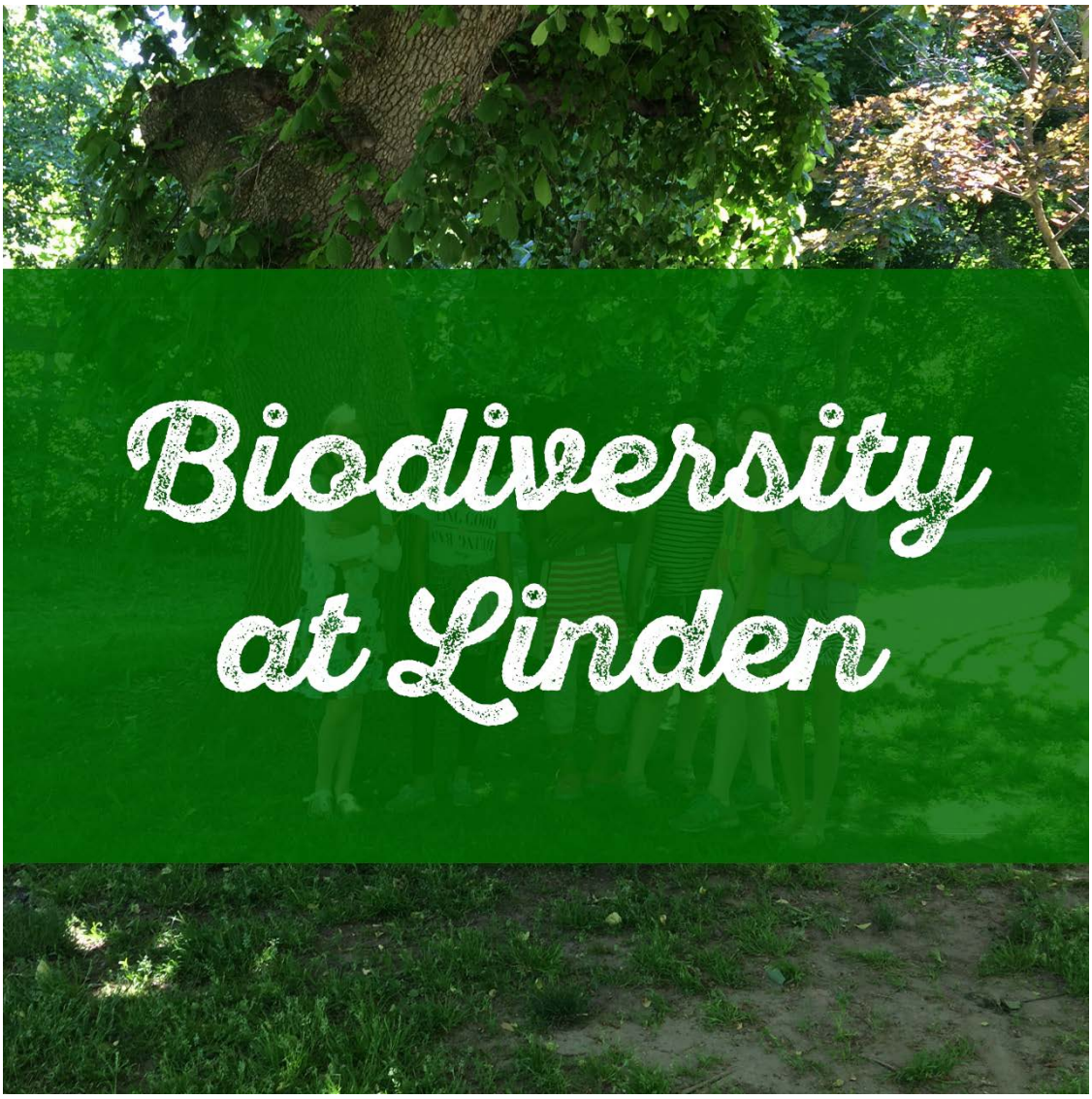


Goals of this Report:

- To raise awareness about the importance of biodiversity.
- To make suggestions to protect and improve biodiversity at Linden, in our neighbourhood, and around the world.

Researchers and Authors:

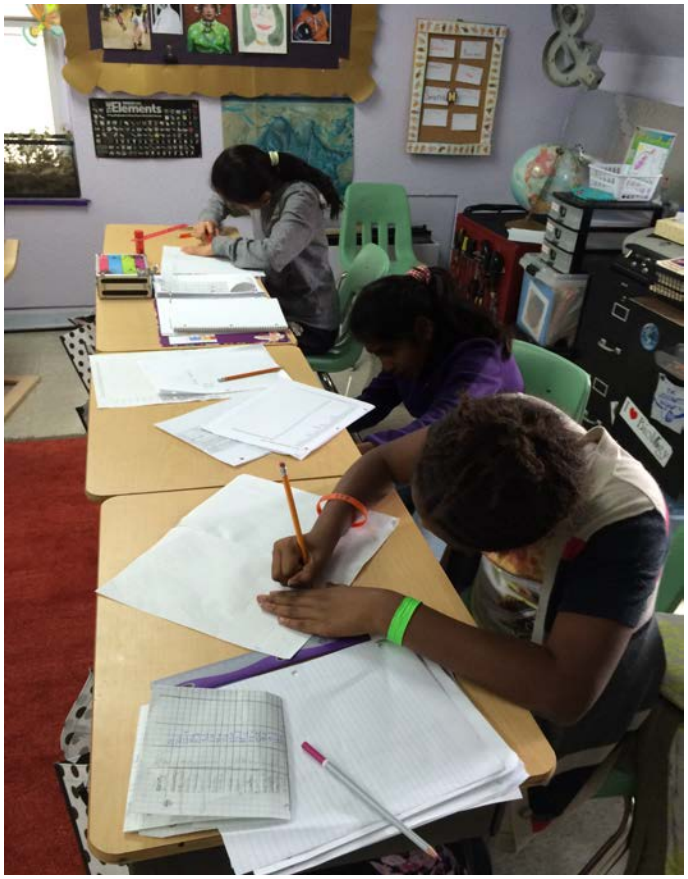
Amina, Anna, Intezar, Gabriella, Karina, and Beth

Grade 6 at The Linden School, Toronto, June 2016

How did we write this report?

