Marie's Garden: Designing and Implementing a Native Plant Space for Summerland Secondary's Biology 11 Class of 2017

Prepared for ER 390 & Valentin Schaefer
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"If we are going to save environmentalism and the environment, we must also save an endangered species: the child in nature."

-Richard Louv, 2005

Abstract

Nature-deficit has been identified as a growing problem among our youth of whom many are more attracted to hand-held devices and screens than they are to the nature that surrounds them. Fortunately, there is a growing movement to get kids outside. Outdoor classrooms, in particular, are gaining in popularity as they successfully meld education and the concept of 'place' so that 'place' is valued.

In order to address nature-deficit in the youth of Summerland, BC, I worked with Shona Becker, a Summerland Secondary Biology 11 teacher and her class of students to create a native plant outdoor learning space in a school owned, unused garden bed that lined Summerland's main street. It was necessary that the design and implementation of the space fulfil BC Ministry of Education Biology 11 curriculum requirements, Ministry core curriculum requirements of Social Responsibility and be student-led. With that in mind, I designed a four-themed native plant garden: Xeriscape, Native Pollinator, Okanagan Nation/Syilx and Edible. The students were involved every step of the way from choosing plants, preparing the beds, planting, irrigation, educational sign design and garden art creation.

Several challenges were encountered along the way. It took some convincing by the students to get school district grounds employees on board. This convincing delayed the project by weeks. Additionally, Shona Becker was the only teacher in the school driving the project forward. With all of her other school commitments she was spread thin and organizing the students in all the different facets of the project became difficult. This also resulted in delays.

Nonetheless the project, both in the process and in the finished product, was a great success. When I first introduced the students to typical native plants of the Okanagan region they were unable to identify any of them. After the project they could name all the plants, plus identify local pollinators and those plants with Okanagan Nation cultural significance. As future students are expected to maintain the space and monitor the plants for native pollinators it seems likely that this pride of place will grow from one biology class to the next.

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1.0 Introduction

The Living Planet Report Canada shows that, on average, from 1970 to to 2014, half of Canada's monitored invertebrate species have declined including those species that are federally protected. The report suggests habitat loss due to human activity and climate change are the primary causes of the staggering decline (WWF 2017). What is needed is a widespread call for action, particularly by the next generation by whom future repercussions of such environmental devastation will be most felt. Some, however, wonder if the youth of today are prepared for this battle. As David Attenborough laments, "no one will protect what they don't care about; and no one will care about what they have never experienced" (Attenborough, 2010).

It sounds a little 'doomsday', perhaps, but the evidence is mounting for the next generation's break from nature. A National Trust report demonstrated that 11 to 15-year-olds in Britain spend, on average, half their waking day in front of a screen, an increase of 40% over a decade (Moss 2012). Another study out of Cambridge showed that children were better able to identify Pokémon characters than native species in the community where they lived (Balmford et al. 2002). This trend forces one to question how humans will continue to benefit from the environmental services upon which we rely when our understanding and knowledge of them continues to diminish, generation by generation.

Fortunately, there is a growing recognition of the environmental, community and educational benefits of outdoor, place-based learning in our schools (Lloyd & Gray 2014, Sobel 2004). It has been repeatedly demonstrated that when students learn outside in their local environment their connection to and desire to protect their local environment and the wildlife within it increases (IDEA 2007). BC Ministry of Education's 2016 revamped school curriculum similarly acknowledges this new pedagogy and stipulates that all students must learn "to consider the interdependence of people with each other and the natural environment [and] to contribute positively to one's family, community, society, and the environment" (Ministry of Education 2016).

Now, before it is too late, is the time to capitalize on this push for place-based learning and get students of all ages outside and appreciating the natural environments in which they live. Educators of all veins much teach them to value and protect what exists and to repair where the environment ails. In this way the next generation can "re-establish an ecologically healthy relationship between nature and culture…repair ecological damage [and] repair the human condition" (SER 2017).

2.0 Study Area and Project Details

Project Duration:	April 2017 to November 2017
Subject Property Address:	Summerland Secondary School 9518 Main Street Summerland, BC V0H 1Z0
Project Coordinates:	lat 49.601468, lon -119.680127
Zoning:	School District 67 property
Biogeoclimatic Description:	PPxh1 – Ponderosa Pine Grassland - very dry hot (BCMoFLNR 2014)
Budget:	$5000

2.1 Project Focus and Scope

To address the issue of nature-deficit in our youth I worked with Shona Becker, a Summerland, BC secondary school biology teacher and her class of Biology 11 students to assist in the design and implementation of an outdoor learning, native plant space. In April, 2017 we were given permission by School District 67 to use a district owned, unused garden space that lines the main boulevard of the District of Summerland (Figure 1, 2 & 3). The space in question had long been an issue of contention between Summerland Secondary School (SSS) and the city because of its unkempt nature in a community that values a manicured appearance (S Becker, pers. comm. 2017). Prior to project commencement, the garden bed was filled with cigarette butts, garbage, weeds and a few plants from a long ago attempt at a formal planting.

At about the same time I acquired $5000 of funding from the Pettigrew Foundation, a foundation in memory of long-time Summerland resident Marie Pettigrew. A non-profit organization the foundation had previously funded had suddenly stopped its operation.

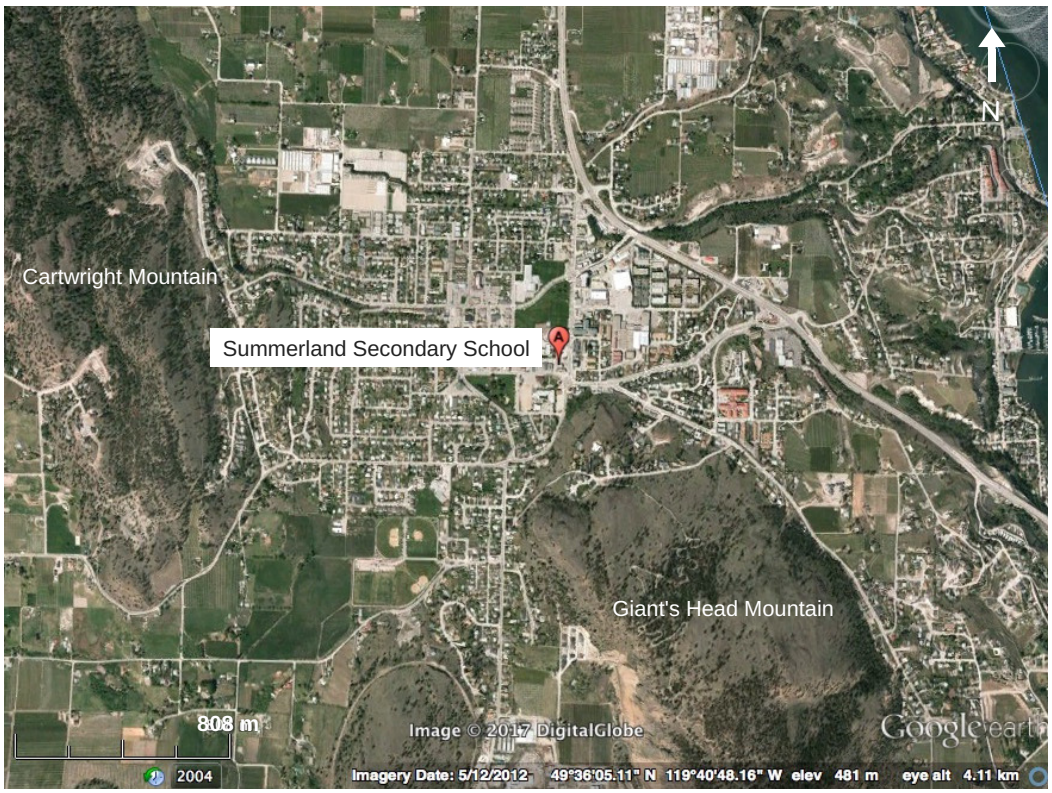


Figure 1. Summerland Secondary School within the larger context of the District of Summerland

Figure 2. Native plant, outdoor learning space highlighted in yellow. (Image source: Google earth pro)

Figure 3. Looking west down Main street at the potential project space.
Note the weeds and unkempt appearance. (Image Source: Tanya Brouwers)

In initial discussions with Shona Becker and school board members it was decided that the project implementation must fulfill Biology 11 curriculum requirements and that final design must facilitate learning in an outdoor space with final design largely student led. Community involvement was also important for Shona Becker. With this in mind, project goals and objectives were formulated.

2.2 Project Goals and Objectives

Goals

- To fulfil part of the Biology 11 curriculum requirements. Specifically, to develop a sustained intellectual curiosity about a scientific problem of local interest, to understand the process of evolution particularly as it pertains to a local environment, to analyze patterns, trends and connections in data and to apply First Peoples perspectives and knowledge as sources of information (Ministry of Education 2016b).

- To fulfil Ministry of Education core competency requirements for social responsibility. Specifically, by fostering the ability and disposition of students to care for their community and the environment (Ministry of Education 2016).

- To encourage outdoor, place-based learning within the school context.

Objectives

- Have students assist in the creation of a themed native plant space that fulfils curriculum goals. Themes will include a xeriscape or waterwise planting (local problem), a native pollinator planting (theories of evolution and local problem), a Syilx/Okanagan Nation planting (First Peoples perspectives) and a native edible planting (requested by the school cafeteria).

- Design a native plant space that encourages both community and student outdoor education by including informational signage, comfortable benches and rustic rock seating areas that are attractive to younger individuals (outdoor, place-based learning).

- Have students conduct all the site preparation, including irrigation placement, and complete all the plantings (outdoor learning).

- Create a long-term maintenance plan for the students so that the native plant space remains visually appealing (care for community) while continuing to foster a connection between the students and 'their' garden (care for environment).

- Create a monitoring plan for native pollinator abundance (analyze data).

3.0 Methods

3.1 Site Assessment

3.1.1 Vegetation Community

Date: April 25, 2017

Tools: 100 m Eslon tape, Plants of the Southern Interior Field Guide (Parish, Coupe and Lloyd 1996), Field notebook, Field Manual for Describing Terrestrial Ecosystems ground inspection forms (FLNRO & MOE 2010)

I divided the total planting space (52m x 2.75m) into the 4 themed plant spaces and assessed each space individually for percent cover using the dominant/indicator plant species section of the *Field Manual for Terrestrial Ecosystems* (FLNRO & MOE 2010).

