



# Comparing pH levels and surface sea water temperatures at two sites in Sliema.

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## St. Dorothy Junior School Sliema



**THE GLOBE PROGRAM**

Global Learning and Observations to Benefit the Environment

## Abstract

The pH levels and the sea water's temperature are important for various reasons. This valuable data improves our understanding of the earth's natural waters. Both the surface sea water temperature and the pH levels influence the amount of diversity of aquatic life; the solubility of chemicals and heavy metals in water and pH than 11 or below 4 can cause skin and eye irritations to humans. This study aimed to investigate whether the location of a beach, the type of beach (shallow inland/deep open sea) affects the surface sea water temperature and the pH levels in its water. Is there a relationship between the air temperature and the surface sea water temperature? Does the debris in one of the bays affect the pH levels of the sea water? This was analyzed by recording the sea temperature and the sea water pH levels of 2 sites in different locations twice weekly, morning and afternoon, for 6 weeks. The main objective was to find out the temperature and pH differences between the two sites. Through our research we concluded that the location of the beach and whether the beach was an inland shallow bay or an open deep beach did not affect pH levels and surface sea water temperatures as the differences between them were minimal, if any. The debris at Balluta bay was sporadic on the sand therefore it did not contribute to the effects on the surface sea water temperatures. However, the pH levels were 0.2 lower than Exiles beach which is explained by the location since it is a feeder of a valley from a heavily polluted area. The area is also surrounded by restaurants and hotels which could explain the difference in pH. With regards to the relationship between the air temperature and the surface sea water temperature as well as the time of the day, our results show that the surface sea water temperature was warmer than the air temperature.

## Research Questions

After a brainstorming session with the Globe and Eco School committee about the sea water found a few meters away from our school, we thought it would be a perfect learning opportunity to look at different beaches and compare the effects of the pH levels and surface sea water temperatures on them. We sought to look into the following research questions:

- Are pH levels and surface sea water temperatures affected:
  - by the location of the beach?
  - if the beach is an inland shallow bay or an open deep sea?
  - if the debris left after a thunderstorm, particularly because of the sloped hill at Balluta bay?
  - by the air temperature?

Additionally, the committee was curious to see whether the time of the day would affect the pH levels and surface sea water temperatures. For this reason, readings were taken at 8am and again at 1.15pm at both sites. Therefore, the final research question was

- Does the time of the day affect the surface sea water temperatures and pH levels?

The research questions we chose are important and of scientific interest because we want to understand whether different sites which are located 8 minutes apart and having different characteristics, are affected by the surface sea water temperatures and pH levels. We also wanted to give back to the community an awareness of these levels and how we can improve what we can control, such as, pollution and litter left at Balluta bay.

The Globe teachers trained in the Hydrosphere and shared the knowledge learnt with the committee.

## Introduction

The aim of this study is to find out whether the location, type of beach (sandy/rocky, shallow/deep and inland/open water) and air temperatures have any effects on the sea temperature and pH levels at two different sites over 6 weeks. The surface sea water temperatures and pH levels were measured during the period of 20th January 2023 and 2nd March 2023. During this period, three readings for the surface sea water temperature and three readings for the pH levels were taken twice a week in order to take an average of the readings - the first readings at 8am and the second readings at 1.15pm. These were taken at the exact same time and places at two different sites in order to make a fair and reliable comparison.

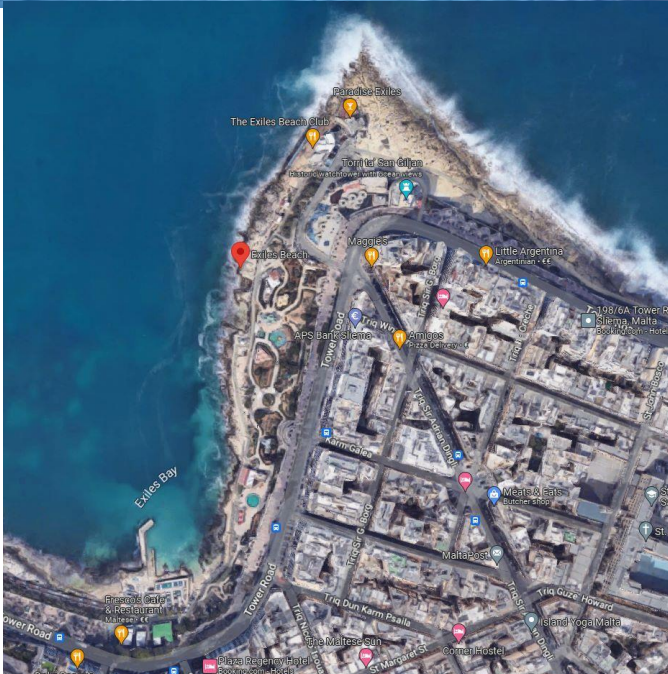
Balluta bay was the first site we set out to investigate. Balluta Bay is a sandy, shallow, inland bay on the northeast coast of Malta within Sliema. It is a popular recreational spot used for swimming, diving, and water sports, with a triangular piazza surrounded by cafés and a main busy road just above it. It is found at the bottom of a sloped hill where lots of debris gets collected from the streets and the nearby valley on rainy days. Unfortunately, for this reason, one can find lots of litter collected by the rain water piled up at the bay. These include plastic bags, cups, bottles, wrappers and cigarette buds.