This report was written in different ways. We always started with a class discussion of what was important to learn, and what questions we had. For some sections, we worked alongside each other to collect data, then discussed how our data should be analysed, combined, and presented. For other sections, we worked independently to do research. You can tell these sections by the name of the author at the bottom. A list of all of our sources is compiled together at the end in our bibliography.

Though some of our field study took place in the fall, most of this work was done between April and June of 2016.



Hard at work!

Table of Contents:

The Importance of Biodiversity/How does Linden Benefit from Biodiversity? Page 4

Human Impacts on Biodiversity Page 5

Primary Research (Field Studies):

- Ravine Quadrat Study Page 7
- Survey of Biodiversity on Linden Property Page 8
- Survey of Tree Biodiversity on Rosehill Ave/David Balfour Park Page 9
- Water Study: Yellow Creek Page 10
- Micro-life Culture: Around Linden Page 12

Secondary Research:

- Changes to the World's Biodiversity Page 14
- Changes to Toronto's Biodiversity Page 15
- Toronto's Biomes Page 17
- Extirpated Species in Toronto Page 18
- The Role of Pollinators Page 19
- How to Help the Bees Page 20
- Reptiles and Amphibians in Toronto Page 21
- FLAP: Fatal Light Awareness Program Page 23
- The Impact of Food Waste Page 24
- The Impact of Landfills Page 25
- Pros and Cons: Rooftop Gardens, Birdhouses, and Beehives Page 26
- Are There Any Downsides to Biodiversity? Page 27

Our Stop-Motion Animation Projects: Invasive Species Page 28

Field Trip to Tommy Thompson Park Page 29

Summary of Recommendations for Linden Page 30

What Can Linden's Principal and Board do to Help? Page 31

Bibliography Page 32

The Importance of Biodiversity

"Without biodiversity, we would not be alive. Trees give us oxygen, bees give us food, bread needs yeast, paper needs trees, etc."--Intezar

"Without biodiversity, the cycles of nature can't be maintained. An ecosystem relies on the interaction of many living things." --Gabriella

"Biodiversity makes the world a more beautiful and interesting place to live."--Serena

"All living things have a right to live. Without biodiversity, many things will die." --Karina

"Everything is connected. When one thing dies out, the food chains can break."--Anna

"Biodiversity is important because without it, different species might overpopulate."--Amina

The Dangers of Monoculture

Monoculture means that in an area, there is just one species of living thing. An example of monoculture is a perfectly green lawn with no weeds, or a farmer's field of one crop. Here are some dangers of monoculture:

- Monoculture is vulnerable to disease. During the Irish potato famine, for example, a bacteria killed most of the crops which made up a lot of the people's food supply.
- Pesticides used to maintain monoculture can be harmful to people and animals.
- Invasive species create monoculture, and they also benefit from it. For example, when the ash borer infests one ash tree, it is more easily spread if other ash trees are close by.

How Does Linden Benefit from Biodiversity?

- Biodiversity is good for a learning environment because there are lots of different things to study and understand.
- By supporting biodiversity, we are showing that we care about more than

just ourselves, or just humans.

- Biodiversity in the building maintains our health. For example, plants put oxygen in our air, and make the classrooms smell better.

- Biodiversity will help make our property beautiful.

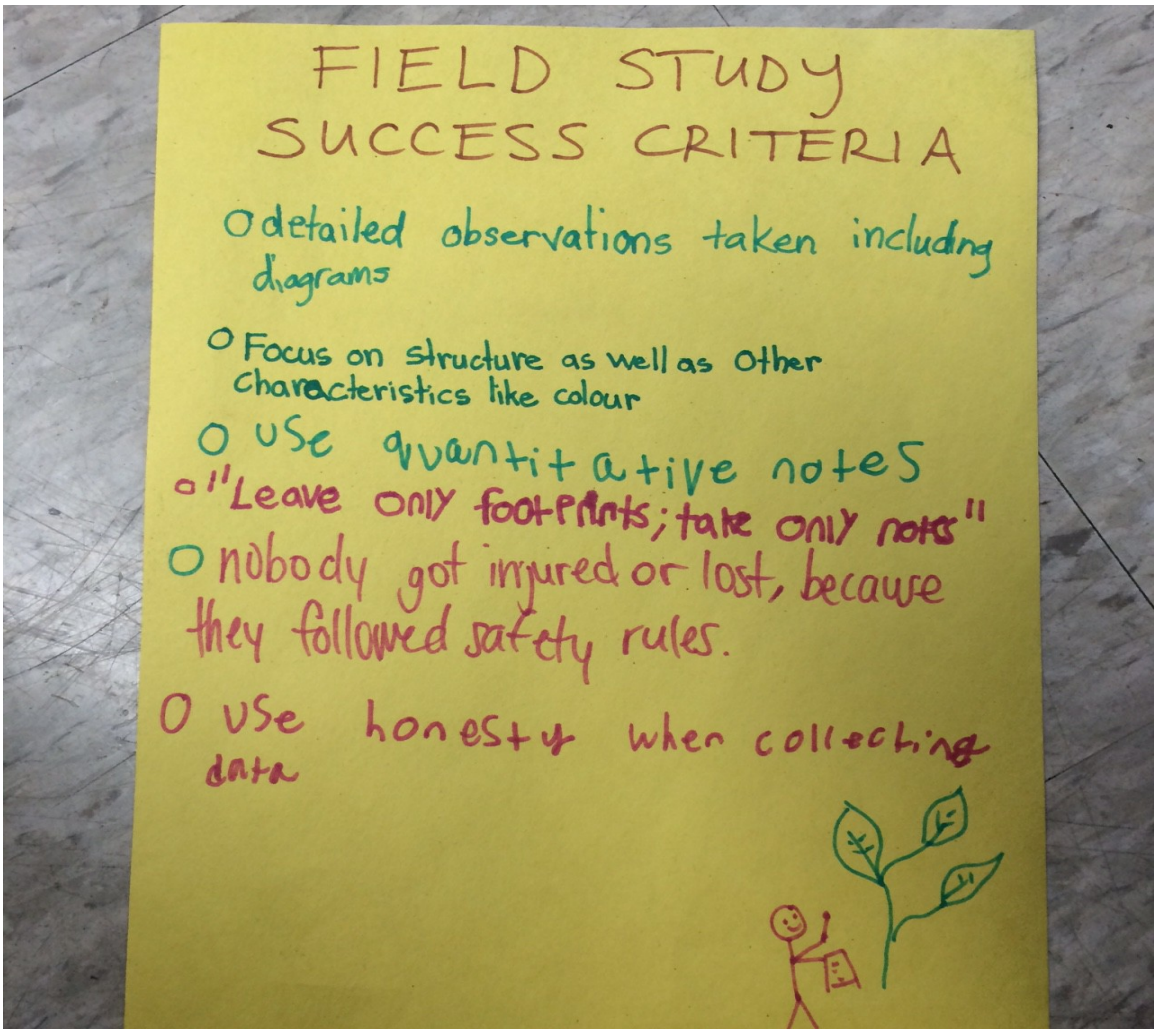
- Biodiversity contributes to a healthy environment for everyone.