Figure 4. Garden space is divided into the four themed gardens. (Image source: Google earth Pro)

Xeriscape Garden (12.5m x 2.75m)

Herb Layer: 30%, Remainder: Bare earth

Herb Layer Species: Idaho fescue (*Festuca idahoensis)* (10%), Common dandelion (*Taraxacum officinale) (10%),* Cheatgrass (*Bromus tectorum)* (10%)

Native Pollinator Garden (14.5m x 2.75m)

Herb Layer: 25%, Remainder: Bare earth

Herb Layer Species: Idaho fescue (*Festuca idahoensis)* (5%), Common dandelion (*Taraxacum officinale) (10%),* Cheatgrass (*Bromus tectorum)* (5%), Non-native ornamental rose (*Rosa sp) (5%)*

Syilx Garden (14.5m x 2.75m)

Herb Layer: 40%, Remainder: Bare earth

Herb Layer Species: Common dandelion (*Taraxacum officinale) (10%),* Cheatgrass (*Bromus tectorum)* (30%), Quackgrass (*Elymus repens)* (5%), Non-native ornamental rose (*Rosa sp) (5%)

Edible Garden (10.5m x 2.75m)

Canopy Layer: 20% Herb Layer: 35%, Remainder: Bare earth

Canopy Layer: Red Maple (*Acer rubrum)* (20%) – unhealthy appearance

Herb Layer Species: Common dandelion (*Taraxacum officinale) (20%),* Quackgrass (*Elymus repens)* (10%), Non-native ornamental rose (*Rosa sp) (5%)

Based on vegetation assessment it was determined that students would remove all plants. The few clumps of Idaho fescue would be donated to a student teacher that had expressed a desire to replant them.

3.1.2 Soil Assessment

Date: April 25, 2017

Tools: Shovel, 10 m measuring tape, iPhone camera

I dug a soil pit in the middle of the Okanagan Nation/Syilx garden, 3 m to the west of the native pollinator concrete pad and 1 m north of the sidewalk (see figure 4 map above). I discovered that the roughly 10 cm below the surface is a mix of organic matter enriched top soil and sand. This is not surprising as this bed was once a garden. This top soil was likely brought in for this purpose.

Below this was a mostly sandy, gravelly substrate. I would suggest it was fill from the time the garden was created (see figure 5). I spoke with Caroline Whyte of Sagebrush Nursery (native plant nursery that would be providing the plants for this project). She noted that this would be prefect for our planting as Okanagan soils are typically nutrient poor and sandy (C. Whyte, pers. comm. April 2017).

Based on the existing vegetation community (nearly all non-native, weedy species that will be pulled – apart from the maple tree), the soil assessment (some organic matter/top soil in the upper horizon with a sandy/gravelly substrate below) and the fact the garden will run west to east (received plenty of unobstructed direct sunlight), this space will be perfect for the school native plant garden.

Figure 5. (left to right) sandy, gravelly substrate dug up from 10 cm below surface; upper horizon is roughly 5 to 10 cm, upper horizon is mix of organics and sand (Image source: Tanya Brouwers)

3.2 Presentation to Biology 11 Class

Date: April 30, 2017
Tools: PowerPoint presentation, screen

Figure 6. Let's talk about our ecosystem! (Image Source: Tanya Brouwers)

I delivered a PowerPoint presentation to the students during a 90-minute-long class. The intent was to broadly cover several topics so that the students would have a basic understanding of the garden themes when they researched plant choices on their own. Key topics included:

- A general discussion of the Ponderosa Pine (PP) BEC zone

    - common plants the students would expect to see around the community (Ponderosa Pine *(Pinus ponderosa)*, Saskatoon *(Amelanchier alnifolia)*, Bluebunch Wheatgrass (*Pseudoregneria spicatum)* and Arrow-leaved Balsamroot (*Balsamorhiza sagittata)*)
    - a climate that is characterized by extremely hot summers and very little overall precipitation (Meidinger et al., 2008)
    - some wildlife species associated with this ecosystem (Western rattlesnake *(Crotalus viridis),* Lewis' Woodpecker *(Melanerpes lewis),* California Bighorn Sheep (*Ovis canadensis Californiana)*, etc.) (Meidinger et al., 2008).

- Threats to the PP zone

    - agriculture, development and climate change (Meidinger & Pojar 1998).

- The Xeriscape Garden

    - I discussed water scarcity in the Okanagan. Specifically, I mentioned the prediction that within 15 years Okanagan water sources will be fully allocated (OBWB 2008). I also noted that residential outdoor water use takes up 24% of all water used in the Okanagan (Okanagan Waterwise 2016). I stressed the importance of using low-water, mainly native plants so as to not amplify the region's water problem.

- The Native Pollinator Garden

    - I first stressed that honeybees are not the only pollinators. There are over 20,000 other bee species (Weidenhammer 2016).
    - I also encouraged the students to consider other pollinators like butterflies, moths, beetles and bats.
    - I discussed how the elements of the PP ecosystem have evolved together over time. For example, native pollinators assist in native plant reproduction, native plants produce berries that feed native birds, these birds disperse native seeds, and so on.
    - I also mentioned that many pollinator species rely upon specific native plant species to fulfil certain life stages. For example, the Painted Lady butterfly will lay her eggs on the leaves of Yarrow and will feed on the nectar of Tall Oregon Grape (Brenner, 2011). As another example I noted that Syrphid flies feed on

the nectar of Mock Orange blossoms during the summer nectar gap in July (Weidenhammer 2016).

- The Okanagan Nation/Syilx Garden

    - It should be noted that my discussion was not the only contribution to this part of the garden. Students were also visited by representatives of the En'owkin Centre, an Indigenous cultural, educational, ecological and creative arts institution that practices and implements Indigenous knowledge and systems. Shona Becker additionally consulted with them for input on plant choices.
    - I noted that members of the Okanagan nation embraced a worldview where humans, like pollinators and plants, were a part of the ecosystem and relied upon the elements of the ecosystem for survival. Their relationship with plants was particularly intimate with many native species having both useful and cultural significance.
    - I gave a few plant examples that highlighted this useful/spiritual connection. For example, I noted ***Saskatoon*** *(Amelanchier alnifolia)*, one of the four food Chiefs. Saskatoon is associated with youth and creative energy (ONA 2010). The berries were also an important winter food source (Parish et al., 1996). I also mentioned ***Bitterroot*** (*Lewisia rediviva):* Bitterroot or *Spitlem* was the chief of all roots and was associated with relationships (ONA, 2010). The root was peeled or cooked and dried for winter use (Parish, 1996).

- The Edible Garden

    - I discussed with the students how foraging for wild foods is becoming increasingly popular (Wasson 2017)
    - The students were keen to grow native plants that could be used by the school cafeteria students. The cafeteria makes food that is sold to the entire student body.
    - I mentioned the hips from native rose species could be used to make jellies and tea. Similarly, the fruits of Blue Elderberry *(Sambucus cerulean)* are popular in jams, jellies and in desserts.

Upon completion of the presentation I left the students with several reference books. Their assignment was to research and choose appropriate plants for each of the themed gardens. They also had to write briefly about the plants they had chosen for the pollinator and Syilx gardens. For the pollinator garden I wanted the students to identify native pollinator species and associated plants. This information would be added to the informational signs so that the public could learn from and appreciate their efforts on this project.

Books left with students:

Victory Gardens for Bees (Weidenhammer 2016), *100 Plants to Feed the Bees* (Xerces Society 2016), *Food Plants of Interior First Peoples* (Turner 2007b), *Plant Technologies of First Peoples in British Columbia* (Turner 2007), *Plants of Southern Interior British Columbia and the Inland Northwest* (1998).

Websites for students:

The Okanagan Xeriscape Association. www.okanaganxeriscape.org (2017)

3.3 Designing the Garden

3.3.1 Defining a plant list

Date: May 1 – June 15

The students were given three weeks to come up with some plant ideas for each of the four themed spaces. On May 20th I was given the list. I went with the list to Sagebrush Nursery in Oliver to determine plant availability and suitability.

I was aiming to achieve a final look that allowed observers to experience the natural world without having an overall scraggly appearance that often happens in native plant gardens. I wanted a stylized native plant space framed with mainly native but also some non-native plants in much the same style of Adam Woodruff (Rainer & West 2015). To achieve this look I allowed for roughly 3 plants per every square meter to fill up the space.

Figure 7. A native plant garden design by Adam Woodruff (Image Source: Adam Woodruff 2017)

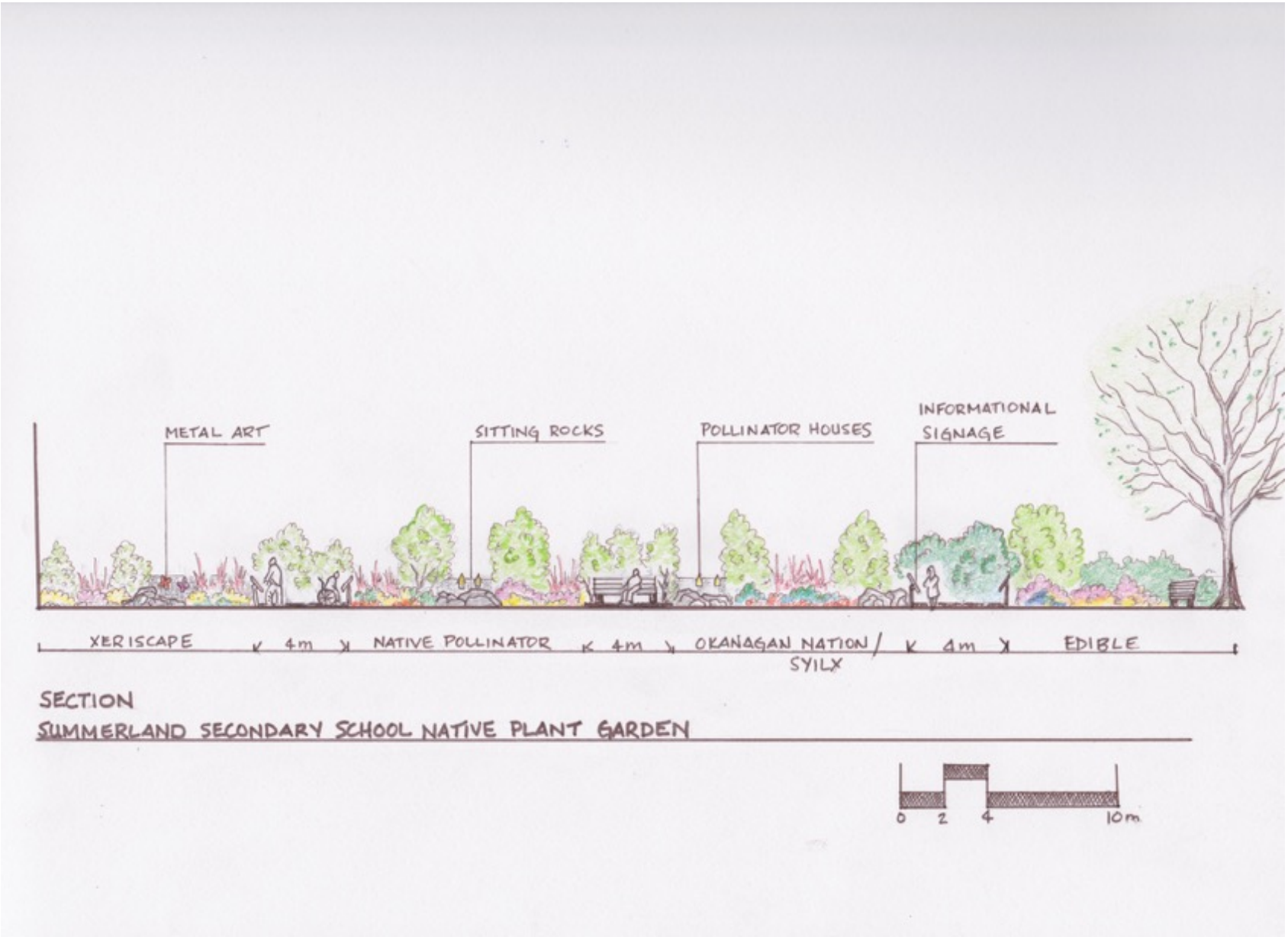
I also wanted to take advantage of existing features in the space. Some large rock formations would serve as perfect sitting rocks for the students. Existing benches would prove inviting to community members. Concrete pads would serve as the space to affix informational signage.

