

Engaging Children with the Outdoors Through Free-Choice Learning: An examination of Discovery Packs
at Royal Botanical Gardens

By

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A handwritten signature in black ink, reading "Megan Haley", is written over a horizontal line. The signature is cursive and includes a long, sweeping underline that extends to the right.

Signature of Author

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Abstract

As an increasing number of people move into urban centres in Canada, it is important to find innovative ways for people to build an understanding of the natural world, as well as an affinity towards it. Museums, science centers, zoos, or botanical gardens combine education and play. As these places are often located near or within urban centers, they pose a unique opportunity to not only provide learning opportunities, but opportunities for people to engage with the natural world. Botanical gardens were chosen as a key setting for study, due to the direct connection they create between people and the natural world. This thesis combines the evaluation of a recently updated program at Royal Botanical Gardens (RBG) in Hamilton, Ontario with the study of free-choice learning, environmental education, and connectedness with nature. The research tool of “Discovery Packs” contains several items for engaging with nature, such as an Activity Booklet, Binoculars, and a Magnifying Glass. This program was intended to be used as a self-guided education and engagement tool within the gardens and trails at RBG. Semi-structured interviews with families who used the Discovery Packs were conducted to evaluate the program and understand the impact of a free-choice environmental education program on children’s connectedness with nature. The study found that free-choice learning provides a valuable opportunity for combining education about the natural world with outdoor engagement, and that education in the form of free-choice learning can generate connectedness with nature.

Key words: Free-choice learning, connectedness with nature, outdoor education, botanical gardens

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1. Introduction

Royal Botanical Gardens (RBG) is a registered charity, containing 5 cultivated garden areas and over 2,400 acres of nature sanctuaries. RBG's Education Department offers visitors a 'Discovery in the Gardens' program which includes interpretive 'Discovery Packs' with educational materials that visitors can borrow as they explore garden areas. RBG is expanding upon the existing Discovery Packs program to provide new material to two audience segments: 'drop-in' family groups and 'pre-scheduled', self-guided school and youth groups. This research will evaluate the newly modified Discovery Packs by interviewing users about their experience with the packs. This study asks to what extent are the RBG Discovery Packs effective in engaging the users, and positively affecting the engagement of children with the outdoors? The study involves semi-structured interviews using a participant group of families (see Appendix B for Research Ethics Board approval). As this is a preliminary examination of the Discovery Packs, families already in connection with RBG (staff, volunteer, or member families) will be asked if they would like to participate in the study via an email recruitment letter. The study will involve a minimum of 20 families. The interview component of the study took place in person and physically distanced, in the Hendrie Park Garden at RBG. The garden includes features such as a small wetland, short hiking trail, Rose Garden, Global Garden, and Prehistoric Grove.

The purpose of the study is to identify if and how components of the Discovery Packs program need to be altered to facilitate the full-scale implementation of the program. Results of the study will be communicated to the partner organization (RBG). Further, this study will investigate the potential benefits that the Discovery Packs program could bring to childhood engagement in the outdoors by investigating if this self-guided exploration tool benefits the engagement of children with the outdoors.

1.1 Partnership

This study was undertaken in collaboration and partnership with Royal Botanical Gardens in Burlington, Ontario, and is an essential component of this research project. This partnership began in December 2020, through an ongoing relationship between the primary investigator and the Education Department at RBG. The partnership supported the Research Ethics Board application for this study through a formal partnership agreement (Appendix C). This partnership supported the formal program implementation of the Discovery Packs program at Royal Botanical Gardens. Further, it contributed to an understanding of free-choice learning in an analysis of relationships between participants in this program and their engagement with the outdoors at RBG.

1.2 Research Objectives

The guiding research question for this project is as follows: "To what extent are the RBG Discovery Packs effective in engaging the users, and positively affecting the engagement of children with the outdoors?". Table 1 presents a summary of research objectives associated with this question. A further objective is to investigate the impact that education has on engagement with the outdoors, and to understand the role that free-choice learning plays in improving this impact. The analysis of results from the Discovery Pack study is contextualized within the relevant literature and significant findings are presented both within the Honours thesis as well as to the RBG.

Table 1. Summary of research objectives for evaluation of the Discovery Packs program at Royal Botanical Gardens.

1. Overall Goal.	2. Project User Group.	3. Project objectives.	4. Guiding questions for developing interview questions and analysis.
Evaluate Discovery Packs	Drop-in Groups	Assess successes and challenges of the activity booklet. <ul style="list-style-type: none"> • Measure user feedback 	<ul style="list-style-type: none"> • How effective is each activity in engaging participants?
		Assess successes and challenges of the overall usability of the discovery packs. <ul style="list-style-type: none"> • Measure user behavior and feedback 	<ul style="list-style-type: none"> • How much is each tactile component being used? • How much are the learning materials being used (i.e., Field guides, Activity Booklet)? • To what extent are participants interested in continued engagement?
		How effective is the Discovery Pack program in delivering the intended outcomes for the drop-in user group? <ul style="list-style-type: none"> • Measure activity implications 	<ul style="list-style-type: none"> • Will the user group borrow a Discovery Pack in the future to engage with the garden areas and/or hiking trails? • Is the public satisfied with their self-guided garden experience, and do they acknowledge their hike was enhanced by using the Discovery Pack resources and guides?

1.3 Significance

This research project can be framed within the scholarly field of free-choice learning which can be understood as the engagement people have with education outside of the classroom, and of their own choice (Falk, 2005). Free-choice learning occurs in many informal settings such as science centers, museums, and botanical gardens (Falk and Needham, 2011) and the recent study by Falk and Needham in partnership with the California Science Centre also highlights the benefits of free-choice learning for education as well as changing visitor mindsets. As a botanical garden, or 'living museum', RBG is an ideal place for the study of free-choice learning and the engagement of children with the outdoors. With the understanding of free-choice learning being that children have an innate curiosity to learn outside of school, and by providing participant in this study with Discovery Packs, we aim to expand the understanding of free-choice learning. This is done by studying the levels at which the use of interpretive materials such as an activity guide and tactile tools like binoculars, magnifying glasses, and insect carriers, engage children and their family with the outdoors.

A study on "Learning Landscapes" that investigates how playful learning can foster education and engagement outside of the classroom found that child-directed play can help with learning (Hassinger-Das et al., 2018). An interdisciplinary review by Zylstra et al. (2014) presents a summary of nature connectivity as an outstanding issue for health, wellbeing, and environmental affinity. This review is a call to action for study and practice of nature-connectivity and contextualizes the Discovery Packs

research as a contribution to the understanding of settings, programs, and tools for connecting people with the natural world. The Discovery Packs study draws from this previous work in relation to engagement and education in the outdoors. By fostering exploration in the gardens and nature sanctuaries at RBG the Discovery Packs engage children both with learning about the outdoors and playing in the outdoors.

1.4 Thesis Outline

This thesis will begin with a presentation and analysis of similar projects found in the literature, while integrating the theoretical framework presented by free-choice learning (Falk, 2005) and provide arguments for why this particular study is both timely and important. The thesis will then describe the methodological choices made for this study, including a detailed description of the semi-structured interviews and partnership with Royal Botanical Gardens. Limitations of the study due to the Covid-19 pandemic will also be presented and addressed. Results of the study will be presented and discussed within the context of the literature. Recommendations and findings to the disciplines of free-choice learning, outdoor engagement, and connectedness with nature will be discussed. The partnership with RBG will be completed through the submission of a formal report detailing the results of the study and specific recommendations to them for the improvement of the program. Table 2 presents a summary of guiding topics for analysis throughout this project and includes the relevant disciplines guiding this analysis.

Table 2. Guiding literature review topics from major concepts.

Informal Environmental Education		Connectedness with Nature in Children and Families		
Free-Choice Learning (Framework for Study)	Environmental Engagement	Impact of Free-Choice Learning Opportunities	Settings for Informal Environmental Learning	Active Learning in an Informal Outdoor Setting
Theory review and guidance, methodologies for study to be considered.	Benefits of outdoor learning for nature connectivity. Health benefits of active environmental learning in the outdoors.	Positive affect in environmental attitudes and behaviours. Wellbeing and nature connectivity.	Other similar projects from cities, science centers, museums, or other botanical gardens.	Positive affect of active outdoor learning for environmental attitudes and behaviours of children.

1.5 Conclusion

Expansion of research surrounding informal environmental education, nature-connectivity, and botanical gardens is the driving force behind this project. A partnership with Royal Botanical Gardens supports the implementation of project goals, while contributing to program development within the organization through the completion of a research summary report by the lead researcher. The research exists within the disciplines of environmental education, and nature-connectivity in peri-urban environments. Overall, this study aims to contribute to the multi-disciplinary goal of understanding how to improve opportunities for children to connect with the outdoors.

2. Literature Review

2.1 Introduction

A literature review on the subjects of free-choice learning, environmental education, and connectedness with nature is necessary to build an understanding of current research as well as gaps in research. The main goals for the literature review are as follows:

- Establish background terms
- Discuss the role of education
- Integrate the connection to sustainable behavior change
- Introduce the relevance of botanical gardens
- Discuss the balance between education and connectedness with nature

This is a scoping literature review that aims to investigate and identify the academic literature that is relevant to this particular research project and to contextualize this thesis within the current scholarly literature. This research project aims to investigate the efficacy of the RBG Discovery Packs in engaging children and their families with the outdoors. As such, literature searches were conducted in the SCOPUS and ERIC research databases focusing on the following areas: environmental education, connectedness with nature, and botanical gardens. Search parameters include the following:

- Informal AND Environmental AND Education
 - Free-choice (within the above results)
- Free-choice AND Museum
- Informal AND Education AND Environmental+Affect
- Informal AND Education AND Evaluation

The search results revealed a variety of literature from journals and grey literature in the areas of environmental education and science. Key Journals that informed this review include Environmental Education Research, Journal of Research in Science Teaching, International Journal of Science Education, Journal of Environmental Psychology, and Science Education. Publications were selected that will further the research investigation and shed light on some of the key areas for discussion as presented below. To begin, however, it is valuable to provide a background on relevant terms found within the literature.

2.2 Background Terms

Biophilia and Biophobia

Biophilia was introduced by Edward Wilson's 1984 book "Biophilia" (Wilson, 1984) and further expanded by his 1993 book "The Biophilia Hypothesis" (Wilson & Kellert, 1993) as all humans possessing a genetic trait of being connected to nature. This is discussed by the book as an important part of protecting both our wellbeing as people and the wellbeing of the planet in the long term. Biophilia in this thesis is understood as a natural affinity (to love and care) for the environment. These terms were often present in literature surrounding connectedness with nature and outdoor engagement, as children may express biophilia while engaged with nature.

Connectedness to Nature

Biophilia can also be described as connectedness to nature. Two scales for measuring the levels of connection are the Connectedness to Nature Scale (Mayer & Frantz, 2004) and the Inclusion of Nature in Self Scale (Schultz, 2002). These scales have been found in the literature surrounding the impact of environmental education. The scales will be expanded on in the methods section of this thesis. Connectedness to nature is a key term in this thesis due to the study of connectedness with nature generated through use of the research tool (Discovery Packs).

Free-choice learning

The concept of free-choice learning is discussed as the engagement people have with education outside of the classroom and of their own choice (John H. Falk, 2005). Falk details the history of the terms formal education (school) and non-formal education (outside of school i.e., museum). He justifies the need for the use of free-choice learning because non-formal learning is defined not by the physical setting but by the motivation of the person learning. This then includes the sociocultural elements of learning, being their access to where and whom they learn from or time they have to take part in learning on their own time. The benefit of using the term free-choice learning is presented as a term that recognizes the individual's lifelong learning journey separate from an institution's prescribed one. Free-choice learning is a key term in this study as it is demonstrated through the Discovery Pack program at Royal Botanical Gardens.

2.3 Where does education come in?

As an increasing number of people move into urban centres in Canada (Statistics Canada, 2018), it is important to find *innovative ways* to maintain an understanding of the natural world, as well as an affinity towards it. This is where education can have an impact. The following articles link education and nature connectedness. They highlight the ongoing research towards improving educational opportunities for childhood connection with nature.

Free-choice learning benefits the connection between children and nature (Kola-Olusanya, 2005), and therefore research surrounding education in centers of free-choice learning should be investigated. A 2007 study at the North Carolina Museum of Natural Sciences investigated the impact of a free-choice learning worksheet on student's connections with their curriculum (Mortensen & Smart, 2007). The author's of this study were investigating the balance between the goals of teachers to meet their curriculums and those of museums which encourage free-choice learning. The worksheets implemented in this study included multiple pages of exhibit-specific activities that students could complete. Using research by both Falk and Dierking (2000) and Kisiel (2003), the authors compiled a table which outlines the suggested design criteria for effective free-choice worksheets (Mortensen & Smart, 2007). This study not only presents useful criteria for the analysis of worksheet design, but highlights research into creating both engaging and educational opportunities in centers of free-choice learning.