Human Impacts on Biodiversity

Humans affect biodiversity in many ways, both good and bad. Here are some of the ways we've recognized:

- Development of buildings and roads leads to habitat loss.
- Many people in Toronto have put up bat boxes to encourage bats to live here.
- People plant flowers and trees to help honeybees, etc.
- Humans introduce invasive species to ponds and rivers; for example, by flushing live goldfish down the toilet.
- People support monoculture through use of pesticides and herbicides.
- Sometimes we reject "imperfect" produce at the grocery store, which leads to waste.
- Farmers breed fruits and vegetables for looks/longevity on transport trucks.
- The use of chlorine in pools affects amphibians.
- Shopping at farmers markets is good for small farms, e.g. bee farms.
- You can help endangered species by fighting against poaching or supporting efforts to protect and repopulate.
- Creating waste fills up landfills.
- Putting garbage in bodies of water results in pollution like the Great Pacific Garbage Patch.
- Recycling can be done either effectively or ineffectively (such as sorting incorrectly).
- Chasing animals out of Toronto/cities because people fear or hate them (e.g. bear, cougars) leads to extirpation.
- Buying products with microbeads affects ocean biodiversity.

Primary Research



The class generated a list of success criteria for collecting data on field work.

Ravine Quadrat Study

Method: A quadrat is a one-meter-square area that researchers use to focus in detail on an ecosystem. Together, we chose to study a fallen log, as it seemed to contain a wide variety of different species of visible living things. We took notes and drawings of what we observed.

We chose to make our quadrat around a decaying tree.

Results:

Kingdom	Species	Pop.
plantae	moss	patch
	lichen	patch
	small sprouts	3
	pine seedling	1
	clover	3
	unknown (2 leaves)	2
animalia	woodlouse (potato bug)	3
	ant	2
	beetle	2
	snail	3
	daddy longlegs	1
	worm	1
Fungi	bracket fungus	1

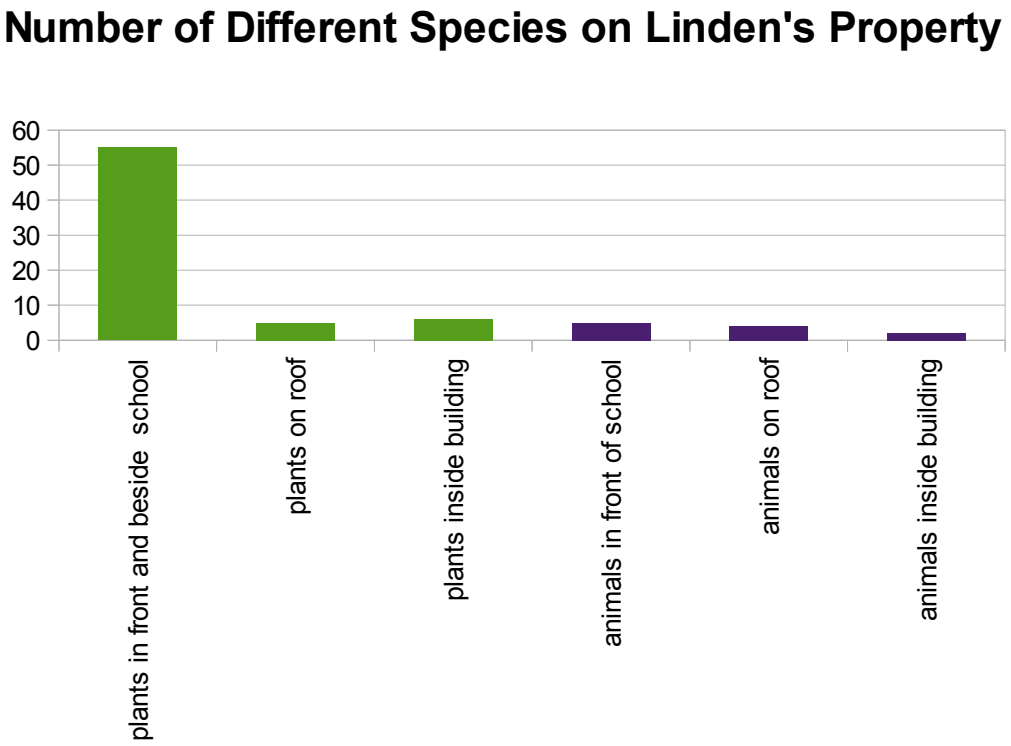
Analysis: A fallen tree is a biodiverse place, full of different living things. This is probably why fallen trees are left alone in the ravine.