Plant List (non-Okanagan native species in red)

Common Name	Scientific Name	Number of Plants
Xeriscape Garden		
Shrubs		
Mock Orange	*Philadelphus lewisii*	5, 5 gal.
Forbs		
Blazing Star	*Liatris spicata*	1, 1 gal
Brown Eyed Susan	*Gaillardia aristata*	2, 4 inch pots
Purple Cone Flower (Canada)	*Echinacea purpurea*	3, 4 inch pots
Rosy Pussytoes	*Antennaria rosea*	4, 4 inch pots
Spreading Phlox	*Phlox diffusa*	2, 4 inch pots
Yarrow (white)	*Achillea millefolium*	3, 4 inch pots
Yarrow (yellow)	*Achillea millefolium*	3, 4 inch pots
Grasses		
Red Switch Grass (Canada)	*Panicum virgatum 'Rostrahlbusch'*	6, 1 gal
Idaho Fescue	*Festuca idahoensis*	4, 4 inch
Native Pollinator		
Shrubs		
Chokecherry	*Prunus virginiana*	3, 5 gal
Rabbitbrush	*Ericameria nauseosa*	1, 1 gal
Saskatoon	*Amelanchier alnifolia*	2, 5 gal
Tall Oregon Grape	*Mahonia aquifolium*	2, 1 gal
Tufted White Prairie Aster	*Aster ericoides ssp. pansus*	1, 1 gal
Forbs		
Bee Balm	*Monarda fistulosa*	2, 4” pots
Brown Eyed Susan	*Gaillardia aristata*	3, 4” pots
Red Columbine	*Aquilegia canadensis*	1, 1 gal
Shrubby Penstemon	*Penstemon fruiticosus*	1, 4” pot
Stonecrop	*Sedum spp.*	3, 4” pots
Wild Blue Flax	*Linum perenne ssp. lewisii*	1, 4” pot
Yarrow	*Achillea millefolium*	3, 4” pot
Grasses		
Bluebunch Wheatgrass	*Pseudoregneria spicatum*	12, 2” pots
Red Switch Grass	*Panicum virgatum 'Rostrahlbusch'*	6, 1 gal
Okanagan Nation/Syilx		
Shrubs		
Blue Elderberry	*Sambucus caerulea*	3, 5 gal

Big Sagebrush	*Artemesia tridentata*	1, 1 gal
Saskatoon	*Amelanchier alnifolia*	2, 5 gal
Soopolallie	*Shepherdia Canadensis*	2, 4” pots
Forbs		
Arrow-leaved Balsamroot	*Balsamorhiza sagittata*	10, 2” pots
Bitterroot	*Lewisia rediviva*	8, 2” pots
Yarrow	*Achillea millefolium*	6, 2” pots
Kinnikinnick	*Arctostaphylos uva-ursi*	2, 4” pots
Grasses		
Bluebunch Wheatgrass	*Pseudoregneria spicatum*	6, 2” pots
Giant Wild Rye	*Elymus cinereus*	1, 1 gal
Needle-And-Thread Grass	*Stipa comata*	3, 2” pots
Red Switch Grass	*Panicum virgatum 'Rostrahlbusch'*	4, 1 gal
Edible		
Trees		
Red Maple (already on-site)	*Acer rubrum*	1
Shrubs		
Prairie Rose	*Rosa woodsii*	5, 1 gal
Saskatoon	*Amelanchier alnifolia*	1, 5 gal
Forbs		
Anise Hyssop (Canada)	*Agastache foeniculum*	2, 2” pots
Bee Balm	*Monarda*	3, 4” pots
Lavender	*Lavandula*	3, 1 gal
Purple Cone Flower	*Echinacea purpurea*	6, 2” pots
Thyme (common)	*Thymus spp.*	4, 2” pots
Thyme (lemon)	Thymus citriodorus	4, 2” pots
Wild strawberry	*Fragaria virginiana*	3, 1 gal
Grasses		
Gold Dew Tufted Hair Grass	*Deschampsia cespitosa*	3, 4” pots

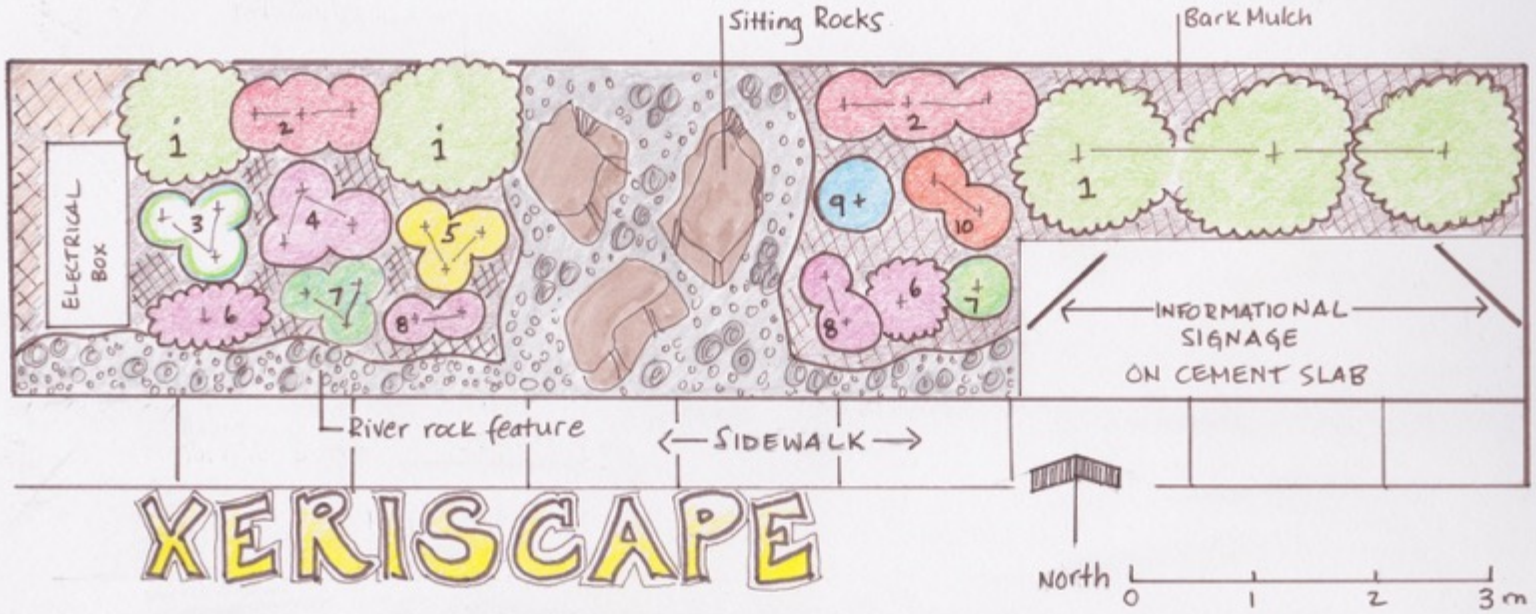
3.3.2 Final Garden Design: Section view & Plan Views



