How does the Urban Island heat effect impact Toledo, Ohio?

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Abstract

- The Urban Heat Island effect is present in many areas of life, and understanding it can help to improve city infrastructure and help to reduce heat-related injuries
- This experiment explores the presence of this effect in Toledo, Ohio, as compared to a smaller suburb, Ottawa Hills
- We hypothesized that downtown Toledo would be slightly warmer than suburban Ottawa Hills
- To test the hypothesis, a thermometer was used to measure temperature and a box was used to block environmental factors that may affect temperature
- The results of our experiment supported our hypothesis and showed that downtown Toledo was, on average, 2.24° F warmer than Ottawa Hills.

Research Question

How does the Urban Heat Island effect impact Toledo, Ohio? Understanding the urban heat island of Toledo, Ohio, could help to improve infrastructure and public safety. This study will show the difference between Ottawa Hills and downtown Toledo, in terms of temperature.

Hypothesis

We believe that the temperature will be higher in the urban area than the rural area because asphalt and other things found in cities affect the air temperature differently

Introduction

Content Knowledge

The Urban Heat Island Effect is a phenomenon where urban areas experience higher temperatures than nearby suburban or rural areas. This occurs because cities are built with materials that absorb and retain more heat than natural surfaces. Understanding this effect is important because increased temperatures can negatively impact human health and safety. Prolonged exposure to heat can lead to dehydration, heat exhaustion, and heat stroke, especially for vulnerable populations. As cities continue to grow, studying temperature differences between urban and suburban areas helps explain how land use and development affect heat exposure and overall environmental conditions.

Urban development is the main cause of the Urban Heat Island Effect. According to the Baltimore Office of Sustainability (2015), modifying land surfaces through urban construction increases heat retention. Materials such as asphalt and concrete absorb more solar energy than grass or soil, causing surrounding air temperatures to rise. NASA (2025) explains that these temperature differences depend on how well surfaces absorb and store heat. In addition, urban areas often have fewer trees and green spaces, reducing natural cooling through shade and evapotranspiration. The Environmental Protection Agency (2025) also notes that vehicle emissions, buildings, and human activity contribute to higher urban temperatures. In conclusion, the Urban Heat Island Effect is caused by heat-absorbing surfaces, limited vegetation, and increased human activity. Understanding this effect can help reduce heat-related health risks and support better urban planning.

Research Methods

Planning Investigations

We are using the atmosphere air temperature globe protocol and before you start the experiment be sure you have a fahrenheit mercury thermometer; the brand doesn't really matter, a shoe box, a computer and a shady area outside to do the experiment. There could be danger of overheating or frostbite if not prepared for the weather outside.

- Our data will be collected once a day in a suburban and urban area around 12pm
- The urban area we will be using is down town toledo and the suburban area we will be using is Ottawa Hills

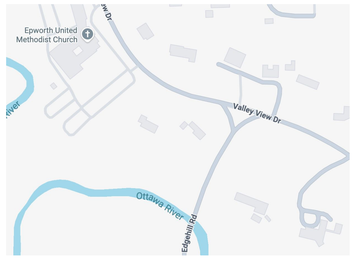
Carrying Out Investigations

Describes what happened

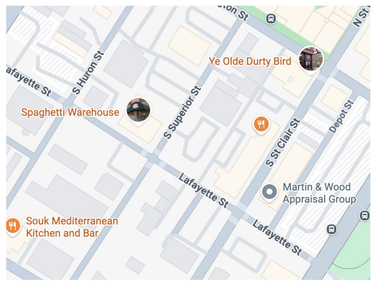
- We collected our data in fahrenheit in Ottawa Hills and in downtown Toledo to record our data

1. Make sure you have a thermometer that is unaltered
2. Go outside to an open area away from buildings, cars, and direct sunlight. You should try to do it on days without snow since it can build up on the thermometer for the suburban area find a back yard you can do it in
3. Place the thermometer in the shade above the ground about 4 feet up
4. Use a cardboard box to block wind from affecting the temperature like a shoe box with no lid
5. Leave the thermometer there for 5 minutes
6. Read the temperature without touching the thermometer stand as close as you can without having your breath or body heat effect it
7. Write down the temperature, date, and time.
8. Repeat steps 1-5 on different days
9. Repeat steps 1-8 in a urban area so you can compare data
10. compare the temperatures you got and the temperature in the city to find the average difference between the suburban and urban area

Ottawa Hills experiment location



Downtown Toledo experiment location



Results

Analyzing Data

- The data shows Ottawa Hills to be cooler than downtown in every test
- The average difference in temperature is 2.24° F, calculated from adding all the temperatures of Toledo together, subtracting the sum of the temperatures of Ottawa Hills, and dividing that number by 5.
- The largest difference was 2.9°, on both January 9 and January 14. The smallest difference was on January 2, with only a 0.6° F difference

Figure #1

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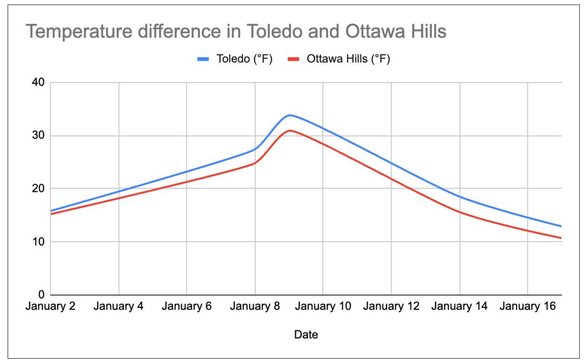
Date	Toledo (°F)	Ottawa Hills (°F)
January 2	15.8	15.2
January 8	27.4	24.8
January 9	33.8	30.9
January 14	18.5	15.6
January 17	12.9	10.7

Figure #2



Discussion

- Other studies report an average difference of 1-7 degrees fahrenheit higher in cities to rural areas
- Our data fits into this range with an average of 2 degrees hotter in the city's
- Our hypothesis was supported because on average the temperature was higher in the city and we predicted it would be slightly hotter in the city compared to the rural area.
- I think we obtained the results we did because cities have more materials in them that heat differently like asphalt and concrete, and there is more motion and movement from cars and people.
- There were some errors in our experiment since they weren't all taken at the exact same time each day some were like 15 min apart for some days.
- We also could have used better equipment to stop outside factors from affecting our experiment.
- Even though our experiment wasn't perfect I do believe it still proved our hypothesis was accurately tested.
- this data is important because it can help people stay safe and prepare for the temperature if moving between urban and suburban areas.

Conclusions

Drawing Conclusions & Next Steps

In conclusion, our project accepted our hypothesis. Our successes were showing that there was a temperature difference between urban and suburban areas of Toledo, as well as utilizing our resources to be able to test our experiment. However, our experiment could have been improved by recording temperatures at different times, for example to see if temperatures at night have a greater or lesser effect on urban islands. Our data could help scientists understand the effect that densely populated areas have on temperature. we could further our research by testing different.

Bibliography

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