Survey of Biodiversity on Linden's Property

Cataloging the plants in the front garden.

Method: We toured the entire school property (inside and out) and categorized each kind of visible living thing. We acknowledge that many living things could not be observed, either because they are microscopic, or because they hide in walls.

Results: We found 62 separate species from Kingdom Plantae and 5 species from Kingdom Animalia at Linden. Here is a breakdown of where we found them:

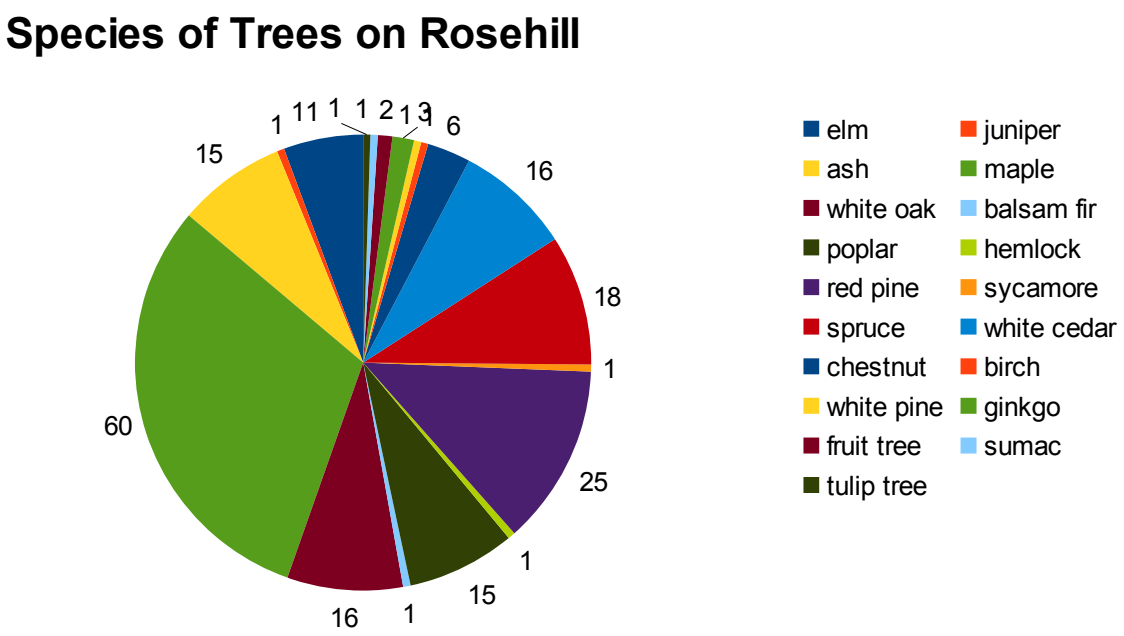


Analysis: We don't want to increase the number of animals inside the building, for health and safety. We would like to see more birds, insects, and bees in the garden and on the roof. We would like to see more plants inside the building.

Survey of Tree Biodiversity on Rosehill Ave/David Balfour Park

Method: Using a dichotomous key, we classified all of the trees along Rosehill Avenue and in David Balfour Park.

Results: We found 19 different tree species. The population of each species can be seen in the following graph:



Analysis: This area contains an impressive amount of tree biodiversity. We should work to help people understand the value of the biodiversity in this area.

World Water Study: Yellow Creek

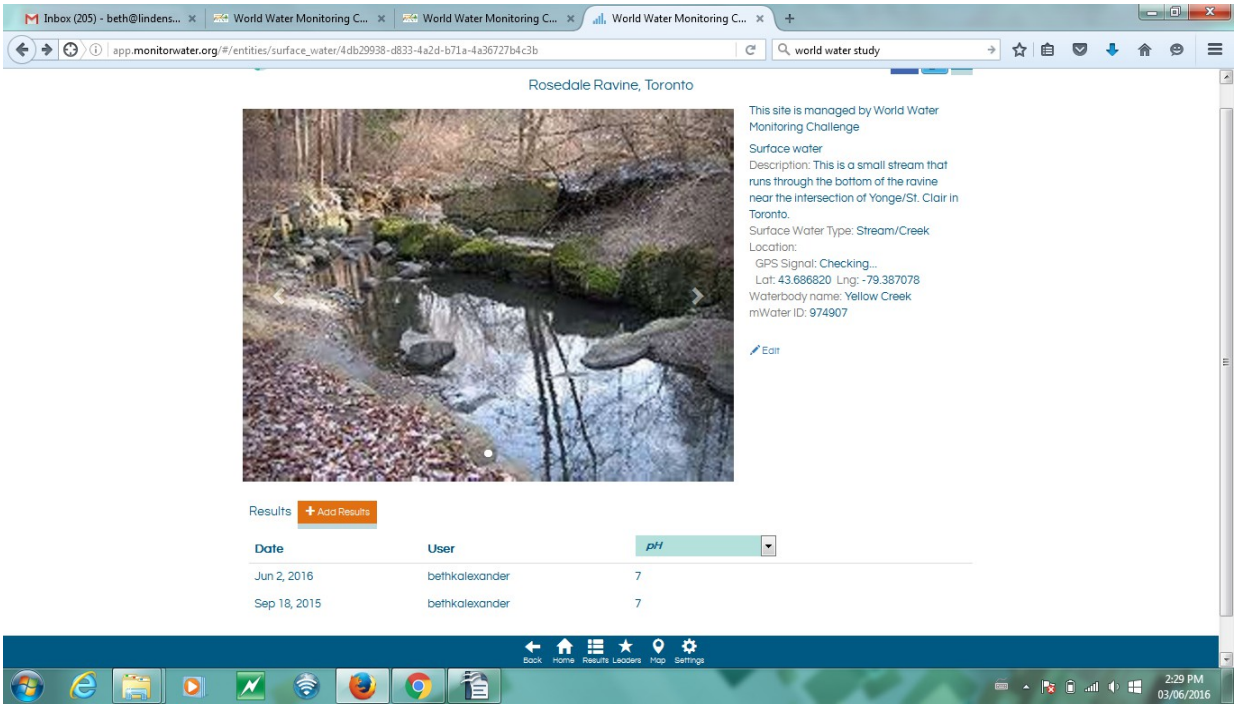
Visiting the creek in the fall.