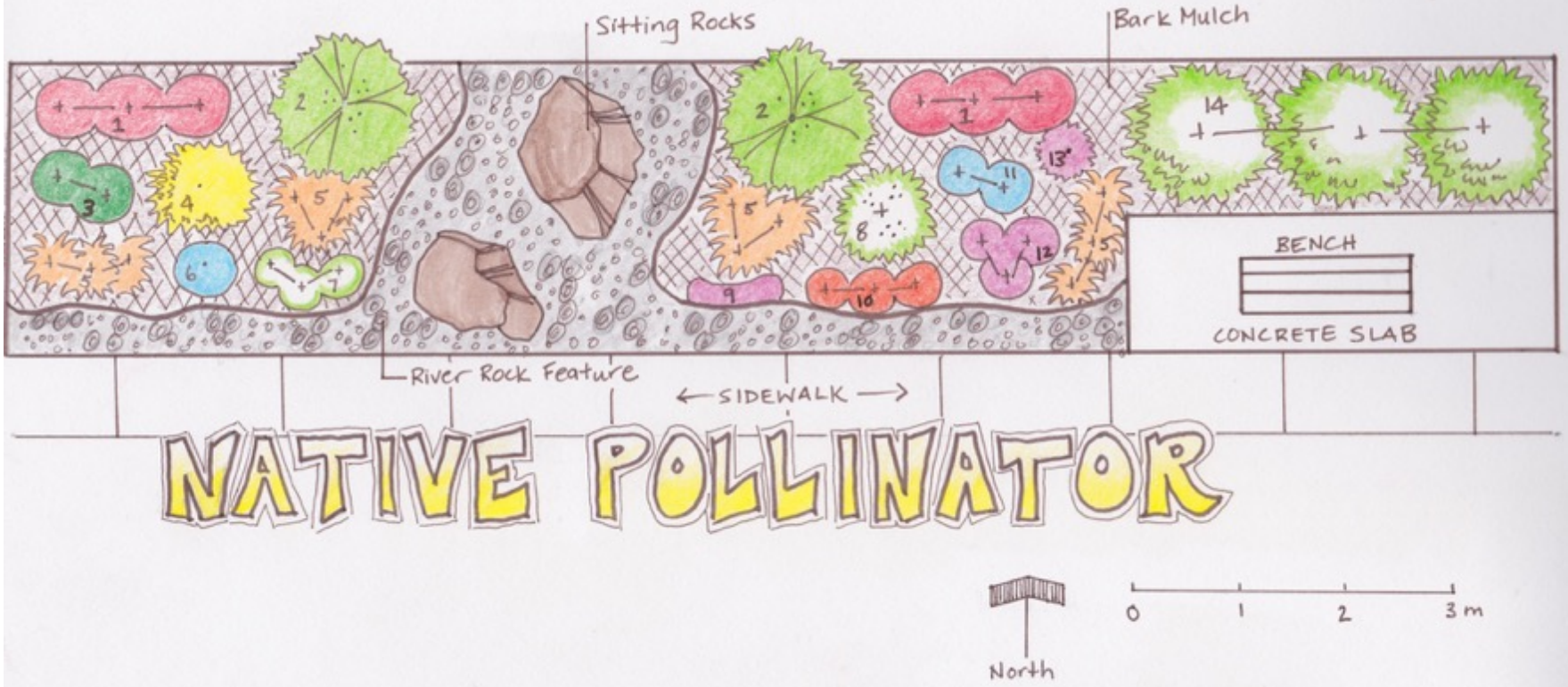
SECTION

SUMMERLAND SECONDARY SCHOOL NATIVE PLANT GARDEN

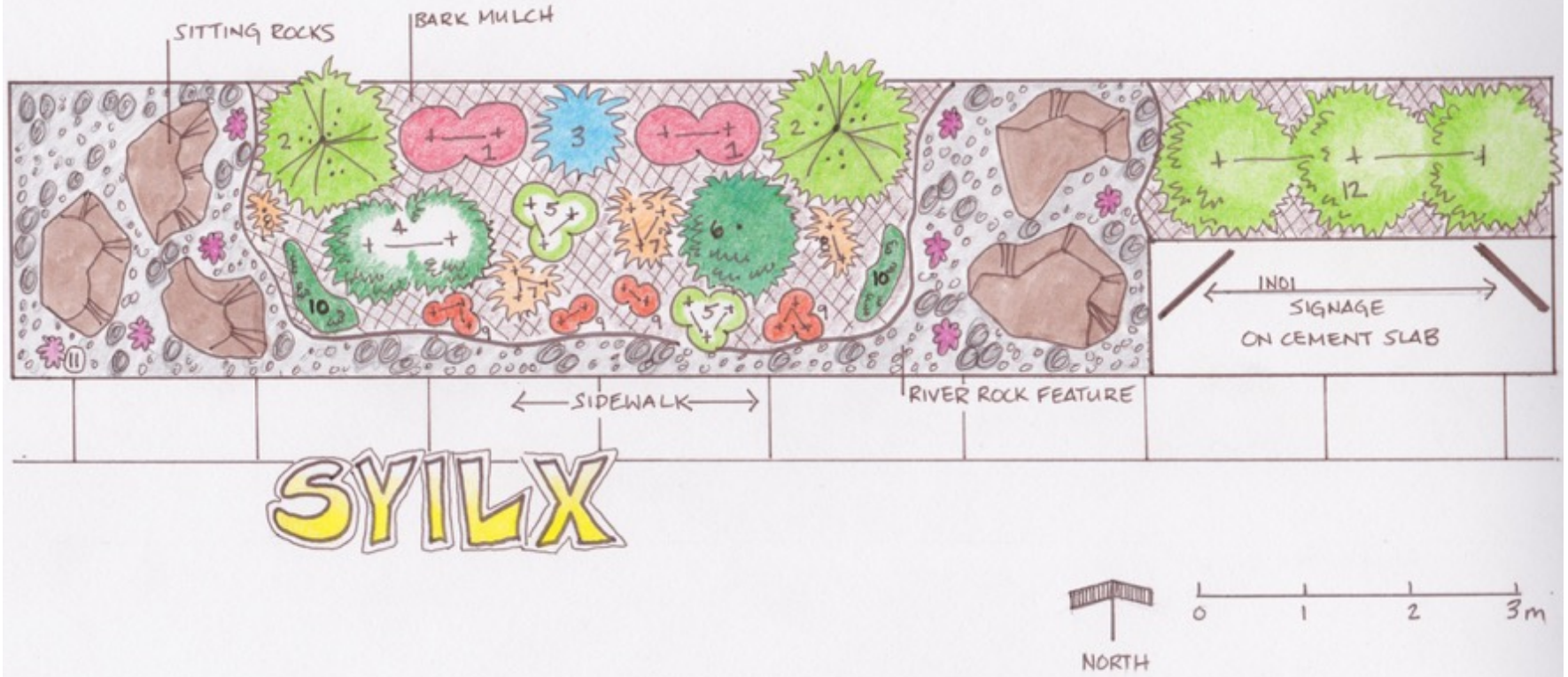
1. Mock Orange - 5
2. Red Switch Grass - 6
3. Yarrow (White) - 3
4. Purple Coneflower - 3
5. Yarrow (Yellow) - 3
6. Spreading Phlox - 2
7. Idaho Fescue - 4
8. Rosy Pussytoes - 4
9. Blazing Star - 1
10. Brown Eyed Susan - 2



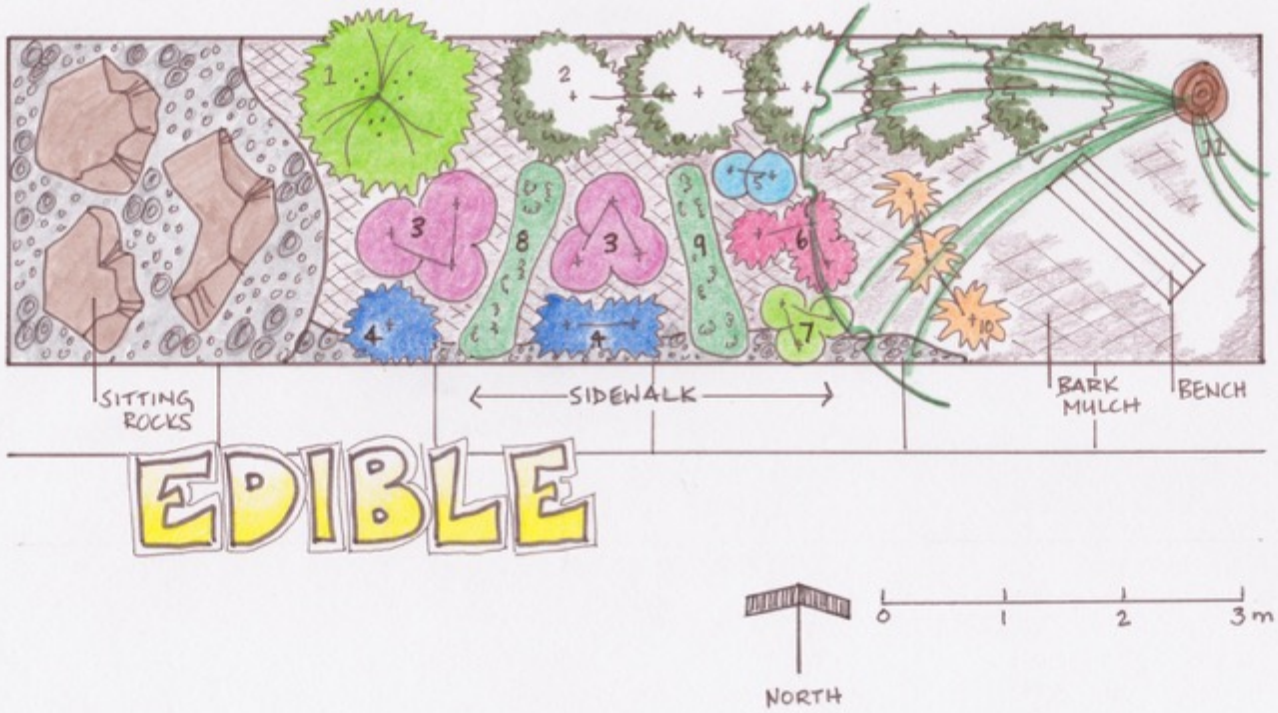
1. Red Switch Grass -6
2. Saskatoon - 2
3. Tall Oregon Grape -2
4. Rabbitbrush - 1
5. Bluebunch Wheatgrass - 12
6. Wild Blue Flax - 1
7. Yarrow(White) - 3
8. Tufted White Prairie Aster - 1
9. Shrubby Penstemon - 1
10. Brown Eyed Susan - 3
11. Bee Balm - 2
12. Stonecrop - 3
13. Red Columbine - 1
14. Chokecherry - 3



1. Red Switch Grass - 4
2. Saskatoon - 2
3. Giant Wild Rye - 1
4. Soopolallie - 2
5. Yarrow (White) - 6
6. Big Sagebrush - 1
7. Bluebunch Wheatgrass - 6
8. Needle-and-Thread Grass - 3
9. Arrow-leaved Balsamroot - 10
10. Kinnikinnick - 2
11. Bitterroot - 8
12. Blue Elderberry - 3



1. Saskatoon - 1
2. Prairie Rose - 5
3. Purple Coneflower - 6
4. Lavender - 3
5. Anise Hyssop - 2
6. Bee Balm - 3
7. Wild Strawberry - 3
8. Thyme: path (common) - 4
9. Thyme: path (lemon) - 4
10. Gold Dew Tufted Hair Grass - 3
11. Red Maple - 1 (pre-existing on site)



3.3.3 Defining Pollinator Plant Connections & Plant Cultural Significance

Date: May 1 – June 15

As previously noted, I had asked the students and Shona Becker to come up with short, concise explanations describing pollinator relationships to plants chosen for the Native Pollinator Garden and the cultural significance of plants chosen for the Okanagan Nation/Syilx garden. I asked them to find at least 6 pollinator/plant connections and 6 cultural uses of the chosen plants. Some of the explanations would be used on the interpretive signs.

Once I received the definitions I edited them using the National Park Service's 'Writing for Wayside Exhibits' guide (NPS 2009). The guide notes that exhibit writing should be short, engaging and leaving the reader wanting more.

Pollinator/Plant Connections

1. The short tongued **Mining Bee** *(Adrena)* is the first to emerge in spring. It benefits from **Yarrow's** early bloom (Weidenhammer 2016).

2. The female **Northern Checkerspot** *(Chlosyne palla)* will lay her eggs on the underside of **Rabbitbrush** leaves (Butterflies and moths of North America, n.d.b; CBIF, 2015c; SOSCP, 2003).

3. **Syrphid flies** *(Syrphidae)* feed on the nectar of **Mock Orange** blossoms between May and July during the summer nectar gap (Weidenhammer 2016).

4. **Mason bees** *(Osmia)* are solitary bees that nest in hollow stems, under bark or in rotting wood. They benefit from a **bee motel** (Weidenhammer 2016).

5. Saskatoon is a host plant for the caterpillars of the **Western Swallowtail** (*Papilio zelicaon)* (Xerces Society 2016b)

6. Tufted White Prairie Aster is an important late-fall food source for bumblebees (Xerces Society 2016b)

Plants with cultural significance to the Okanagan Nation

1. **Saskatoon** or **Siya** was one of the four Food Chiefs and is associated with youth and creative energy (ONA, 2010). The berries were also an important food source (Parish et al., 1996).

2. **Kinnikinnick** leaves were dried and smoked like tobacco. The berries were eaten raw or cooked (Turner 2007b).

3. **Balsamroot** was one of the most versatile plants used by the Okanagan: a tea boiled from the leaves could ease a sore throat and the dried and powdered root was used as a flour (Turner 2007b).

4. The berries, shoots and leaves of **Soopolallie** were used to treat everything from indigestion to heart attacks. The berries were whipped to make an 'ice cream' (Turner 2007b).

5. **Big Sagebrush** leaves and branches were used to make a tea for colds. The leaves were used as a fumigant and dried for a smudge (Turner 2007).

6. **Bitterroot** (*Lewisia rediviva)**:*** Bitterroot or *Spitlem* was the chief of all roots and was associated with relationships (ONA, 2010). The root was peeled or cooked and dried for winter use (Parish, 1996).

