can be integrated into the program itself so that participants don't have to take more time out of their day to provide you with that feedback.

Surveys and other evaluation methods can help you see who is coming to your program, if or how your program design/methods are achieving your intended results, and if there is a future interest in your community for that programming.

For more resources on evaluation and incorporating evaluation into your program design, see the resources section on the next page.

To see an example of a paper survey that was used as a way to get feedback on an art integrated pilot program, see Appendix 2. The feedback from this survey helped the program developers to make adjustments to their programming and incorporate more specificity for the science topics into that programming in the future.

Evaluation Resources

Evaluation Guides

Better Evaluation
(https://www.betterevaluation.org/)

University of Wisconsin Program Development and Evaluation
(https://fyi.extension.wisc.edu/programdevelopment/)

Equity in Evaluation

We All Count
(https://weallcount.com/)

Evaluation Association Resources

Informal Science
(https://www.informalscience.org/)

Visitor Studies Association
(https://www.visitorstudies.org/resources)

American Evaluation Association
(https://www.eval.org/)

Chapter Five:

Five Key Takeaways from this Toolkit

1. STEAM/arts integrated programming is doable for your organization! This type of programming can both benefit participants and help your organization expand its reach.
2. The art should be fully incorporated into your science programming. The art topic and science topic should be relevant to each other.
3. If you don't have in-house arts expertise, it is a great opportunity to partner with arts education experts.
4. Value holistic experience over knowledge transmission in your programming/program design.
5. Ask your audience to help make your program better through surveys or other evaluation instruments.

References

Bowen, D. H., Greene, J. P., & Kisida, B. (2014). Learning to Think Critically: A Visual Art Experiment. *Educational Researcher*, *43*(1), 37–44. https://doi.org/10.3102/0013189X13512675

Costantino, T. (2018). STEAM by another name: Transdisciplinary practice in art and design education. *Arts Education Policy Review*, *119*(2), 100–106. https://doi.org/10.1080/10632913.2017.1292973

Eising, Dorian. (2019, June 25). *How arts can help improve your mental health*. Mental Health Foundation. https://www.mentalhealth.org.uk/blog/how-arts-can-help-improve-your-mental-health

Falk, J. H., & Needham, M. D. (2011). Measuring the impact of a science center on its community. Journal of Research in Science Teaching, 48(1), 1–12. https://doi.org/10.1002/tea.20394

Grant, J., & Patterson, D. (2016). Innovative Arts Programs Require Innovative Partnerships: A Case Study of STEAM Partnering between an Art Gallery and a Natural History Museum.

Green, K., Trundle, K. C., & Shaheen, M. (2018). Integrating the Arts into Science Teaching and Learning: A Literature Review. Journal for Learning through the Arts, 14(1). https://doi.org/10.21977/D914140829

Khine, M. S., & Areepattamannil, S. (Eds.). (2019). *STEAM Education: Theory and Practice*. Springer International Publishing. https://doi.org/10.1007/978-3-030-04003-1

Knowles, M. S., Holton III, E. F., & Swanson, R. A. (2005). The Adult Learner: The Definitive Classic in Adult Education and Human Resource Development. Taylor & Francis Group. http://ebookcentral.proquest.com/lib/washington/detail.action?docID=232125

Lesen, A. E., Rogan, A., & Blum, M. J. (2016). Science Communication Through Art: Objectives, Challenges, and Outcomes. *Trends in Ecology & Evolution*, *31*(9), 657–660. https://doi.org/10.1016/j.tree.2016.06.004

Quigley, C. F., Herro, D., & Jamil, F. M. (2017). Developing a Conceptual Model of STEAM Teaching Practices. *School Science and Mathematics*, *117*(1–2), 1–12. https://doi.org/10.1111/ssm.12201

Rolling Jr., J. H. (2016). Reinventing the STEAM engine for art+ design education. Art Education, 69(4), 4–7.