Exiles beach was the second site we set out to investigate. Exiles is a rocky, deep, open water beach also in the northeast coast of Malta within Sliema and 8 minutes walk from Balluta bay. It is also a popular tourist beach and its crystal-clear waters are perfect for swimming, snorkeling and other water activities. The promenade and busy coastal road is a few meters away from this beach. We feel that this investigation is relevant to the Sliema community and indirectly also towards the visiting tourists that frequent our beaches. Through beach clean-ups we will be achieving and contributing towards this goal. The Sliema local council will also be informed about the results of our investigation and future collaboration beach clean-ups.



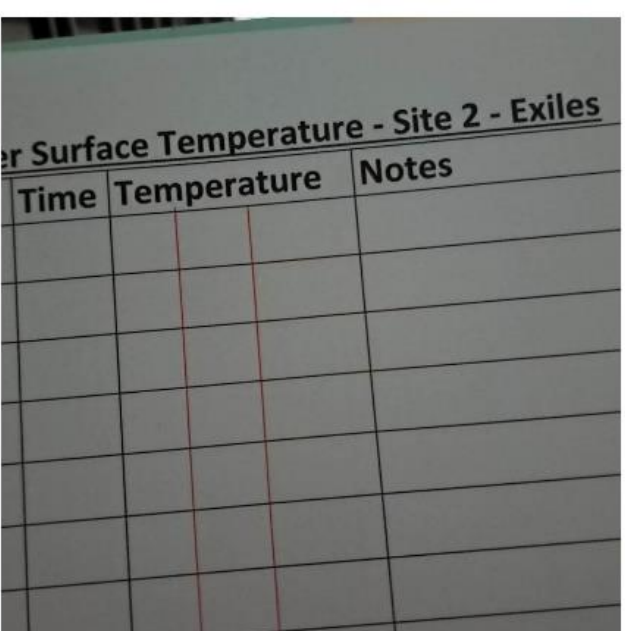
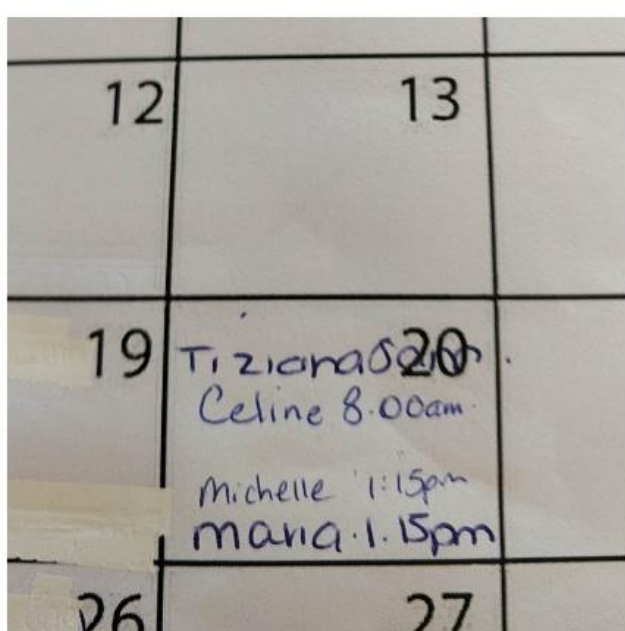
## Research Methods

Our school is located in Sliema, two minutes away from the coast, surrounded by lots of beaches. Following a walk along the Sliema front with the Globe and Eco School committee, the students decided to investigate the surface sea water temperature and sea water pH levels of two sites. The first site chosen was Exiles beach – a rocky beach with deep, open sea and further away from the coastal road. The second site chosen was Balluta Bay - a sandy, shallow, inland bay found at the bottom of a sloped hill, very close to the busy coastal road. In order to learn more about pH levels of sea water and how to use a digital pH reader, students were asked to bring a sample of water from their mains at home. Every committee member tested their water and it was noted that there was a significant difference in pH results, depending on their geographical locations.