Education at a young age may be more significant for sustained connection with the natural world. A 2012 study investigated the connections between environmental education and connectedness with nature among different ages of students (Liefländer et al., 2013). The authors found that education was able to create short term increase in connectedness with nature, and that those under the age of 11 saw an increase in the longer term (4 weeks). This study highlights the

fact that environmental education for the sake of knowledge is not always sufficient to create long-term benefits and that connectedness with nature provides the necessary motivation for pro-environmental behaviour. Should the goal of environmental education be to create a sustainable society, the authors argue that incorporating connectedness with nature is essential (Liefländer et al., 2013).

In the *Journal of Environmental Education*, an article entitled “‘Love honey, hate honey bees’: reviving biophilia of elementary school students through environmental education program.” (Cho & Lee, 2018) investigates how an education program can impact biophilia (knowledge, understanding) and reducing biophobia (fear) towards the natural world. Highlighting the connection between education and biophilia will allow for further successful education programs like this one.

Free-choice environmental education discussed by Kola-Olusanya (2005) highlights the difference between formal education and informal education through free-choice learning. Free-choice environmental education could occur at the home, museums, zoos, nature centres, parks, and wilderness. Essentially, this could be anywhere someone encounters the natural world and has the intention to learn about it. With the variety in opportunities for free-choice education it differs significantly compared to formal education in a classroom setting. Levels of choice in free-choice learning are studied by Bamberger and Tal (2007) in a survey of 750 students visiting 4 museums on class visits. The study found that the benefit of choice in learning was significant among all levels which involved choice, by providing students the opportunity to learn something personal to them and making it easier to connect their learning to their prior knowledge. However, the study demonstrated that while free-choice learning generates more excitement and engagement with the museum setting, limited choice opportunities which were guided by activities or tasks were much more effective for generating educational interactions which balanced both engagement and learning.

2.4 Sustainable Behaviour Change: The Role of Centers of Free-Choice Learning

Museums, zoos, science centres, and botanical gardens are all visited by people looking to expand their learning outside of school. But what is their potential for impacting the environmental behaviours of their visitors? Investigation of the Vancouver Science Centre over a time period of 10 years, found that the local use of the center increased the science literacy of the local community, and positively influenced public attitudes and behaviours towards science and technology (John H. Falk & Needham, 2011). The long-term impact of centers of free-choice learning on behaviour change is argued to be similar to formal learning where reinforcement is needed to sustain the impact of education (Ballantyne & Packer, 2011). As these places recognize their role in education, and the value of education in sustainability, they could positively impact the environmental behaviours of their visitors using post-visit action resources such as take-home activities.

Furthering the discussion around environmental education from above, Liefländer et al. (2013) suggest that positive informal experiences in nature be blended with environmental education. This is found by the authors to be the best option in both promoting connectedness with

nature for creating pro-environmental behaviours in the long term, while building a knowledge of the natural world.

2.5 Opportunities for Botanical Gardens

Museums, science centers, zoos, or botanical gardens combine education and play. As they are often located near or within urban centers, they pose a unique opportunity to not only provide learning opportunities, but opportunities for people to engage with the natural world. Botanical gardens were chosen as a key setting for study, due to the direct connection they create between people and the natural world. Botanical gardens allow for childhood experiences in nature, which was found by Wells and Lekies (2006) to positively affect a person's environmental behaviours and attitudes when they are older.

To review the academic research surrounding botanical gardens, education, and outdoor engagement, the ERIC and SCOPUS databases were used. Search terms included:

- a) "botanical garden" AND "free-choice learning"
- b) "botanical garden" AND "outdoor engagement"
- c) "botanical garden" AND "connectedness with nature"

The main questions to investigate were: Are there any studies of free-choice learning or engagement with nature in botanical gardens? Are there any that took place in North America?

Table 3. Peer-reviewed search term results in major databases.

Search Terms	Number of Results (and database)	Number of Results in North America
a) "botanical garden" AND "free-choice learning"	6 results in SCOPUS 1 result in ERIC	5 in the United States
d) "botanical garden" AND "outdoor engagement"	2 results in SCOPUS 2 results in ERIC	2 in the United States
e) "botanical garden" AND "connectedness with nature".	2 results in SCOPUS 0 results in ERIC	0 results in North America

This literature search was conducted to uncover other research projects with similar goals towards understanding environmental education and botanical gardens. There appears to be a dearth of literature in the area, with only one article found that shares a similar goal with this study. "Using discovery maps as a free-choice learning process can enhance the effectiveness of environmental education in a botanical garden" (Yang & Chen, 2017) was conducted in China focusing on the impact of a discovery map on visitor education. The study found that by giving visitors a tool for free-choice learning in the botanical garden, the visitors not only spent more time in the garden but were more

engaged and demonstrated better results of environmental education compared to visitors that did not use the map. The only similar research project conducted in North America was done in Pennsylvania USA and investigated the benefit of mobile computers on outdoor science learning in a botanical garden (Zimmerman et al., 2019). This study found that the use of mobile computers which adapt their lessons based on the movement of the student within a garden, were effective at increasing the “sense-making conversations” of visiting children around science.

A review of grey literature supported the focused understanding of botanical gardens in Canada and investigated their programs. According to Botanic Gardens Conservation International (*About Botanic Gardens*, n.d.) a botanical garden uses education to support the furthered conservation of plants. The main question of this review is: How many educational mandates or programs of Canadian botanical gardens mention Climate Change, sustainability, or something similar (i.e., environmental stewardship, conservation)? The total number of botanical gardens in Canada is approximately 19 (Tyrrell, 2015). Of these 19, the grey literature search found that 12 of their education mandates or programs include education surrounding the criteria outlined above. Secondly, the review of grey literature investigated how many Canadian botanical gardens have self-guided environmental education programs for children. This found that only one, Royal Botanical Gardens in Hamilton, Ontario had a self-guided education program for children in the garden. This literature search identifies the gap in programs supporting both education and engagement with the outdoors in Canada.

2.6 Balancing Education and Connectedness with Nature

With centers of free-choice learning, there is a balance between educational goals and visitor experiences. Teachers must meet curriculum requirements while museums seek to use free-choice learning and self-guided exploration (Mortensen & Smart, 2007). Globally, among botanic gardens, education is a key function (Wyse Jackson & Sutherland, 2000). In 2019, the Government of Canada conducted a survey of heritage institutions using data from 2017. These institutions include not-for-profit art galleries, museums, historic sites, archives, zoos, and botanical gardens. The survey found that 13.5% of employees (full-time and part-time) at zoos and botanical gardens were in education/programming and engagement roles (Canadian Heritage, 2018).

Zylstra et al. (2014) define connectedness with nature as “a stable state of consciousness comprising symbiotic cognitive, affective, and experiential traits that reflect, through consistent attitudes and behaviours, a sustained awareness of the interrelatedness between one’s self and the rest of nature.”. The cognitive component may come from education, with the potential for the experiential factor as well. Affect, however, comes from personal experience and love, which free-choice education can create as it allows people to learn about things that are personal to them.

To support the discussion between education and connectedness with nature, free-choice learning is discussed by Ballantyne and Packer (2005). If it is assumed that connectedness with nature is needed to promote sustainable behaviour change, this article is useful as their goal is to understand the connection between positive environmental attitudes and behaviours and free-choice learning experiences. The authors suggest that the following factors support change towards positive environmental attitudes: arousing emotions, challenging beliefs, and enhancing environmental conceptions (understandings). Connections with nature through encounters such as in zoos and aquariums are discussed in the articles, with the educational and experiential connections combining to alter people’s attitudes towards environmental issues such as trawling in fishing. The same finding could

be applied to learning in botanical gardens where people may be more inclined to alter their behaviours or attitudes not only because of what they are learning but because of what they are encountering.

One opportunity for balancing education and connectedness with nature was highlighted by Beery and Jørgensen (2018) in the discussion of sensory engagement with nature. The authors analysed two studies of engaging multiple senses during childhood interaction with nature. They found the importance of integrating the senses at the beginning of environmental understanding encouraged interest in biodiversity and suggest that environmental education incorporates sensory-based experiential education. Another study by McClain and Zimmerman (2016) addresses this suggestion by studying the use of an e-trail guide at an environmental centre. The study found that the use of prompts and questions in the e-trail guide increased engagement with the environment.

2.7 Conclusion

This literature review has primarily highlighted the research towards improving the connection between children and nature within environmental education. The review found opportunities and justifications for the achievement of this with the use of free-choice learning and centres of free-choice learning such as museums. These topics were then contextualized in botanical gardens, as places where children can directly engage with the environment they are learning about. The gap in the research between environmental education, free-choice learning, and botanical gardens was also highlighted, and provides a justification for why this thesis project is both important and timely. Should this study find that environmental education in free-choice learning is effective at engaging children with outdoors, there will be motive for the growth of education programs at botanical gardens that generate opportunities for children to connect with nature.

3. Methods

3.1 Study and Methods Overview

This study aims to use the research tool of Discovery Packs to investigate the benefits of a free-choice learning and tactile engagement tool on user learning and engagement with nature. The Discovery Pack tool was recently updated by Royal Botanical Gardens, and the study of the research tool will not only contribute to the aim discussed above but will support program implementation at RBG. This study uses topics of free-choice learning and connectedness with nature to frame and analyze the results.

In this section the methods of the study will be presented. This consists of background information, including the nature of the study partnership, the study location, and the study tool. The timeline of the recruitment and interviews for the study will be presented. Then, the study sample as well as recruitment tools and methods will be detailed. The interview questions will be presented and discussed, along with the procedure for each interview. Finally, this section will discuss the methods that will be used to analyze the results of the interviews, and present any limitations and/or problems with the methods and how they were mitigated.

3.2 Partnership Development and Agreement

The project partnership began in December 2020, through an ongoing relationship with the Education Department at Royal Botanical Gardens. The partnership supports the ethics application for a study of environmental education materials through a formal partnership agreement (Appendix C). This

partnership will support the formal program implementation of the Discovery Packs program at Royal Botanical Gardens. Further, it will contribute to an understanding of free choice learning in an analysis of relationships between participants in this program and their engagement with the outdoors at RBG.

3.3 Timeline

The timeline for this project was altered from the original project timeline agreed upon between the lead researcher and RBG, due to limitations presented by Covid-19 for interviewing school group participants. Research questions were developed in April, with Dalhousie Research Ethics Board approval obtained June 24, 2021 (Appendix B). The research group of staff, volunteer, and member families at RBG were interviewed from July through September 2021. Results will be analyzed and discussed in January and February of 2022. Finally, the partnership between the lead researcher and RBG will be completed upon the submission of the Discovery Pack Pilot Evaluation Report by the lead researcher in April of 2022.

3.4 Sample and Recruitment

The recruitment was done using convenience sampling, from a sample of people already connected with RBG. This included staff, volunteer, and member families. Convenience sampling was selected because it is fast, cost efficient, and generates non-inferential data for preliminary research in identifying trends, issues, and future directions for the Discovery Pack program. However, there is a higher risk of bias in convenience sampling, as those that will be selected for the pilot test will have pre-existing opinions and expectations from their existing connections to RBG. As this is a non-probability-based sample, the results of the study will not support formal statistical inference. The sample was taken on a first-come first-serve basis to recruitment emails.

Study recruitment occurred over a three-month period, including July, August and September of 2021. Recruitment was done by the lead researcher Megan Haley, in partnership with Jennifer Dick the Manager of Interpretation at RBG. A total of approximately 500 emails and a newsletter announcement regarding the study were sent to invite families to participate. This email can be found in Appendix D. Responses to these recruitment emails included 5 staff, 5 volunteers, and 15 members. After the recruitment period, a total of 15 families agreed to participate and were interviewed. The breakdown of interviews included 2 staff families, 3 volunteer families, and 10 member families. Out of all those that identified interest in the email responses, 55% participated. Families who participated were invited to be interviewed at RBG's Hendrie Park. They were given three suggested dates and times. The time-slots for the interviews were 2 hours.

