

Organization: Gozo College Middle School

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Grade Level: 6th - 8th Grades (Middle School, ages 11-14)

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Presentation Type: [Video](#)

Optional Badges: Make an Impact, Be a Collaborator

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1. **Title** - The effect of trees on Urban Temperatures

2. **Abstract**

The alarming rate at which trees are being chopped off when ‘upgrading’ streets and the excessive rate of building in an already high densely populated area prompted us to study in detail urban temperatures. The purpose of this study was to investigate the effects of trees on urban heat islands. The urban heat island effect indicates that the urban or built up areas are warmer than the natural open space area. This study investigated the effects of trees on surface temperatures. This was analysed by recording the surface temperature from two different areas: built up areas (concrete/asphalt), and grassy patches with trees planted nearby. The main objective was to find out the temperature differences between these two sites. Results showed that the more trees there are the less difference in temperature. Results support the statement that lack of trees contributes to the formation of UHIs. Having discovered all this the students went a step further. They wanted to be part of the change and not just pointing fingers and complaining about the environmental degradation. Thus, they came up with an innovative idea on how to promote the growth of indigenous and endemic trees. Using recycled materials, of which toilet paper rolls and newspapers, the students prepared over 450 seed packs, with seeds collected locally. The seed packs were given out to students, teachers, school staff and people from the general community who saw the adverts and participated in the Climate Action Fun Walk. The aim of this walk was to raise awareness about climate change and the need for action. The students also carried out research on the various local trees and shrubs of which they distributed seed packs, amongst which: Judas Tree, Myrtle, Aleppo Pine, Lentisk, the Maltese Everlasting, Wild Thyme, and many more.

Key words: surface temperature, urban area, trees and grass, climate action

3. **Research Questions**

What role do trees play in the Urban Heat Island Effect?

Is there a change in surface temperatures between built up areas and green open spaces?

Taking a whole school approach and integrating the investigation with various subjects including geography and science, the students learnt about Global Warming. Experiments about greenhouse gases (e.g. carbon dioxide) were made in the science lab to understand better the concept of how such gases retain more heat and thus result in an increase in temperature. Students carried out data collection and used it to investigate ways how to mitigate high temperatures in built-up areas. Using an Infrared Thermometer the students measured surface

temperatures during the month of December. Readings were taken from two selected sites: the school ground covered in cement/asphalt and an open area a few hundred metres away, which is covered in grass and has trees planted in it. Research about the characteristics of the indigenous trees and how trees help to offset high temperatures in urban areas was carried out.

From the study of the surface temperature protocol and the observation of variations in temperatures according to the surface type (asphalt/cement, grass, soil) the students discussed and came up with their own conclusions.

Is there a relationship between temperature and the type of surface?

What is the effect of trees on urban temperature?

Urban areas covered in asphalt and cement amongst other materials, tend to experience higher temperatures when compared to rural/less built-up areas. Supported with the knowledge obtained by the students during their science lessons and through the GLOBE protocol, it was concluded that there really is a correlation between trees and temperature.

4. Introduction

The aim of the study is to find out the extent of the effect of trees on urban temperatures. In this study we used the experimental method, where the surface temperature protocol was measured during December 2018. During this period, the surface temperature of 2 different sites within the school in Victoria, town in the island of Gozo, was measured. From this study it was found that the type of surface cover has an effect on the surrounding temperature. This study contributes significantly to the importance of safeguarding trees, increasing the number of open spaces and having good urban planning in our region.

Trees can, by providing shade and cooling through transpiration and evaporation processes, reduce temperatures around them. Mature trees probably represent the most effective tool available to urban designers in combating urban heat islands in cities. Heat accumulates in urban areas as a result of solar energy which is absorbed by hard, dark surfaces like cement and asphalt. This stored heat is released over night thus having no time to cool before the next day.