### Methodology:

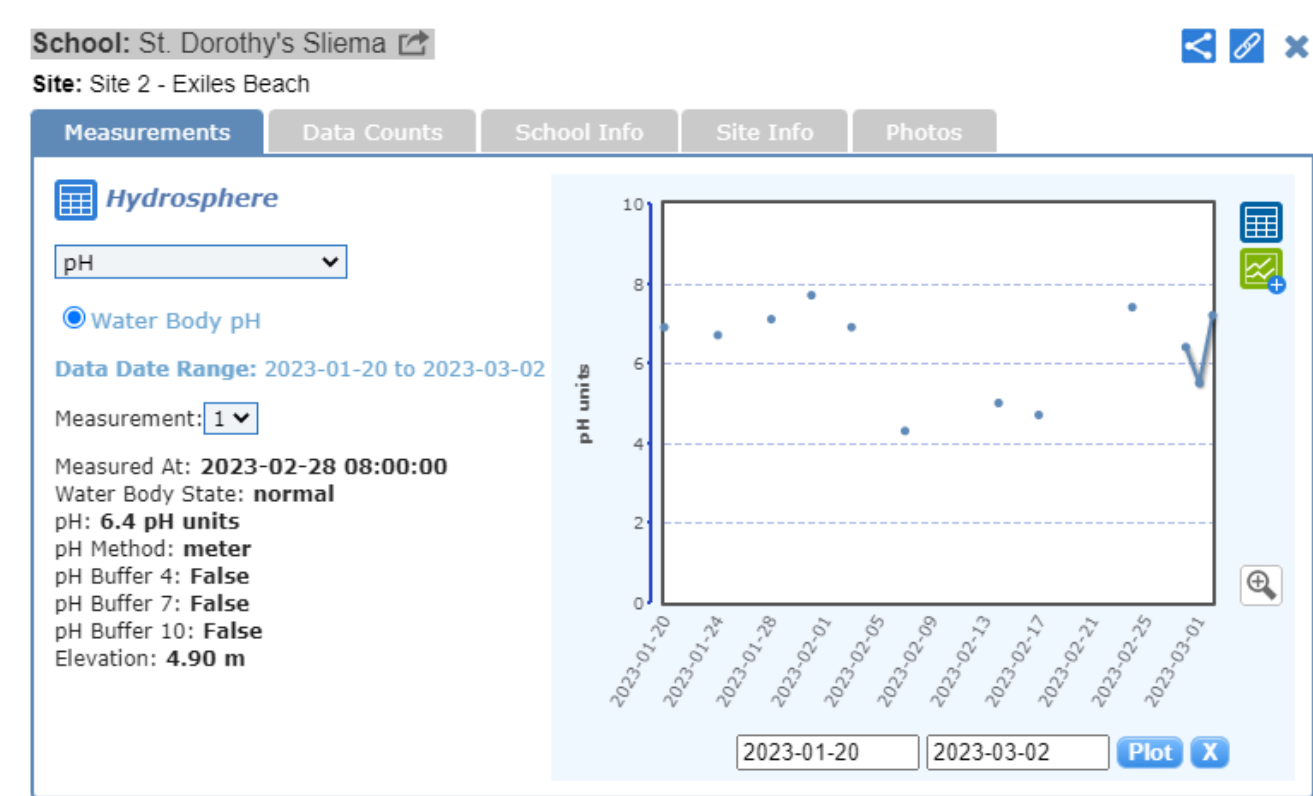
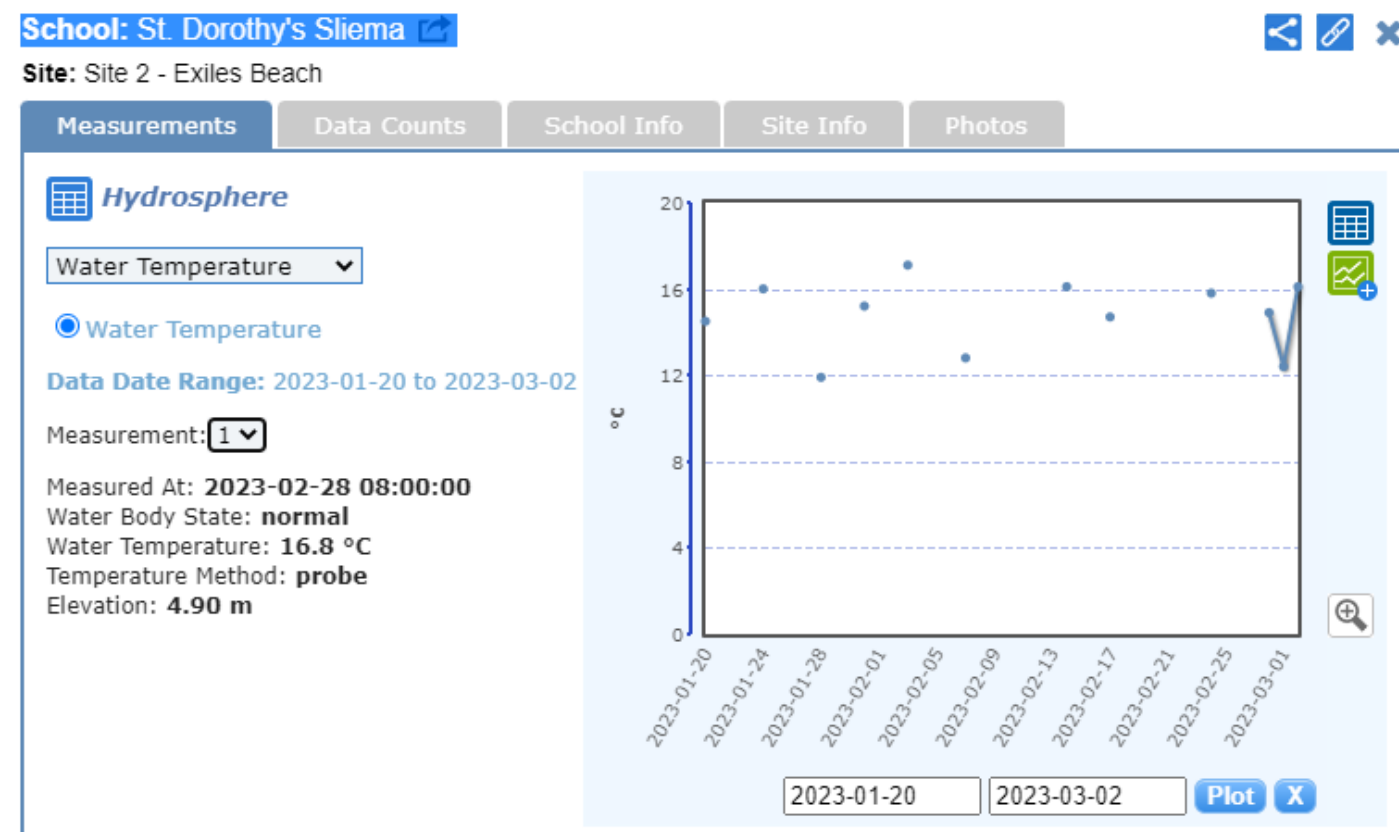
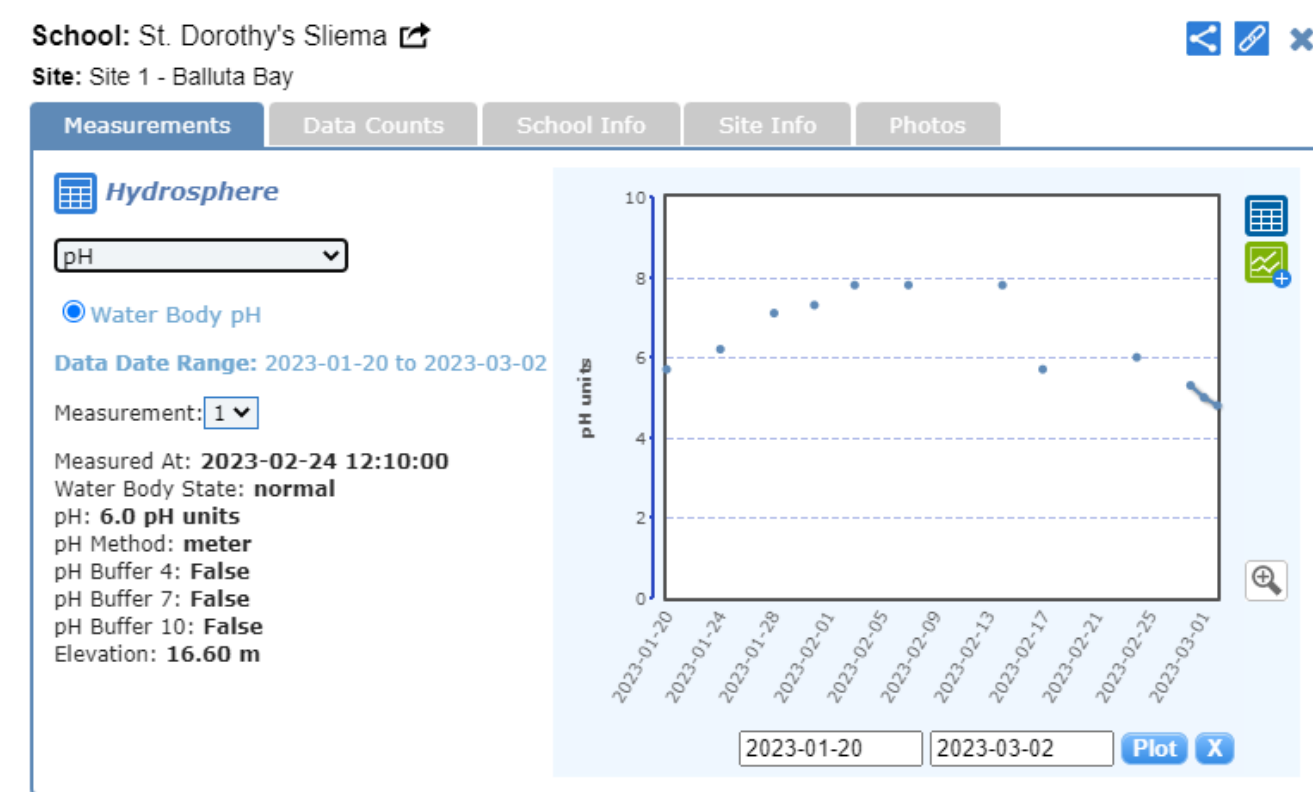
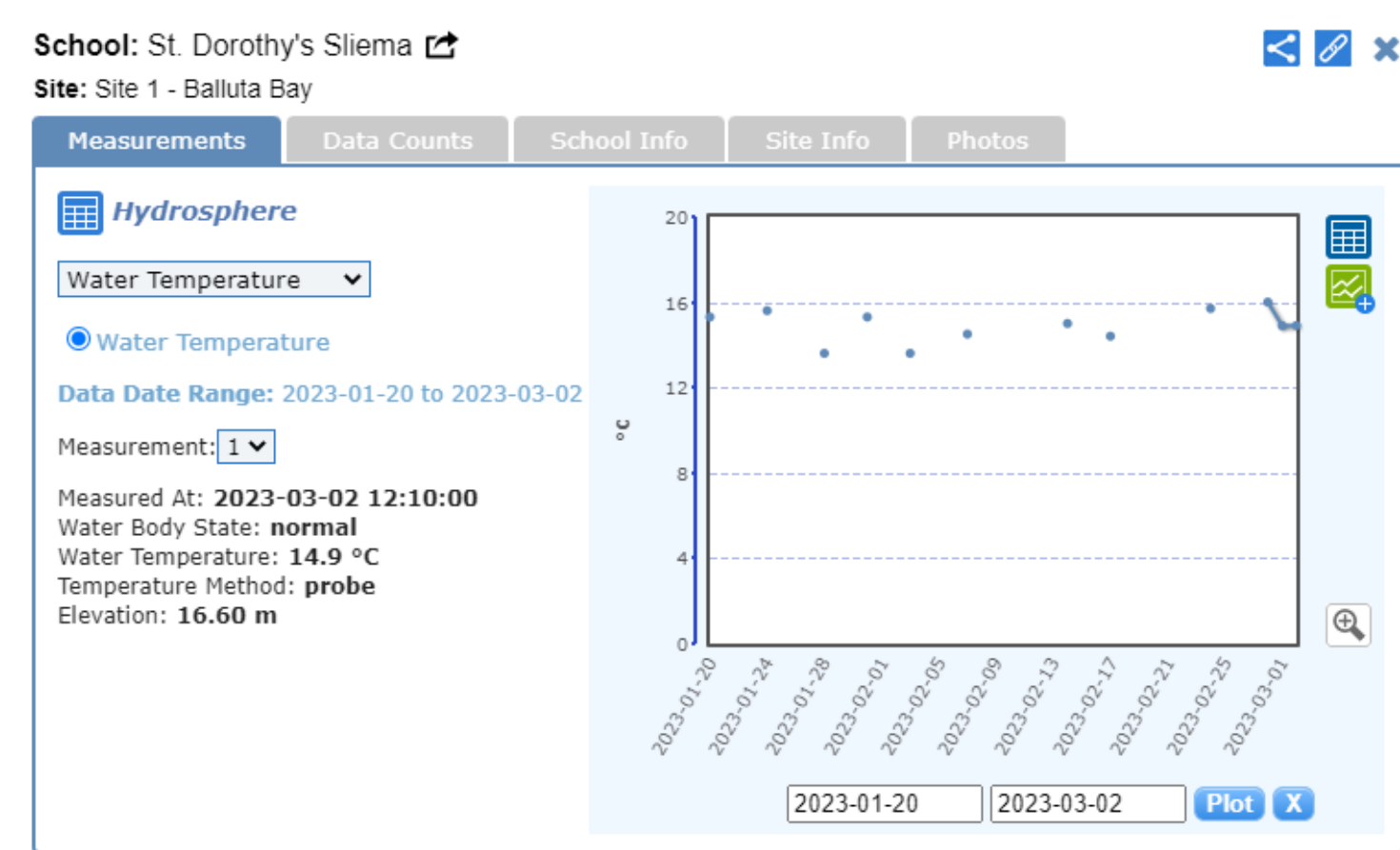
A 6-week roster was set up for the two sites. One teacher and two committee members visited each site twice a week at 8am and 1.15pm. Since the two sites were visited at the exact same time, two digital pH readers and two digital thermometer readers were needed. A sample of sea water was collected in a glass jar at each visit in order to take the three pH readings. A digital thermometer was then directed at the sea to take three surface sea water temperature readings. This enabled us to get a more accurate average of the readings. Notes about the weather and sea conditions were noted too. The students took pride in measuring and taking down notes themselves, together with the guidance of their teachers.