3.5 Study Tool: Discovery Pack

The Discovery Pack was highlighted by the partner organization as an ideal tool for the study of the engagement of children in the outdoors as it combines both free-choice learning and tools for exploration in the outdoors. The research of this tool would also offer a benefit to RBG as it is a recently re-developed program with new activities and in need of program evaluation. It is important to note that due to limitations presented by Covid-19, the Discovery Packs were not completed for the study. The researcher used the original version of the backpacks, with the new components being evaluated were the Activity Booklet and laminated activity pages. This may impact study results as suggestions for improvements could occur due to damaged or poor-quality items which will be improved in the newly updated Discovery Packs. Each Discovery Pack contains the following items:

- Activity Booklet (16 pages)

- Insect Carrier with magnifying lid
- Magnifying glass
- Binoculars
- Clipboard
- 2 field guides (insects and wildflowers)
- Pencil case (crayons, pencil crayons, and sharpener)
- Laminated pages on a binder ring (On the trail eye spy, Discovery Pack Pledge)

The activity booklet includes multiple different activities and includes prompts that guide the user to different areas in the garden and the different tools in the Discovery Pack they could use with the activity. The activities in each Activity Booklet included the following:

- Safety First
 - list of items to bring outdoors
 - Prompt to look through the backpack at everything
- Stay on the Trail
 - maze and information on the importance of staying on the trail
 - Try one of the eye spy pages
- Wonderful Wetlands
 - Find wetland animals in picture
 - Use the binoculars at a pond or marsh
- Pollination Partners
 - Draw pollinator next to drawing of flower it pollinates
 - Use the magnifying glass on insects on the flowers
- Lots of Leaves
 - Look through garden for leaves pictured on the page
 - Use the field guides
- Delicious Plants
 - Plan a menu for each meal of the day
 - Visit Veggie Village in Hendrie Park
- Forest floor
 - Explore a fallen log and identify insects pictured on the page
 - Use the Insect Carrier and Magnifying Glass
- Colourful Nature
 - Find the different colours on the page in the garden and colour each petal the associated colour when you find it
 - Use the field guide for missing colours
- Intriguing Insects
 - Draw insects you've seen and identify the body parts using the given example of a bee.
 - Use the insect carrier and magnifying glass
- Travelling Seeds
 - Connect each seed pictured with the method it uses for travelling
- Promise to Protect
 - Write one thing you are doing now to protect the planet, and one thing you will improve

- Homey Habitats
 - Match the animal pictured to the habitat(s) you will find them in
 - Use the binoculars to look for animals in each habitat
- Leaf Rubbings
 - Press fallen leaves underneath the page and colour on top of the paper
 - Use the clipboard to work on



Figure 1. Display of Discovery Pack and contents.



Figure 2. Display of Discovery Pack and it's contents, with a focus on the Forest Floor activity in the Activity Booklet.

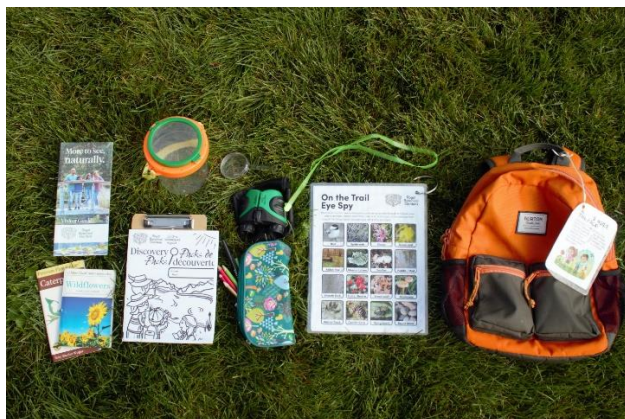


Figure 3. Display of Discovery Pack and it's contents laid out.

3.6 Study Area: Royal Botanical Gardens

The study took place at Royal Botanical Gardens in Burlington, Ontario, in Hendrie Park and the Arboretum. The Hendrie Park garden was the primary study location, with the Arboretum used only twice as a backup location due to events occurring in Hendrie Park. Hendrie Park is large garden with 12 different garden areas. The rose garden in it's center is the main display, and the other major features are a vegetable garden, global garden, pond, and a small trail with a boardwalk. Interviews in this garden were conducted near the vegetable garden on a long bench under a pine tree.

The Arboretum is a separate garden area with the main attraction being hiking trails. This garden is seasonal, with a large lilac collection, as well as magnolias, cherry trees, and crab apple trees. The interviews at the Arboretum took place at a picnic table under a pavilion.

3.7 Semi-structured Interviews

To investigate both the education and engagement impacts of the Discovery Packs on participants time in the garden, semi-structured interviews were used. The interviews allowed for casual conversation but were guided by some specific questions (Appendix E). These questions were developed by the lead researcher in partnership with Royal Botanical Gardens education department staff. Within the literature, methods for studying childhood engagement with nature include the Connectedness to Nature Scale (Mayer & Frantz, 2004) and the Inclusion of Nature in Self Scale (Schultz, 2002). These scales were not used in this study, due to the combined objectives of the partnered research. Questions in the study needed to have a second benefit to Royal Botanical Gardens and therefore also ask about favourite activities, suggested changes, and interest in future use of the Discovery Packs. The questions were developed to investigate the users level of learning from each component, their engagement with the program and the natural world, and their interest in further use. Mitigation of bias in the responses was included in the interviews, with the opening interview conversation involving the lead researcher describing bias to the user and expressing the importance of honesty in their responses. During the interviews, the lead researcher took notes on an interview form, and later entered the results into an excel spreadsheet for analysis. The first 10 minutes included the researcher introducing themselves, providing an overview of the Discovery Packs program, and thanking the family. Families then used a Discovery Pack to explore the Hendrie Park garden for approximately 1.5 hours. Afterwards, they returned to the agreed upon meeting location for an interview conducted by the researcher, which

lasted approximately 15-20 minutes. Each interview involved responses from multiple members of the family, including parents.

3.8 Methods Procedure

- 1) Send recruitment emails to staff members.
 - 2) Schedule interviews with the first 5 respondents, for the first available interview time slots.
 - 3) Send recruitment emails to volunteers.
 - 4) Schedule interviews with the first 5 respondents, for the next available interview time slots.
 - 5) Send recruitment emails to members.
 - 6) Schedule interviews with the first 10 respondents, for the last available interview time slots.
-
- 1) Meet family at the entrance to RBG Main Centre.
 - 2) Introduce yourself and lead the family to the meeting spot in Hendrie Park.
 - 3) Describe the purpose of their visit and the timeline.
 - a. Evaluating the Discovery Pack.
 - b. Getting you to try using this backpack in the garden for a couple of hours, and hearing about your experience with it.
 - c. Please use the Discovery Pack for approximately 2 hours, after which I will meet you here for a 15-minute interview.
 - 4) Obtain consent through signature of consent form by parent/legal guardian and verbally from the children.
 - 5) Ask if they have any questions.
 - 6) Suggest they look through the contents of the Discovery Pack before they head off so they don't miss anything.
 - 7) Go inside until 2 hours have passed.
 - 8) Return to meeting place.
 - 9) Turn on recording device.
 - 10) Ask for verbal consent again and ask again if it is okay to record and use quotations from the interview.
 - 11) Go through the interview questions. Record notes about their responses on the interview form (Appendix E)
 - 12) Thank the family for their support in the improvement of the Discovery Pack program and lead them to the exit.
 - 13) Enter notes from interviews into an excel spreadsheet for later analysis.

3.9 Limitations of Methods and Mitigation

As this study contains qualitative data and interviews with children, one limitation was bias in participant responses. This was mitigated within the methods through a discussion with participants prior to each interview, where the interviewer described bias and asks the participants to be completely honest with their answers, describing that even negative responses were helpful because they would help to improve the Discovery Packs for the next children that use them. A second limitation was that the Discovery Packs would normally be available for use in all garden areas as well as on the hiking trails at RBG. Due to time constraints this was not possible for the study, however Hendrie Park was selected as the best area for study with multiple different gardens as well as a small hiking trail. The Discovery

Packs used as the research tool were not fully completed in time for the study due to Covid-19, however the main component which was changed from the original Discovery Packs was the addition of the Activity Booklet, which was completed and used for the study. Finally, the study did not use a formal research tool for the interviews such as the Connectedness with Nature Scale, due to the need to meet partnership organization goals of program evaluation.

3.10 Analysis

The results of the semi-structured interviews will be analyzed as both quantitative and qualitative data. This mixed-methods approach is justified due to findings by Falk and Adelman (2003) due to the high variability in prior knowledge and interests of participants. Quantitative data is not representative of this personal variability and therefore must be combined with qualitative data. Quantitative data will be used to generate descriptive statistics. The size of variations in the responses that will be presented by the descriptive statistics will highlight difference of user opinions on the effectiveness of the Discovery Packs, which can then be supplemented with discussion from qualitative results. The interviews will be transcribed using the Otter online transcription service. These qualitative results will then be coded using *a posteriori* codes. These themes and their prevalence among users will demonstrate trends in user responses and areas for improvement in the Discovery Packs Program. Finally, the results of analysis will be shared with the partner organization, Royal Botanical Gardens, in the form of a report. This will complete the agreed upon partnership requirements and support the improvement and effective implementation of the updated Discovery Packs program.

4. Results

The results of the Discovery Packs study are presented below as both quantitative and qualitative data. Quantitative data was collected to gain a generalized understanding of trends in both education and engagement with the Discovery Packs. Questions such as “Did you learn anything new using the Discovery Pack” were intended to gauge whether children used the Discovery Packs for educational purposes, and questions such as “Would you come back to use the Discovery Pack again?” were intended to demonstrate a child’s engagement with both the backpack and the garden. Some questions such as “Which part of the Discovery Pack did you spend the most time using?” or “How would you describe the Discovery Pack to your friend?” may demonstrate whether the child appreciated the Discovery Pack more for it’s educational purposes, for having fun, or for both. This section is intended to present the results of the semi-structured interviews. A discussion section will follow to consider these results in relation to the literature and present recommendations for the Discovery Pack program.

After the interview process was complete, data was collected from a total of 15 families. Five of the families were those of staff and volunteers, and ten were those of members. The demographics of the study group can be found in Table 1 below.

Table 4. Demographics overview.

Number of Families	Number of Kids	Most Common Age	Age Range	Avg Number of Kids Per Family
15	31	5	2 to 12	2

4.1 Quantitative Results

Quantitative interview results were analyzed primarily using descriptive statistics. These statistics demonstrate general response trends. The results are as follows:

Table 5. Descriptive statistics for the rating Of Discovery Pack components as tools for learning.

	Activity Booklet	Nature Finds	Field Guides	Binoculars	Magnifying Glass	Insect Carrier
Mean	1.62	1.65	0.95	1.79	0.9	1.54
Median	2	2	0	2.375	0	2
Mode	2	3	0	3	2	0
Mean Std.dev	1.16	1.26	1.19	1.34	1.04	1.40



Figure 4. Representation of the average response to Question #7.

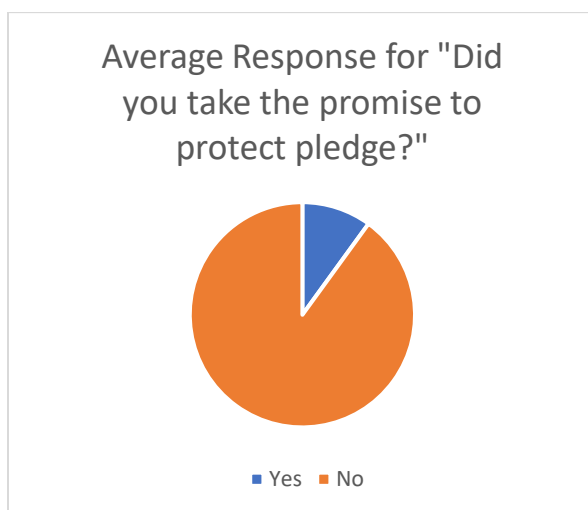


Figure 5. Representation of the average response to Question #9.

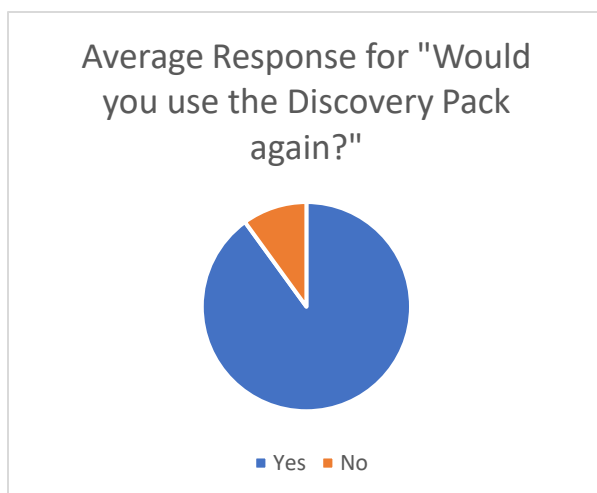


Figure 6. Representation of the average response to Question #12

In Table 5 (above) the columns containing the names of each item within the Discovery Pack present the results of the first major question in the interview, "How would you rate _____ as a tool for learning?". This question was intended to gain a general quantitative understanding of the users' opinions of each item as an educational tool. Accompanying trends in responses such as "It was really cool" "It helped me find my favorite insects" can be found in the qualitative section below. On these questions, 1 indicated that the tool was not helpful for learning, and 3 indicated that it was a very good tool for learning. The average responses ranging from approximately 1 to 1.5 reflect the high standard deviation in opinions. This was expected, given the diverse age range of the participants and associated reading levels. However, the mode may likely be a better indication of opinions as it does not consider outlying answers. Unexpectedly, the Activity Booklet did not have a mode of 3 as a tool for learning and was outcompeted by the Nature Finds "eye spy" sheets and the binoculars.