The use of trees and vegetation in urban areas brings many benefits besides mitigating urban heat islands. These include:

- Trees and vegetation that directly shade buildings decrease demand for air conditioning.
- By reducing energy demand, trees and vegetation decrease the production of associated air pollution and greenhouse gas emissions. They also remove air pollutants and store and sequester carbon dioxide.
- Vegetation reduces runoff and improves water quality by absorbing and filtering rainwater.
- Trees and vegetation provide habitat for many species and can reduce noise.

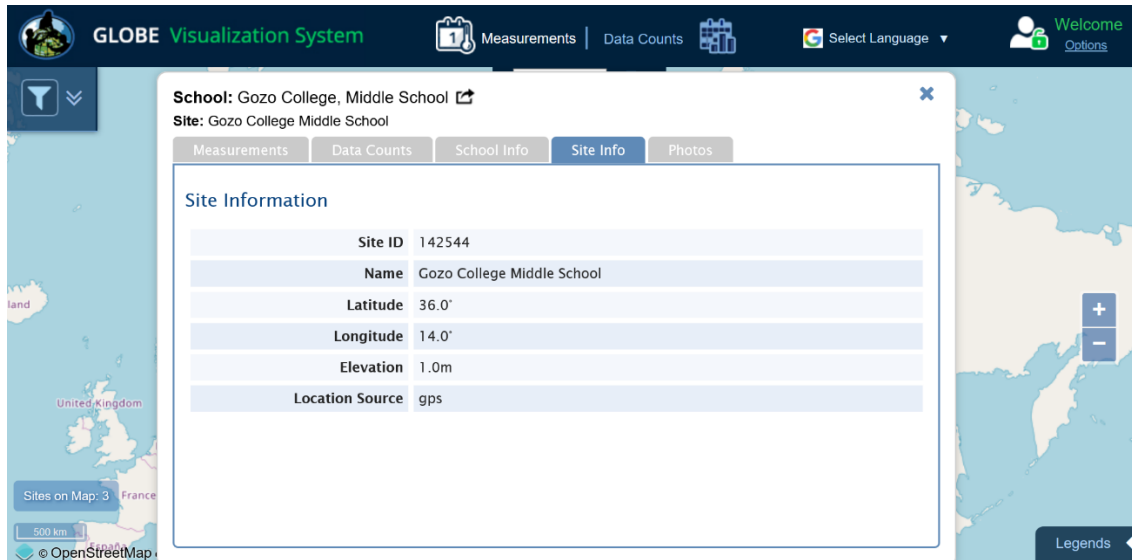
<https://www.epa.gov/heat-islands/using-trees-and-vegetation-reduce-heat-islands>

<https://articles.extension.org/pages/58136/trees-and-local-temperature>

5. Research Methods

Two sites were identified, one within the school and another just a few hundred metres away school with a patch of grass.

Study Site A – School ground covered in cement/asphalt



The screenshot displays the GLOBE Visualization System interface. At the top, there is a navigation bar with the GLOBE logo, the text "GLOBE Visualization System", and several icons for "Measurements", "Data Counts", and "Select Language". A "Welcome" message with a user icon and "Options" link is also present. Below the navigation bar, a map of the United Kingdom is visible on the left, and a "Sites on Map: 3" indicator is shown. The main content area features a pop-up window titled "School: Gozo College, Middle School" and "Site: Gozo College Middle School". This window contains a tabbed interface with "Measurements", "Data Counts", "School Info", "Site Info", and "Photos". The "Site Info" tab is active, displaying the following site information:

Site Information	
Site ID	142544
Name	Gozo College Middle School
Latitude	36.0°
Longitude	14.0°
Elevation	1.0m
Location Source	gps

On the right side of the map, there are zoom controls (+ and - buttons) and a "Legends" button.



Study Site B – Grass covered area with some trees.

