

# NH Education and Environment Team

## NH Field Investigations Model

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### Maximum and Minimum Air Temperature Data, 1956-2007 Hubbard Brook Experimental Forest Woodstock, NH

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The **NH Education and Environment Team** is a public-private collaborative of state-based, teacher professional development providers in the fields of environmental education, natural science, and scientific inquiry. Members include the GLOBE Program, Project HOME, Project Learning Tree, Project WET at NH Department of Environmental Services, Projects WILD and Aquatic WILD at NH Fish and Game Department, and the US Forest Service. Our mission is to support schools and teachers to provide their students with the resources and opportunities to be skilled and knowledgeable stewards of our natural environment.

#### **Using Field Investigations to Model Scientific Inquiry**

State and national science standards emphasize the importance of inquiry and problem-solving for today's students. Field investigations offer rich opportunities for students to practice inquiry in engaging and authentic ways. Key steps in field investigations mirror the inquiry process. They are posing research questions, planning and conducting investigations, using evidence to describe findings, communicating research findings to target audiences, and asking new research questions based on findings.

#### **Field Investigations in NH**

Just as New Hampshire is gifted with abundant natural resources, so too do we benefit from plentiful scientific field investigations. Several ongoing investigations are offered as models to guide teachers and their students through an authentic scientific inquiry process.

This model describes maximum and minimum air temperature data collected at Hubbard Brook Experimental Forest in central NH. These data are collected to assess change over time. This model is recommended for high school use.

Another model recommended for high school use is a study of precipitation collected at several rain gages in the Hubbard Brook Experimental Forest.

The Winter Severity Index is recommended for middle school use. It provides a subset of data used by the NH Fish and Game Department to assess how the severity of winter may impact deer populations.

A model recommended for elementary school use presents data on the species of birds observed from Project Feeder Watch. (This model is still in development.)

All models and accompanying spreadsheets are available at [www.nhplt.org](http://www.nhplt.org). Funding for their development and distribution was provided by the federal Math-Science Partnership grant program.

# Field Investigation Design

## Research Question

Have the average maximum and minimum temperatures at the Hubbard Brook Experimental Forest, Station 1 changed over time?

## How Does the Data Answer the Question?

This dataset is used to understand long-term temperature trends at the Hubbard Brook Experimental Forest (HBEF) and to predict how other ecosystem processes may respond to future climate change.

## About the Data

The dataset is provided in an accompanying Microsoft Excel spreadsheet with the daily maximum and minimum temperature from 1956 through 2007. Temperature is recorded in degrees Celsius for each day of each year of the study. These data were recorded at Station 1 at the HBEF. Average maximum and minimum air temperature data for the year and for the month of June are also provided. These last two sets of data may be most useful to students, as the daily data can be cumbersome. More advanced students may want to work with subsets of the daily data.

## Study Protocol

Daily maximum and minimum temperatures from up to 8 locations at HBEF have been measured since October 1955 using mechanical hygrothermographs in weather shelters. (A hygrothermograph is an instrument that measures and records atmospheric humidity and temperature on the same graph.)

## Notes on Data

Comparisons among stations should be made with caution because data have not been corrected for possible instrument bias. The expression “-99” is the value for missing

## Data Collected

Maximum and Minimum Air Temperature Data

## Data Source

Hubbard Brook Experimental Forest

## Principal Investigator

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## Others Involved

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## Begin date

1956

## End data

Ongoing

data, when the weather station is not operational. Otherwise, if a day of data is missed, the value for that day is estimated from values at the other stations. Estimated values are not flagged. The Fahrenheit to Celsius conversion and rounding to whole degrees Centigrade leads to considerable underrepresentation of values of -5, 0, 5, 10, etc.

Data used in this publication were obtained by scientists of the Hubbard Brook Ecosystem Study (HBES); this publication has not been reviewed by those scientists. The Hubbard Brook Experimental Forest is operated and maintained by the Northern Research Station, U.S. Department of Agriculture, Newtown Square, Pennsylvania. Please note that data sharing

and availability policies vary among the datasets available. Publishers of Hubbard Brook data are encouraged to contact the original data provider to obtain information for an acknowledgement of the original funding source of the research. This information is available from the Hubbard Brook Ecosystem Study website at [www.hubbardbrook.org](http://www.hubbardbrook.org).