Figures 4 through 6 present the data for responses to the Yes or No questions in the interviews. The first question asked, "Did using the Discovery Pack help you learn anything new?". In general, this question was quite popular with older children who could read the Activity Booklet, and younger children that did not have a lot of previous experience in nature. The average was a very high number of "yes" responses, which was expected given the development of the Discovery Pack was done by the education team at RBG. The second yes or no question was in regard to page number thirteen in the Activity Booklet, which was called the "Promise to Protect Pledge". This activity asked the user what they are currently doing to protect the earth, and what they hope to improve. The quantitative component of this question asked only if they completed the activity, which most did not. The final question was "Would you use the Discovery Pack again?". This question received a very high average response of yes, and most children were very excited at the prospect of coming to use the Discovery Packs again – as demonstrated in the qualitative section below.

Question 4 (Figure 7) asked the users which item they spent the most time using. This question not only indicated engagement but also provides RBG with information on which tools were most

successful. Unexpectedly, the highest scoring item was the Binoculars, with the Activity Booklet and the Nature Finds (“eye spy”) sheets tying for second place.

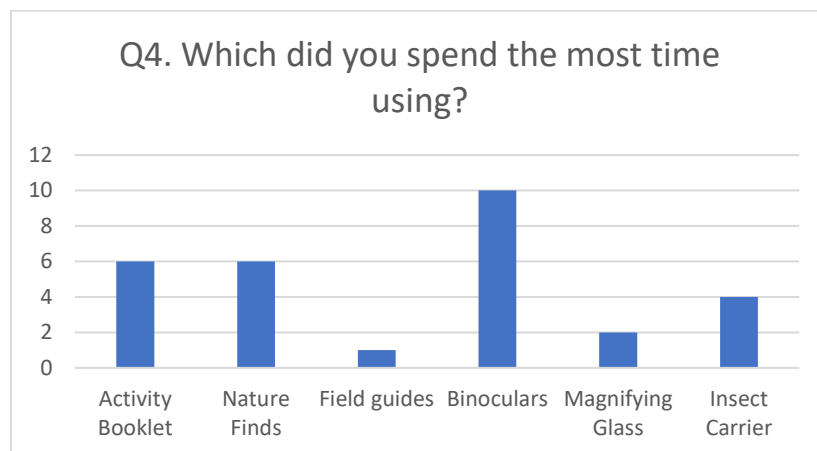


Figure 7. Results of Question 4.

Question 6 (Figure 8) asked the users to rate their favourite activities in the Activity Booklet. This question was also intended to provide RBG with information on which activities were most popular, for further program development. The results of this question were expected, with the highest-ranking activity being the maze. The other most popular activities included Forest Floor, which prompted children to turn over logs and look for insects, and the Delicious Plants activity which had children use the vegetables in the Vegetable Garden to plan a meal.

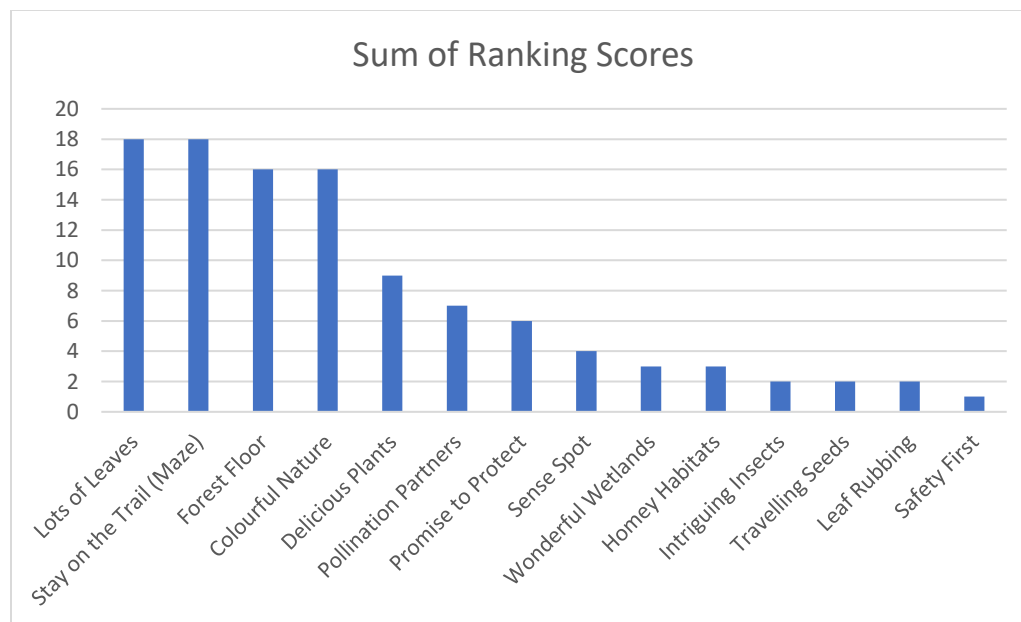


Figure 8. Results of Question 6. Activities ranked #1 were given 3 points, those ranked #2 given 2 points, and #1 were given 1 point.

4.2 Qualitative Results

Qualitative data was analysed using *a posteriori* codes, generating both initial and interpretive codes. The number of times a theme appeared in an interview was recorded, and qualitative information was collected on the ways the themes presented themselves, with examples in the form of quotations.

The codes that were developed through the *a posteriori* coding are as follows:

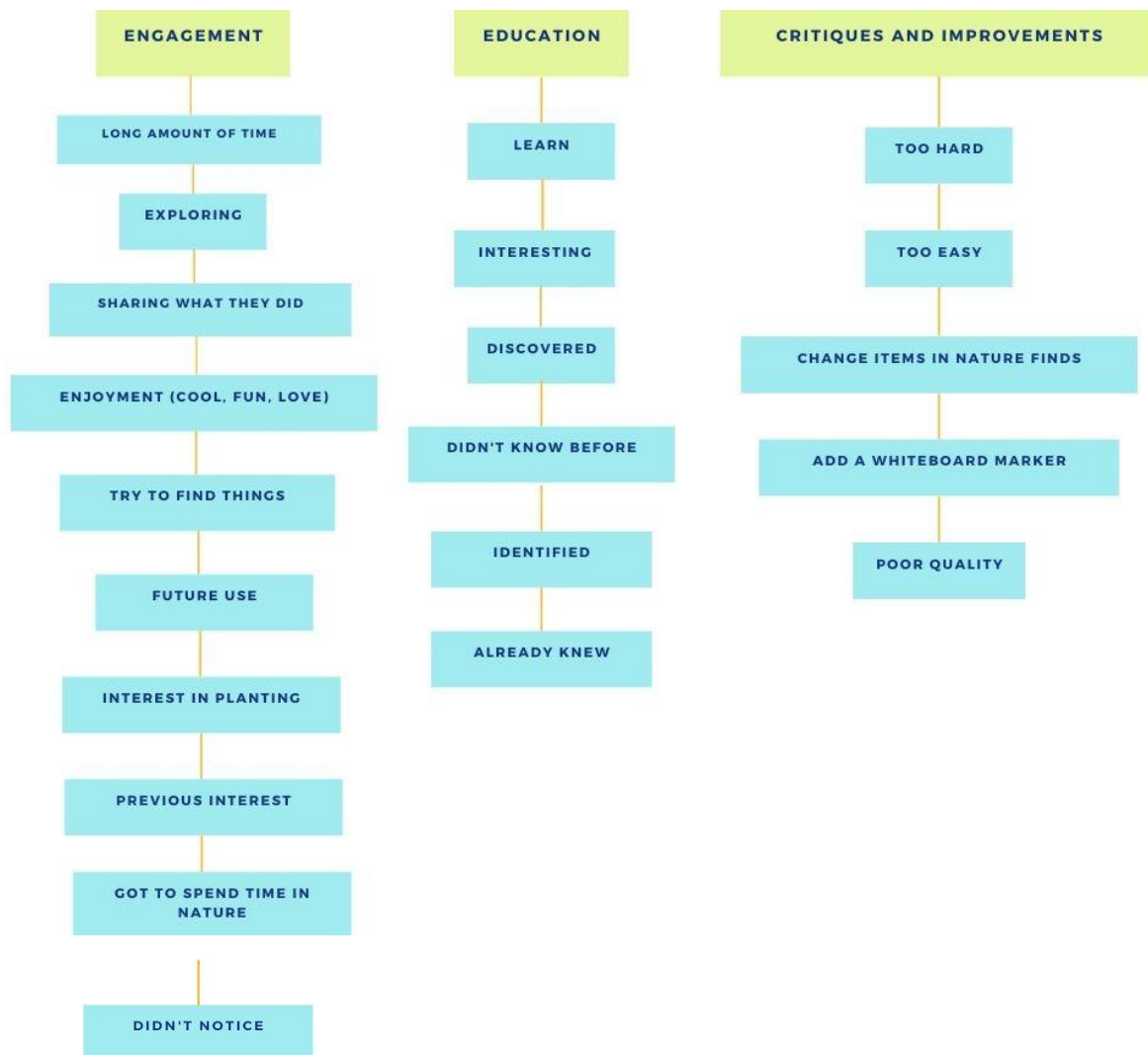


Figure 9. Code trees.

These codes were then used in the analysis of each of the interview questions. As the reader will notice below, some of the themes were found to emerge throughout all of the questions, while others were unique to individual questions. The remaining parts of this results chapter below are dedicated to describing the results of each interview question and illuminating the codes therein.

For the first question, regarding how each item in the Discovery Pack helped the user learn in the garden, the figures below present the results of quantitative coding. The first question was in regard to the Activity Booklet. As discussed in the quantitative section above, the average response for this item was unexpected as it was not voted highly as a tool for learning. The qualitative results indicate that users found the Activity Booklet to be both educational and engaging with high numbers of responses under both parent themes.

“A two. Like, there's all the different types of fun activities. Yeah. And there's like a mix of like fun stuff and learning stuff.” (Family #1, child)

Many children indicated very high enjoyment of the Activity Booklet by sharing unprompted examples of what they had seen or done using the booklet.

“I thought that was this one was actually a really fun one. Because you got to kind of write down some things that you have at breakfast and you got to see some of that stuff in that garden, actually, which was really fun. Because the stuff you wrote down, it was right there. And did it help you learn about like, what you were eating and everything (Interviewer)? Yeah, it really did. Because you got to see all the stuff in the ground. Like I wrote down carrots and I saw some carrots.” (Family #2, child)

Participants also expressed an appreciation for the diversity of activities within the Activity Booklet, as demonstrated by the following quote from a parent.

“I would have said the booklet is the thing we use the most we kind of use it as our guide. Yeah, good. And there's a lot of like, you can read it, x just sat down right away. And he just read the whole thing, because he's a reader. So that's how he gets a lot of his information. And y is very visual and artistic. So, she held on to it because she wanted to color and keep looking at the pictures and stuff. So, it's very visual. And I think a lot of people learn very visual, right? So, it's nice to have definitions and words and stuff to look for.” (Family #6, parent)

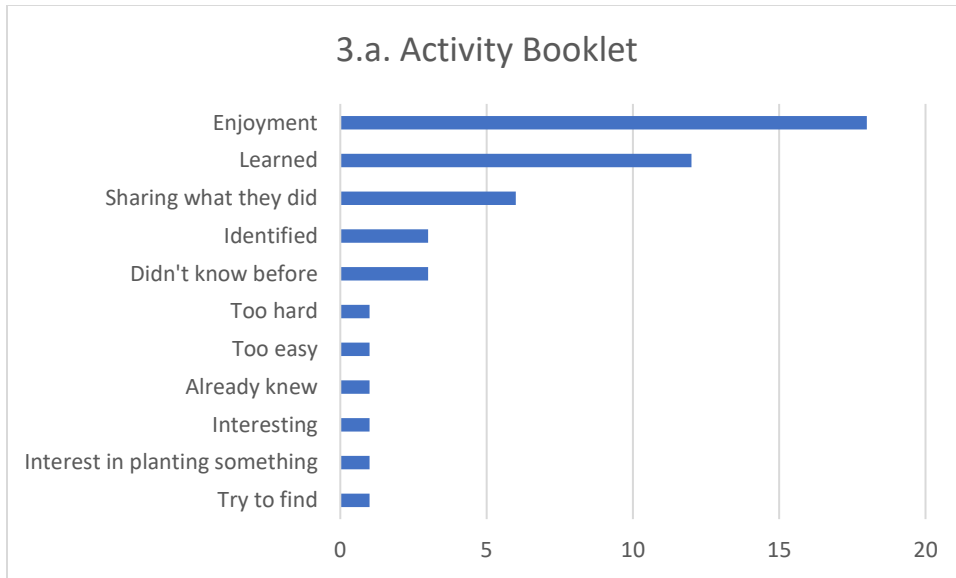


Figure 10. Activity Booklet results.