Measuring pH

Method: This is a citizen science project and part of a global study to track water quality around the world. Citizen scientists collect information about temperature, turbidity, pH, and dissolved oxygen, then upload the data to www.monitorwater.org. People around the world can then remotely examine water quality at different sites, and researchers can use the data for various studies. Together with the grade 5 class, we collected a variety of data about the water quality at Yellow Creek (the stream at the bottom of the ravine near school).

Results (The mode of our collective readings):

	Qualitative Observations	Air Temp.	Water Temp.	pH	Turbidity	Dissolved Oxygen
Sept.	Water is clear and rocky. There are waterfalls and currents. It's freezing and I can hear the water moving rapidly. There are leaves in the water, but no garbage. Living things include flies, moss, humans, birds.	11 º C	11 º C	7	40 JTU	4 ppm
June	There are lots of rocks and moss. The water is clear. It is warm and the water is moving quickly. It is sunny and warm. Other living things include plants, trees, lots of birds, some insects.	20 º C	20 º C	7	40 JTU	4 ppm



We have uploaded our data to monitorwater.org

Analysis: The creek appears to be healthy in both spring and fall. The pH is neutral, which means that it can support plant and animal life in this ecosystem. The stream is not too turbid to allow fish eggs to grow. The temperature matches that of the air. The lack of garbage is good and means that people are taking care of the creek.

Recording qualitative data.

Micro-life Study

Swabbing the front door handle.

Transferring micro-life to the surface of the agar.

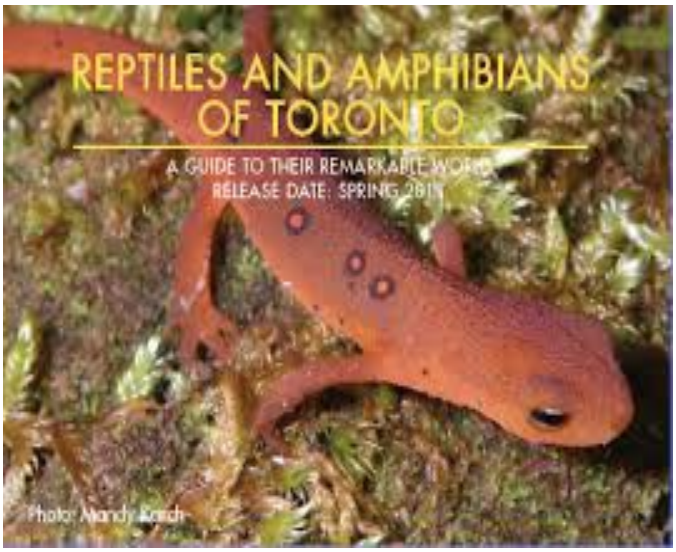
Method: Using sterile swabs and petri dishes prepared with nutrient agar, we swabbed five areas of the school. After one week, we examined the colonies of micro-life that grew.

Results: After one week, we observed no growth! We will continue to wait.

Location	**Colonies Observed on Petri Dish**
Third floor toilet seat	*Stay tuned!*
Beth's Keyboard	*Stay tuned!*
Front Door Handle	*Stay tuned!*
Third Floor Water Handle	*Stay tuned!*
Beth's Desk Surface	*Stay tuned!*

Analysis: We should have started our survey earlier! It's also possible that our samples were destroyed by factors such as bright sun sterilizing the surfaces without our knowledge. However, from Anna's science fair project, we know that microlife is all around us, and with enough time for colonies to grow, we can observe that different kinds of microscopic life makes different shapes and colours of colony.

Secondary Research



Here are some questions we needed to answer:

- Is biodiversity in danger in Toronto and around the world?
- What are some characteristics of the biome we live in?
- Which species have been extirpated from Toronto?
- Why are pollinators important and what can we do to help bees and other pollinators?
- What is the status of reptiles and amphibians in Toronto?
- How can we help birds?
- How does garbage—including food waste—affect biodiversity?
- What are the pros and cons of adding planters, birdhouses, and beehives to a roof?
- Are there any downsides to biodiversity?

Changes to the World's Biodiversity

The extinction rate on Earth has increased one hundred times the natural rate. It's normal for species to go extinct, but not this much. Changes of biodiversity in the world have made us lose the dodo, passenger pigeon, great auk, Tasmanian tiger, sabre-toothed cat, Baiji white dolphin, Steller's sea cow, and woolly mammoth, which are all extinct. The causes of these animals going extinct are habitat loss, such as cutting down trees, littering into waters, climate change, hunting, and even comets and meteorites hitting the earth.

Others reasons we are losing biodiversity, is because of invasive species, pollution and the fact that when we kill one animal we don't use its whole body for a good purpose.

Some impacts:

When one species dies off that can cause another species die off and so on. For example when all gazelles die that can kill off lions and break the whole food chain.

