Program Name: Ecosystem Ecology Research Projects
Grade Level(s): 10-12
Recommended Group Size: less than 15
Curriculum Connection(s): Cycling of Matter in Living Systems (Gr. 10); Ecosystems and Population Change, Changes in Living Systems (Gr. 11); Population and Community Dynamics (Gr. 12)

Approximate time required: 3 days, 2 overnights

Student Learning Objectives:
Demonstrate group work skill in learning, working, and living environments.
Develop skill in study design and research methods.
Develop an understanding of ecosystem ecology, specifically directed to grade level curriculum.
Develop lifestyle strategies that foster contact with the natural world and encourage responsibility for local and global environments.

Brief Description of Program:
A 3-day program where students work collaboratively to design, implement, analyze and present their own ecological field research, including aspects of the physical sciences as well as fine arts. Field studies should be based on biology, chemistry, physics, environmental studies, etc. and should include presentations that may require language arts, creative artistic expression, and technological innovation in presentation mediums.

Students will also help with maintaining group dynamics through assisting with meal planning, cooking, cleanup, assembling tents, organizing data collection and data analysis groups, creating a presentation schedule, etc.

Allowing students to design their own research projects allows for more grade-specific projects as well as more personally interesting projects, which generate more willing participation, advanced learning, and a more enjoyable overall experience.

Activities:
<u>Day 1: Preparation</u>
Have students set up tents and organize sleeping arrangements if they haven't been arranged already (beds for up to 8 inside AMLRS), organize and store food in proper places in the Station (do not leave food or snacks in the tents as there are wild animals in the area!), and bring lunches on a short walk (to the beach, around a trail, in the Park) to see more of Miquelon Lake Provincial Park and have a picnic.
After lunch, break students into research teams (keep in mind that the Station has 5 laptops available for use) and present teams with the list of research questions (Appendix 1). Have teams choose a question from the list, adapt a question from the list to be more specific or personally interesting, or help them design their own research question. Teams should then record their answers to the questions in Appendix 2 in their notebooks, in as much detail as they

can, addressing how they will perform their research and what they hope to achieve with it. Create secondary groups including individuals from each research team to get together and share their ideas on what their projects are, what data they will need, how they will collect and analyze data, what problems they expect, etc.
Take a game break (or half hour of free time) and have supervisors design a 'Meal Chart' assigning each team a meal that they are responsible for - they should help prepare the meal, set out dishware, assist with clearing and wiping down tables, and help with dishes.
Have students begin the write-up for a basic Experiment Report (Appendix 3) on the Station laptops.
Assign a research team help prepare supper and assist with cleanup. Evening activities may include a campfire, board games, a movie (ex: Jurassic World (2015), Transcendence (2014), Meet the Robinsons (2007), October Sky (1999) - all rated PG-13 and have experimental research aspects, but are up to the discretion of the teacher), homework from other classes, exploring the Park trails under supervision, outdoor games, etc.

Day 2: Research

Have a group of students assist with breakfast. Break into research groups and gather necessary equipment, signing out each piece of equipment to one member of each group to be responsible for. Give students until noon to reach their site, collect and record data, return to the Station, clean their equipment and sign it back in. Have a group of students assist with lunch. After lunch, begin data analysis; students should be able to complete the Results, and Discussion and Conclusion sections of their Experiment Reports along with any sections previously not completed.
As students are working, set up a 'gallery' of whiteboards or poster paper with question headings (samples below):

- What did you find the most challenging about data gathering and analysis?
- What did you do that allowed your data collection and analysis to go smoothly?
- If you could do your research project again, what would you do differently?

Have students write their responses on the whiteboards/poster paper. Once responses are written, have students write their own comments or feedback on post-it notes and stick those notes to other student responses. Allow students time to go through the 'gallery' again reading comments. Have students discuss in their research groups how they can apply responses to their own research projects.
Have a group of students assist with supper before evening activities.

Day 3: Presentation

Have a group of students assist with breakfast. Break into research groups and begin preparing a presentation. Presentations can be planned in any format (lecture, poster, powerpoint, video, etc) but should include the research question, background information on the question, experiment design (how data was collected), the results and a discussion on why the results are important. Presentations should be planned to include each member of the group in equal speaking parts, and students should practice their delivery even though they may not have their presentation media actually prepared. Have a group of students assist with lunch. (Presentation

media can be assigned as homework or can be done later in class. Presentations can then be given back in the classroom, in front of other classes, in front of parents, etc.)
After lunch, students should pack their things, clean out and disassemble tents, clean and return all Station equipment to its proper position, help clean the kitchen (including removing your food from the fridge and cupboards), and sweep out the building. Remember to turn off all water and lights, and deposit your key **before** exiting the Station **after** ensuring both exterior doors are locked and windows are closed.

Note: For a student or students that may experience difficulty in performing or heavily participating in research projects, establish a camera crew or video blog team to document the research proceedings, becoming involved in recording different aspects of various research projects. Footage and photos can then be used as class memoirs, explanatory research videos, promotional tools or for various other activities, as needed.

Equipment & Resources Provided:
Research Station Facilities - two washrooms; fully equipped kitchen and dining room; two bedrooms (2 sets of bunk beds per room); wet lab space and multi-purpose rooms for indoor lessons, work space, and living space
3 tents
Wi-Fi
Park maps
For a list of lab equipment, visit our website

Equipment & Resources Required:
Meals (including a picnic lunch for the first day... and probably s'more materials)
Additional tent(s), if necessary - AMLRS can provide three 6-person tents + indoor accommodation for 8
Journals / Notebooks for data recording

Ensure participants bring:
Weather appropriate clothing, including footwear (closed-toe outdoor shoes, winter boots, etc.)
Sleeping gear (sleeping bags, pillows, etc)
Toiletries
Reusable water bottles
Backpacks to carry equipment / food
Evening activities - board games, cards, a movie, etc.

