A comprehensive investigation on Carbon Storage in the vegetation of our schoolyard and determining the Carbon Footprint of the school through the measurement of carbon using GLOBE's Carbon Cycle Protocols.

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Gratitude

We would like to express our sincere gratitude to **Mr. Todd Toth** for providing us with the carbon sensor and all the technical support. Our project would remain incomplete without your support and guidance.

We appreciate the contribution of all the **GLOBE members of Pelrithang Higher Secondary School** and **The GLOBE Bhutan**.

We express our heartfelt gratitude to our former country coordinator, **Dr. Chenga Tshering** for bringing The GLOBE Program to Bhutan.

This very first IVSS is dedicated to you, sir.

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Research Questions

i. What is the pattern in which biomass and carbon storage change over time in the vegetation of our schoolyard?
ii. How does the uptake of carbon by our schoolyard vegetation compare to the emission of carbon by our school. (Determining carbon footprint)

Objectives

Through this research, we intend to:

i. understand the pattern in which the biomass of the schoolyard vegetation affects the amount of carbon stored in it over a period of three years. This would help us determine the Net Primary Productivity (NPP).
ii. measure the amount of carbon sequestered by our schoolyard vegetation and compare it with the amount of carbon emitted by the school in a year. This would help us to determine the carbon footprint of the school and accordingly we would be able to regulate the amount of carbon that we emit into the atmosphere.

Protocols involved

i. Site selection and scaling protocol (A supporting protocol)
ii. Tree protocols
iii. Shrub/Sapling protocols
iv. Herbaceous protocols

Hypothesis

The green vegetation in our schoolyard comprises of trees, shrubs/saplings and herbaceous. We believe that a greater proportion of these vegetation present in our site helps in storing a greater amount of carbon. We hypothesize that the trees store greater proportion of carbon as compared to the shrubs and the herbaceous. Further, larger the trees, greater the carbon stored in them.

Calculating Net Primary Productivity (NPP) is one of the effective ways to understand the change in the amount of carbon stored in the vegetation over the years. Determining the carbon footprint would allow us to regulate the amount of carbon we emit, thus minimizing carbon emission into the atmosphere.

Abstract

In completing this research, we were able to estimate the amount of carbon stored in the vegetation of our schoolyard. Through the GLOBE program's *Non-Standard Site Carbon Cycle Protocol,* we were able to measure the carbon stored in the trees, shrubs and the herbaceous present in our site. Based on the measurement of their biomass, we obtained an estimate of 3756 g C/m^2 (in the year 2022). The school stands on an area of 33 acres (133,547.3 m^2), of which 50% (66,773.7 m^2) of it contains vegetation. Thus, the amount of carbon stored in the vegetation of the whole school area is approximately 2.50×10^8 g C or **250.00 tons**. In the subsequent years, the carbon stored in the schoolyard were 4335 g C/m^2 or **289.47 tons** (in 2023) and 4629.7 g C/m^2 or **309.14 tons** (in 2024). There is a gradual increase in the carbon stored in our schoolyard vegetation, and this is because of the increase in the biomass of the vegetation over the years.

On comparing the amount of carbon stored by the vegetation in our schoolyard and the carbon emitted by the school, we could determine that our school stands as Carbon Negative at the time of measurement.

Introduction

Our surrounding comprises of vegetations and human interference. In GLOBE terminology, such a site is called a non-standard site. A school is a good example of a non-standard site and the measurement of carbon would be more realistic and accurate using non-standard carbon cycle protocols.

Our school lies within 26.903259^{o} N and 90.490304^{o} E and stands at an elevation of 292.2 m above sea level. It covers an area of 33 acres (133,547.3 m^2), of which approximately 50% of its area is under human interference due to the construction of classroom blocks, assembly courts, games and sports facilities, car parks and teachers' quarters. The other 50% contains trees, shrubs and herbaceous.

Key words/Important terminologies:

- Non-standard site: *a site comprising of both vegetations and human interference (i.e. a local park, city block, or some kind of structure)*
- Trees: *single-stemmed woody plants that are greater than 15cm circumference at 1.35m*.
- Saplings: *single-stemmed woody plants that are currently less than 15cm circumference at 1.35m*
- Shrubs: *multi-stemmed woody plants (that can range significantly in size).*
- Herbaceous: *referred to the grasses present in the site.*
- Net Primary Productivity (NPP) *or the production of plant biomass, is equal to all of the carbon taken up by the vegetation through photosynthesis minus the carbon that is lost to respiration*.
- Carbon Footprint: *it refers to the total amount of greenhouse gases released into the earth's atmosphere as the result of the activities of a particular individual, organization, or community*.

Background information

Figure 1 Carbon in nature

Life on earth would not be possible without carbon. Carbon dioxide, which is one of the oxides of carbon is an important gas for life on the planet. It is important for the plants to photosynthesize. Photosynthesis is one of the biological processes that sustains life on earth. Carbon dioxide is also crucial in maintaining the protective blanket that is Earth's atmosphere. It is one of the primary greenhouse gases on Earth. Greenhouse gases trap heat from the sun. Without these gases, that heat would escape Earth's atmosphere and go back into space. (NASA, 2022).

As important as carbon dioxide is for the living beings, the excess amount of the gas can also result in some severe negative impacts on earth's climate. Thus, it is important to maintain the amount of carbon dioxide present especially in the earth's atmosphere. One of the easiest methods we can adopt is to maintain our own carbon footprint.

Carbon is found and is exchanged between global reservoirs: the atmosphere, the ocean, terrestrial plant biomass, and soil. The balance of carbon between these reservoirs is important for life. The movement of carbon between the atmosphere, land, and oceans is called the Global Carbon Cycle. It is a key regulator of Earth's climate system and is central to ecosystem functioning.