## Results

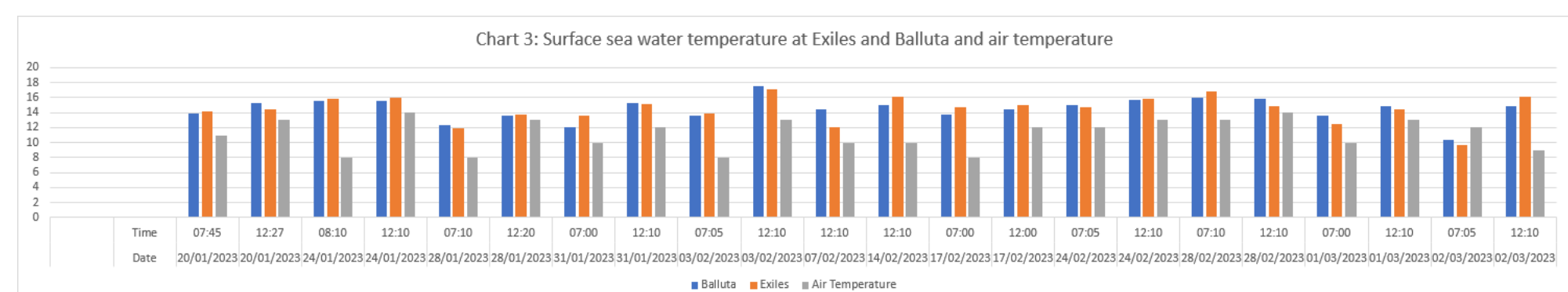
Once all the data was collected the students presented it in tables and charts and analyzed it. They considered all the data for the surface sea water temperature and the pH level.

The screenshots below show data uploaded on the GLOBE website during the investigation period between 20<sup>th</sup> January 2023 and 2<sup>nd</sup> March 2023. The students collected three readings for the surface sea water temperature and three readings for the pH levels following the GLOBE Protocols guide for both sites.



Date	Time	Balluta		Exiles		Air Temperature (°C)
		Average	Sea Temperature (°C)	Average	Sea Temperature (°C)	
20/01/2023	07:45	13.9	14.1	13.1	13.1	13.1
20/01/2023	12:27	15.3	14.5	14.5	14.5	14.5
24/01/2023	08:10	15.6	15.6	15.6	15.6	15.6
24/01/2023	12:10	15.6	15.6	15.6	15.6	15.6
28/01/2023	07:10	12.4	12.4	12.4	12.4	12.4
28/01/2023	12:20	13.6	13.6	13.6	13.6	13.6
31/01/2023	07:00	12.1	12.1	12.1	12.1	12.1
31/01/2023	12:10	15.3	15.3	15.3	15.3	15.3
03/02/2023	07:05	13.6	13.6	13.6	13.6	13.6
03/02/2023	12:10	15.3	15.3	15.3	15.3	15.3
07/02/2023	07:05	13.6	13.6	13.6	13.6	13.6
07/02/2023	12:10	15.3	15.3	15.3	15.3	15.3
14/02/2023	07:05	13.6	13.6	13.6	13.6	13.6
14/02/2023	12:10	15.3	15.3	15.3	15.3	15.3
17/02/2023	07:05	13.6	13.6	13.6	13.6	13.6
17/02/2023	12:10	15.3	15.3	15.3	15.3	15.3
24/02/2023	07:05	13.6	13.6	13.6	13.6	13.6
24/02/2023	12:10	15.3	15.3	15.3	15.3	15.3
28/02/2023	07:10	13.6	13.6	13.6	13.6	13.6
28/02/2023	12:10	15.3	15.3	15.3	15.3	15.3
01/03/2023	07:00	13.6	13.6	13.6	13.6	13.6
01/03/2023	12:10	15.3	15.3	15.3	15.3	15.3
02/03/2023	07:05	13.6	13.6	13.6	13.6	13.6
02/03/2023	12:10	15.3	15.3	15.3	15.3	15.3

Table 3: Surface sea water temperature at Balluta bay, surface sea water temperature at Exiles beach and air temperature



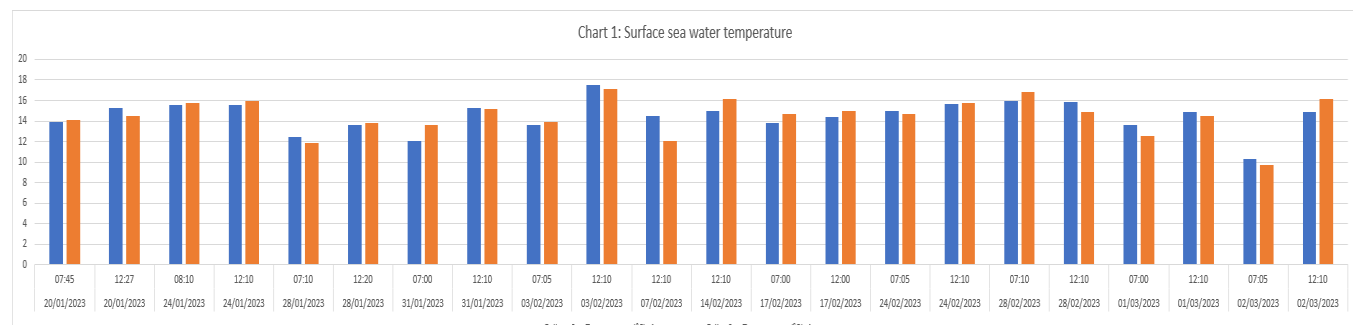
## Discussion

After gathering the data, the GLOBE and Eco School committee met and analyzed the data together. The first hypothesis was that the surface sea water temperature at Balluta bay would be warmer than that at Exiles beach since Balluta bay is sandy, shallow and sheltered. However, when comparing the temperatures and when taking an average of the temperatures at both sites, the average turned out to be the same, 14.5 °C (See Table 1 and Chart 1 below). After brainstorming reasons why, the temperature was the same, the committee came up with the conclusions that Exiles has got more exposure to the sunlight, which starts shining directly on the sea from sunrise all throughout the day till sunset. On the other hand, Balluta bay is inland and sheltered, and the sun starts shining on the sea at a much later time and for a shorter period of time.