Sachatello-Sawyer, B., & Fellenz, R. (2000). Coming of Age: A National Study of Adult Museum Programs. Curator: The Museum Journal, 43(2), 147–156. https://doi.org/10.1111/j.2151-6952.2000.tb00010.x

Smiraglia, C. (2016). Targeted Museum Programs for Older Adults: A Research and Program Review. Curator: The Museum Journal, 59(1), 39–54. https://doi.org/10.1111/cura.12144

Appendix One: Sample Program

Description, Outcomes, & Learning Objectives

Program Title: *Patterns in Nature* - An Exploration of Plants through Print-Making

Program Description:
Come investigate the textures and patterns of plants through an exploration of mixed media printmaking. This class will invite you to look closely at the plants around us to see how they are similar and different from each other. Through the practice of printmaking, this class will introduce you to look at the patterns and shapes of different plants and see how scientists observe patterns in nature.

In this class, you will be invited to walk through some of the areas of the Washington Park Arboretum and pick up fallen leaves to explore how plants have different patterns and textures. After finding some interesting natural materials, the class will embark on a printmaking practice by taking the found leaves, flowers, and bark rubbings and using them to create a print. We will then use both the print and the plant matter to explore the patterns within plants.

Program Outcomes:

1. Participants feel inspired by the program about making connections between science and art.
2. Participants will better understand how art and science can relate.
3. Participants will be engaged in the program topics (print-making and plants).

Learning Objectives:

- Participants are able to create their own prints from found materials.
- Participants can identify patterns in plants that relate to the plant's anatomy and species families.
- Participants become more comfortable with observing and identifying patterns in plants.

Appendix One: Sample Program

Materials & Activities

Materials List:

- Water soluble block printing inks
- Printing paper
- Brushes
- Newsprint paper
- Palette paper
- Cut leaves and flowers for examples
- Disposable cups
- Scissors
- Rulers
- Paper or plastic bags for material gathering
- Paper towels or cloth rags
- Pens
- Pencils
- Program handout, photo release, & survey

Outline of Activities

Pre-Program:

- Set up tables and materials

Introductions (10 minutes)

- Introduce self & thank them for joining
- Ask the following questions:
  - Raise your hand if you've ever done block printing before or if you are familiar with the process.
  - Raise your hand if you are familiar with plants or botany terms.
- Ask each person to share their name, pronouns if they're comfortable sharing, and why they are taking the program

Appendix One: Sample Program
Activities (Continued)

Program Introduction (20 minutes)

- Introduce the program - as a science and art integrated program that uses print-making to explore botany
- Go over program agenda
- Introduce how botanical features will be translated into 2-D shapes & patterns in the print-making process
- Go over relevant botanical families, anatomy, and features
    - Emphasize how this knowledge relates to our printmaking practice

Outside Exploration/Plant Collection (20 minutes)

- Prior to going outside, go over guidelines for choosing plant matter
    - Only can choose fallen plant matter
    - Plant matter must be flexible & not too 3-dimensional for printing
    - Specify locations for collection and time returning to classroom
- Set everyone free to walk, walk with everyone to choose materials to use
- Stay close, pointing out what materials might give interesting texture.
- Return to classroom at specified time.

Printmaking Tutorial (10 minutes)