The Carbon cycle data collected with GLOBE contributes to a better understanding of the relationship between carbon storage in plants and surface climate. (The GLOBE Program, 2022) For example, if there were no carbon dioxide in the atmosphere, photosynthetic organisms like plants would have no source of carbon and die out. In the long term, the exchange of carbon between the different reservoirs is balanced so this does not occur. However, changes in atmospheric carbon on geological timescales have been shown to drive (and be driven by) changes in global temperatures. (Doheny-Adams, 2023)

Human activities, such as burning fossil fuels and cutting down forests, are changing the balance between how much carbon is in the air and how much carbon is stored in plants and the ocean. These activities cause the amount of CO_2 in the air to rise. Big increases in CO_2 in our atmosphere can negatively affect Earth's climate. Understanding how ecosystems cycle and store carbon is key to understanding solutions to climate change. (The GLOBE Program, 2022)

Another critical step towards fighting climate change is neutralizing our carbon footprint, because it helps in protecting forests around the world. Nature is the most powerful technology to fight climate change. Yet, we are losing vital ecosystems at alarming rates. To prevent complete climate breakdown, we must halt the degradation and deforestation of habitats and restore nature. The planet is at a tipping point, and we need each other's support. Reducing our carbon footprint is one simple thing which we can do for saving our nature. (Conservation International, 2024)

Methodology

The method to carry out the measurement of carbon stored in the vegetation in a non-standard site is summarized in Figure 2, which is obtained from the GLOBE carbon cycle protocol.

It involves investigation of four protocols, namely *site selection and site setup protocol, tree protocols, shrub/sapling protocols* and *herbaceous protocols* depending on the type of vegetation present in the site during the time. (The GLOBE Program, 2022)

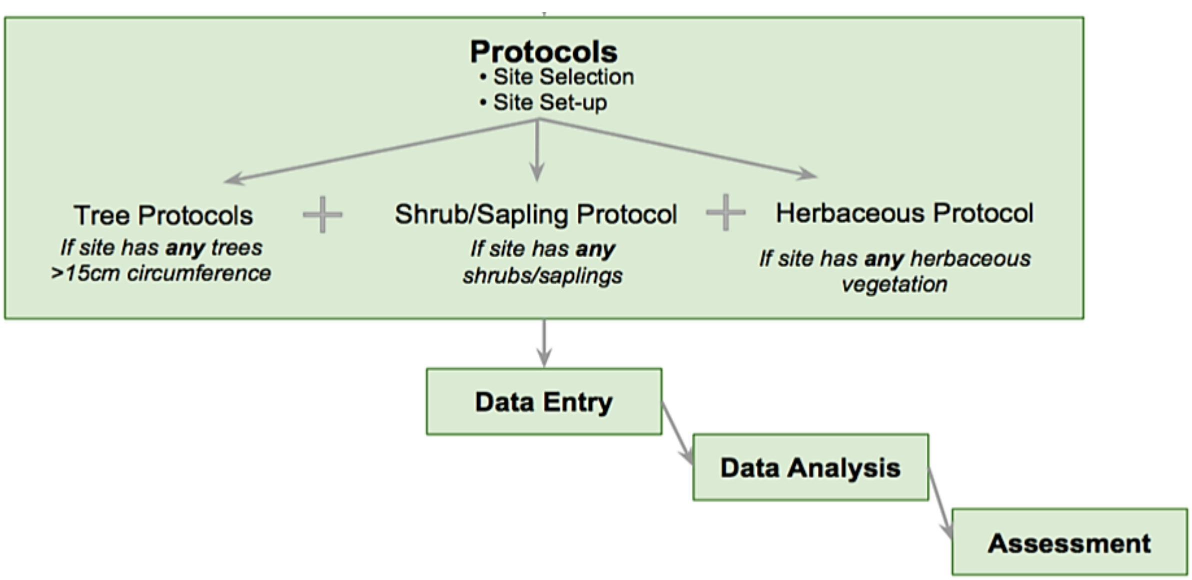


Figure 2 The overall procedure for Carbon measurement in a site

A. Site selection and site set-up

*Figure 3 Determining **map : ground** ratio*

Determining scale and calculating area is the first and mandatory step in selecting a carbon site for the research project. We determined a scale for a selected feature using the aerial photo and measuring the actual ground length of the same feature. In our case, we selected a basketball court for the measurement. With these measurements, a photo distance/ground distance ratio was obtained.

We obtained the ratio as **1 cm:1826.8 cm**

Using this ratio and the equation given below (obtained from GLOBE resources), we could easily calculate the ground distance and the area of our carbon site (the non-standard carbon site in the schoolyard).

$$\frac{\textbf{Photo distance}}{\textbf{Ground distance}} = \frac{\textbf{Photo distance of carbon site}}{(\textbf{X})\textbf{ground distance of carbon site}}$$

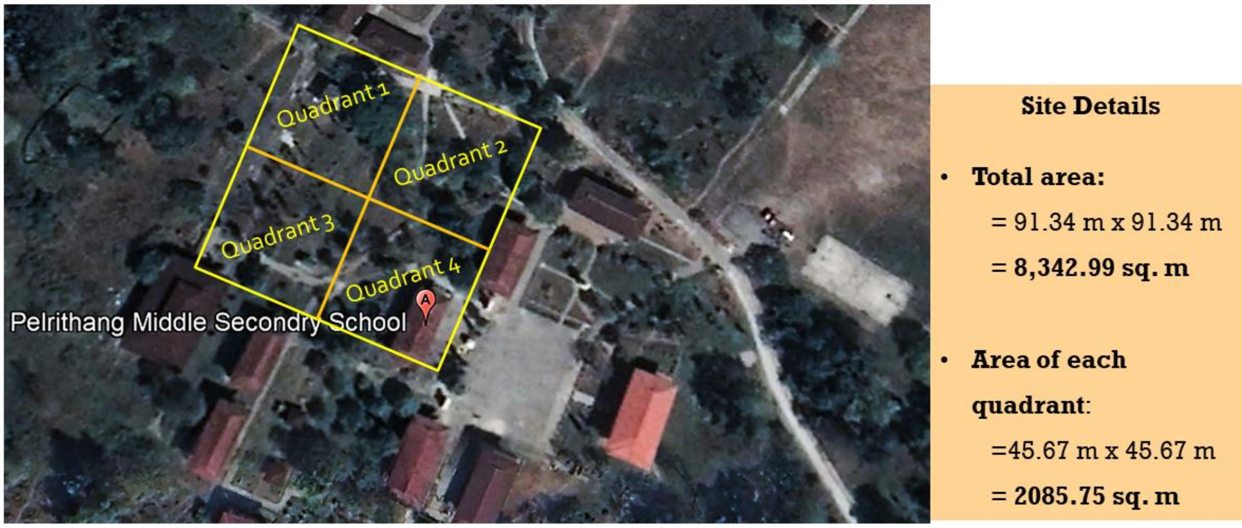


Figure 4 Our carbon cycle site in schoolyard with the relevant specifications

For the site setup, we worked in teams with specific task:

i. **Perimeter team**: We divided the site and took the measurements of the quadrants and recorded bearing and paces.

ii. **Photography team**: We took the photographs of the site facing nine directions as per the requirement and added them to our site details.

iii. **Data recording team**: We filled up the data entry sheets and competed the site selection forms.