3.4 Preparing the Garden Bed

Dates: May 15 – June 15 (during Biology class time – roughly 6 classes)

Tools: shovels, garden forks, wheelbarrows, 4 rolls of 3' x 25' landscape fabric, 7 cu yards ¾" – 2" rounded rock, 1 cu yard 2" – 6" rounded rock ***(rock provided in-kind from Summerland Ready Mix Concrete)***

1. Between May 15 and June 6, Shona Becker used approximately 4, 90-minute class times to weed out the beds. I also attended the weeding sessions and assisted with the bed preparation. I also used the sessions to talk about noxious weeds, particularly the Cheatgrass that had infested the bed. We discussed how this weed is outcompeting native plants on wild lands in the Okanagan.

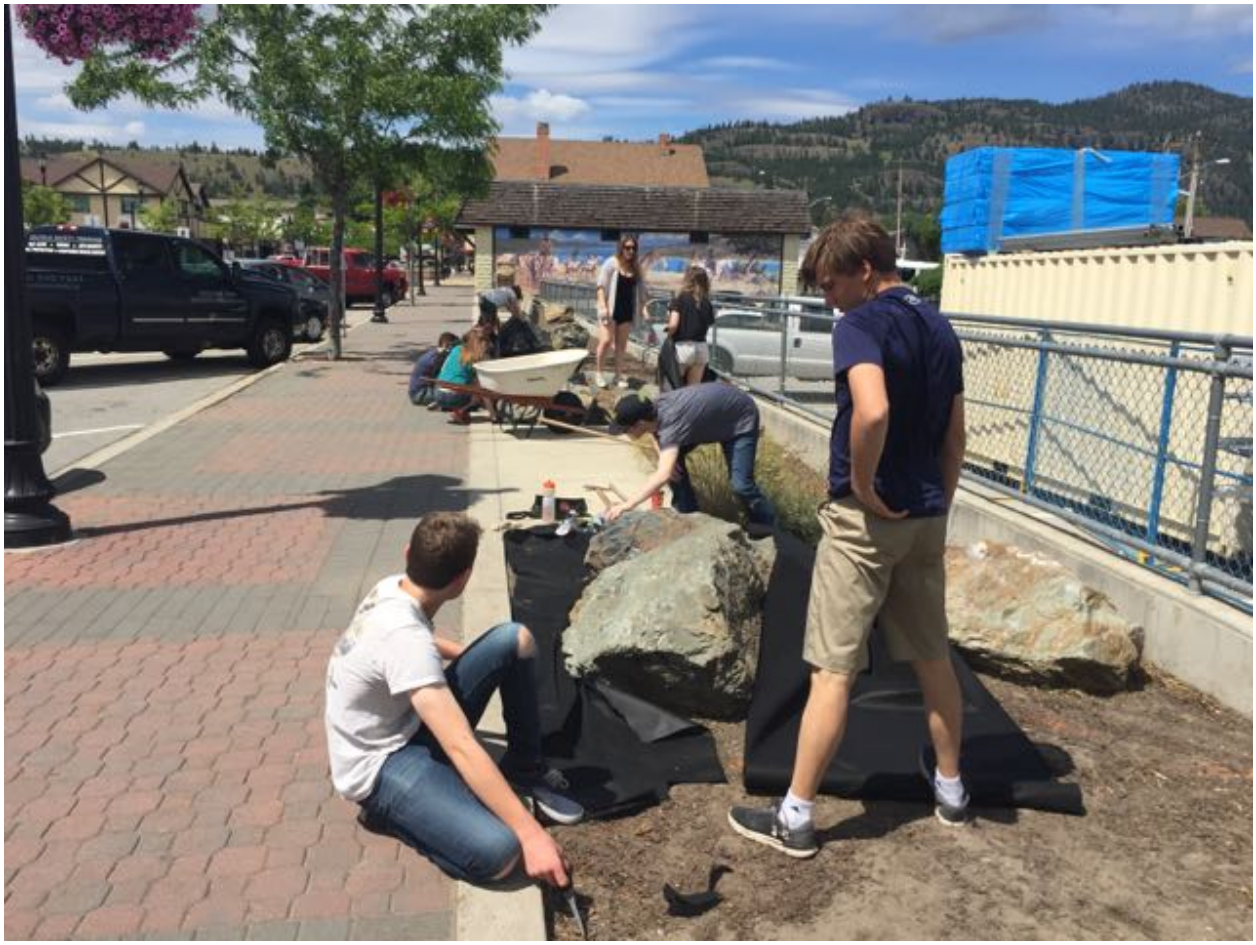


Figure 8. Pulling out the last of the weeds & laying down landscape fabric
(Image Source: Tanya Brouwers)

During four classes on June 14 and 15th, students placed landscape fabric around the large sitting rocks and along the sidewalk edge. Various sizes of rounded rock were placed on top of the fabric in a curved, undulating shape. The students wanted to create a dried river bed feel.

Figure 9. Starting to place the river bed feature (Image source: Tanya Brouwers)

Figure 10. River bed and weeding complete (Image source: Tanya Brouwers)

After completing the river rock feature the students went back through the beds and fluffed up the soil using long handled garden forks to mitigate the compaction that had likely occurred during weeding and rock placement.

3.5 Creating Garden Art and Bee Motels

Date: May 31 to June 15

Tools: Metal work class and woodworking class

The biology students also wanted to personalize the garden in their own way. Many of the students were passionate about metal and wood working so we determined that those skills

should be highlighted in the garden. Additionally, it has been found that when students 'plant' art in school gardens, community interest is further cultivated and sustained (Inwood 2006).

Metal butterflies were placed artfully between the rocks. Additionally, the students constructed a bee motel. A relative of one of the students knew about bee hotel design and gave the students a lesson prior to construction.

Figure 11. Left: a bee motel to be eventually raised 3 feet off ground (Bauer et al. 2015). Right: metal garden art (Image Source: Tanya Brouwers)

3.6 Planting the Garden

Dates: September 15 – September 19, 2017 (a total of 8 class times)

Tools:

Planting: shovels, garden spades, gloves, plants, 8, 10kg bags of top soil
Irrigation: 2, 100' rolls ¾" poly irrigation line, 6 50' rolls ¼' drip emitter line, drip emitters (0.5, 1.0, 2.0 gph), connectors, 10 25 L bags top soil, metal stakes for irrigation

Mulch: rough bark mulch - 6 yards **provided in-kind from Mountain View Greenhouses of Summerland**

September 15: Shona had two of her biology classes go through the bed for a final weeding after the summer. As the summer had been so hot very little time was needed to pull. The students also fluffed up the soil one more time.

I also started to deal with the irrigation on this day. Automatic irrigation was an option in this bed so it was decided that we would hook into the main line that comes out by the maple tree and use drip irrigation on the plants to help with establishment. We were lucky to have this option as the soil was so dry from the hot summer and we were planting late in the season so giving the plants a head start was important. I mentioned to the students that in restoration work out in the field, irrigation is usually not an option. Mortalities in those scenarios is usually much greater, sometimes upwards of 50% (Rinella & James 2017). As this is also a community project we were trying to avoid that happening.

I attached a ¾" poly irrigation tube to the main line and ran it along the back of the north side of the bed all the way to the western border. I blocked the end.

I also spoke with the school district landscape employees and it was determined that the bed would be irrigated for 1 hour a day until the lines were blown out four weeks later.

September 16: I picked up the plants from the nursery and kept them at my greenhouse for the weekend.

September 18: At 8 AM I met the District of Summerland representative. He turned on a city source of water so we could water in the plants. The school district was not prepared to give us an external hose bib.

I also met Caroline Whyte of Sagebrush Nursery at the school site. She was on hand to help lay out the plants according to the planting plan. During the planting period she also gave the students a lesson on proper planting. She noted that human error results in substantial plant mortality. She also noted that many of the native plants we were using were quite finicky and difficult to transplant. Her lessons were:

- Loosen the root mass on all plants before going into the ground EXCEPT Arrow-leaved Balsamroot and Rabbitbrush. These two plants do not like to be disturbed.
- Create a planting hole roughly twice the diameter of the plant root ball
- DON'T amend the soil. The native plants in our region are used to sandy, nutrient poor mediums. Amendments will increase mortality.
- Once plant is in hole throw in a few handfuls of top soil, fill up with removed soil and then surround surface around plant with additional top soil.
- Water in the plants heavily

- Give larger shrubs a 1.5 to 2.0 gph irrigation emitter. The more finicky plants like Arrow-leaved Balsamroot and Rabbitbrush should only get a 0.5 gph emitter.

The students were also responsible for running all irrigation lines out to the plants and affixing the proper emitter to each line. I divided the class into planters and irrigators.

Figure 12. All smiles on planting day (Image source: Tanya Brouwers)

Figure 13. Getting ready to tackle the Saskatoons (Image Source: Tanya Brouwers)

Figure 14. Students learn a new skill: drip irrigation installation (Image source: Tanya Brouwers)

Once students were finished planting they fluffed up the soil around the plants with garden forks to aid in root spread. This step was recommended by one of my RNS course instructors, Fiona Hamersley Chambers.

September 19: Two biology classes spread the mulch. Shona Becker had picked it up in her ½ tonne truck in the morning. The students spread an 8 to 10 cm layer using garbage pails, wheelbarrows and shovels. By using the mulch were attempting to suppress weeds and provide some visual appeal.

Figure 15. Bark mulch in place (Image source: Tanya Brouwers)

3.7 Designing & Installing Signage

Date: September 15 – November 26

Tools: 2" square steel tubing for info signage framing, bolts, cold rolled steel for plant labels, signage printed on aluminum

Plant Label Designs

Shona Becker and I decided upon plant labels made of the same aluminum as the plant signs. These would be printed out at Inkworks, a local print company. Labels would be affixed to 5" x 2" (12.5cm x 7.5 cm) painted rolled steel plant label stakes. Again, these would be created in the metal shop by the students. One plant label was created per species so as to keep the budget in check for a total of 34 labels.

On November 25, plant labels were installed.