### **Examples of Data Analysis**

Students may analyze these data in many ways. The following are suggestions of two ways among many to visually represent the data.

Students may analyze these data by graphing temperature over time. The average maximum temperature for a particular month for each year would be one series of data and the average minimum temperature for that month would be another series graphed on the same axes with the years as the x-axis label range, and the monthly average data as the range of data for the y-axis.

Students may select another month from the yearly maximum and minimum data sheet and format it as above to analyze it in the same way and look for differences and similarities between data for different months. Average yearly maximum and minimum data may be graphed and analyzed for trends. Students may also collect data at their site for a given month or over the course of the school year and compare this to the HBEF data.

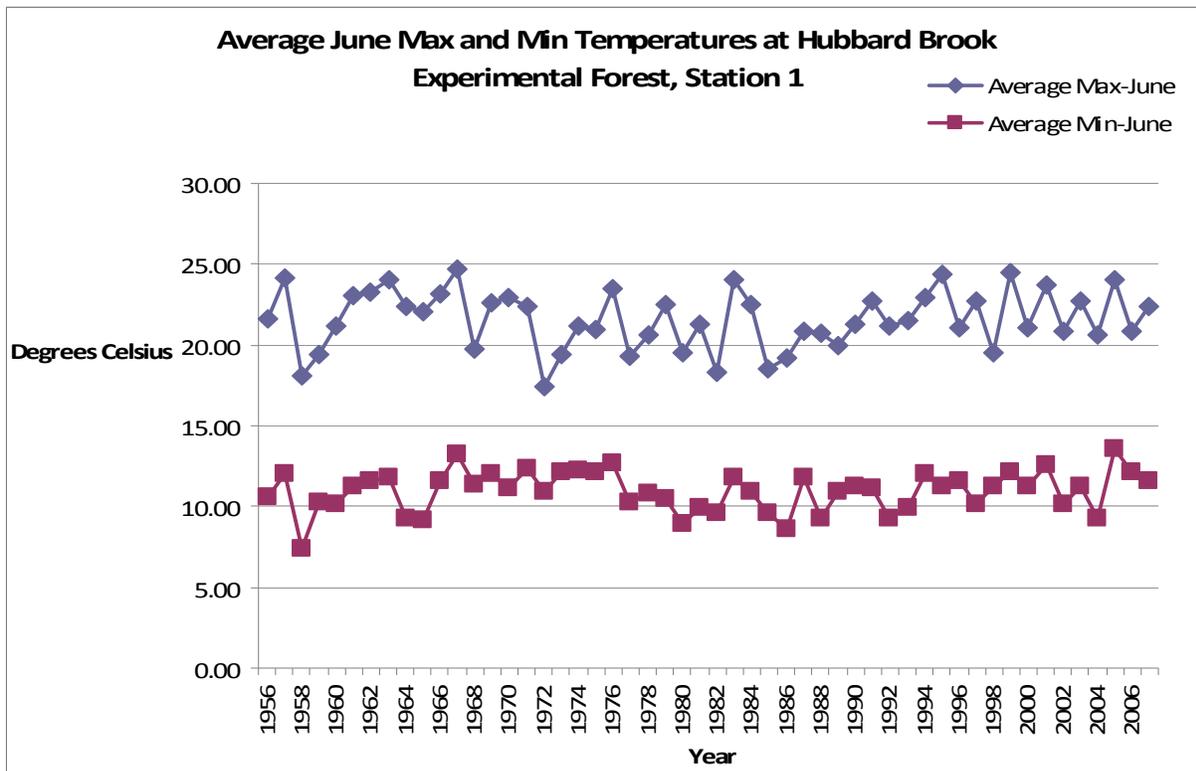
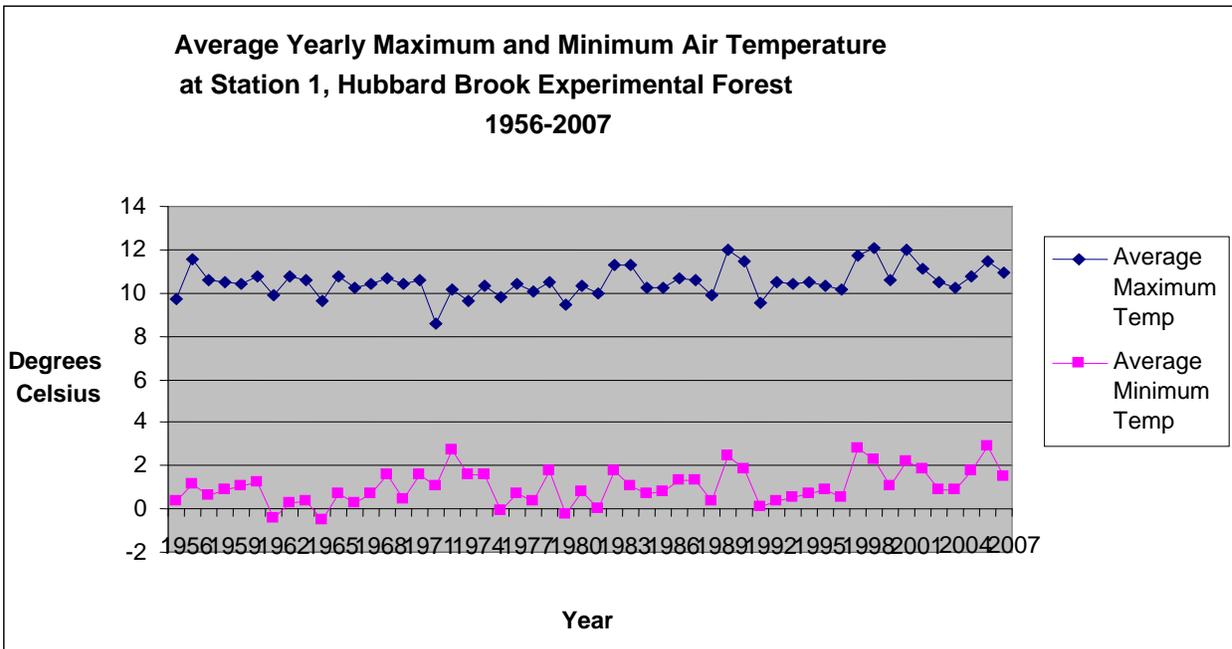
### **Examples of Questions for Data Analysis**