B. Trees protocol

The following GLOBE procedure was used to collect and estimate the carbon stored in trees in our schoolyard. (The GLOBE Program, 2022)

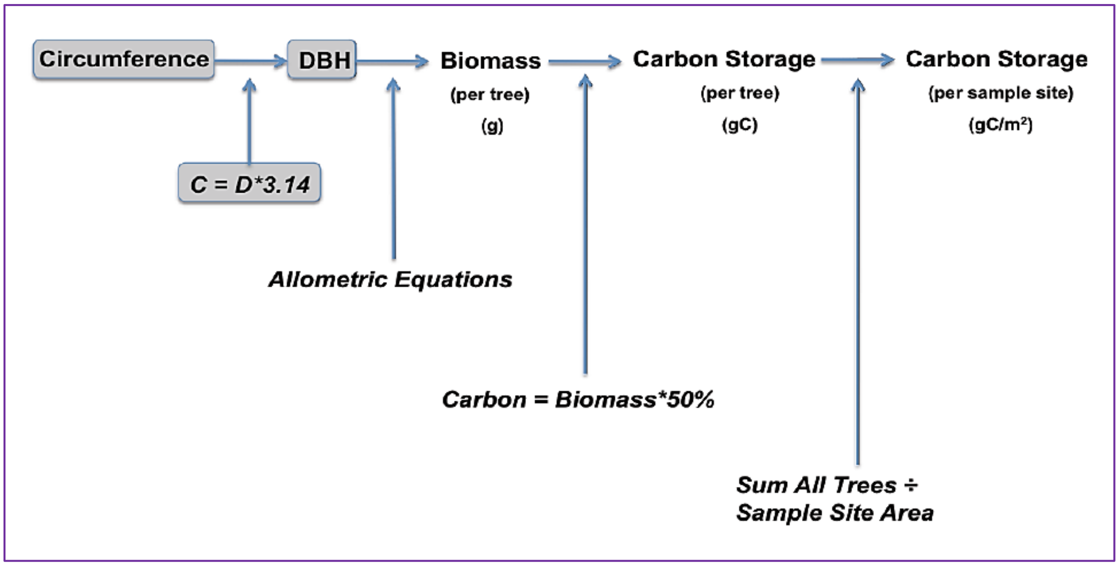


Figure 5 Steps involved in calculating Carbon stored in trees

To carry out the procedure, we started with mapping the trees in our site. We worked in three groups, each with the specific role(s).

i. **Tree verification group**: we used *Aerial Map* to identify the trees in each quadrant. We gave appropriate numbering to the trees.

ii. **Tree species group**: we used *Tree Identification Guide* and *Species Groups List* to identify the tree species and their scientific names.

iii. **Tree circumference group**: we measured the circumference of the trees and filled up the *Tree Data Entry Sheets*.

For each tree, three sets of 'circumference at breast height (CBH)' were recorded and the average was taken for more accurate measurement. The circumference was used to calculate the diameter at breast height (DBH) of the tree. The measurements were recorded in *GLOBE Carbon Cycle – Tree Data Sheet for Non-Standard Sites.*

Using the MUC field guide, we were able to identify the species group of the trees in our site. As per the description of the *woodland*, *it comprises of open stands of trees at least 5 metres tall with crowns not interlocking. The tree canopy covers at least 40% of the ground*. Thus, we concluded that the group species in our site relates to *woodland*, because the vegetation we have is mainly evergreen with a mixture of broad-leaved and needle-leaved trees (MUC 111 and MUC 1121).

After that, the allometric equation for the species group list was used to estimate the biomass of the trees. The estimated biomass was then used to calculate the carbon contained in each tree. Further, the carbon stored in the site was calculated by finding the total carbon stored in all the trees in the site and dividing it with the site area.

We took measurement of 75 trees in our site and entered all the data in the GLOBE database. For the measurement in the subsequent years, it was much easier because we just had to locate the trees and measure their circumference at breast height.

Species Group List

(Reproduced from Jenkins et al. 2003, Figure 1)

Species Group	Common name	Genus	Species
AspenAlder	Balsam poplar	Populus	balsamifera
AspenAlder	Bigtooth aspen	Populus	grandidentata
AspenAlder	Black cottonwood	Populus	trichocarpa
AspenAlder	Black willow	Salix	nigra
AspenAlder	Cottonwood (general)	Populus	spp.
AspenAlder	Diamond willow	Salix	eriocephala
AspenAlder	Eastern cottonwood	Populus	deltoides
AspenAlder	Fremont cottonwood	Populus	fremontii
AspenAlder	Narrowleaf cottonwood	Populus	angustifolia
AspenAlder	Peachleaf willow	Salix	amygdaloides
AspenAlder	Plains cottonwood	Populus	sargentii
AspenAlder	Quaking aspen	Populus	tremuloides
AspenAlder	Red alder	Alnus	rubra
AspenAlder	Silver poplar	Populus	alba
AspenAlder	Speckled alder	Alnus	rugosa
AspenAlder	Swamp cottonwood	Populus	heterophylla
AspenAlder	White alder	Alnus	rhombifolia
AspenAlder	Willow (general)	Salix	spp.
CedarLarch	Alaska-cedar	Chamaecyparis	nootkatensis
CedarLarch	Atlantic white-cedar	Chamaecyparis	thyoides
CedarLarch	Baldcypress	Taxodium	distichum
CedarLarch	Eastern redcedar	Juniperus	virginiana
CedarLarch	Giant sequoia	Sequoiadendron	giganteum
CedarLarch	Incense-cedar	Calocedrus	decurrens
CedarLarch	Larch (general)	Larix	spp.
CedarLarch	Pondcypress	Taxodium	distichum var. nutans
CedarLarch	Port-Orford-cedar	Chamaecyparis	lawsoniana
CedarLarch	Redwood	Sequoia	sempervirens
CedarLarch	Softwoods (general)	Softwood	spp.
CedarLarch	Southern redcedar	Juniperus	silicicola
CedarLarch	Subalpine larch	Larix	lyallii
CedarLarch	Tamarack (native)	Larix	laricina
CedarLarch	Western larch	Larix	occidentalis
CedarLarch	Western redcedar	Thuja	plicata
CedarLarch	White-cedar	Thuja	occidentalis
DougFir	Bigcone Douglas-fir	Pseudotsuga	macrocarpa
DougFir	Douglas-fir	Pseudotsuga	menziesii
FirHemlock	Balsam fir	Abies	balsamea

Figure 6 Students collecting tree data for biomass measurement in groups

C. Shrub/sapling protocol

Shrubs are any woody plants with multiple stems, while sapling is a tree with a diameter at breast height less than fifteen centimeters.