The second question asked users about the Nature Finds “eye spy” sheets which provided multiple pictures of animals to look for while in the garden. This item received high votes as a learning tool in the quantitative section, and then received more qualitative responses in the engagement section. This provides additional support to the quantitative results above that the Nature Finds activity is highly regarded both as a tool for learning and engaging with the outdoors. The activity booklet was similarly well regarded as an engaging activity keeping children actively aware of their surroundings, while also teaching them new things to look for. The following quote from a parent expresses this regard.

“I like that (eye spy nature finds). This gives you somewhat of a direction to follow. Because I mean, you can just walk around the garden aimlessly all day. Yeah. But this gives you actually stuff to look for things like actual specific topics, which would be very helpful. And then yeah, this thing is a hit. Like, if somehow you could make one that like they could physically write check marks on.” (Family #8, parent).



Figure 11. Nature Finds results.

The third question asked users about the Field Guides, which included a book on identifying wildflowers and another about insects. The major themes to investigate are education, engagement, and improvement. Overall, there were less responses that included any of the themes, indicating less engagement with this item in the Discovery Pack. When they were discussed, the Field Guides did receive high numbers of responses for both engagement and education. Interestingly, the responses coded for engagement were not in the typical “enjoyment” category, rather most responses involved children sharing what they did with the Field Guides. This indicates that although the Field Guides were not actively used by many, those who did use them found them very engaging and were passionate enough to share what they had used them for.

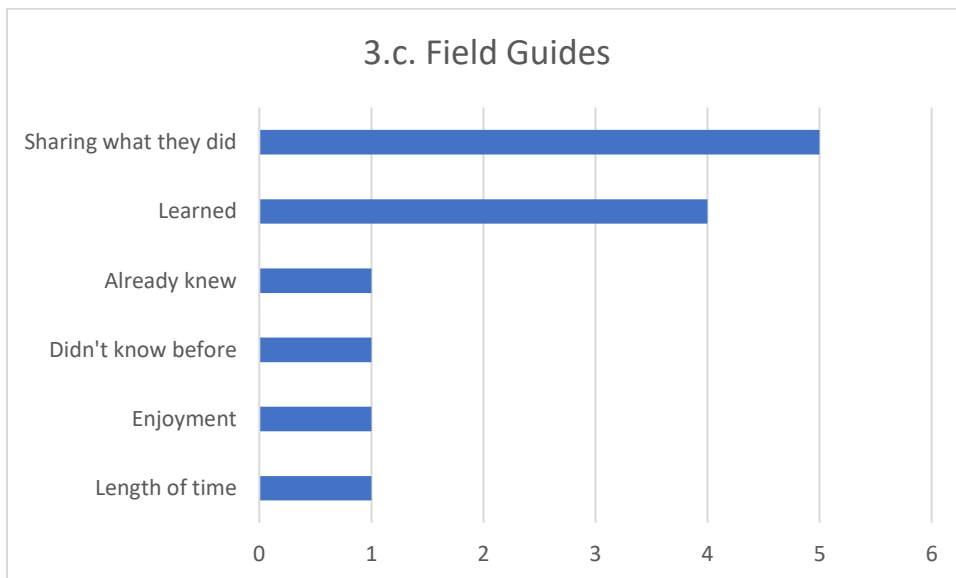


Figure 12. Field Guides results.

The fourth question asked about the binoculars that are given to the participants with the Discovery Pack. Similar to the Activity Booklet, this item received many responses for both engagement and educational codes. However, the Binoculars are opposite to the Activity Booklet, as they received high quantitative responses for learning, but mostly qualitative engagement responses. This indicates that the Binoculars were both highly regarded for helping children learn about the natural world, and the children were very passionate about sharing their experiences with the binoculars and their enjoyment of them. This item did receive one response that the Binoculars were poor quality, and it was due to the small size of the Binoculars. The great appreciation for the binoculars as a tool for engagement and education can be demonstrated by the following quote:

Child: "I loved the binoculars! They were my favorite!" Parent: "They wish there was more! Yeah, there could have been more in the bag for they were fought over. It was it was very fun. I feel like had we just walked through by ourselves, this would have been a half an hour thing. So, we did like they found they did find it very fun to do the different activities and animals are a highlight when they get to see them." (Family #15, child and parent).

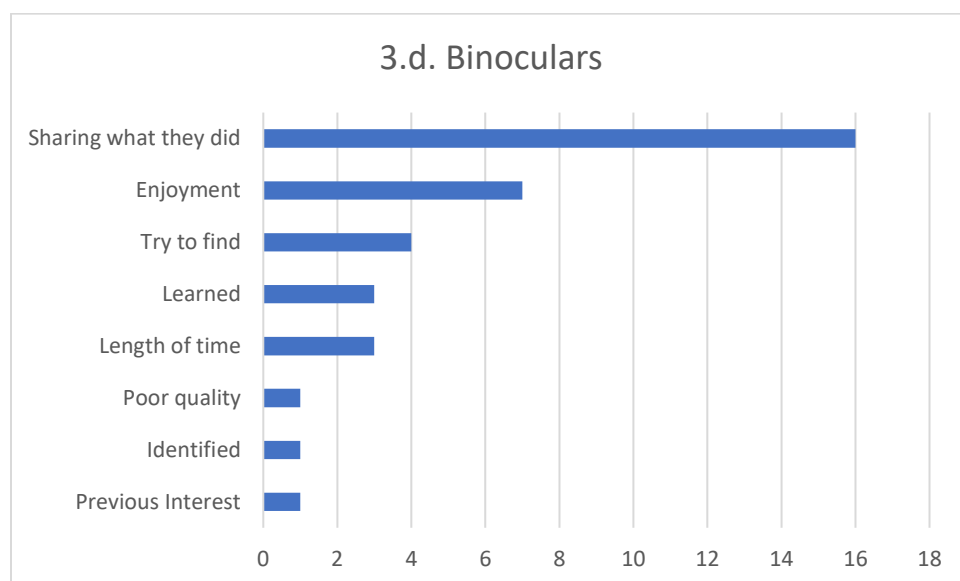


Figure 13. Binoculars results.

The next question asked users about the Magnifying Glass. This item did not have many responses that demonstrated the coded themes, indicating poor usage. Although some responses indicated high enjoyment associated with the Magnifying Glass, these were outnumbered by the number of comments on the poor quality of the tool. Most users indicated that the lens of the Magnifying Glass was too blurry to see through. Some suggested investing in scratch-proof coating on the lenses of the Magnifying Glasses.

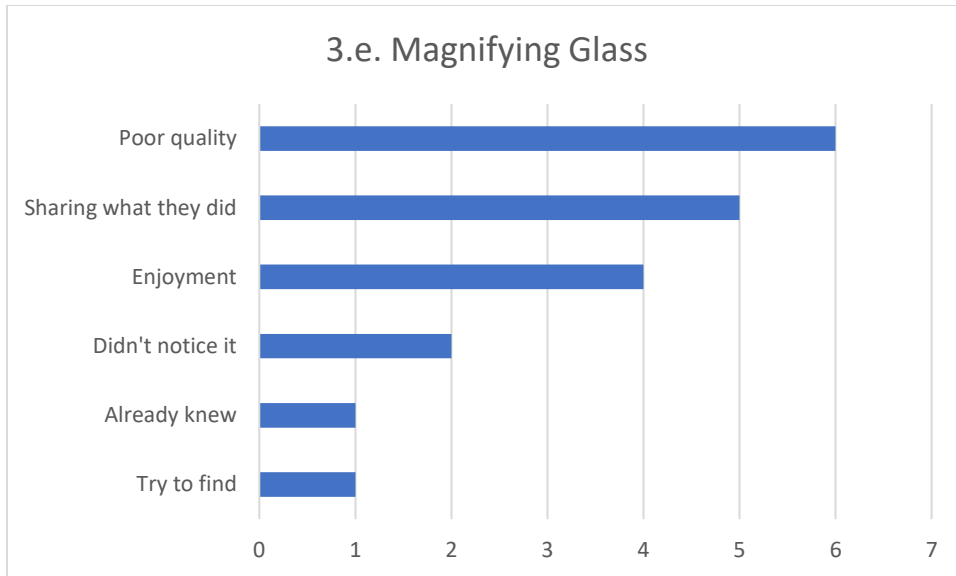


Figure 14. Magnifying glass results.

The final question regarding the rating of each item as a tool for learning asked the users about the Insect Carrier. This item includes a large clear plastic container, with a hinged lid and a magnifying glass on top. The Insect carrier was very popular, with a large amount of enjoyment expressed through the children sharing what they had done or found with the Insect Carrier. This tool was also used for learning, demonstrating an effective dual purpose similar to the Binoculars and the Activity Booklet.

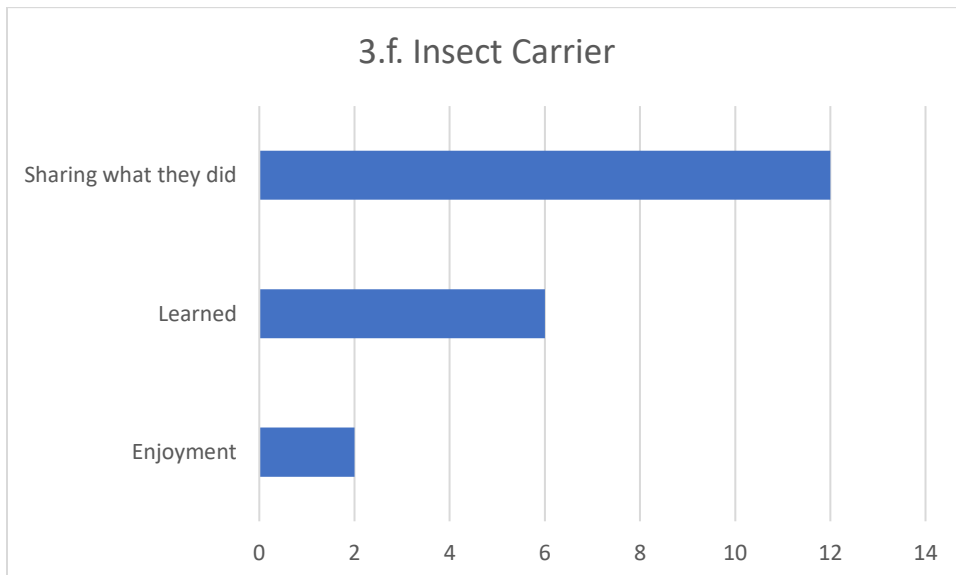


Figure 15. Insect Carrier results.

The next question, “Which part of the Discovery Pack did you spend the most time using?” was asked primarily as a rating question with results presented in the quantitative results section above. However, the question presents an opportunity to see the range of user attitudes when discussing their favourite part of the pack. There was a wide range in responses, with most indicating high levels of

enjoyment. This question also demonstrated that the previous interests of users could drive what they spent the most time using. This was often presented through use of Binoculars or the Activity Booklet.