The following are examples of questions that may guide students in analyzing the data. Many more questions may be asked and students should be encouraged to formulate their own questions as they work with the data. Students should also be encouraged to explore the Hubbard Brook Ecosystem Study website, [www.hubbardbrook.org](http://www.hubbardbrook.org) for answers to questions about the data and for more information about the study site.

- What is the range of temperature variation for the average maximum temperature for a particular month?
- What is the range of temperature variation for the average minimum temperature for the same month?
- To what degree does the difference between daily maximum and minimum temperature vary over the course of a year?
- What is the range of temperature variation for the yearly average maximum temperature and the yearly average minimum temperature for the length of this study?
- To what degree is there change in the data over the length of the study?
- What patterns do you notice in the data?
- What statistical tests could you perform on this data?
- What questions do you have about this data?
- What other data would be helpful to compare with this data? Where might you find additional data?

## Examples of Graphs

These graphs were created in Microsoft Excel by using the line chart function and graphing the yearly and monthly data in a series over the course of the study. Students may analyze the graph for significant changes over time or correlate this data with related data.



## Resources

**Hubbard Brook Ecosystem Study**, [www.hubbardbrook.org](http://www.hubbardbrook.org). The Hubbard Brook Ecosystem Study (HBES) sustains long-term ecological research within the Hubbard Brook Experimental Forest, located in the towns of Ellsworth, Thornton, and Woodstock. On-site research has produced some of the most extensive and longest continuous data bases on the hydrology, biology, geology and chemistry of a forest and its associated aquatic ecosystems.

**Hubbard Brook Experimental Forest**, <http://nrs.fs.fed.us/ef/locations/nh/hubbard-brook/>. The Hubbard Brook Experimental Forest is a 3,160 hectare reserve in the

White Mountain National Forest, managed by the [USDA Forest Service Northern Research Station](#). It was established in 1955 as a major center for hydrologic research in New England.

Colburn, E. 2009. **Show Me A Picture, Tell Me A Story; An Introduction to Graphs for the Analysis of Ecological Data from Schoolyard Science Research Studies.** <http://harvardforest.fas.harvard.edu/museum/data/k12/Colburn%202009%20Graphing%20Manual.pdf>

Colburn, E. 2009. **Graphing Exercises.** <http://harvardforest.fas.harvard.edu/museum/data/k12/Colburn%202009%20Graphing%20Exercises.pdf>