We used *Shrub/Sapling measurements - Non-Standard -Student Field Guide* to make ourselves familiar with the procedures to carry out the measurements. Using the guide, we made four groups with three members each. We then started recording the shrub's crown length (longest sides and shortest sides). We also recorded if it is deciduous or evergreen and estimated the representative height of the whole shrub.

We took measurement of about 25 shrubs in our site and entered all the data in the GLOBE database.

D. Herbaceous protocol

Figure 7 Students collecting herbaceous for biomass measurement

We used *Herbaceous Vegetation Measurements -Student Field Guide* in collecting herbaceous from the site. We identified three random sites within our carbon site to collect the herbaceous.

We made three 'one-meter square' sample sites. Using grass clippers, we clipped all the vegetation close to the ground within the squares and placed them in paper bag(s). The bags containing the herbaceous were labelled accordingly and kept in safe place for the herbaceous to dry properly.

Once the herbaceous were dried, we used the *Herbaceous Vegetation -Lab Protocol and Data Sheet* to keep record of the measurements. The *Herbaceous Biomass Data Sheet* was then used to calculate the average biomass and the carbon stock.

All of the data were entered in the GLOBE database.

Measurement of CO_2 emitted by the school

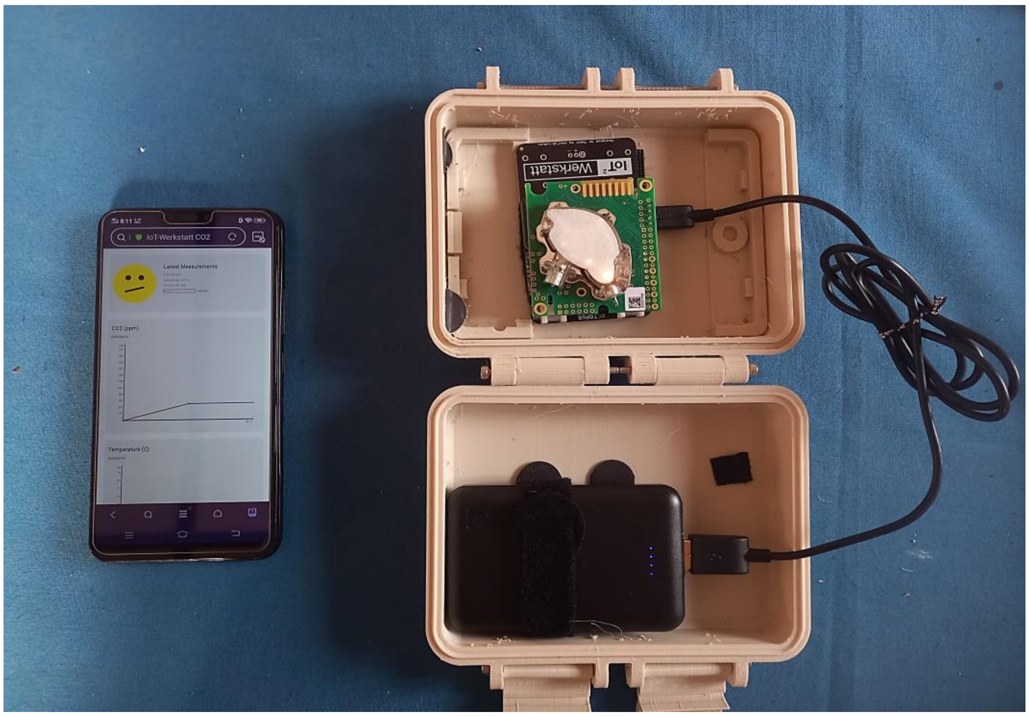


Figure 8 CO2 sensor connected to mobile phone via Wi-Fi. Phone displaying CO2 data.

For the purpose of determining carbon footprint of the school, we measured the amount of carbon emitted by the school using carbon sensor. We could do it only after having one of our own in the year 2023. In this report, we would be using the data from 2023 to determine the carbon footprint of the school.

Carbon sensor which we have is the Octopus CO_2 detector kit designed by the Fab-Lab.eu. in Germany. It was created to help schools during COVID19 to ventilate classrooms so that they could reduce the number of potential infected aerosols. Besides displaying the CO_2 reading as easy-to-understand colours (green/yellow/red), the kit also comes in with graphical programming extension that sends the carbon data into our mobile phones, laptops and tablets using its own Wi-Fi. (Maker Shed, 2019)

We used the sensor to estimate the amount of carbon emitted by the students while in classroom. The sensor records the amount of carbon present in the room at an interval of 60 seconds for a duration of two hour. We took the measurements from different classrooms during different time of the day. We then took the average to get the estimate of the amount of CO_2 emitted per minute. We used the estimate to approximate the amount of CO_2 emitted by the school as a whole. We used online calculator, from *Lenntech* to convert the CO_2 measured by the sensor in parts per million (ppm) to grams (g).

Table 1 The estimated amount of carbon released by the school.