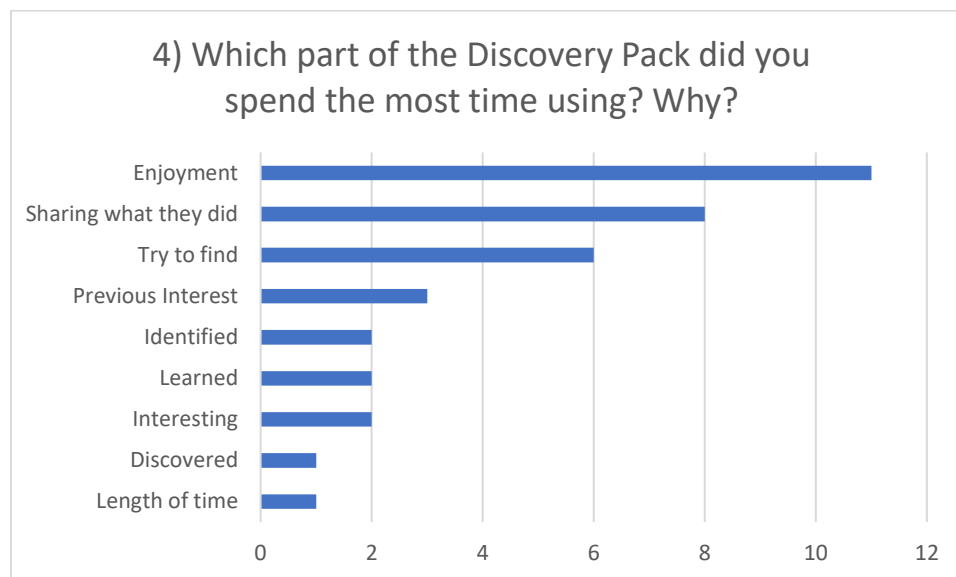


Figure 16. Results for question 4.

The next question asked children in general what their favourite part of using the Discovery Pack was. Some listed their favourite items in the pack, and most indicated enjoyment using expressions such as “love”, “cool”, or through sharing stories about what they had done with everything in the Discovery Pack. The high level of positive response to this question supports the growth of the Discovery Pack program by indicating a high likelihood of program success. This question also prompted multiple parents to discuss how using the Discovery Pack improved their visit compared to when they normally come to the garden, indicating very high levels of enjoyment:

“Yeah, we usually come and go for a hike or walk and it's just we'll see some things or stop and look at the chipmunks running across. But this made us stop and listen and then look for things more closely. Because I think I'm sure we've seen bees here before, but we saw more in a 10-minute period than we probably ever noticed here in dozens of visits, right? Yeah, so it made us slow down and appreciate it.” (Family #13, parent).

“I think they all took turns wanting to actually carry the backpack. So that made them feel like it was almost like a dress up thing like they were getting into the roll of exploring. And then I liked the eye spy thing because I felt like it gave us a goal to focus our attention while we were on the trails. And I think like it extended our stay a little bit. Like if we were just here to visit on a super hot day or a super cool day, it would have maybe given them a little bit more just tactile things to focus on.” (Participant #7, parent).

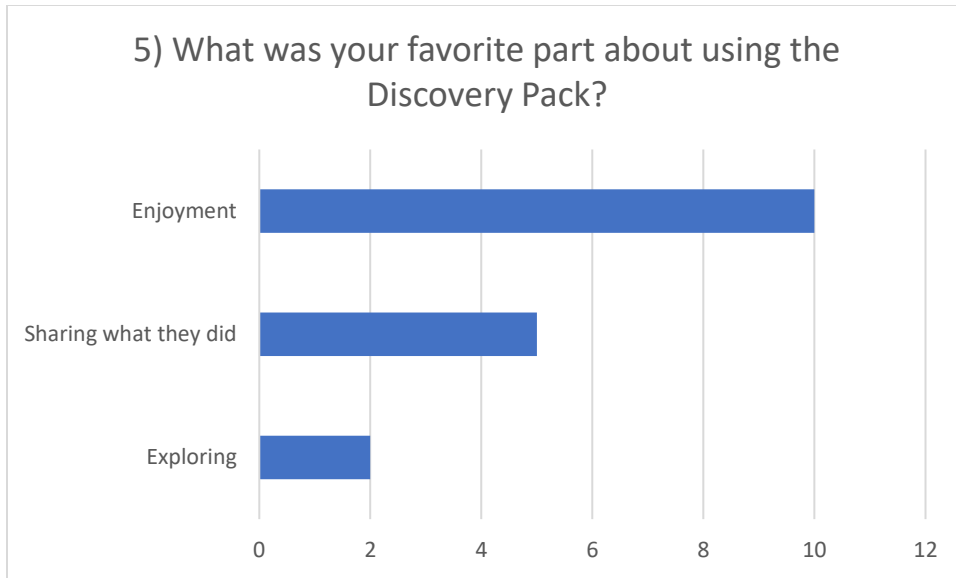


Figure 17. Results for question 5.

Similar to question 4, question 6 was intended to provide quantitative data by having the children rate their favourite activities. However, these results also support the findings expressed in the results for question 5, with most users indicating high levels of enjoyment associated with the activities in the Activity Booklet.

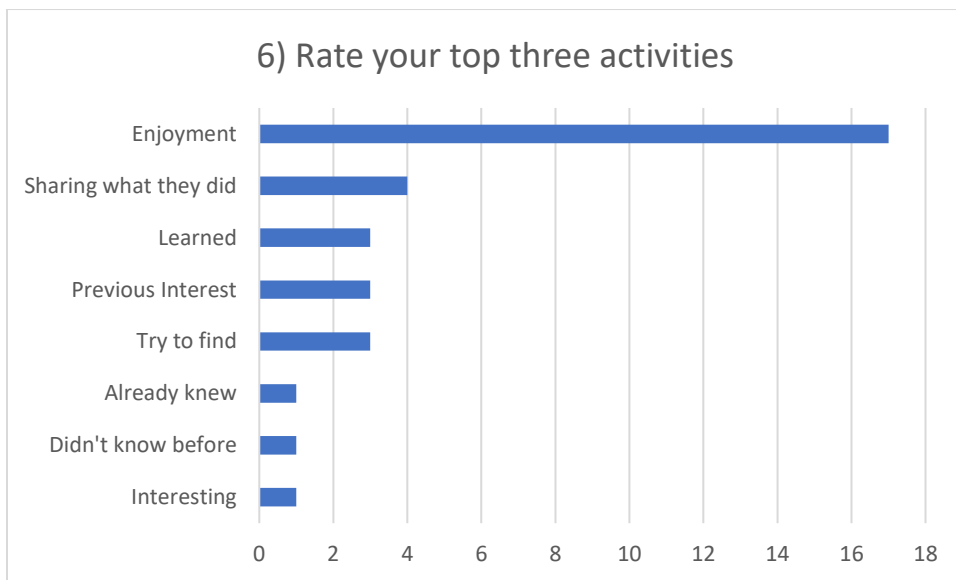


Figure 18. Results for question 6.

The 7th question was also intended for quantitative analysis, but demonstrates that while the children were discussing the educational value of the Discovery Packs, they also often expressed enjoyment. This speaks further to the combined value of the Discovery Pack for education and connection with nature. The following were common things that most of the children had learned:

- New types of leaves (using the activity booklet).

- Insect body parts (using the insect carrier with a magnifying lid).
- Where animals lived (using the activity booklet).
- New birds and animals (using the Nature Finds “eye spy”).

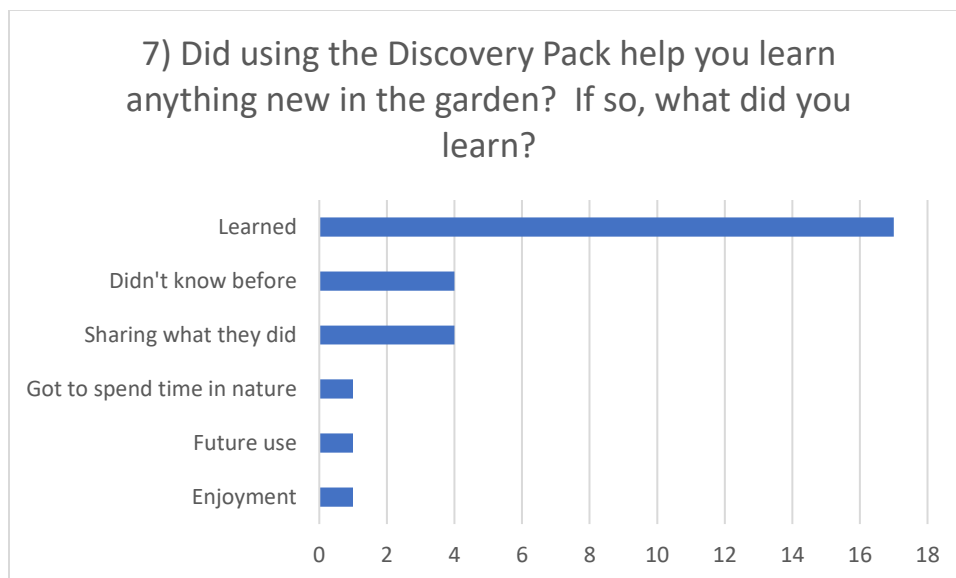


Figure 19. Results for question 7.

Question 8 asked the children if they were to visit a friend that day how they would describe their experience with the Discovery Pack to that friend. This question revealed an unexpected result that the child would not only express their enjoyment through sharing what they did or how much fun they had, but many children also expressed what they had learned about.

“I would describe it as a kit to help you notice things while you're on a hike or visiting a garden that you wouldn't normally have noticed, or kind of slowing you down to really enjoy it and take notice of the little things.” (Family #6, parent).

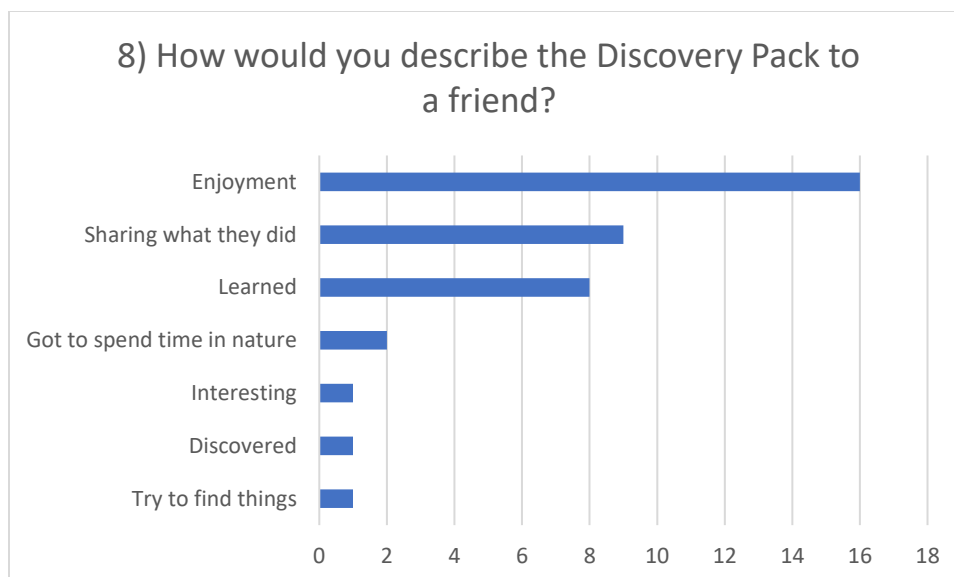


Figure 20. Results for question 8.

Questions 9 through 11 were all in regard to one of the activities in the Activity Booklet. These questions were intended to understand the range of users attitudes towards environmentalism given their interest in an outdoor education/engagement program. However, these questions demonstrated that most users either did not see this activity or were not interested in completing it. Of those that did complete the activity, only one provided responses that included coded themes, and that user expressed previous interest in caring for the environment.

The next question (12) was asked to gain an understanding of the users intentions for future use of the Discovery Pack, which might indicate both levels of engagement and enjoyment. Unsurprisingly, many users indicated high levels of enjoyment. Further, multiple children said that they were happy to have spent time in nature and would like to do so again. This not only indicated engagement, but also is a clear indication of connectedness with the natural world. The major themes of engagement and education were expressed in the following quote through words of “fun” and “interesting”.

“Oh, yeah, I would love to come back and try the pack again. Just, that was actually really fun. It makes me want to come back and finish everything I did. And do more. Because it's so interesting. And it catches your eye on everything. And it actually it makes you think of like, I don't know how to explain it, it makes you think of new things to look for.” (Family #2, child).

By sharing their experience with the Discovery Pack, the following parent clearly expresses the enjoyment theme.

“I like that it gave us a reason to stop and enjoy different places. So we could stop in the garden and they could draw in their thing. And then somebody could use the magnifying glass to look at flowers and somebody else would draw something, somebody else would use the eye spy thing to see what they could see. So, there was kind of a variety of things. Yeah, for each one of them. We could stop sit in the shade, and then each person could kind of do their own thing with the discovery pack. We did that in the garden over there. And then we did the same thing at the pond. And then we did the same thing in the forest on the boardwalk. In each area, we kind of

picked the page that was most relevant and then sat and did that so that kind of was nice for me that it wasn't just like a walk through, and it gave us a purpose.” (Family #4, parent).

Many participants shared their enjoyment through descriptions of what they had done and how they had had fun. The following two quotes indicate the major theme of enjoyment through the expression of interest in future use.