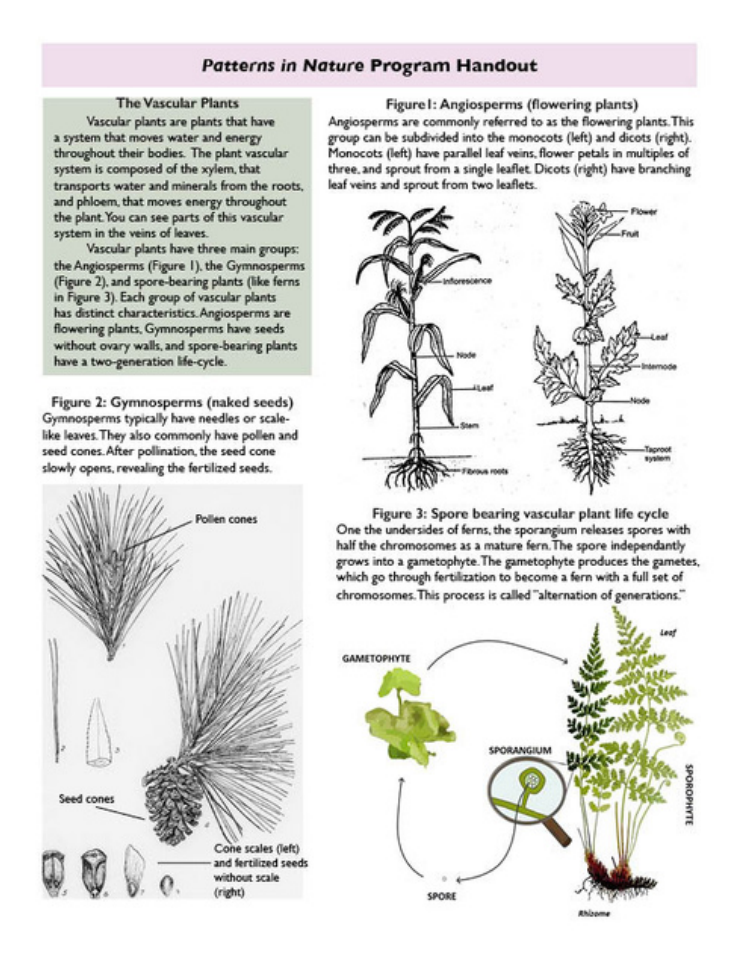
Free-Time for Printmaking (40 minutes)

- Encourage participants to experiment
- Point out where botanical features are apparent in their prints
- Encourage participants to share their creations with each other

Wrap up and ask folks to take the survey (10 minutes)

Appendix One: Sample Program

Program Handout



***Patterns in Nature* Program Handout**

The Vascular Plants

Vascular plants are plants that have a system that moves water and energy throughout their bodies. The plant vascular system is composed of the xylem, that transports water and minerals from the roots, and phloem, that moves energy throughout the plant. You can see parts of this vascular system in the veins of leaves.

Vascular plants have three main groups: the Angiosperms (Figure 1), the Gymnosperms (Figure 2), and spore-bearing plants (like ferns in Figure 3). Each group of vascular plants has distinct characteristics. Angiosperms are flowering plants, Gymnosperms have seeds without ovary walls, and spore-bearing plants have a two-generation life-cycle.

Figure 1: Angiosperms (flowering plants)

Angiosperms are commonly referred to as the flowering plants. This group can be subdivided into the monocots (left) and dicots (right). Monocots (left) have parallel leaf veins, flower petals in multiples of three, and sprout from a single leaflet. Dicots (right) have branching leaf veins and sprout from two leaflets.

Figure 2: Gymnosperms (naked seeds)

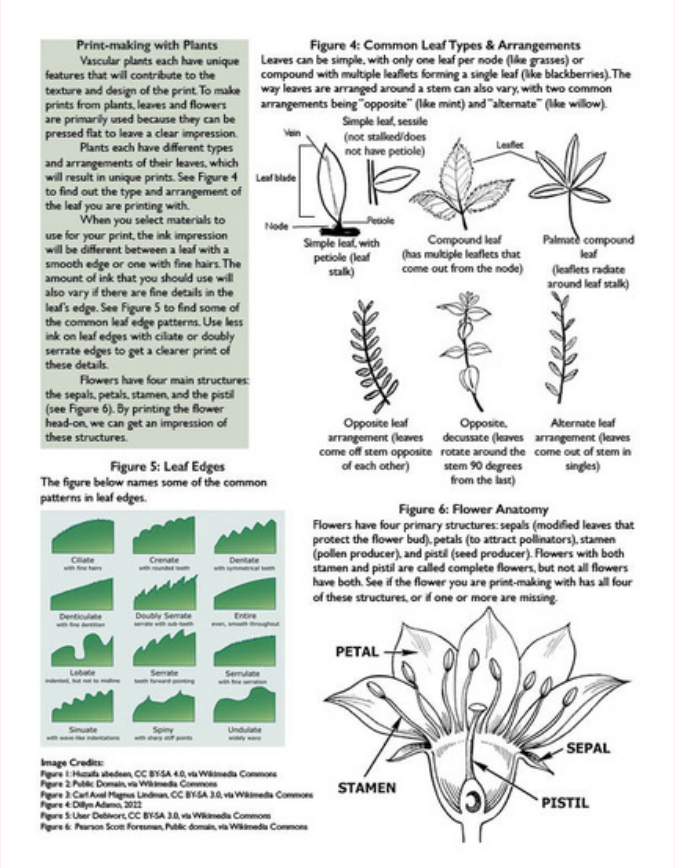
Gymnosperms typically have needles or scale-like leaves. They also commonly have pollen and seed cones. After pollination, the seed cone slowly opens, revealing the fertilized seeds.