Contact the Station Manager at gth@ualberta.ca for pricing and more details.

APPENDIX 1 - POTENTIAL RESEARCH QUESTIONS

How does flower composition change from a mowed lawn to unmowed field to forested area?
How does forest composition change in relation to distance from Miquelon Lake?
What is the ratio of native to invasive plant species in the Park?
How does soil composition change in different areas of the Park?
Which bird species can be found at the Park Centre bird feeders/ on Miquelon Lake beach/ in forested areas away from camping on the trail system and why?
How does water quality differ between different areas of Miquelon Lake/ Miquelon Lake and other water bodies in the Park?
How fast does the average ant move and why does it matter?
What kind of invertebrates are found in Miquelon Lake and why?
Which animals left tracks around Miquelon Lake/ the Station and why?
What conditions grow the best strawberries?
How often do robins/ chickadees/ seagulls/ etc. sing and why does it matter?
Under what conditions do you have the strongest light intensity?
Under what conditions does snow melt fastest?

APPENDIX 2 - QUESTIONING YOUR RESEARCH QUESTION

What is your research question?
What data will you need to gather?
What materials and equipment will you need to gather your data?
What problems might you encounter?
How will you avoid or prepare for those problems?
How will you analyze your data?
What materials and equipment will you need to analyze your data?
What do you expect to find?
What other research questions can you think of if you find what you expect is true?
What other research questions can you think of if you find what you expect is NOT true?
Why is your research question important?

APPENDIX 3 - EXPERIMENT REPORT

Heading - Research question, researchers' names, date

Introduction - Explain the research question and why it is important to answer. Discuss background information already known about the research question.

Hypothesis - Explain what you expect to find.

Materials and Equipment - List the materials and equipment needed to collect the data.

Procedure - Write step-by-step instructions on how the data will be collected.

Results - Report the data you collected. Use graphs, charts, and tables if you can. Be sure to only discuss the data, not what the data tells you about the experiment.

Discussion and Conclusion - Talk about what the data shows. Explain and interpret what it means, or what it could mean. Once you have discussed your results, come up with some new research questions that relate to what you discovered.

BASIC SAMPLE EXPERIMENT REPORT

Between blue and yellow butterflies, which species land more frequently on orange flowers?

Charlie Brown, Lucy van Pelt, and Snoopy

June 1, 2015

Introduction

Blue and yellow butterflies both live in Miquelon Lake Provincial Park, and both species have been known to land on a patch of orange flowers growing behind Augustana Miquelon Lake Research Station. This research project answered the question of which of those two butterfly species landed on the flowers more frequently. It was important to answer this question because it provided more information on which flowers are preferred by which butterflies. By planting more or fewer of these orange flowers, people can influence which butterflies are more likely to be found in that area.

Hypothesis

It was expected that there would be the same number of yellow and blue butterflies landing on the orange flowers. (This represents the null hypothesis, the idea that there is no difference between variables.)

Materials and Equipment

- Clipboard with paper
- Pencils and an eraser
- Butterfly identification book
- Lawn chair
- Hat and sunglasses

Procedure

Set up the lawn chair so that the orange flowers are easy to see. Sit quietly and mostly still as much as possible. Wear the hat and/or sunglasses if it is too sunny to see butterfly colour. Wait for butterflies to come. Record how many butterflies of each colour land on the flowers; butterflies must land and not just fly over the flowers. (Be prepared to write down other things you notice while watching for butterflies as they may end up being influential factors or may just be interesting to report in the data.)

Results

Table 1: Data on blue and yellow butterflies landing on a patch of orange flowers behind Augustana Miquelon Lake Research Station in Miquelon Lake Provincial Park on June 1, 2015.

Butterfly Colour	**# Landed**	**Notes**
Yellow	12	All arrived separately Stayed 1-2 minutes Never came when flowers were shaded
Blue	3	All arrived and left together Stayed for 5 minutes, 20 seconds Left when clouds shaded the flowers

As seen in Table 1, there were 4 times as many yellow butterflies as blue butterflies, with 3 blue butterflies and 12 yellow butterflies. The blue butterflies stayed longer than the yellow butterflies. All of the blue butterflies came at the same time, and all the yellow butterflies came individually. No butterflies came or stayed when the flowers were not in full sunlight.

Discussion and Conclusion

There were 4 times as many yellow butterflies as blue butterflies, which could mean that yellow butterflies like the orange flowers more, or that there are more yellow butterflies in this area of the Park.

All of the blue butterflies coming together could mean that they travel in groups as a safety tactic so that each individual has a smaller chance of being the butterfly that gets eaten, or it could mean that they are breeding. The yellow butterflies coming individually could mean that they are not breeding, or that they camouflage better with the orange flowers and so travelling in groups would attract more predator attention.
That they only came in full sunlight may indicate that they are strictly diurnal insects.

This research opens opportunities for future research to be done on the butterflies. There could be a study on whether there are more yellow or blue butterflies in total in the Park, or whether just that particular ecosystem has more yellow butterflies; whether other colours of flowers attract the same proportions of blue and yellow butterflies; or where the butterflies go when there isn't full sunlight on the orange flowers, like during the night or on very cloudy days.