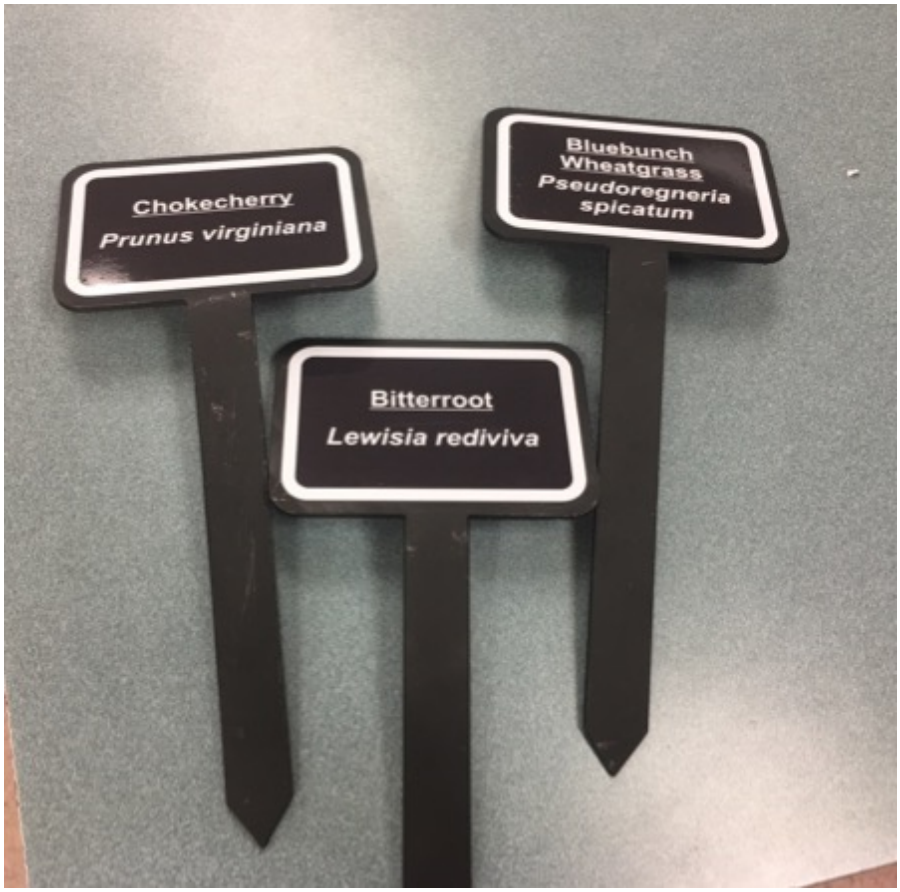


Figure 16. A sample of plant labels ready to go (Image source: Tanya Brouwers)

Figure 17. Happy students ready to get plant labels in the ground before the snow flies (Image source: Tanya Brouwers)

Figure 18. Plant labels in the ground (Image source: Tanya Brouwers)

Informational Signage

As earlier stated, the students were informed they would also have to assist in designing informational signage that would explain the purpose and meaning behind each garden theme. The days after planting were spent finalizing sign imagery and writing. I assisted the students in editing their information so that it was sufficiently concise. I then created the final design using Canva and Adobe Photoshop. Images were chosen that reflected the 'fun' feel that was already in place with the metal art and bee hotel.

Shona Becker and myself also finalized sign frame design. Using the National Park Waysides Exhibit Guide (NPS 2009) and the City of Toronto Accessibility Guidelines (CoT 2004) we determined that each sign should measure 3' x 2' (91cm x 61 cm) and sit 36 inches or 91 cm off the ground. With these measurements signs will accommodate small children and those in wheelchairs.

Again, the students were involved with metal frame construction in the metal shop. The informational portion was also printed out at Inkworks on an aluminum backing that was bolted to the frame.

Final Sign Designs

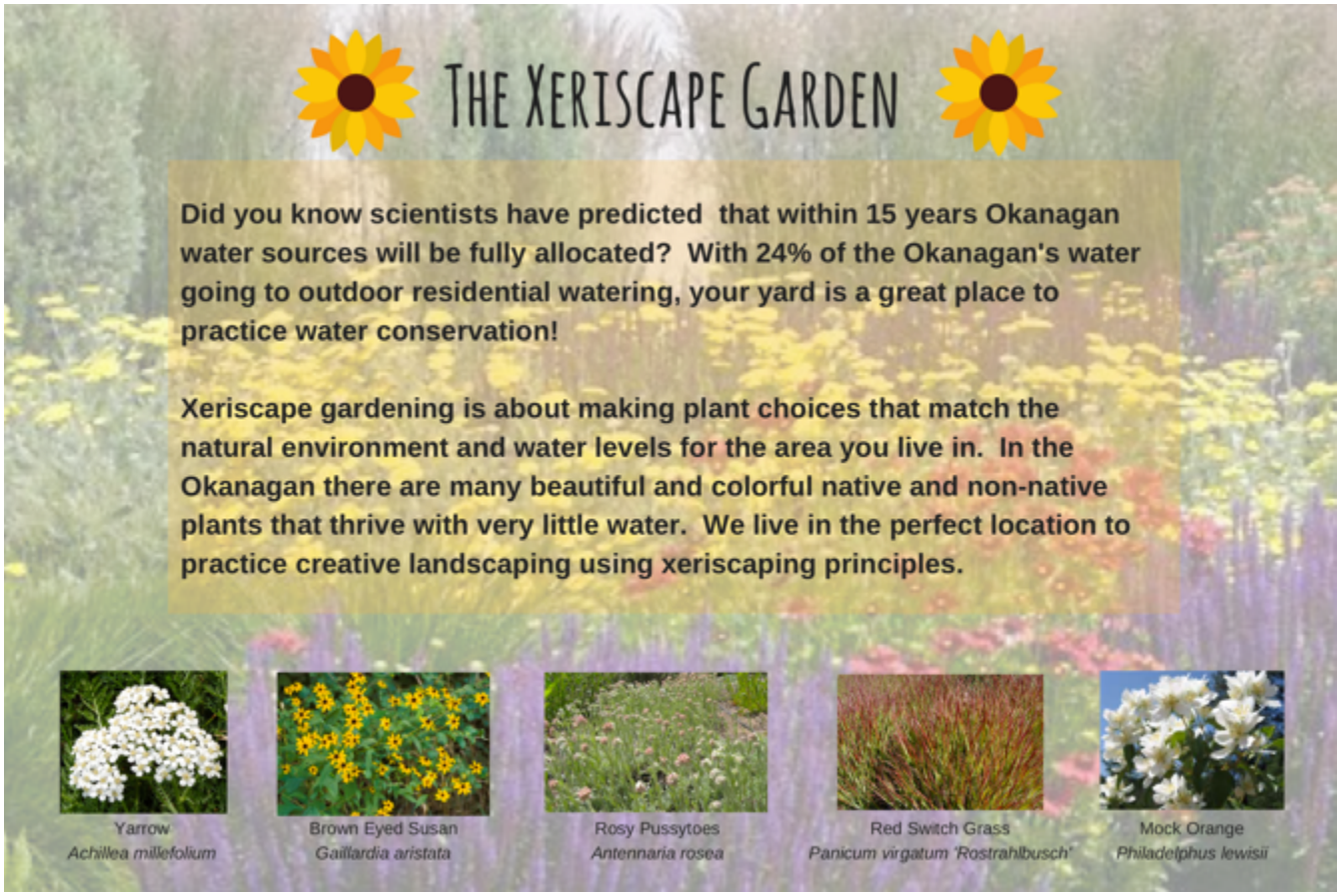


Figure 19. Xeriscape Garden Sign. (Image Source for all images: Shutterstock.com)

Main text: (OBWB 2008; Okanagan Waterwise 2016)

Figure 20. Native Pollinator sign. (Image Source for all images: Shutterstock.com)

Main text: (Weidenhammer 2016)

Insect information: See section 3.3.2 for references

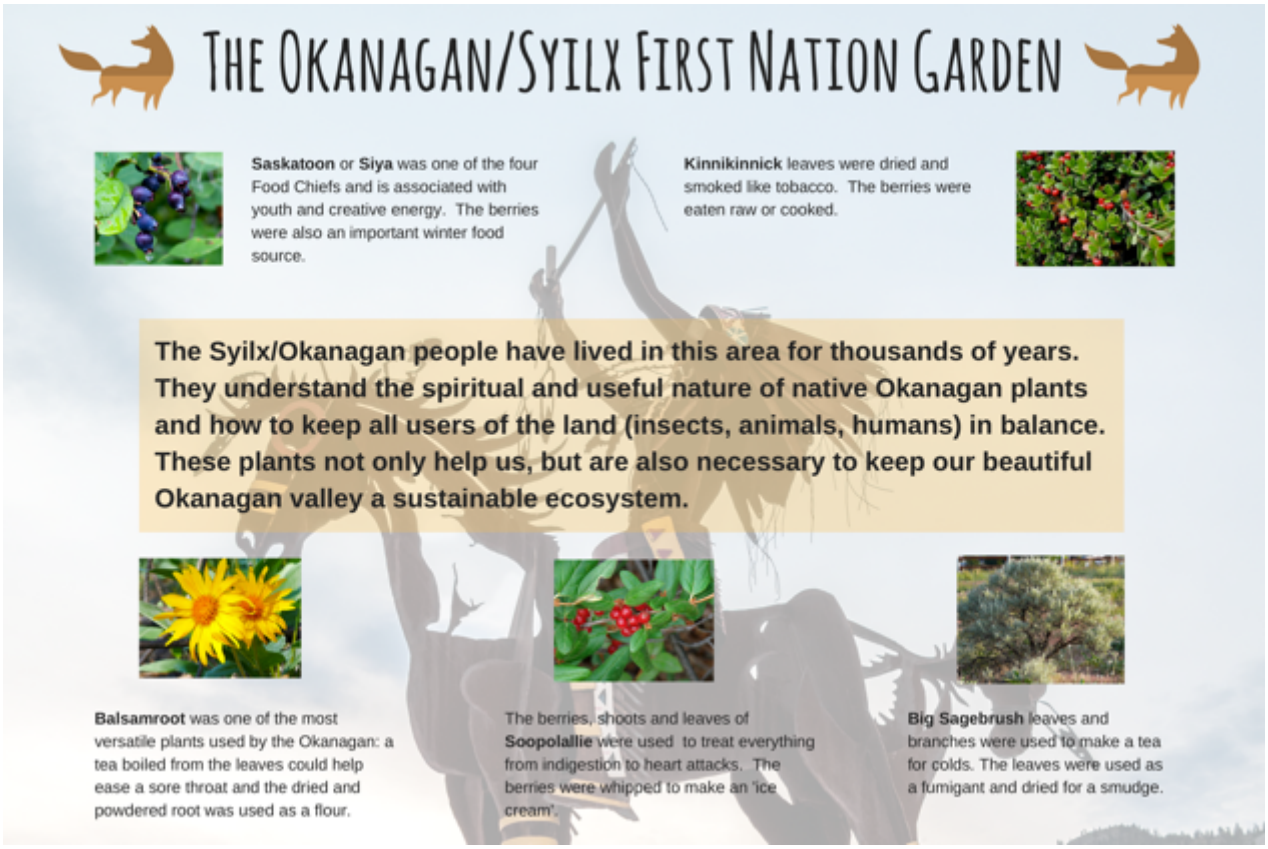


Figure 21. The Okanagan/Syilx First Nation Garden. (Images source for all images: Shutterstock.com)

Main body text: Developed by students with input from En'owkin Center representatives.

*Plant text: See section **3.3.2** for references.*

Figure 22. The Edibles Garden sign. (Image source for all images: Shutterstock.com)

Main body text: Shona Becker and students

Plant text: Wild strawberries (Parish et al. 1996), Blue Elderberry (botanical.com 2017), Prairie Rose (Parish et al. 1996), Purple Cone Flower (Okanagan Xeriscape 2017; UMM 2016)

On November 26 the frames were ready to be installed. Students assisted bolting signs to concrete pads.

Figure 23. Clockwise from top: installed signs; students observing the Edible Garden sign; students checking out the Okanagan Nation garden sign (Image source: Tanya Brouwers)

Garden name and thank-you sign

A welcome and thank-you sign was also created. The aluminum sign was bolted on a similar frame to which the informational signs were affixed and embedded into one of the rock features. Shona Becker and the students wanted to call the space 'Marie's Garden'. Marie Pettigrew was a long-time resident of Summerland that loved gardening. On her passing a foundation was created. The money for this project came from that donation.