The screenshot displays the GLOBE Visualization System interface. At the top, there is a navigation bar with 'GLOBE Visualization System', 'Measurements', 'Data Counts', and a 'Select Language' dropdown. A 'Welcome' message with an 'Options' link is on the right. The main content area shows a pop-up window for 'School: Gozo College, Middle School'. Below this, it says 'Site: Patch with grass and mature trees, nearby Gozo College Middle School'. There are tabs for 'Measurements', 'Data Counts', 'School Info', 'Site Info' (which is active), and 'Photos'. The 'Site Information' section contains a table with the following data:

Site ID	143647
Name	Patch with grass and mature trees, nearby Gozo College Middle School
Latitude	36.0234°
Longitude	14.1427°
Elevation	99.0m
Location Source	gps

The background shows a map of Gozo with a scale bar for 500 km and a 'Sites on Map: 3' indicator. The bottom left corner has the 'OpenStreetMap' logo.



Data Collection: Using an InfraRed Thermometer the two sites were visited several times. Nine samples were taken on each visit using the GLOBE Surface Temperature Data Sheet. On each visit the cloud cover was also observed and recorded using the GLOBE Observer App and Cloud data sheet. Using the LabDisc instrument readings of the ambient temperature, relative humidity and barometric pressure were taken.

All data collected was logged on the GLOBE website as per screenshots below.

The screenshot shows the GLOBE Science Data Entry interface. The browser tabs include 'Ramona Mercieca - GLOBE', 'GLOBE Science Data Visuali', 'Gozo College, Middle Schor', and 'The GLOBE Program'. The address bar shows the URL: https://data.globe.gov/#/submissions?site_id=142544&protocol_set_id=109&orgid=48428321. The page title is 'THE GLOBE PROGRAM SCIENCE Data Entry'. The user is logged in as 'Welcome Ramona Mercieca'. The breadcrumb trail is 'Data Entry Home / Gozo College, Middle School / Gozo College Middle School / Surface Temperature'. The main heading is 'Past Observations for Surface Temperature'. Below this, there are date filters: 'From 2018-12-01' and 'To 2018-12-31'. A table titled 'Measured at time in UTC' displays five observations with their timestamps and delete buttons.

Measured at time in UTC	
1	2018-12-05 11:00 UTC
2	2018-12-17 11:26 UTC
3	2018-12-18 08:35 UTC
4	2018-12-20 11:27 UTC
5	2018-12-27 11:25 UTC

This screenshot shows a similar view of the GLOBE Science Data Entry interface. The browser tabs are the same. The address bar shows the URL: https://data.globe.gov/#/submissions?site_id=143647&protocol_set_id=109&orgid=48428321. The page title is 'THE GLOBE PROGRAM SCIENCE Data Entry'. The user is logged in as 'Welcome Ramona Mercieca'. The breadcrumb trail is 'Data Entry Home / Gozo College, Middle School / Victoria Bus Terminus / Surface Temperature'. The main heading is 'Past Observations for Surface Temperature'. Below this, there are empty date filter boxes: 'From' and 'To'. A table titled 'Measured at time in UTC' displays five observations with their timestamps and delete buttons.

Measured at time in UTC	
1	2018-12-27 13:00 UTC
2	2018-12-28 11:39 UTC
3	2018-12-29 11:50 UTC
4	2018-12-30 14:45 UTC
5	2018-12-31 11:45 UTC

Data analysis: Average surface temperatures were totalled and the mean difference was calculated.

6. Results

Data collected shows that surface temperature varies on average by 9°C between grass covered surfaces and cemented/asphalt surfaces.

Surface Temperature readings for December in school ground:

Average Surface Temperature C

26.2

23.4

13.4

25.1

22.9

Surface Temperature readings for December in a grass covered area:

