

# Evaluating the Correlation between Air Temperature and Precipitation

Peyton Ree and Oliver Ford

Ottawa Hills High School



## Abstract

- The question this experiment tested is how air temperature affects precipitation.
- This is important because air temperature is slowly rising due to global warming.
- A temperature sensor and precipitation gauge were used to measure data at solar noon.
- The independent variable is air temperature.
- The dependent variable is precipitation.
- Constant variables include location, time of day, and sensors.
- The data, displayed using a climograph, showed a moderate positive correlation.
- Some outliers appeared, showing that air temperature may not always affect precipitation.
- This suggests precipitation is affected by air temperature, but not in all cases.

## Research Question

### Asking Questions

- This question is scientifically important because air temperature is increasing due to global warming.
- Global warming is a major global environmental issue that affects Earth's atmosphere and weather patterns.
- Precipitation is a critical part of Earth's environment because it provides fresh water and influences ecosystems.
- Warmer air is able to hold more water vapor, which may lead to changes in precipitation levels.
- Previous investigations show that rising temperatures increase evaporation, but precipitation patterns can vary by location.
- This investigation focuses on the relationship between air temperature and precipitation using locally collected data.
- The question is testable through scientific research by measuring air temperature and precipitation using sensors.

## Introduction

### Content Knowledge

- This experiment investigates whether air temperature has an effect on precipitation
- The hypothesis states that if air temperature increases, then precipitation will also increase, because warmer air is able to hold more moisture.
- Climate change has a major impact on Earth, with global warming being the most notable change.
- Global warming is caused by the burning of fossil fuels, which raises global air temperature, so weather patterns become harder to predict.
- Precipitation is significant because it is the source of freshwater.
- Even though air temperature plays a large role in precipitation formation, the exact effect is not always clear.
- NASA states that for every degree Celsius increase in atmospheric temperature, water vapor can increase by about 7%.
- Increased water vapor enters the atmosphere through evaporation.
- This water vapor later condenses to form clouds and precipitation.
- Rising global temperatures may lead to heavier precipitation in some regions and droughts in others.
- Studying the relationship between air temperature and precipitation is important in a warming climate.

## Research Methods

### Planning Investigations

Describes the planning process

- The planning process began by identifying the research question of how air temperature affects precipitation.
- The study site was located at Ottawa Hills High School in Ottawa Hills, Ohio.
- The investigation followed GLOBE atmospheric protocols supported by NASA.
- NASA assets were accessed through the GLOBE Program, allowing data to be uploaded and compared globally.
- A temperature sensor and precipitation gauge were selected for data collection.
- Instruments were checked before use to ensure consistency.
- Data collection was planned for solar noon to limit daily temperature variation.
- Measurements were collected at the same location over multiple days to observe trends.

### Carrying Out Investigations

Describes what happened

- The investigation was conducted following the planned procedures.
- Air temperature and precipitation data were collected using GLOBE protocols.
- Data collection took place in the chemistry classroom at Ottawa Hills High School.
- Air temperature was measured using a temperature sensor.
- Precipitation was measured using a precipitation gauge.
- Measurements were taken at solar noon on each data collection day. Temperature data was recorded in Fahrenheit and converted to Celsius.
- Precipitation data was recorded in inches and converted to centimeters. The collected data was uploaded to the GLOBE database, a NASA-supported platform.
- A climograph was created to analyze trends and identify patterns.

## GLOBE Badges

### Be a Collaborator

All team members are listed including students from the same school or schools from around the world, along with clearly defined roles, how these roles support one another, and descriptions of each student's contribution. The descriptions clearly indicate the advantages of the collaboration. If the students collaborated with students from another school, describe how working with other schools improved the research.

### Be a Data Scientist

The report includes in-depth analysis of students' own data as well as other data sources. Students discuss limitations of these data, make inferences about past, present, or future events, or use data to answer questions or solve problems in the represented system. Consider data from other schools or data available from other databases.

### Be an Engineer

The report uses student-generated sources of evidence to describe an engineering problem, looks at solutions through engineering, or optimizes a design to address a real-world problem, and describes the potential impact of the engineering principles on the environment.