Many other members of the community also donated their time and products. Their logos were added to the thank-you sign. The thank-you sign was installed November 26.

Figure 24. Welcome to Marie's Garden: thank-you sign for contributors

Figure 25. Finished! Students gather around the welcome sign (Image source: Tanya Brouwers)

3.8 Creating a maintenance schedule

Shona Becker wishes for this garden to be a continual project for her future Biology 11 classes. Part of that will involve ongoing maintenance of the garden. I gave her a flexible maintenance schedule that will help her to keep the garden looking visually appealing. This is important as the community walks by the spot on an ongoing basis. Additionally, many local businesses have attached themselves to the project by including their logos on the thank-you sign. It's also important because the ongoing tasks associated with a garden keep the students engaged in the place they created. The outdoor learning continues.

Shona also plans to create a summer volunteer crew that will check irrigation and pull weeds during the months that school is not in session.

I have not included a plan for dividing plants when the garden matures. The plants that went in the ground were very small. It will be years before dividing is a concern.

Maintenance Schedule

Month	Weeding	Pruning/Plant Care	Irrigation
January			
February			
March	Check & pull 2X/month	-Start looking for spring growth/winter kill -cut back grasses	
April	Check & pull 1X/week	-continue to look for growth -remove any dead plants & replace	Likely irrigation turned on either end of April or early May – check emitters
May	Check & pull 1X/week	-cut out dead branches on shrubs -continue to look for dead plants -apply fertilizer around large shrubs (Elderberry, Mock Orange, Saskatoon and Chokecherry)	Check emitters 2X/month
June	Check & pull 2X/month	Deadhead flowering perennials 2X/month	Check emitters 1X/week
July	Check & pull 2X/month	Deadhead flowering perennials 2X/month	Check emitters 1X/week

August	Check & pull 2X/month	Deadhead flowering perennials 2X/month	Check emitters 1X/week
September	Check & pull 2X/month	Deadhead flowering perennials 2X/month	Check emitters 1X/week
October	Check & pull 1X/month	Depending on weather it could be time to start cutting back forbs.	Irrigation will likely be off sometime during this month
November	Check & pull 1X/month	Cut back forbs as necessary	
December			

3.9 Monitoring the Garden

3.9.1 Monitoring Plant Growth

I set up a simple photo point monitoring protocol so that Shona Becker can track the passage of time in the garden.

Date of photograph: June 15 annually
Time of photograph: 10 AM
Camera: iPhone (this device was chosen because nearly everyone has one and it is easy to use)
Location: see map below

Figure 26. Yellow stars indicate location of photo point monitoring.
Photographer should shoot towards blue stars at opposite end of garden.

Take two photographs. One photograph will be taken from the eastern most corner of the garden that lines the sidewalk (yellow star) aiming for the westernmost corner of the garden that sits adjacent to the parking lot north of the garden (blue star). Similarly, the second photograph should be taken from the westernmost corner of the garden that sits adjacent to the sidewalk (yellow start) with the camera aiming for the easternmost corner of the garden that sits adjacent to the parking lot north of the garden (blue star – essentially aim for the maple tree).

Initial photographs: The two photographs are a good initial reference. However, it should be noted that they weren't taken on the June 15th day but rather after planting on September 18. It is also an option for Shona Becker to take monitoring photos on this day as well if she desires.

Figure 27. Photo point monitoring: photo one taken looking east.

Figure 28. Photo point monitoring: photo 2 taken looking west

3.9.2 Monitoring Native Pollinator Abundance

In order to fulfil project goals and curriculum requirements of **data analysis** I created for Shona Becker and the students a simple pollinator monitoring protocol using the Xerces Society for Invertebrate Conservation's protocol as a guide (Xerces Society 2014). The purpose of the protocol is to monitor for native pollinator abundance so as to determine the efficacy of the restored habitat.

Monitoring Plan:

Supplies: timer on phone, device to measure temperature, data sheets (see appendix 1), monitoring instructions (provided in this section), clipboard, pencils, ground tape (100 m Eslon tape is a good choice)

When: two visits: one at the end of May and another one three weeks later (determine specific date and try to stick to that date yearly). Visits should occur between noon and 4 pm, skies should be clear, weather calm and temperature greater than 15^0C.

How: Using the ground tape lay out two transects down the middle (lengthwise) of the garden bed.

Figure 29. Transect placement for monitoring pollinator abundance

Transect 1 (27 m) will run from the westernmost edge of the garden to the edge of the native pollinator garden on the eastern edge of the second cement slab from the western edge. The transect should run 1.5 meters from the edge of the sidewalk so as to avoid the slabs.

Transect 2 (25 m) will run from the eastern edge of the second cement slab from the western edge to the easternmost edge of the garden. Again, the transect should run 1.5 meters from the edge of the sidewalk so as to avoid the slabs.

Students will observe a 1 m strip along each transect (bring a tape measure) for 7.5 minutes. Students will measure number of native bees/flies, number of butterflies/moths and number of honeybees observed. As students are not experts on insect identification it is sufficient to note numbers rather than species type. It is assumed that students will know (or be shown) what a honeybee looks like. This will make it easy to note non-honeybees. Students should make sure to walk slowly and pay particular attention to open flowers.

Students will then fill in their data sheets with transect number, date, time, weather and the number of pollinators. Students should also record dominant flowers in bloom and which plant species are attracting the most pollinators.

4.0 Results & Interpretation

This project met, in the immediate, stated goals and objectives. Biology 11 life science curriculum goals were fulfilled by the student-led design and installation of the four themed gardens. Student involvement in all stages of the project (design, planting, irrigation, art) also met the goals of facilitating place-based outdoor learning and fostering a heightened sense of social responsibility as it pertains to both community and environmental needs.

The project, however, was not without challenges. The literature suggests that challenges plague nearly all school projects of this nature. Funding, personnel stability, community buy-in, teacher preparation, maintenance and ongoing enthusiasm have all been cited as significant challenges to school gardens (Valdez 2017; Yu 2012; Province of British Columbia n.d.).

In this case, funding was not a problem as we had a large monetary donation and many in-kind contributions. Donations of material by local businesses helped to keep costs down. Summerland Ready Mix donated the rock and Mountain View Growers donated the mulch. Additionally, the school contributed the metal for the signage. Without this school donation costs would have increased by at least $1600. After in-kind donations were subtracted, total

project costs came in at $2773.66 which was well below our $5000 donation (see budget, Appendix 1).

School District grounds maintenance employee buy-in was, however, a challenge. From the start of the project in April, Shona Becker and the students had to convince these employees that the garden was a good idea. After I gave my presentation in April, the students gave a similar, shortened version to the maintenance workers and two school district representatives. This delayed the project by at least two weeks. Additionally, when the time came to put on the irrigation, the maintenance workers were difficult to track down. When a meeting was finally scheduled it near the end of June. As a result, we had to delay planting until September, which was not ideal. September is a very busy time for both teachers and students.

The other significant challenge was the fact that Shona Becker was the only member of the Summerland Secondary School on board for this project. Shona is busy beyond her teaching role in the school. She also coaches field hockey, organizes the district science fair and hosts math conferences. As a result, it was difficult for her to find sustained time for this project. This was exacerbated by the fact that Shona's dream was to have the students involved in all phases of the project including creation of the informational signage, the metal frames for the signage and the plant label steel stakes. I was able to coordinate planting efforts but I was not in a position to work with the metal and woodworking teachers nor could I dictate when Shona made class time for these different phases. As a result, the infrastructure component of the project was continually delayed so that signage and stakes didn't get in the ground until the end of November.

The aforementioned delays forced the project to extend from one school year into the next. As a result, two different Biology 11 classes were expected to complete the project. It is expected that ongoing classes will take part in the maintenance of the project, however there was a significant drop in enthusiasm from one class to the next in completing the project. This was expected as the 2016/2017 class had designed it and the 2017/2018 class was merely there in a labor capacity without the pride of design driving their efforts.

Challenges aside, the project, overall, was a great success. As I worked in the garden I continually heard favorable comments from passing community members about its beautiful and improved appearance. At one point in the planting a community member sat in one of the benches and starting talking to the students about the plants they were using. It was encouraging to see this cross communication between the generations about our local environment. Additionally, the students gained a greater knowledge of our native plants. When I first gave the presentation not one of the students could name any of the native plants I

was showing them. Not only can both Biology 11 classes now name these plants, they can also explain their cultural significance and their importance to native pollinators.

5.0 Discussion & Recommendations

This project demonstrates that student-led native plant space design and implementation can be successful on many levels. Marie's Garden fulfilled science curriculum requirements, encouraged social responsibility, fostered connections with the community and, most importantly, gave students a connection to and value of their 'place' by moving learning outdoors into their local environment. This, despite time management constraints, communication challenges and multi-phase involvement that continually delayed the project.

Of course, certain gaps in knowledge necessitate further monitoring for project success. As noted in the report, Shona Becker intends to have a student volunteer crew conduct summer maintenance on the garden. Maintenance issues have been cited as one of the greater challenges to school garden project success (Yu 2012). I did create a maintenance schedule for Shona Becker however, it remains to be seen how this will be followed.

It also will be interesting to see if future Biology 11 classes use the native pollinator monitoring protocol I provided for them. Shona did request this component of the project in order to fulfill certain curriculum requirements. I would like to see the results of this over the years to ascertain whether the native plant habitat is conducive to native pollinators.
I would also like to see if the edible planting will, indeed, be used by the school cafeteria and in what capacity. It is uncertain at this time what the teachers of that class had envisioned.

Finally, plant mortality is not known at this time. Most of the students were not familiar with planting and, despite the lesson, it was likely that planting errors were made. Additionally, a month after the planting Summerland had a sudden cold snap that went well below freezing. It is hoped that the September plantings had sufficient time to establish themselves before this weather incident.

Based on a review of this project's challenges, certain recommendations follow:

1. Try to have more than one teacher or, ideally, the entire school staff, including administrators, on board for a school garden project. In this way there will be greater support and a larger number of resources and human hours available to complete the project in a timely manner. One teacher is not enough and can lead to complete burn-out.

2. If possible, project start and finish dates should fall within the same school year. In this way the class that starts the project will have the satisfaction of seeing its completion. I predict that project momentum would also remain steady if this were to occur.

3. If time is a constraint, teacher support is limited and the budget allows, consider farming out some of the infrastructure projects to local businesses. In this project there was the option to have the metal frames for the informational plaques made at a local metal fabrication business. This would have lessened the load for Shona and limited the number of delays.

4. Keep part of the funding for maintenance. Some plants will die, irrigation will need repair and future amendments will be necessary so hold back some money to cover these inevitable costs.

5. Have a backup plan for summer maintenance (or maintenance throughout the year) that involves community members. For example, Blue Mountain Elementary school in Maple Ridge worked out an arrangement with the Alouette Corrections Centre for Women near the school. The prison sent out a 5-person crew twice a week to water, weed and look after the garden during the summer. They were able to enjoy some of the produce as a benefit. The Richmond High School worked out an arrangement with the local community garden group to look after their garden in the summer (Province of British Columbia n.d.). The Summerland Ornamental Gardens is associated with The Friends of the Gardens, a volunteer driven group of gardening aficionados. Perhaps an arrangement could be worked out with these individuals.