Trials	**CO_2 emitted (ppm) per minute**	**CO_2 emitted per day**	**CO_2 emitted per day**	**CO_2 emitted per year**
I (Morning)	623.32	636.57 x 24 (classrooms) x 60 (min) x 7 (hrs)	**1.243×10^4 gC** Or	0.0137 x 30 (days) x 10 (months)
II (Noon)	655.96			
III (Evening)	630.42			
Average	**636.57**	= **6,416,625.6 ppm**	**0.0137 tons**	= **4.11 tons**

NOTE: we had to make some assumptions such as:

- *There are 24 classrooms then*
- *The school-time is approximately 7 hours a day.*
- *The school is open for 10 months in a year, and remains closed for 2 months.*

Data Analysis and Interpretation

All of the data were entered into the GLOBE database using desktop entry form, from which the analyses were done easily using the visualization system. Alongside, we also used the *Tree Biomass Analysis Template* and *Shrub/Sapling Biomass Analysis Non-Standard Template,* both Microsoft Office Excel Templates downloaded from the GLOBE website for the analyses. These templates contain all the instructions for the correct usage, and has all the data entry fields and self-analyzing tables and graphs. The rest of the analyses were also done automatically by the preinstalled formulas.

A. Summary of data analysis obtained from Microsoft Excel Templates.

i. Tree Data Analysis

Table 2 The summary of carbon stored in trees in our schoolyard vegetation

Year	Table summarizing the tree data	Total Aboveground
2022	Plot Biomass (g/plot)	12024224.43
	Plot Carbon Storage (g C/plot)	6012112.22
	Biomass (g/m2)	1441.24
	Carbon Storage (g C/m2)	720.62
2023	Plot Biomass (g/plot)	13127709.80
	Plot Carbon Storage (g C/plot)	6563854.90
	Biomass (g/m2)	1573.50
	Carbon Storage (g C/m2)	786.75
2024	Plot Biomass (g/plot)	13934788.85
	Plot Carbon Storage (g C/plot)	6967394.43
	Biomass (g/m2)	1670.24
	Carbon Storage (g C/m2)	835.12

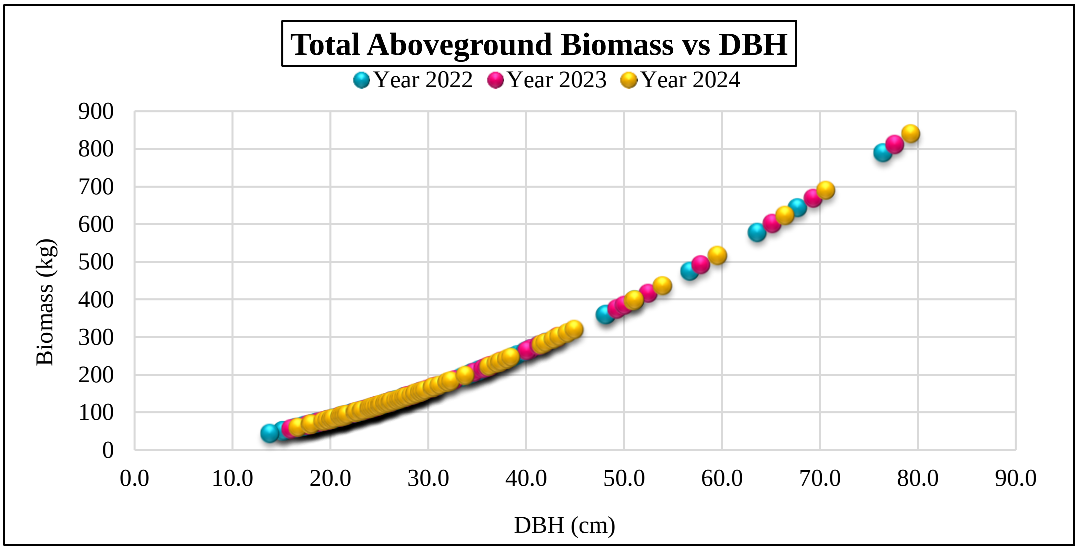


Figure 9 Graph showing the relation between the biomass and diameter at breast height (DBH)

From the graph, we could derive the relationship between biomass and diameter at breast height. We could conclude that as the size of the tree increases, so does its biomass and the amount of carbon it sequesters. Thus, it is very important that we save the larger trees.

ii. Shrubs/Sapling Data Analysis

Table 3 The summary of carbon stored in shrubs/saplings in our schoolyard vegetation

Year	Shrub/Sapling Biomass Table	Total Aboveground
2022	Deciduous Biomass (g/m2)	0.15
	Evergreen Biomass (g/m2)	1.17
	Total Biomass (g/m2)	1.32
	Total Carbon Storage (g C/m2)	0.66
2023	Deciduous Biomass (g/m2)	1.17
	Evergreen Biomass (g/m2)	5.09
	Total Biomass (g/m2)	6.26
	Total Carbon Storage (g C/m2)	3.13
2024	Deciduous Biomass (g/m2)	4.55
	Evergreen Biomass (g/m2)	13.85
	Total Biomass (g/m2)	18.41
	Total Carbon Storage (g C/m2)	9.20

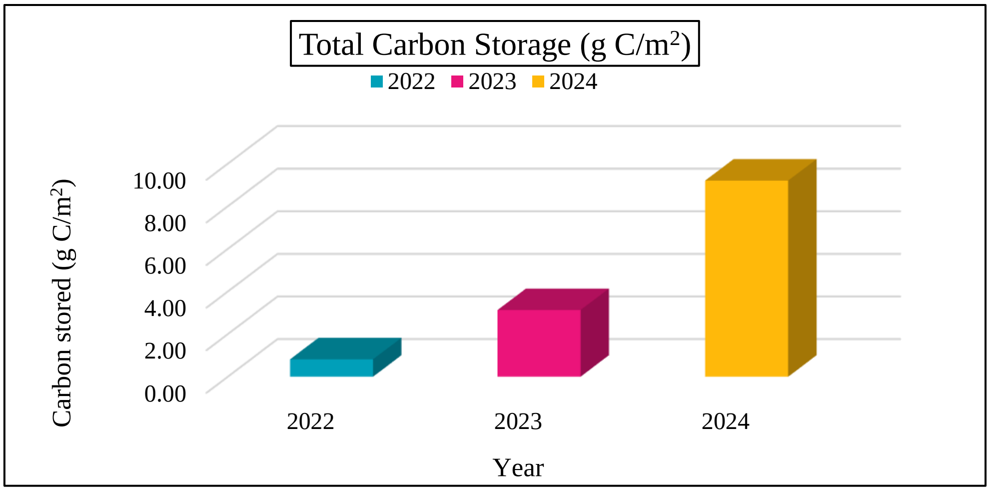


Figure 10 Graph showing the amount of carbon stored in shrubs/saplings over three years