Table 1: Surface temperature at Balluta Bay and at Exiles Beach

Date	Time	Balluta		Exiles	
		Average	Sea Temperature (°C)	Average	Sea Temperature (°C)
20/01/2023	07:45	13.9	14.1	13.1	13.1
20/01/2023	12:27	15.3	14.5	14.5	14.5
24/01/2023	08:10	15.6	15.6	15.6	15.6
24/01/2023	12:10	15.6	15.6	15.6	15.6
28/01/2023	07:10	12.4	12.4	12.4	12.4
28/01/2023	12:20	13.6	13.6	13.6	13.6
31/01/2023	07:00	12.1	12.1	12.1	12.1
31/01/2023	12:10	15.3	15.3	15.3	15.3
03/02/2023	07:05	13.6	13.6	13.6	13.6
03/02/2023	12:10	15.3	15.3	15.3	15.3
07/02/2023	07:05	13.6	13.6	13.6	13.6
07/02/2023	12:10	15.3	15.3	15.3	15.3
14/02/2023	07:05	13.6	13.6	13.6	13.6
14/02/2023	12:10	15.3	15.3	15.3	15.3
17/02/2023	07:00	13.6	13.6	13.6	13.6
17/02/2023	12:10	15.3	15.3	15.3	15.3
24/02/2023	07:05	13.6	13.6	13.6	13.6
24/02/2023	12:10	15.3	15.3	15.3	15.3
28/02/2023	07:10	13.6	13.6	13.6	13.6
28/02/2023	12:10	15.3	15.3	15.3	15.3
01/03/2023	07:00	13.6	13.6	13.6	13.6
01/03/2023	12:10	15.3	15.3	15.3	15.3
02/03/2023	07:05	13.6	13.6	13.6	13.6
02/03/2023	12:10	15.3	15.3	15.3	15.3

Chart 1: Surface and sea water temperature



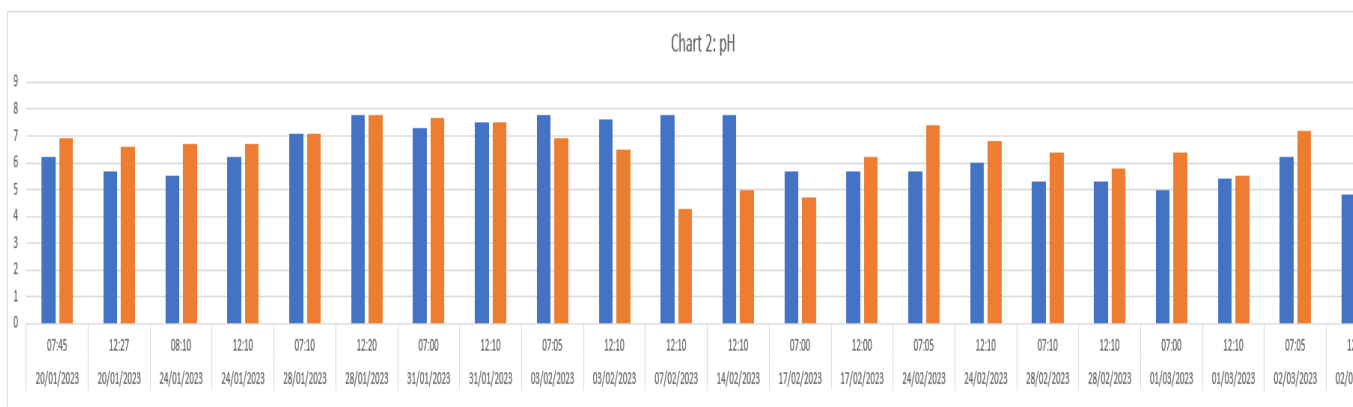
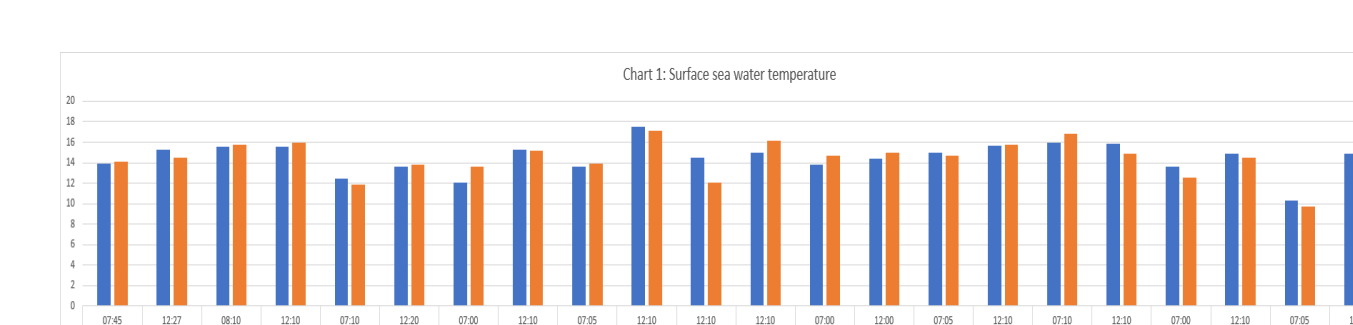
The second hypothesis was that the surface sea water temperature at 8am would be colder than that of 1.15pm. When taking a close look at the results of both sites, one may notice that the hypothesis was correct (See Table 2 and Chart 2 below). The reason for this was discussed and the committee concluded that when the sun goes down, the sea temperature takes a very long time to cool down. By the morning, the sea would have cooled down, then the sun starts to warm up the water and by the afternoon, the surface sea water temperature would have started to increase again.