Figure 3: Spore bearing vascular plant life cycle

One the undersides of ferns, the sporangium releases spores with half the chromosomes as a mature fern. The spore independantly grows into a gametophyte. The gametophyte produces the gametes, which go through fertilization to become a fern with a full set of chromosomes. This process is called "alternation of generations."

Page one of the handout focused on vascular plant families. It drew on the different venation patterns in each of the plant families that would show up in different ways in when they were printed.

Page two of the handout dove into plant structures, specifically looking at patterns in these structures and connecting them to the print-making process, in order to have a high level of detail within a print.



Print-making with Plants

Vascular plants each have unique features that will contribute to the texture and design of the print. To make prints from plants, leaves and flowers are primarily used because they can be pressed flat to leave a clear impression.

Plants each have different types and arrangements of their leaves, which will result in unique prints. See Figure 4 to find out the type and arrangement of the leaf you are printing with.

When you select materials to use for your print, the ink impression will be different between a leaf with a smooth edge or one with fine hairs. The amount of ink that you should use will also vary if there are fine details in the leaf's edge. See Figure 5 to find some of the common leaf edge patterns. Use less ink on leaf edges with ciliate or doubly serrate edges to get a clearer print of these details.

Flowers have four main structures: the sepals, petals, stamen, and the pistil (see Figure 6). By printing the flower head-on, we can get an impression of these structures.

Figure 4: Common Leaf Types & Arrangements

Leaves can be simple, with only one leaf per node (like grasses) or compound with multiple leaflets forming a single leaf (like blackberries). The way leaves are arranged around a stem can also vary, with two common arrangements being "opposite" (like mint) and "alternate" (like willow).

Figure 5: Leaf Edges

The figure below names some of the common patterns in leaf edges.

Figure 6: Flower Anatomy

Flowers have four primary structures: sepals (modified leaves that protect the flower bud), petals (to attract pollinators), stamen (pollen producer), and pistil (seed producer). Flowers with both stamen and pistil are called complete flowers, but not all flowers have both. See if the flower you are print-making with has all four of these structures, or if one or more are missing.

Appendix Two: Evaluation Example

Sample Program Evaluation Plan

Patterns in Nature Program Formative Evaluation Plan

Plan Summary:

Patterns in Nature is a program developed as part of a Museology thesis project by Dillyn Adamo and hosted by the University of Washington Botanic Gardens. This program focuses on how art integration in science programming can benefit adult learners. As part of Dillyn's thesis project, a survey will be conducted at the end of each delivered program. This survey will inform the development of a toolkit that will help other educators build and deliver their own art & science integrated programs.

Participant-Focused Program Outcomes:

- Participants feel inspired by the program about making connections between science and art.
- Participants will be engaged in the program topics (print-making and plants).
- Participants in the program will better understand how art and science can relate.

Evaluation Purpose Statement:

The purpose of this evaluation is to understand how effective the program is in conveying to participants how art and science learning can be integrated and to understand audience reactions to art & science integrated programs. The findings from this formative evaluation will be used to inform the creation of a toolkit that details how educators can deliver art & science integrated programs.

Evaluation Questions:

1. To what extent do participants understand how art and science can relate to each other after the program?
2. To what extent did participants enjoy the program? Would they participate in a similar program in the future? What (if anything) about the program made it enjoyable?
3. What improvements (if any) would make the program more effective in conveying either the science and art topics or the connections between science and art?