The places most being affected from changes of biodiversity are:

- South America
- Asia
- South Africa

by Amina

Changes to Toronto's Biodiversity

BEFORE:

In the early 1900s, there were 11 species of reptiles and 16 species of amphibians in Toronto. But as the city expanded up north, many wetlands got filled with dirt of bricks or were drained. Many industrial wastes and sewage were put directly into the Don River. Before the big settlement boom in the 1800s, wetlands, forests, and valleys had a striking amount of reptiles and amphibians.

Beaver also played an important role in creating wetlands but were replaced with mills and mill ponds. The area also slowly transformed for agriculture purposes. Before humans ever came to the Toronto area there were many animals that we see no more. Some examples are: the wooly mammoth, giant beaver, and stag moose. Many roads were made and laid out and were put in the middle of many habitats for animals. Before, our beaches had nice cool water for wish to be able to swim and live in and rivers provided habitats for fish like the Atlantic Salmon. Along shorelines there were lush wetland vegetation. Much of Lake Ontario's shoreline was covered with sand, gravel, and stone. When European settlement moved in and forests were cut down, more runoff went into streams and rivers, which caused them to flood. The huge Ashbridge's Marsh (approximately eight square kilometers, one of the largest wetlands in Eastern Canada) was drained and filled in in 1912.

AFTER/TODAY:

Currently, Ontario has 45 species of reptiles and amphibians, but most don't live in Toronto. The greatest biodiversity is along the river valley systems. Many lands that used to be big forests are now agriculture lands. Many bigger mammals that relied on forests disappeared, such as black bear and moose. The ravines that are still in Toronto are crucial for keeping wildlife that still have their habitat in Toronto. All the shorelines and the Toronto islands are all critical habitats for mammals that are adapted to living in those areas.

Wetland and riparian habitat restoration has improved the mink populations along the waterfront. Certain animals have been adapted to living in a human society now and even might have benefited from it. But because of all the “free food”/garbage that are in our environment, raccoon, skunks, foxes, and the domestic cat are coming into our environment. They are preying on smaller animals so the predator population has increased. Predators force prey populations down until prey is becoming scarce. Prey populations are soon then going to face extirpation. Some native species in Toronto couldn't adapt at all

and disappeared.

A feral animal is one that was once tame but then became wild. They can now be a source of parasites and diseases. They also have a bad impact on wildlife by killing millions of birds and small mammals annually. Groundhogs or woodchuck used to be very common in Toronto but is now disappearing slowly. It may be because of habitat loss or increasing predators (coyote).

Certain animals have adapted to benefit from human habitation. These are called “subsidized predators” (raccoon, skunk, chipmunks, crows, and even the domestic cat!) They will prey on smaller animals which include threatened or endangered species. Roads also cause a threat to many animals. Especially reptiles and amphibians because they don't scurry when scared. Then they bask on warm surfaces like the road, a car may hit them or when on warm wet nights, a mass number of frogs move across the road, they are killed because of heavy traffic. We put up signs in areas where many animals commonly cross the road.

by Serena

Toronto's Biomes

A biome is an area on earth that has similar climate patterns and geographical patterns. These are some types of biomes: Oceans are the largest biome by area of earth at 71%. Deserts have very little rainfall. 19.5% of the earth's terrestrial surface is desert. 17% is covered by tropical rainforest, which have a lot of plant growth and rainfall. Ice covers 11% of the earth, and is the coldest biome. The savannah covers 10% and has experiences two seasons: the wet season and the dry season. There are large grasslands, and there are huge herds of herbivores. Cultivated land (9.5%) is the only biome created by people. This is used to grow crops.

Which biome is Linden found in?

We live in Toronto and Toronto is surrounded by Boreal and Deciduous Forests. Boreal Forests are normally cold with long winters and short summers. The landscape is mostly covered with coniferous trees such as pine. In Deciduous Forests, when the temperature falls, the leaves change and turn brown. When the winter gets cold, there isn't water for the leaves, so they fall off. Coniferous trees have adapted and keep their needles during the winter; the needles don't collect snow. Summers are very hot, humid, and short, and winters are cold. Precipitation is spread through the year; in spring, summer, and fall, it is in droplets, and in winter it is frozen snow and hail.

In Toronto, we are also near lowlands and plains. In the winters, it can get as cold as 30 degrees below zero. There are 180-200 growing days, and 2,000 hours of sunshine a year.

We live in an urban environment. You don't see a lot of deer, moose or large animals; the largest you'll usually see is a raccoon. There are a lot of paved sidewalks and roads, and tall buildings. There are parks and ravines, but there aren't many forests in the middle of a city.

by Anna

Which Species Have Been Extirpated from Toronto?

By the beginning of the 20th century, the Northern river otter, fisher, American marten, black bear, wolf, cougar, Canada lynx, and bobcat vanished from this area. Moose and elk disappeared even earlier during the initial European settlement of the Toronto area in the 1700s. Western chorus frog left Toronto after habitat loss.

Wood turtles are extirpated from Toronto and threatened in Ontario due to habitat loss and predators such as raccoon, foxes, and skunk.

The eastern ribbon snake was extirpated after humans started to build factories on the land that they lived on and ran over them with cars while they were lying on the road to sun themselves.

Eastern hog-nosed snake were forced to move out of Toronto after they suffered from habitat loss.

Blue-spotted salamander used to live under rocks and logs in the forest, but since the forests in Toronto were cut down, they had to find somewhere else to live.

The spiny softshell turtle had to leave Toronto because of habitat loss due to shoreline development.

by Karina

How Can We Help Pollinators?

I read an article about how we can make our garden more pollinator friendly. Without them, over 30% of the food we eat will not be pollinated. Many pollinators are at risk because of climate change, habitat loss, and pesticide exposure.