Parent: “It was nice to do something different. That I didn't have to plan. Yeah. I think the ease of like someone can just come pick this up. There's already activities for the kids, bring a snack box and it gives you a good a good hour or two to walk through and stop and think about things that normally you just walk past” Child: “Can we come here every day?” (Family #10, parent and child).

“It's wonderful. I think it would probably make us come more often, because when he was really little, we came here pretty much weekly. But then now that he's in school, and then since COVID started we're not getting out here as much. So, if it's kind of like, hey, let's go grab the backpack and go to the Marsh this time or go to the Rose Garden or something.” (Family #13, parent).

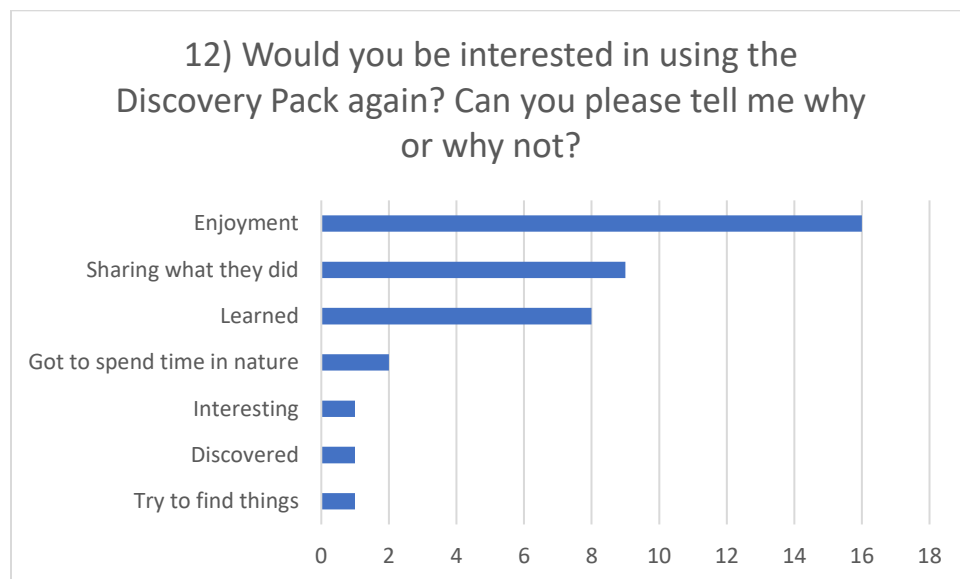


Figure 21. Results for question 12.

The final question asked users about improvements for the Discovery Packs. Although this question was intended to generally find weaknesses in the program, many users took the opportunity to express what they had enjoyed about it and what they did. The majority of responses to this question were that the Nature Finds (“eye spy”) activity could be improved. Some found the animals on the page to be too hard to find and some suggested easier ones such as a frog or a robin. The second common suggestion was that a whiteboard marker be added to the Discovery Pack, so that users could check off the animals as they went and could keep track of what they had seen.

Suggested additions:

- Add garden areas under each activity in the Activity Booklet where you can likely find the animal or insect discussed in the activity

- Black and white map of Hendrie Park children can color in as they visit each garden area
- A checklist to check of things you can find in the garden or one specific to each activity at the bottom of the page
- Mark off one of the trails or a garden with Discovery Pack activities (ex. a sign at the pond directing you to look for frogs)
- Carabiners on the backpack to clip things on so you have less things in your hands but don't lose them
- Two activity booklets for different ages (4-10 and 10+).

“The one thing we were actually talking about at the beginning, is that maybe there could be two based on the ages, like have age groups, because this one is not as challenging for maybe someone his age. Yeah. So maybe like an under 10 and then a 10 and up. Because, like, for example, the pollinator one? Yeah. It could be more specific to different species like because, you know, monarchs depend on milkweeds. And then there's other butterflies and Caterpillar, just like, just a little bit more information.” (Family #6, parent)

- An activity on rare plants to look for
- Step by step instructions for using the Discovery Packs (ex. start by looking through the pack, reading the Activity Booklet) so you don't miss anything

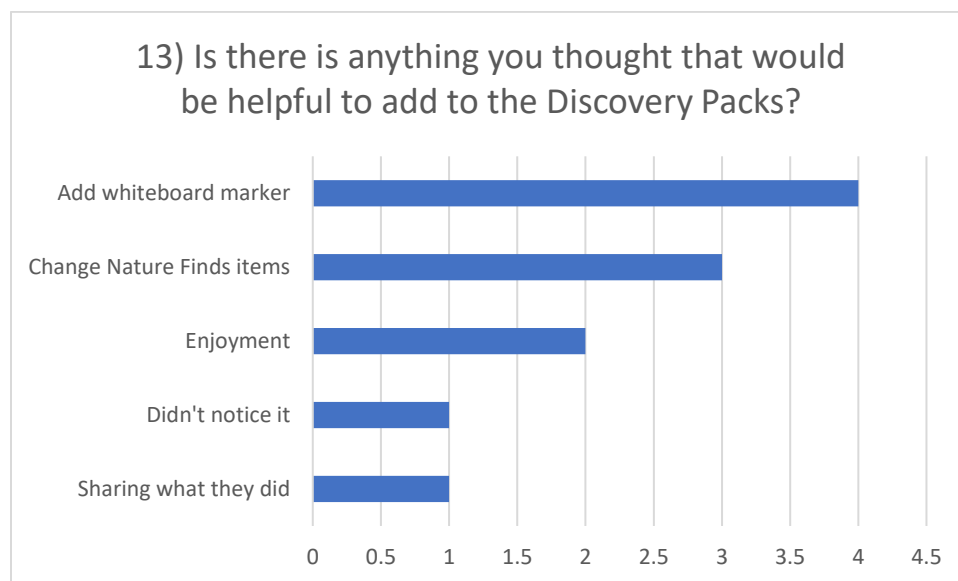


Figure 22. Results for question 13.

Throughout the interviews, users also suggested several improvements or changes for the Discovery Packs. These were as follows:

- 2 people mentioned including a device that plays bird calls to help identify birds
- 3 people asked for a net or tweezers to help add insects to the insect carrier
- 4 people were interested in field guides that would help identify trees
- 3 children suggested adding a “treasure map” with the different areas of the garden that you could color in once visited.

5. Discussion

5.1 introduction

The results of the Discovery Pack interviews presented in Chapter 4 provide significant information for the discussion of Free-Choice Learning and connectedness with nature. In the following chapter, these results will be discussed and reviewed in the context of relevant academic literature. The significance of the findings will also be presented, followed by a discussion of the recommendations for program improvement and areas for future research. The discussion will center around the key research objectives, the role of the Discovery Packs as an educational tool, and the intersection of environmental education and connectedness with nature.

5.2 Discovery Packs and Education

The key questions from the Discovery Pack interviews that directly indicate educational results are question 1, which asks how the child would rate each component as a learning tool, and question 7, which asks if the child learned anything new while using the Discovery Pack. The components of the Discovery Pack with the highest rating (an average response of 1.5 or above) as a tool learning are the Activity Booklet (1.62), the Nature Finds (1.65), the Binoculars (1.79) and the Insect Carrier (1.54). The Activity Booklet was expected to be highly rated as an educational tool, as it contains 13 pages of activities grounded in outdoor education (ex. pollination partners, lots of leaves). The Nature Finds is also an expected highly rated item, as it was likely to introduce new species for children to identify while in the garden. The Binoculars and Insect Carrier, however, were unexpected as choices for helping children to learn. Both of these items were often eagerly discussed by the children during the interviews as tools for helping them learn by watching animals or insects. They expressed the value of the Binoculars in helping them observe animals from far away to see how they moved, or what habitat they lived in. The Insect Carrier has a magnifying glass as a part of its lid, and children often described using this to watch the insects move around or learn about their body parts. Further, there was one question that received high numbers of responses for educational codes that did not directly ask about the child's learning experience. This was question 8, which asked "How would you describe the Discovery Pack to a friend?". This question, as expected, received high responses for the engagement themes, such as "fun" or sharing what they did. Unexpectedly, there was a high level of responses for educational themes for this question, and many children mentioned that they would share with their friend what they learned or that they could use the Discovery Pack to learn new things about nature.

The results discussed above indicate the potential for free-choice learning to generate effective educational opportunities for children. The Discovery Pack program was entirely self-directed and did not require the children to do any learning, but the results of the interviews demonstrate that the children often desired to learn or ended up learning new things about the outdoors while using the backpacks. Through this study, free-choice learning has been exemplified as an opportunity to combine both play and learning. A potential reason for the success of the Discovery Packs in generating learning among users could be due to the level of free-choice learning. A study by Bamberger and Tal (2007) found that when free-choice learning activities provided limited choice through offering activities (such as the Activity Booklet) participants have a greater sense of control and are more engaged with their learning. The Activity Booklet in the Discovery Pack provides choices that are somewhat limited, such as topics about pollination or habitats. The participants were therefore limited in their choices, but still had a sense of control due to the wide selection of both activities and tools to use.

5.3 Education and Connectedness with Nature

One of the research objectives for the Discovery Packs study was to understand the intersection between environmental education and connectedness with nature. Within the interview, questions surrounding engagement with the Discovery Packs were intended to gauge children's connectedness with nature. As the nature of the Discovery Packs program is to combine play with outdoor education, studying engagement with the program provides a fairly direct indication of connectedness with nature. The results for the Activity Booklet, Nature Finds, Binoculars and the Insect Carrier indicate the potential for free-choice learning opportunities to generate both engagement and education. One of the key indicators for connectedness with nature was the code "sharing what they did". This is a key indicator because it not only demonstrates engagement through an enthusiastic response, but the answers all involved a positive discussion surrounding the child's engagement with nature. For example, one participant said:

Child: "I'm happy because I can walk around. And if I see something, like if I saw a vegetable, I could write it down. And if I saw insects, I could write it down. And if I saw different leaves, I could write it down. Instead of just walking through it, and then just forgetting about all this."

Parent: "I think the interactivity helps them remember. Yeah. As with most people. You're doing something you're interacting with it, you're more likely to remember it." (Family #11)

The frequent appearance of both education and engagement codes together in interviews is an indication that environmental education in the form of free-choice learning activities will build connectedness with nature. The combination of educational activities in the Activity Booklet and engaging tools such as binoculars, magnifying glass, and an insect carrier demonstrate the ability to generate both engaging and educational opportunities for connecting with nature.

Increasing urban populations and less interaction with nature for survival has led to the loss of human and environment connectedness. Lumber et al. (2017) define environmental connectedness as "a sense of belonging to the natural landscape similar to nature connection.". In this article's background information section, the authors find that nature connection is increased by engaging in outdoor activities like gardening, birdwatching, hiking, camping, walking outdoors. This article uses three studies to investigate the best ways to increase people's connection with nature other than education, which has been used most commonly in the past. It identifies which of the 9 values of the biophilia hypothesis best connect people with nature. The biophilia hypothesis is based in humans innate connection for nature since our evolution alongside it and dependence on it. It is an unconscious emotional bond with and sense of awe towards nature. The values it identifies as "predictors of nature connectedness" were naturalistic (contact with nature through the senses), aesthetic (appreciating beauty in nature), symbolic (finding indirect meaning in nature), humanistic (experiencing emotion after interacting with nature) and moralistic (feeling compassion or concern for nature). This article highlights the many ways people can develop a connection with nature and the importance of such a connection. It also finds that walking in nature does not increase nature connectedness. This article justifies the study of the Discovery Packs as an opportunity for increasing engagement with and connectedness to nature through more than education, but by providing activities and tools to interact with nature through many senses in a beautiful, cultivated garden where biophilia could easily be strengthened.

5.4 Long-term Impacts

Due to time constraints for this research project, it was not possible to study the long-term impacts of the Discovery Packs program. It is possible, however, to discuss the likely impacts in context

of similar programs found in academic literature. Liefländer et al. (2013) investigated the impact of environmental education at different ages, and found that when children under age 11 engage with nature through environmental education there is a sustained increase in connectedness with nature.

A further factor for discussion is the impact of both environmental education and connectedness with nature on sustainable behaviour change. An article by Barrable et al. (2021) highlights the importance of connection with nature for wellbeing as well as positive affect towards the environment. The authors repeatedly emphasize that people must first feel love for nature as children before they take sustainable action and behaviours towards it. The study aims to demonstrate the benefit of incorporating connecting with nature through mindful engagement with environmental education, as the positive affect produced would have a long-term impact in people, making them more inclined to fight climate change. In a nature reserve in Wales, this study engaged children in mindful activities and found a small to medium impact on nature connection but a significant increase in positive affect towards the environment. The Discovery Packs connect to this research as it provides activities that allow for mindful connection with nature such as “Sit Spots” in the activity booklet where children are guided through a listening and observational activity and can record what they notice. The tools in the Discovery Packs such as the binoculars also encourage mindful awareness in the outdoors as children will be listening and looking for things to see with the binoculars.