Each passing year shows the growth in height of the shrubs/saplings in our site. Thus, there is the increase in their biomass and the carbon they sequestered.

iii. Herbaceous Data Analysis

Table 4 The summary of carbon stored in herbaceous in our schoolyard vegetation

Year	Herbaceous Biomass Table	Total Aboveground
2022	Herbaceous Biomass per sample (g/m2)	205.7
	Average Herbaceous Biomass (g/m2)	68.6
	Herbaceous Carbon Stock (g C/m2)	34.3
2023	Herbaceous Biomass per sample (g/m2)	207.2
	Average Herbaceous Biomass (g/m2)	69.1
	Herbaceous Carbon Stock (g C/m2)	34.5
2024	Herbaceous Biomass per sample (g/m2)	197.0
	Average Herbaceous Biomass (g/m2)	65.7
	Herbaceous Carbon Stock (g C/m2)	32.8

Unlike the trees and the shrubs/saplings, the carbon stored in herbaceous has no proper pattern. It is much lesser in 2024 compared to the previous years. This is because during the time of the biomass measurement, there were lesser herbaceous in the site as it was still winter then.

B. Data visualization using globe visualization system

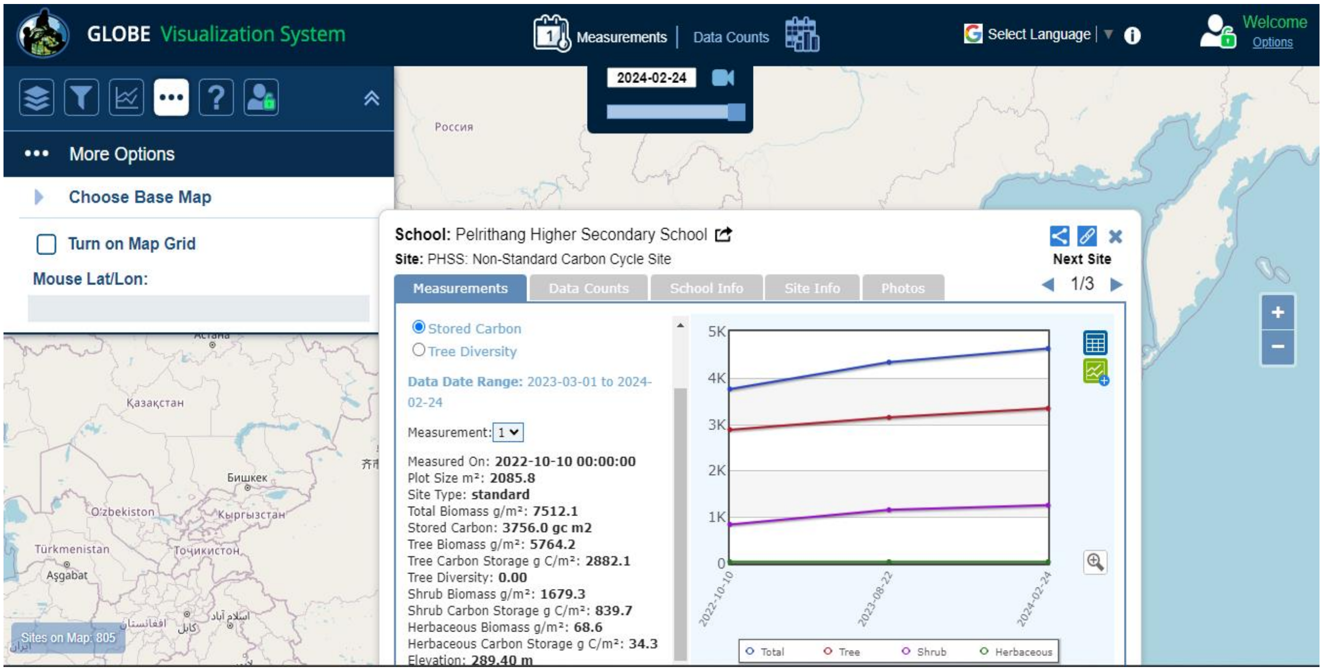


Figure 11 Data analysis as obtained from the GLOBE Visualization System

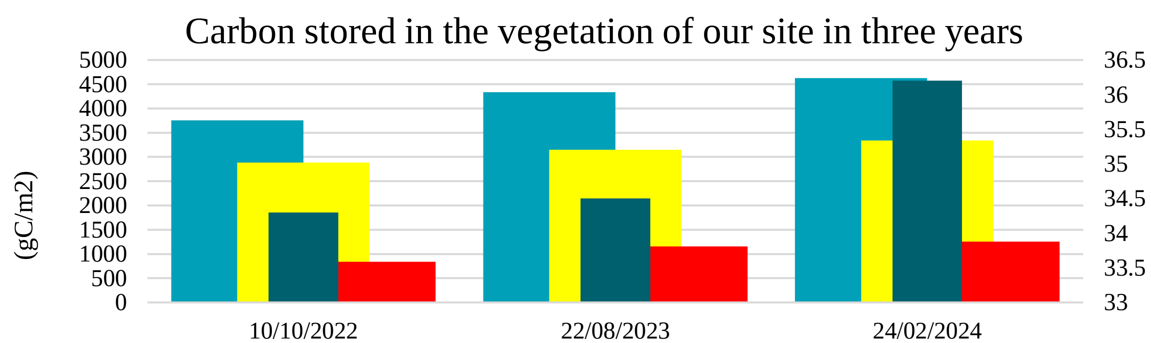
Table 5 The details from the GLOBE Visualization System for the three measurements.