Average Surface Temperature C

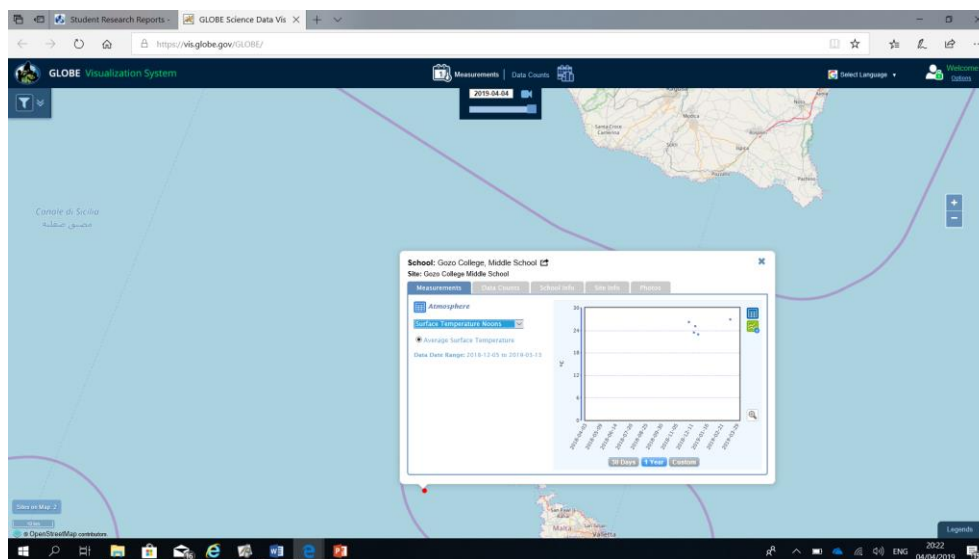
12.7

12.6

12.5

12.3

14.7



7. Discussion

The data collected helped to determine whether there is an effect on the temperature as a result of surface cover and that there is a relationship between them. The darker the surface, the higher is the temperature with regards to manmade materials/objects. Grass though darker kept cooler temperatures.

Temperatures recorded were illustrated on a graph and concluded that the relationship between them is a direct relationship. These results correspond to the conclusions obtained following the hypothesis and the data collected was sufficient to answer our research question. Thus a healthy tree canopy has been proven to reduce temperatures in urban areas by providing shade, preventing sunlight from reaching asphalt and radiating heat back out into the built up environment.

The students did not stop here. Having discovered how important trees are, they wanted to bring change as quickly as possible. So besides contacting the local authorities to take action and plant more trees they took the matter in their hands. After doing research on the indigenous and endemic trees of Malta, they came up with an innovative idea on how to add fun to planting. Using 'waste' material, that is, toilet paper rolls and old newspapers, the students prepared over

450 seed packs. Seeds were provided by the Grow 10 Trees project which promotes the growing of local trees and which seeds were collected locally from beneath trees.

8. Conclusion

Through the data collected it was concluded that the hypothesis can be accepted. Trees do have a positive effect on decreasing the UHI effect as they provide shade, lower temperatures of the surrounding areas, increase transpiration and absorb carbon dioxide. This study contributes significantly to the importance of trees and the need to increase the number of open spaces in urban areas. In urban areas there are heat islands, so it is ideal to try to cool them. Planting more trees in city centres would lower the temperature, improve air quality and cool the surfaces, will provide a welcoming habitat for fauna and places for people to sit and relax.

This is actually the reason why the students took the initiative and went a step further. They wanted to set the example and be part of the change. Through the Climate Action Fun Walk the wider community got a better understanding of what's happening in our built up environments. The students explained their investigation and findings and suggested ways on how city centres can be made 'cooler'. The walk itself was an action to combat global warming and participants were able to view an exhibition in the school grounds, which highlighted Sustainable Development Goals. They also learnt about the importance of trees in combating global warming, and got to know about various indigenous trees and shrubs which grow in the Maltese Islands. At the end of the walk, participants were given a seed pack to take home and hence start planting more trees NOW.

Recommendations:

- i. Other similar but more detailed studies of surface temperatures are conducted involving different areas, during different months/seasons, to be able to identify which surfaces are best to lower temperatures and affect the regional climate positively.
- ii. Raise awareness amongst the local community and authorities as regards better planning of urban development and regeneration.

9. Bibliography/citations

<https://www.globe.gov>

<https://climatekids.nasa.gov>

<http://www.maltawildplants.com/>

<https://sites.google.com/view/g10t>