The third hypothesis was that the pH level at Balluta bay would be more acidic than that at Exiles beach given the amount of pollution, plastics and debris build-up found daily at Balluta bay. In fact, the average pH level of Balluta bay was found to be 6.3, whereas the average pH level of Exiles beach was 6.5. This means that Balluta bay is 0.2 lower than Exiles beach. However, both beaches are found to be in the acidic levels of pH (See Table 2 and Chart 2 below).

The last hypothesis was that the air and surface sea water temperatures would vary, with the air temperature being warmer (See Table 3 and Chart 3 below). However, on all the days and times that the readings took place, the surface sea water temperature was warmer than the air temperature. The reason for this could be because global warming is contributing to the warmer air temperatures. Also, according to sea water takes longer to cool down.

Date	Time	Balluta		Exiles	
		Average	pH reading	Average	pH reading
20/01/2023	07:45	6.3	6.3	6.5	6.5
20/01/2023	12:27	5.7	5.7	6.6	6.6
24/01/2023	08:10	6.2	6.2	6.7	6.7
24/01/2023	12:10	6.2	6.2	6.7	6.7
28/01/2023	07:10	7.1	7.1	7.1	7.1
28/01/2023	12:20	7.8	7.8	7.8	7.8
31/01/2023	07:00	7.3	7.3	7.7	7.7
31/01/2023	12:10	7.5	7.5	7.9	7.9
03/02/2023	07:05	7.8	7.8	8.9	8.9
03/02/2023	12:10	7.6	7.6	8.5	8.5
07/02/2023	07:00	7.8	7.8	8.3	8.3
07/02/2023	12:10	7.8	7.8	8.3	8.3
14/02/2023	07:05	7.7	7.7	8.4	8.4
14/02/2023	12:10	7.7	7.7	8.4	8.4
17/02/2023	07:00	7.7	7.7	8.4	8.4
17/02/2023	12:10	7.7	7.7	8.4	8.4
24/02/2023	07:05	7.7	7.7	8.4	8.4
24/02/2023	12:10	7.7	7.7	8.4	8.4
28/02/2023	07:10	7.7	7.7	8.4	8.4
28/02/2023	12:10	7.7	7.7	8.4	8.4
01/03/2023	07:00	7.7	7.7	8.4	8.4
01/03/2023	12:10	7.7	7.7	8.4	8.4
02/03/2023	07:05	7.7	7.7	8.4	8.4
02/03/2023	12:10	7.7	7.7	8.4	8.4

Table 2: pH levels at Balluta bay and Exiles beach



## Conclusions

Through our research we concluded that the location of the beach as well as whether the beach was an inland shallow bay or an open deep beach, did not affect pH levels and surface sea water temperatures as the differences between them were minimal, if any. This could be because the location is geographically not far apart (coordinates for Balluta are 35.9156° N, 14.4943° E and Exiles beach are 35.9182° N, 14.4984° E). Also, the surface sea water temperature did not vary because the warmth created by the sand and shallowness of Balluta bay balanced out the direct sunlight found at Exiles beach which was lacking at Balluta bay.

The debris at Balluta bay was sporadic on the sand therefore it did not contribute to the effects on the surface sea water temperatures. However, the pH levels were 0.2 lower than Exiles beach which is explained by the location since it is a feeder of a valley from a heavily polluted area. The area is also surrounded by restaurants and hotels which could explain the difference in pH. Having said this, it would be interesting to take this study further and investigate the effects of pollution in the surrounding area.

With regards to the relationship between the air temperature and the surface sea water temperature as well as the time of the day, our results show that the surface sea water temperature was warmer than the air temperature (14.5 °C sea water vs 11.3 °C air temp). This is scientifically proven because water has a much higher heat capacity than air; and because of its higher heat capacity, it takes longer for water to gain heat and also to lose heat (cool), than it does for air. In both cases, either heating or cooling, there will be a lag between the air and water temperatures.

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