Humans are harming plants by spraying pesticides on them to make their garden more pretty. Humans are also hurting plants because they pick the dandelions off of their lawns but they provide essential nutrients in the early spring. Pollinators' habitats have been lost as well; for example trees can have many homes for different spaces in them. Climate change has also been affecting the pollinators.

I think that Linden should plant a garden on the roof and we can all take turns watering it and we can show the kids at Linden how to take care of their garden and make it more pollinator friendly. We can plant plants such as the milkweed plant. We can also leave patches of bare soil behind our garden to help make habitats for the bees with a tiny bit of water and rocks so that the bees can land on the rocks and drink from the water without the risk of drowning.

Humans are affecting global climate change from the cars we drive to the electricity we use. Linden can help by turning of the lights when they are done with it and we can carpool to school and back and take public transit. We can also turn of the computers in the computer lab because they use a lot of electricity.

by Gabi

What Can We Do to Help the Bees?

I read an article about helping bees, which are an important pollinator. What they said in the article is that people are picking dandelions, and also adding pesticides to the ground, which is affecting bees and their pollination. Dandelions are one of the most beneficial flower for bees.

29% of honey bee colonies have vanished. Humans have used chemicals like clothianidin and neonicotinoids on their grass, which is probably the reason for this colony collapse.

Linden can help with this problem. We could make a match of wildflowers and dandelions on the roof for the bees. We should also avoid using pesticides. We can also give donations to beekeepers, share our knowledge of bees, and maybe even hold a festival about bees! We could also go visit a beekeeper in order to ask more questions. In another place, I wrote about some pros and cons of building a beehive on our roof.

by Intezar

The Status of Reptiles and Amphibians in Toronto

I read an article that talks about how many reptiles and amphibians are disappearing in Toronto. It was mostly because of expanding city and draining wetlands. Sewage also flowed into the Don Valley River, which caused diseases. Many marshes even got destroyed by humans. Many lawn snakes also got killed by lawn mowers or by human activity. But, humans can also help increase the population, like by building your own backyard pond and putting natural vegetation around. Many animals will visit and you will have lots of vegetables.

Humans have been destroying animal and plant habitats for a long time to build roads and houses. Many animals have been extirpated, such as the ring-necked snake. Humans have also drained wetlands so that 75% of Ontario's wetlands have been lost in the past 100 years. But you can help the animals and insects come back by planting native plants so they can hide from predators. Also, by building your own backyard pond, you can help attract animals and amphibians to your backyard.

At Linden, we can help spread awareness about how to help plants and animals, such as:

--When mowing your lawn, start in the middle, then work out. The small animals/insects hiding inside have a chance to get away before the mower goes on them.

--Try to avoid pesticides or other harmful chemicals because it can hurt many animals and insects.

--Let plants grow naturally, such as tall grass, to help prey escape from predators.

At Linden we could see if we could make a tiny pond on the rood, or make a patch of lawn to help reptiles or amphibians hide from predators. We can always work to raise awareness.

We are not allowed to put tall grass on the rooftop or in the yard, so here are some rules for going on field trips:

--Don't pick plants, especially taller ones where prey can hide.

--If you see someone spraying pesticides, try to ask the to stop.

--It isn't a good idea to move tadpoles since it can spread diseases from another pond. If you do take some, you should release it in the same lake or river/pond you found it in.

by Serena

FLAP: Fatal Light Awareness Program

This article is about what you can do to prevent birds from flying into windows, sheds, lighthouses, wind turbines, houses, and office buildings, which causes them to die. It also explains about FLAP. FLAP stands for Fatal Light Awareness Program. It explains what to do if you see an injured bird.

Humans affect birds in lots of different ways. When humans leave lights on inside a building, birds are attracted to the light and fly into the building and then die. Humans can help birds by supporting organizations like FLAP that nurse birds that hit buildings back to health.

Linden can help by turning off all the lights when we leave a room, especially at night. We can also put hawk stickers on the large windows to scare birds away from them. We can also put out food for the birds to eat.

by Karina

The Impact of Food Waste

I read an article about the food that we eat, and how it can turn into waste and harm other types of living things. For example, when we eat food then throw it out in the trash that trash goes to a dump. Animals like bears can get into the dump and eat it; sometimes they choke on garbage. Food waste also wastes water, because it takes a lot of water to grow crops. Food waste also contributes to climate change because rotting food gives off greenhouse gases. Most of the food waste comes from high income regions because of what they can afford. In low income regions they take more care of their food.

First of all human action has been harming this issue in many ways by wasting food. Though people have helped by volunteering cleaning out waters and fencing harmful things to animals. 54% of the population help and 46% harms.

Linden can take action into this issue by:

- Taking time and care of where they put their extra food and learning more about foods that can disintegrate
- Buy Less Food: people over buy food because they mostly worry into the future, don't know how much they are cooking or the amounts the grocery stores packages the food. Such as asparagus is packaged in 27 pieces.
- Donate To Food Banks: if you overbuy food that you don't need you can donate to food banks where 96% of the food is not wasted

by Amina

The Impact of Landfills

When garbage in a landfill rots, CO2 and methane come out an pollute the air. This contributes to climate change.

Landfills also make leachate. Leachate is like a “juice” that comes out of the garbage. This pollutes the water and soil and hurts biodiversity. We need biodiversity because we are all connected.

So, landfills pollute the air, water, and soil, contribute to climate change, and hurt biodiversity.