In the study of a specific free-choice learning program, authors Herman et al. (2013) fill a gap they identify in free-choice learning research and investigate the long-term impacts 1-4 years afterwards on knowledge and attitudes about the program topic (waterways). The program occurs at the Skunk River Navy where volunteer biology students can learn about the river while participating in cleaning up trash and ecosystem monitoring tests. The authors describe free-choice learning as defined by Falk as education motivated by the learner, with the goal of free-choice environmental learning to build knowledge and help the learner take pro-environmental actions through their life. One limitation identified in the article that is relevant to the study of the Discovery Packs is that it is hard to measure free-choice learning because of very large differences in people’s background experiences, and motivations have a large impact on what people learn. The authors suggest using small-scale qualitative research where you can better understand previous exposure of participants, which the Discovery Pack study is. The 2013 study found that those who participated had a significantly better understanding about river content than other biology majors who did not participate.

5.5 Significance

Connectedness with nature is inherently beneficial to children, with the potential to generate long-term interest in spending time outdoors. Spending time outdoors can be a lifelong contribution to someone’s wellbeing, with benefits for both mental (Buckley et al., 2018) and physical health (de Bell et al., 2020). The Discovery Packs program is likely to generate such benefits through building committed connectedness with nature among it’s participants. Zylstra et al. (2014) define committed connectedness with nature as “a stable state of consciousness comprising symbiotic cognitive, affective, and experiential traits that reflect, through consistent attitudes and behaviours, a sustained awareness of the interrelatedness between one’s self and the rest of nature.”. The author’s literature review is driven by the rise of calls for people to reconnect with nature, the benefits this has for wellbeing, and the importance of this connection for creating environmentally responsible behaviour. However, the article highlights that despite such calls there has been little change amongst society or decision makers. It generated a framework for committed connectedness with nature as the intersection of mind, body and spirit through information and experience. Committed connectedness with nature is defined as “the sustained embodiment of this tripartite as a behavioural set aimed at serving social and ecological

communities through transformative leadership.”. The Discovery Packs allow children to connect with nature both through mind (educational activities in the activity booklet), body (hiking and walking through the gardens and trails), and spirit (prompted mindful activities and engaging with nature through many senses) and could be considered a study of committed connectedness with nature. The 2014 article also highlights a gap in research specific to how to create or cultivate connectedness with nature, a gap that the Discovery Pack study could definitely fill as a tool for connecting people with the natural world at RBG.

6. Conclusion

6.1 Significant Findings

The guiding research question for this project was as follows: “To what extent are the RBG Discovery Packs effective in engaging the users, and positively affecting the engagement of children with the outdoors?”. Further research objectives included investigating the implications of combining environmental education and outdoor engagement on connectedness with nature.

Both the quantitative and qualitative results demonstrated that the Discovery Packs were a successful tool for both engaging children with and educating them about the outdoors. The variety of activities provided opportunities for children to explore their interests in the outdoors, from bugs to birds to leaves. These interests were expressed through the large number of engagement responses, combined with high numbers of educational codes. Some tools such as the Binoculars, Insect Carrier, and Activity booklet were most helpful for providing learning opportunities, while combining this with engagement. Children expressed engagement through sharing what they had done, what they had learned, and sharing their passion for something through terms such as “love” “cool” or “my favorite”. These responses also provided beneficial feedback on the successful components of the Discovery Pack for further program development and highlighting areas for improvement. The combination of environmental education through free-choice learning activities and outdoor engagement through the use of tools such as binoculars was observed to generate strong connectedness with nature.

6.2 Implications

Through this study’s literature review, the study of the impact of free-choice learning on connectedness with nature was found to be fairly new. There is also little research on the connection of these subjects in the context of a botanical garden. This study has demonstrated the potential for free-choice learning experiences at botanical gardens to generate connectedness with nature. As opportunities for generating connectedness with nature will decline in an urbanizing world, researchers may expand research efforts at botanical gardens as places where nature is preserved, and engagement or educational efforts can be studied.

6.3 Recommendations

Recommendations specific to program improvement have been made to the partner organization for the purpose of program development. These recommendations include the suggestions from study participants discussed in the results section. The major recommendations will also be discussed here in the context of program improvement for generating connectedness with nature. The recommendations are as follows:

1. The addition of a map to the Discovery Packs.

- a. A black and white map that children can colour in as they visited each area
 - b. A treasure map to build on the exploration theme that the Discovery Packs convey.
2. The addition of a whiteboard marker to the Discovery Packs.

These suggestions regarding maps demonstrate that some participants would like more guidance in the garden and had a desire to see more of it. This is a valuable suggestion, as it indicated that they are interested in discovering more of the garden spaces and connecting further with nature. Secondly, there were multiple requests for the addition of a whiteboard marker to the Discovery Packs. Participants commented that they would like the option of using a whiteboard marker during the “Nature Finds” activity, to check off the animals, birds, or insects they had seen in the garden. As with the map, this suggestion indicates that participants were eager to improve their engagement with nature and keep track of what they were observing.

A clear area for future study would be to repeat this study with children at younger ages (4-6) and then with their older selves when 10-12 and investigate whether they have experienced continued connectedness with nature. As discussed above, there is a gap in research surrounding the long-term impacts of programs which combine environmental education and connectedness with nature. Further, it was generally observed to in this study but would also be interesting to note the difference in children’s attitudes and demeanors before and after using the Discovery Packs. This could be a good indication of connectedness with nature because the children would be demonstrating positive engagement if their attitude towards spending time outdoors was improved after use of the Discovery Packs.

6.4 Conclusion

Following the analysis of the interviews it became clear that the Discovery Packs program was well enjoyed by children over a wide age range (4-12) and provided meaningful educational opportunities. The study demonstrates that free-choice learning activities can effectively combine education and engagement to generate connectedness with nature. Further research on improving these opportunities will benefit children by improving their understanding of the natural world as well as their affinity towards it. In an urbanizing world, botanical gardens provide the much needed opportunity for children to develop a lifelong love of nature.

Appendix A: References

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Appendix B: Research Ethics Board Approval

9/6/2021

Mail - Megan Haley - Outlook

REB # 2021-5673 Letter of Approval

ethics@dal.ca <ethics@dal.ca>

Thu 6/24/2021 11:24 AM

To: Megan Haley <MHaley@dal.ca>

Cc: Tarah Wright <Tarah.Wright@Dal.Ca>; Research Ethics <ethics@dal.ca>



Social Sciences & Humanities Research Ethics Board
Letter of Approval

June 24, 2021

Megan Haley

Science\Earth and Environmental Sciences

Dear Megan,

REB #: 2021-5673

Project Title: Engaging Children with the Outdoors: An Examination of Discovery Packs at Royal Botanical Gardens

Effective Date: June 24, 2021

Expiry Date: June 24, 2022

The Social Sciences & Humanities Research Ethics Board has reviewed your application for research involving humans and found the proposed research to be in accordance with the Tri-Council Policy Statement on *Ethical Conduct for Research Involving Humans*. This approval will be in effect for 12 months as indicated above. This approval is subject to the conditions listed below which constitute your on-going responsibilities with respect to the ethical conduct of this research.

Effective March 16, 2020: Notwithstanding this approval, any research conducted during the COVID-19 public health emergency must comply with federal and provincial public health advice as well as directives from Dalhousie University (and/or other facilities or jurisdictions where the research will occur) regarding preventing the spread of COVID-19.

Sincerely,

A handwritten signature in blue ink, appearing to read "Karen Foster".

Dr. Karen Foster, Chair

Post REB Approval: On-going Responsibilities of Researchers

After receiving ethical approval for the conduct of research involving humans, there are several ongoing responsibilities that researchers must meet to remain in compliance with University and Tri-Council policies.

<https://outlook.office.com/mail/id/AAQKAGZmYzE4M2NjLTUDYjEINDUwMS04OWI2LTVM2U3ZmU2NDQ1MwAQAD8%2F1wGvmspCf%2Fu42Uyw70...> 1/3

Appendix C: Partnership Agreement

Research Partnership Agreement

Project Title: Engaging Children with the Outdoors: A Pilot Test of Discovery Packs at Royal Botanical Gardens

Lead Researcher: Megan Haley, BSc. Candidate at Dalhousie University, mhaley@dal.ca

Supervising Professor: Dr. Tarah Wright, Faculty of Earth and Environmental Science at Dalhousie University, tarah.wright@dal.ca

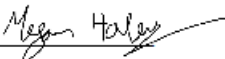
By signing this form, I signify that I have reviewed the Research Ethics Board application written by Megan Haley to be submitted in June 2021 for approval. This application includes the study research methods as well as all aspects of partnership with Royal Botanical Gardens (RBG). I agree that the research methods and use of RBG Main Centre facilities and Hendrie Park garden areas are permitted for the duration of this study. I agree that the lead researcher Megan Haley will access RBG facilities for the purpose of conducting participant interviews. In addition, RBG will make accessible secure storage space for the safe keeping of hard copy study documents. Finally, I confirm that I have collaborated on the development of this study as a representative of RBG, and agree with the methods being used.

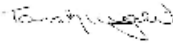
Signed Consent from Royal Botanical Gardens Representative:

Name: Jennifer Dick Role at Royal Botanical Gardens: Manager of Interpretation

Signature: 

Signed Consent from the Dalhousie Research Team:

Lead Researcher Signature: 

Supervising Professor Signature: 

Appendix D: Recruitment Email



Wed 6/30/2021 10:38 AM

To: AllStaff <AllStaff@rbg.ca>

Cc: Megan Haley

Hello everyone,

This year we are undertaking a redesign and expansion of our Discovery Packs program thanks to generous funding from the TD Friends of the Environment Foundation. We are also very fortunate to have Megan, a student from Dalhousie University, to undertake the evaluation research portion of this project for her undergraduate thesis. I've included a message with additional details from Megan below.

If you have children, grandchildren, nieces, nephews, and loved ones between the ages of 4 and 12, we'd love your help!

Cheers,
Jenn

Dear RBG Staff Member or Volunteer,

This email is to invite you and your family to consider participating in a study with RBG and Dalhousie University called "Engaging Children with the Outdoors: An Evaluation of Discovery Packs at Royal Botanical Gardens". This study is being conducted by Megan Haley, an undergraduate student studying Environmental Science and Sustainability at Dalhousie, and a Garden Interpreter with RBG.

If you and your family agree to participate in the study, you will be asked to spend approximately 1-2 hours in Hendrie Park using one of RBG's new Discovery Packs. We then ask that you meet with the lead researcher Megan Haley in the garden at a previously agreed upon location, physically distanced, to answer questions in an approximately half an hour interview about your experience with the Discovery Pack. This is to conduct a study for the new interpretive tools, and to study their effectiveness in engaging children with the outdoors.

It is important to note that your participation is completely voluntary. The interviewer Megan Haley has completed a police background check, and has First Aid training to ensure safety while working with children.

If you have any questions about the study and/or are interested in participating, please contact Megan Haley by email to mhaley@dal.ca or telephone (289-439-4718).

Thank you for considering this request,

Megan Haley

Appendix E: Interview Form

Questions

1. How many children were using the Discovery Pack?
2. What are each of your ages?
3. I'd like to start by asking how you would rate each part of the Discovery Pack as a tool for learning in the garden and tell me why you rated it that way. A score of 1 means it was not a very good tool for learning, a score of 3 means it was a very good tool for learning.

Let's go through each of the aspects of the pack now:

a. Activity booklet

(Can you rate the activity booklet first? If it was 1 it didn't help you learn anything and if it was 3 it helped you learn lots, you can pick numbers in between if you're not too sure)

- i. Score 1-3
- ii. Reason rated that way:

b. Nature Finds ("eye spy" laminated sheets)

- i. Score 1-3
- ii. Reason rated that way:

c. Field guides

- i. Score 1-3
- ii. Reason rated that way:

d. Binoculars

- i. Score 1-3
- ii. Reason rated that way:

e. Magnifying glass

- i. Score 1-3
- ii. Reason rated that way:

f. Insect Carrier

- i. Score 1-3
- ii. Reason rated that way:

4. Which part of the Discovery Pack did you spend the most time using?

- a. Answer:
- b. Can you please tell me why you spent the most time with this?

5. What was your favorite part about using the Discovery Pack?

6. Please rank your top 3 favorite activities in the activity booklet.

Please tell me why did you choose those as your top 3?

7. Did using the Discovery Pack help you learn anything new in the garden?

- a. Yes/No