School Name	Pelrithang Higher Secondary School		
Site Name	PHSS: Non-Standard Carbon Cycle Site		
User id	85378938		
Latitude	26.90234		
Longitude	90.49045		
Elevation	289.4		
Plot Size (m^2)	2085.8		
Site Type	Non-Standard		
Measured on	2022-10-10	2023-08-22	2024-02-24
Total Biomass (g/m^2)	**7512.1**	**8670.3**	**9259.3**
Total Carbon Storage (gC/m^2)	**3756**	**4335.1**	**4629.7**
Tree Biomass (g/m^2)	5764.2	6291.3	6681.3
Tree Carbon Storage (gC/m^2)	2882.1	3145.6	3340.6
Shrub Biomass (g/m^2)	1679.3	2310	2505.7
Shrub Carbon Storage (gC/m^2)	839.7	1155	1252.8
Herbaceous Biomass (g/m^2)	68.6	69.1	72.3
Herbaceous Carbon Storage (gC/m^2)	34.3	34.5	36.2

C. Determining Net Primary Productivity (NPP)

Net Primary Productivity (NPP), or the production of plant biomass, is equal to all of the carbon taken up by the vegetation through photosynthesis *minus* the carbon that is lost to respiration. NPP can be calculated with this equation:

$$NPP = Carbon\ stored\ for\ Year\ 2\ - Carbon\ Stored\ for\ Year\ 1$$



	10/10/2022	22/08/2023	24/02/2024
Total Carbon Storage (gC/m2)	3756	4335.1	4629.7
Tree Carbon Storage (gC/m2)	2882.1	3145.6	3340.6
Shrub Carbon Storage (gC/m2)	839.7	1155	1252.8
Herbaceous Carbon Storage (gC/m2)	34.3	34.5	36.2

Figure 12 The overall comparison of carbon stored in the schoolyard vegetation in three different years.

Table 7 Determining Net Primary Productivity of the site

Year	**Total Carbon Storage (g C/m^2)**	**NPP (g C/m^2)**
2022	3756.0	Not Available
2023	4335.1	579.1
2024	4629.7	294.6

It is evident from the data that the amount of carbon stored in the vegetation of our schoolyard shows an increasing trend over the years. With the NPP of about 600 g C/m^2 between 2022 and 2023, the vegetation sequestered large amount of carbon. Within few months in 2024, NPP is already 294.6 g C/m^2. This number is likely to increase by the end of the year as the biomass of the vegetation would continue to increase.

D. Determining Carbon Footprint

Carbon footprint is determined by finding the difference between the amount of carbon stored by the vegetation of the schoolyard and the carbon emitted by the school. Though there are also other parameters to be considered while determining one's carbon footprint, we are primarily focusing on the amount of carbon emitted by the students and teachers in the classroom.

Table 8 Carbon status of the school in the year 2023

CO_2 stored by the vegetation of the schoolyard	CO_2 emission from the school	Carbon status of the school
289.47 tons	**4.11 tons**	**Negative**
98.6%	**1.4%**	

While comparing the amount of CO_2 emitted by the school with the carbon stored by the vegetation of the schoolyard, we could conclude that the carbon sequestered by the vegetation in our schoolyard is by many folds greater than the carbon emitted by the school. Thus, our school stands as carbon negative.

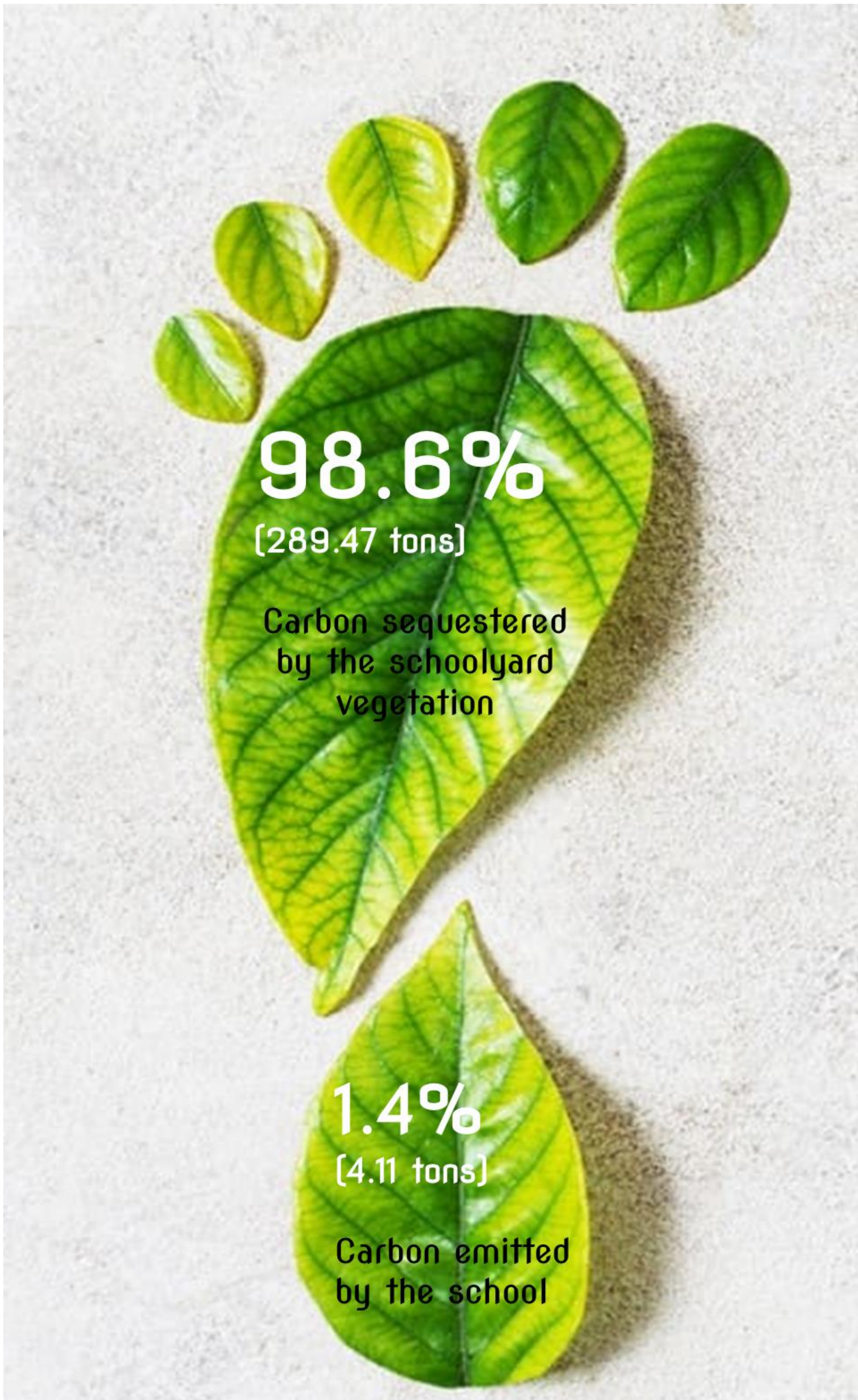


Figure 13 The Carbon Footprint of our school for the year 2023

From all of the above data analyses, we could draw the following conclusions:

i. The amount of carbon stored in the schoolyard is directly proportional to the amount of vegetation present in it. Carbon stored is 50% of a plant's biomass.