### Make an Impact

The report clearly describes how a local issue led to the research questions or makes connections between local and global impacts. The students need to clearly describe or show how the research contributed to a positive impact on their community through making recommendations or taking action based on findings.

### Be a STEM Professional

The report clearly describes collaboration with a STEM professional that enhanced the research methods, contributed to improved precision, and supported more sophisticated analyses and interpretations of results.

### Be a STEM Storyteller

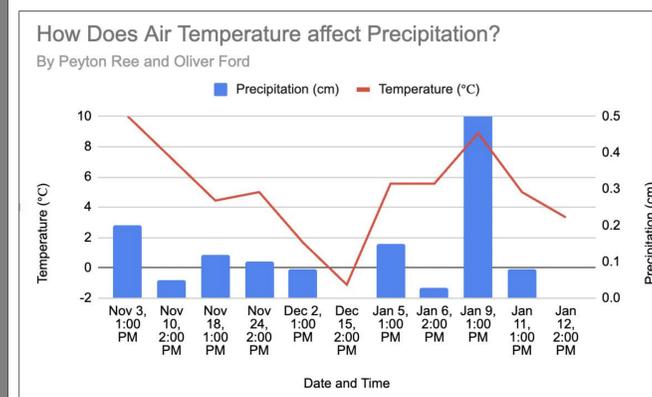
The report describes or shows how the students shared the story of their research in a creative way. This could be via a dramatic interpretation, a blog, Instagram post, artistic rendering, or any other way to creatively share what the students learned.

## Results

### Analyzing Data

- The data analysis addressed the research question of how air temperature affects precipitation.
- Air temperature and precipitation data collected during the investigation were analyzed to identify patterns and trends.
- Temperature values were converted from Fahrenheit to Celsius using the equation  $C = (F - 32) \times (5/9)$ .
- Precipitation values were converted from inches to centimeters using the equation  $cm = in \times 2.54$ .
- The converted data was organized and plotted on a climograph.
- The graph allowed for a visual comparison between air temperature and precipitation over time.
- The graph showed a moderate positive correlation, where higher air temperatures generally corresponded with higher precipitation.
- Several outliers were present, showing that increases in temperature did not always result in increased precipitation.
- These inconsistencies suggest that additional atmospheric factors influence precipitation.
- The graph clearly displays overall trends as well as variability within the data.

Figure



## Discussion

### Interpreting Data

- The project was completed successfully, but improvements could be made.
- Data collection was not fully consistent.
- A larger data set would improve the reliability of results.
- Collecting data at more frequent and consistent time intervals would strengthen the experiment.
- Other atmospheric factors besides temperature may influence precipitation.
- Future studies could examine additional variables such as humidity or air pressure.
- This experiment provides a foundation for further research on climate patterns and precipitation.

## Conclusions

### Drawing Conclusions & Next Steps

- The experiment found that air temperature and precipitation have a moderate positive correlation.
- The results were obtained through consistent data collection and analysis.
- Air temperature does affect precipitation, but not in every situation.
- Some inconsistencies and outliers were observed in the data.
- These findings suggest that other factors also influence precipitation.
- Comparing the results to other studies showed similar patterns.
- This study helped improve understanding of how global warming may affect precipitation.

## Bibliography

### References

- Mishra, V., Wallace, J. M., & Lettenmaier, D. P. (2012). Relationship between hourly extreme precipitation and local air temperature in the United States. *Geophysical Research Letters*, 39(16), n/a-n/a. <https://doi.org/10.1029/2011GL015290>
- NASA Earth Observatory. (2010, October). The Water Cycle. NASA Science. <https://science.nasa.gov/earth-observatory/the-water-cycle/>
- NASA. (2022). How does climate change affect precipitation? | NASA Global Precipitation Measurement Mission. Gpm.nasa.gov; NASA. <https://gpm.nasa.gov/resources/faq/how-does-climate-change-affect-precipitation>
- NASA. (n.d.). NASA Earth Science: Water Cycle | Precipitation Education. Gpm.nasa.gov. <https://gpm.nasa.gov/education/articles/nasa-earth-science-water-cycle>
- NCEI. (2020, November 13). A Warming Earth is Also a Wetter Earth. National Centers for Environmental Information (NCEI). <https://www.ncei.noaa.gov/news/warming-earth-also-wetter-earth>