I would suggest we have a litterless lunch programme at Linden. We should reduce, reuse, and recycle. I also don't think we should continue the hot lunch from Kid's Kitchen because it produces so much garbage. Maybe we can ask them to think of ways to make less garbage.

by Anna

Pros and Cons of Adding to Our Roof

Advantages and Disadvantages of Building a Roof Garden

PROS	CONS
--accessible to disabled or elderly persons --helps keeps roots away from contaminated soil --can be neat and tidy --if high enough, can keep out predators --no need to improve soil --keeps roots from getting waterlogged in a wet climate	--requires materials to construct --might need to buy soil --roots get dry more quickly in hot climate --lack of mineral content in bagged soil --use of peat moss in bagged products --need to be careful about leakage

Advantages and Disadvantages of Adding Birdhouses

PROS	CONS
--birds are protected because the wood provides insulation in extreme warm and cold weather --post bars make it difficult for predators to reach inside the birdhouse --this attracts more birds to the yard --it helps birds during migration --it educates people	--may attract rats, squirrels or other pests --may fall prey to hawks and cats --suffer more diseases --may compete with nesting birds --require cleaning and maintenance --leads to more window casualties --seed production has environmental impacts

Advantages and Disadvantages of Adding a Beehive

PROS	CONS
--human health benefits --healthier bees --getting honey and wax --pollination	--overcrowding --stings --cost of supplies --the sound of bees

by Intezar

Is there any such thing as too much biodiversity?

We all know that too little biodiversity is a bad thing. When people are constantly building buildings on top of areas where animals need to live, this causes habitat loss. Sometimes we need the buildings, though. Too much biodiversity can increase poverty for people, or make it so that people don't have a place to live.

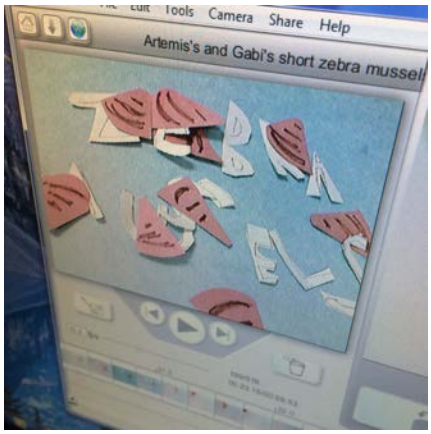
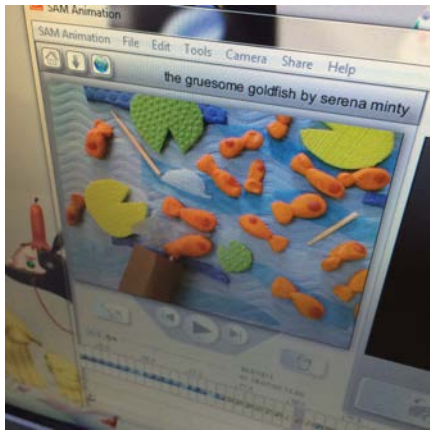
Sometimes, adding living things to an ecosystem is bad. For example if there is a new invasive plant that has been discovered and that has released into the forest the biodiversity in that forest will continue increasing, but it will be bad for the forest in the end.

If you plant too many plants in one place. it can be to counterproductive. Every type of living thing needs a habitat but too much biodiversity can hurt it. Though biodiversity is usually good it can also affect lots of living things and takes up a lot of room. For example, if an animal eats milkweed, but there is only one plant in the area, the animal might not see it. It will not go back to that area because there's not a lot of milkweed plant for them to eat. That is why a garden should have larger patches of plants, and not too many single plants.

by Gabi

Our Stop-Motion Animations About Invasive Species in Ontario

In computer studies, we researched species considered invasive to Ontario, then made stop-motion animation films about what people can do to help. Here's a short summary of what our films are about.

Anna and Amina **"Borer Horror"**	Gabi and Karina **"The Attack of the Zebra Mussels"**	Intezar and Serena **"The Gruesome Goldfish"**
		
This film is about the emerald ash borer. People can help stop the spread of this insect by not moving firewood. Instead, you can burn it where you find it.	This film is about the zebra mussel. One thing that people can do to stop the spread of the zebra mussel is to check their boats to make sure none have attached. This will help keep the mussel from spreading to new lakes.	This film is about the common goldfish. Instead of flushing unwanted goldfish into the sewers (where they can get into local ecosystems), people should return them to the pet store.

Stay tuned for a link to our finished films!

Our Field Trip to Tommy Thompson Park

Collecting data in this biodiverse area.

Planting native species after invasive vines have been removed.

Wetland Species Survey

The scientists in the bird research centre collect data from many different species.

One of the many interesting insects we saw in the park.

Summary of Recommendations for Linden:

Linden Should Continue To:	Linden Should Start To:	Linden Should Stop:
Maintain a biodiverse front garden. Foster a carpooling system for organizing rides to school. Encourage use of TTC to get to school and to go on field trips. Take elementary students on field trips to allow field studies of natural habitats. Keep separate recycling and garbage cans in each room, with compost bins on each floor. Enforce a “no disposable cup zone” at Linden. Avoid the use of pesticides in the garden. Celebrate Earth Day with a community cleanup.	Add more plants to rooftop planters. Create a greenhouse on the roof to extend growing season. Enforce a stricter litter-less lunch programme. Put a plant in each classroom improve the air quality in the school. Take secondary students on a greater number of field studies in natural habitats. Consider a biodiversity-related service trip for senior students. Do outreach to teach people not to be afraid of insects. Make a greater effort to turn off lights when leaving rooms, and at night. Sort our recycling more effectively. Instead of using chemical pesticides to control vermin in the building, focus more on reducing food waste and debris. Set up a “free to take” box for reusable items. Extend our community cleanup to zones that need more attention (such as Don River). Add a bat box and a birdhouse to the roof.	Allowing Kid's Kitchen lunch program to generate so much un-recyclable waste. Leaving hall lights on in the school overnight. Allowing students to play with planters and flowerpots in a rough way. Wasting paper in general. Getting rid of plants on the roof. Swatting bees found on the roof (educate people to move away from the bee instead.)

What can Linden's Principal and Board Do To Help?

Your ideas:

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