ii. The trees account for the maximum biomass; thus, the trees absorb larger portion of the carbon.

iii. The larger the trees, larger is the amount of carbon stored in them. Thus, we could also conclude that preserving larger trees are very important. We were able to relate the importance of preserving the largest and oldest forests on earth, such as the amazon rainforest.

iv. Based on the measurement of the biomass, we obtained an estimate of 3756 g C/m^2 in the year 2023. With about 50% (66,773.7 m^2) of the school area under vegetation, the amount of carbon stored in the vegetation of the whole school area was approximately **289.47 tons.**

v. While estimating the amount of CO_2 released by the students in the classroom using the CO_2 sensor that we had, we could determine that our school emitted about **4.11 tons** CO_2 in 2023. On comparing it with the amount of carbon sequestered by our vegetation, we could determine that our school stands as carbon negative. However, we do understand that there are also other sources of CO_2 in school which would add up to its emission, but the figure would still remain comparatively lesser than the total carbon sequestered by the vegetation in our school.

vi. The carbon stored in the vegetation of our site is likely to change over the years because of many factors. One major factor that would lead to decrease in carbon storage is the human interference. Therefore, it is important to keep track of the biomass of these vegetations and calculate the carbon stored in them annually so that we would be able to maintain our carbon footprint at all times to come.

vii. A very important lesson learnt through this project is that, even if we are not able to maintain 100% vegetation coverage in our site, we could still preserve few larger trees, because these trees have higher capacity to store more carbon. This way, we would be able to maintain our own carbon footprint at all times.

Conclusion

One of the pertaining environmental issues which is of the global concern nowadays is the ever-increasing global temperature leading to global warming and the climate change. It is known to everyone that the main cause of global warming is the increase of carbon dioxide in the atmosphere due to human activities. It is the mankind who is responsible for the severe deforestation, desertification, urbanization, and other similar activities that emits most of the greenhouse gases (GHGs). These GHGs cause greenhouse effect and results in global warming and climate change.

The consequences of climate change are hitting us already and will do so in the future. The studies point out that to avoid the worst climate impacts, global greenhouse gas emissions need to be slashed in half by 2030 and reach net zero around mid-century. Reaching net zero emission requires us to do two things.

i. Reduce Our Emissions

First, we must reduce our carbon emissions to as close to zero as possible as quickly. Phasing out coal, investing in clean energy, shifting to electric vehicles, protecting forests, and reducing food loss and waste are just a few ways to reduce your carbon footprint.

ii. Pull out carbon from nature

Second, we need to pull just as much carbon out of the atmosphere as we pump into it. This can be done by planting trees that absorb carbon into their trunks, limbs, and roots as well as by deploying emerging technologies such as direct air capture which takes carbon out of the air and stores it in geological formations underground.

A number of countries have already committed to reaching net zero emissions by 2050 and some nations are even more ambitious. Bhutan is one of the few nations which is carbon negative, and commits to remain carbon neutral at all times. Thus, the constitution of Bhutan demands about 70% of the land should remain under forest coverage. (Natnavi Foundation, 2024)

This research aims to help people understand how important it is to preserve the vegetation in our surrounding as they would help in reducing the amount of carbon dioxide we emit into the atmosphere.

If every school, town, institution, would maintain their own carbon footprint and remain carbon neutral, only then we would be able to combat global warming.

Through this research, we also come to understand the importance of ancient trees; the bigger ones because these trees are better carbon sequesters. It is of paramount importance that we safeguard world's largest vegetations, such as the Amazon Rainforest.

We believe that our research will inspire and motivate GLOBE schools around the world to carry out similar projects on the topic and help create awareness about Carbon and Climate change, so that globally we will be able to reduce our carbon footprint reducing the amount of carbon dioxide which is already in excess in the atmosphere.

And in the process, we ensure a bright future for our children and all life on earth.

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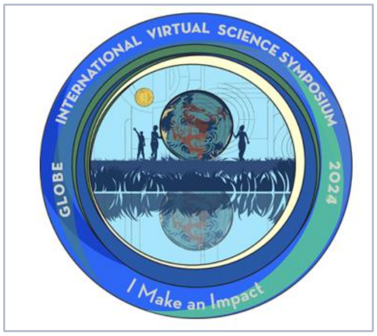
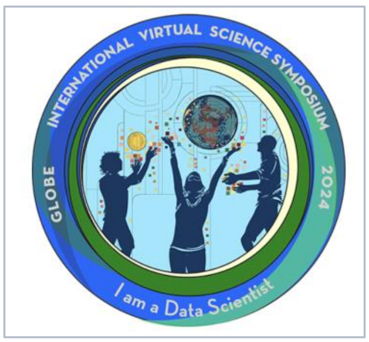
Badges selection



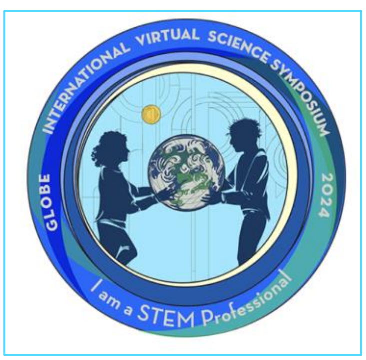
I MAKE AN IMPACT

Through this research, we are able to educate people on the importance of maintaining our carbon footprint, so that we reduce the excess emission of carbon dioxide into the atmosphere, thus reducing the cause of global warming.



I AM A DATA SCIENTIST

This research involves a thorough measurement of carbon stored in the trees, shrubs and herbaceous of our schoolyard.
We have tried to provide an in-depth analysis of the data collected over a period of three years. We also analyzed net primary productivity (NPP) and the Carbon Footprint.



I AM A STEM PROFESSIONAL

Through this research, we could enhance our scientific knowledge, mathematical, analytical and computational skills that a stem professional requires. Working closely with our mentor, who is a GISN member and a Mentor Trainer has made us stem professional too.