6.0 Acknowledgements

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And of course, the hugest thanks ever goes to Shona Becker and her amazing class of Biology 11 students. To the students: I can't say how grateful I am for your willingness to try new things, your enthusiasm, your respect and your contagious energy that only the youth possess. To Shona: you're a true powerhouse and an amazing teacher. The biology students of Summerland Secondary are so very lucky to have you.

7.0 References

Attenborough, D. (2010) *Speech to Communicate conference*, November 2010.

Balmford, A., Clegg, L., Coulson, T., & Taylor, J. (2002). *Why conservationists should heed Pokémon*. *Science*, *295*(5564), 2367-2367.

Bauer, E., Lynch, L, Golick, D., Weissling, T. (2015) *Creating a Solitary Bee Hotel*. University of Nebraska. Retrieved from: http://extensionpublications.unl.edu/assets/pdf/g2256.pdf

Botanical.com. (2017) Elder
British Columbia Ministry of Education. (2016b) *Grade 11 Science – Life Sciences Draft Curriculum*. Retrieved from: https://curriculum.gov.bc.ca/sites/curriculum.gov.bc.ca/files/pdf/10-12/science/en_s_11_lsc.pdf

Brenner, K. (2011) *Urban Species Profile: Painted Lady Butterfly*. Retrieved from: http://www.metrofieldguide.com/urban-species-profile-painted-lady-butterfly/

British Columbia Ministry of Forests and Range and British Columbia Ministry of Environment. (2010) *Field manual for describing terrestrial ecosystems. – 2nd ed.* BCMFR Research Branch and BCMOE Resource Inventory Branch: Victoria, B.C.

Butterflies and moths of North America. (n.d.b) Attributes of Chlosyne palla. Retrieved from: http://www.butterfliesandmoths.org/species/Chlosyne-palla

Canadian Biodiversity Information Facility. (2015c) *Northern Checkerspot*. Retrieved from: http://www.cbif.gc.ca/eng/species-bank/butterflies-of-canada/northern-checkerspot/northern-checkerspot-chlosyne-palla-sterope-male/?id=1370403265221

City of Toronto. (2004) *Accessibility Design Guidelines*. Retrieved from: https://www1.toronto.ca/static_files/equity_diversity_and_human_rights_office/pdf/accessibility_design_guidelines.pdf

Directorate of Agencies for School Health. (2008) *Healthy Fundraising for Schools*. Retrieved from: http://healthyeatingatschool.ca/uploads/Healthy_Fundraising_For_Schools.pdf

Inwood, H. (2006) *Art in School Gardens*. Retrieved from: http://www.hilaryinwood.ca/Writing/art_in_school_gardens.html

Lloyd, A., & Gray, T. (2010). Place-based outdoor learning and environmental sustainability within Australian Primary School. *Education*, *2010*.

Louv, R. (2005) *Last Child in the Woods: saving our children from nature-deficit disorder*. Algonquin Books of Chapel Hill: Chapel Hill, North Carolina.

Meidinger D., Pojar J. (1991) *Ecosystems of British Columbia*. Prepared for BC Ministry of Forests. Crown Publications, Queen's Printer: Victoria, BC.

Meidinger D., Pojar J. (1998) *The Ecology of the Ponderosa Pine Zone*. Prepared for BC Ministry of Forests. Retrieved from: https://www.for.gov.bc.ca/hfd/pubs/docs/bro/bro60.pdf

Ministry of Education. (2016) *BC's New Curriculum: Social Responsibility*. Retrieved from: https://curriculum.gov.bc.ca/competencies/social-responsibility

Ministry of Forests, Lands and Natural Resources Operations. 2014. Biogeoclimatic Ecosystem Classifications Subzone/Variant Map for the Penticton Subunit Okanagan Shuswap Resource District Thompson/Okanagan Region. *Government of the province of British Columbia*. Retrieved from: ftp://ftp.for.gov.bc.ca/HRE/external/!publish/becmaps/PaperMaps/field/DPE_PentictonSubunit_OkanaganShuswapResourceDistrict_ThompsonOkanaganRegion__field.pdf

National Park Service. (2009) *Wayside Exhibits: A guide to developing outdoor interpretive exhibits*. Retrieved from: https://www.nps.gov/hfc/pdf/waysides/wayside-guide-first-edition.pdf

Okanagan Basin Water Board. (2008) *Okanagan Sustainable Water Strategy*. Retrieved from: http://www.obwb.ca/fileadmin/docs/osws_action_plan.pdf

Okanagan Nation Alliance. (2010) *Okanagan/Syilx Nation Health Plan*. Retrieved from: http://www.syilx.org/wordpress/wp-content/uploads/2010/11/Okanagan-Syilx-Nation-Health-Plan-2010.pdf

Okanagan Xeriscape Association (2017) Plant Database http://okanaganxeriscape.org/

Parish, R., Coupe, R., Lloyd D. (1996) *Plants of Southern Interior British Columbia and the Inland Northwest.* Lone Pine Publishing: Vancouver, BC.

Okanagan Waterwise. (2016) *Be waterwise in the yard*. Retrieved from: http://www.okwaterwise.ca/waterwise-in-the-yard.html

Province of British Columbia. (n.d.) *School Food Garden: challenges, barriers and how to overcome them.* Retrieved from: http://healthyeatingatschool.ca/take-action/school-food-gardenschallenges-barriers-and-how-to-overcome-them

Rainer, T., West, C. (2015) *Planting in a Post-Wild World: designing plant communities for resilient landscapes.* Timber Press: Portland, Oregon.

Rinella, M. J., & James, J. J. (2017). A modelling framework for improving plant establishment during ecological restoration. *Ecological Modelling*, *361*, 177-183.

Sobel, D. (2004). Place-based education: Connecting classroom and community. *Nature and Listening*, *4*, 1-7.

South Okanagan Similkameen Conservation Program. (2003) *Living in Nature Series: Butterflies of the Antelope-brush Community*. Retrieved from: http://www.soscp.org/wp-content/uploads/2013/02/Butterflies-of-the-Antelope-Brush-Community.pdf

Turner, N. (2007) *Plant Technologies of First Peoples in British Columbia*. Royal BC Museum: Victoria, BC.

Turner, N. (2007b) *Food Plants of Interior First Peoples*. Royal BC Museum: Victoria, BC.
University of Maryland Medical Center. (2016) Echinacea. Retrieved from: http://www.umm.edu/health/medical/altmed/herb/echinacea

Valdez, J. (2017) *The 6 Main Challenges of Classroom Gardens: and how to overcome them*. Retrieved from: https://blog.brightagrotech.com/the-6-main-challenges-of-classroom-gardens-and-how-to-overcome-them

Wasson, J. (2017) *What to Grow in Your Forage Garden*. Huffington Post. Retrieved from: https://www.huffingtonpost.com/julia-wasson/what-to-grow-in-your-fora_b_10850630.html

World Wildlife Federation. (2017) *Living Planet Report Canada: A national look at wildlife loss*. Retrieved from: http://assets.wwf.ca/downloads/WEB_WWF_REPORT_v3.pdf?_ga=2.153298488.1865565632.1511457788-189388351.1511457788

The Xerces Society. (2014) *Streamlined Bee Monitoring Protocol for Assessing Pollinator Habitat*. Retrieved from: http://www.xerces.org/wp-content/uploads/2014/09/StreamlinedBeeMonitoring_web.pdf

The Xerces Society. (2016b) *100 Plants to Feed the Bees*. Storey Publishing: North Adams, MA.

Yu, F. (2012). *School garden sustainability: major challenges to the long-term maintenance and success of school garden programs* (Doctoral dissertation, University of Delaware).

Appendix 1: Budget

Description	Quantity	Unit Price	Cost
Site amelioration, preparation and construction			
Weeding out the garden bed by 28 students (2 sessions: one in May and one in September) *Industry would have used 3 laborers @ $20/hr*	9 hours (students) *4 hr*	*$60/hr*	In-kind *$240*
Layout of landscape fabric & rock feature - students *Industry: 3 laborers@ $20/hr*	6 hr (students) *5 hrs*	*$60/hr*	In-kind *$300*
Planting, irrigation installation & mulch placement (students) *Industry: 3 laborers @ $20/hr*	6 hrs *16 hrs*	*$60/hr*	In-kind *$960*
		Subtotal: (before in-kind)	**$1500**
		Subtotal: (after in-kind)	**$0**
Site Amendments			
¾" – 2" rounded rock delivered 2" – 6" rounded rock delivered	7 cu yards 1 cu yard		In-kind *$130*
Local wood chips & mulch (Mountain View Growers)	6 yards	*$35/yd*	In-kind *$210*
28 L bags of top soil (Nature's Care)	10	$7.99/bag	$79.90
Landscape fabric (3' x 25')	4	$5.99/roll	$23.96
		Subtotal (before in-kind)	$443.86
		Subtotal (after in-kind)	$103.86
Irrigation			
100' ¾" poly tubing	2	$25	$50
50' roll ¼" emitter line	6	$16	$96
0.5, 1.0, 2.0 gph emitters	160	$1	$160

Connectors (main and emitter line)	160	$.20	$32
Metal pins to stake irrigation	160	$.15	$24
		Subtotal	$362
Plants			
4", 1 gal and 5 gal	151	Various	**$1673.28**
Art			
6 Metal Bees: steel tubing, spray paint (Lordco)			$104.17
Pollinator hotels: 1 large and 6 small: stain Remainder of supplies from school			$27.22
		Subtotal	**$131.39**
Informational Signage and Plant Labels			
Spray paint for plaques			$35.13
Metal & labor for metal plaques	*34*	*$20*	*$680* *In-kind*
Metal & labor for metal frames for info signs	*5*	*$200*	*$1000* *In-kind*
Printing of plant labels (5" x 2")	34	$2	$68
Printing of info signs (3' x 2')	5	$80	$400
		Subtotal (before in-kind)	$2183.13
		Subtotal (after in-kind)	**$503.13**
		Total	**$2773.66**
		In-kind donations (incl. labor)	**$3520.00**

Appendix 2: Native pollinator monitoring data sheet

Pollinator Monitoring Data Sheet

Observer Name:
Site Name: **Date:**
Visit #: of 2 **Skies (circle):** Clear/Partly Cloudy/Bright Overcast **Temp (^{0}C):**

Conduct observations between noon and 4pm, when temperatures are over 15^{0}C, skies are clear (partly cloudy or bright overcast is alright as long as you can see your shadow) and wind speed is low (a gentle breeze).

Conduct observations on a 1 m strip along transect 1 (27 m) and transect 2 (25 m) for 7.5 minutes each. Observe all plants that lie within the 1 m strip. Record the number of native bees/flies, honeybees and butterflies/moths that you see within the strip.

Transect	Start Time	End Time	# Native Bees & Flies	# Honeybees	# Butterflies & Moths
Transect 1					
Transect 2					

Site Notes (details of the planting, dominant plants in bloom, plants with the most visitors):