Method:

- Paper survey at the end of each program for each adult participant to be filled out anonymously at the end of the program

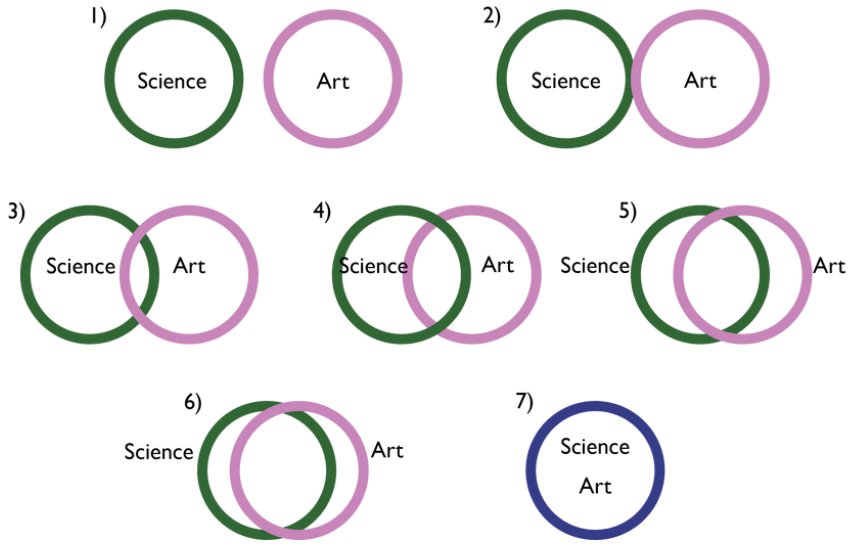
Appendix Two: Evaluation Example

Sample Program Survey

Patterns in Nature Program Survey

Thank you for participating in the program, Patterns in Nature! The program and survey are being conducted as part of a UW Museology thesis project, and your feedback is greatly appreciated. The results of this survey will help educators build similar or better programs in the future. If you have any questions about the survey, please ask the program facilitator.

1. Circle the image below that best describes the relationship between "science" and "art"? Science refers to the botany topics that we covered in the program. How connected do you feel these topics are to each other?



2. Did this program influence or change your perspective on the connections between art and science?

- Yes
- No
- I don't know/unsure

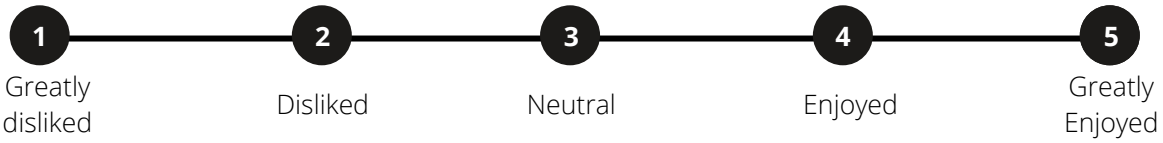
If yes, can you explain what about the program may have influenced your perspective?

3. What is the most memorable thing you learned from the program?

Appendix Two: Evaluation Example

Program Survey (Continued)

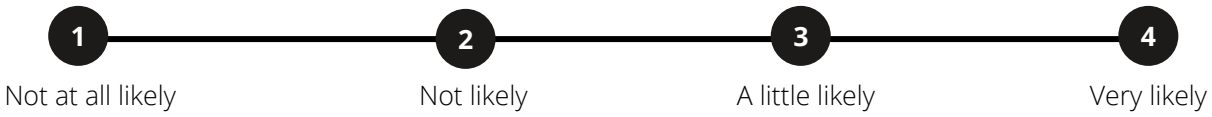
4. On a scale of 1-5, please rate your overall enjoyment of the program (circle one):



Can you explain the reason for your rating?

5. What would make the program more enjoyable or interesting for you?

6. In the future, how likely are you to participate in a program that integrates art and science topics (circle one)?



Why or why not would you participate in a program that integrates art and science?

7. Anything else you want to comment on about your experience in the program?

8. What is your age?

- 18-30
- 31-40
- 41-50
- 51-60
- 60-70
- 71+
- Prefer not to answer

9. How often do you attend UW Botanic Gardens programs or events?

- This is my first time
- About once a year
- 2-3 times a year
- 4 or more times a year
- Prefer not to answer