EXAMINING EVIDENCE FOR CLIMATE CHANGE

INTRODUCTION
There is an abundance of evidence that the climate of the Earth is changing. There is a consensus among scientists that much of the warming of the Earth is likely to be the result of anthropogenic activities. Snow cover around the world is decreasing, sea level is rising, extreme rainfall events are becoming more frequent, biomes are migrating towards the poles, and glaciers are retreating. Despite all of these warning signals, many people fervently hope that it might not be true, for it is, as Al Gore says, a very inconvenient truth.

Are there some places on Earth experiencing a cooling trend? If those places exist, would that provide evidence against global warming? You will investigate climate changes around the world and apply a statistical analysis to answer this question.

You will view 100 years of temperature data in an area. Not all places have 100 years of continuous data. You are encouraged to look for a city of your choice, or you may choose among the list of locations which have been found by previous students to contain (approximately) 100 years of temperature data. Sign up on the class sheet so that no two students choose the same city.

List of locations with 100 years of temperature data – this is not a complete list

Fresno, CA	Aomori, Japan	Armidale, Australia
Central Park, NY	Boulia, Australia	Kirovabad,
Azerbaijan		
Tashkent Uzbekistan	Akita, Japan	Melbourne, Australia
Suez Egypt	Aleksandrovsk, Russia	Agassiz, BC Canada
Boulia, Australia	Hiroshima, Japan	Saga, Japan
Albany, Georgia	Vancouver, BC	Chippaua Lake, Ohio
Santa Barbara, CA	Blacksbury, VA	Durham, Ontario
Corning Arkansas	Barkerville, Canada	Electra, CA
Pasadena, CA	Shelbyville, KY	Cornwall, Vermont
Albany, Texas	Baton Rouge, LA	Montreal, Canada
Berkeley, CA	Amherst, MA	Lewiston, ME
Odessa, Ukraine	Shanghai, China	Sutsu, Japan
Kuala Trennga, Malaysia	Charlottesville, VA	Gwelo, Zimbabwe
Conway Arkansas	Syracuse, NY	Burlington, VT
Bath, NY	Belleville, Canada	Minsk, Belarus
Markovo, Russia	Gumri, Armenia	Tokyo, Japan
Kirovabad, Azerbaijan	Lake Placid, NY	Nome, Alaska

To view 100 years of weather in an area, log on to the website:
http://lwf.ncdc.noaa.gov/oa/climate/climateresources.html

- Click on **Get/View Online Climate Data**.
- Select **Graphs**, where that option appears on the line that begins with **Surface Data.**
- Click on **Climate Visualization** (CLIMVIS).
- Click on Time Series below the heading **Global Historical Climatological Network Data.**
- Select **Version 2 Temperature Data: Regularly Updated Max/Min Temperature Data*** by clicking on the sample graph below the heading.
- The next page contains the terms to which you must agree before using the data. Read the terms, and if you agree to them, click on **I Agree to These Terms** (continue).
- Choose **Display Two Parameters For One Station** from the scroll down list. Then select your geographic location by **clicking on the world map**. Select a state or country from the scroll-down list that appears, select a location that has data that starts before 1900, and click on **Okay** once you make your selection.
- On the next page, first select the station that most closely matches your location. Second, choose the **degrees Celsius**. Third, make sure that the graph will show the correct information. Make sure that the First Parameter is Max Temperature, the Second Parameter is Min Temperature, and choose August in the Months column. Also make sure that the Start Year precedes the End Year, and that both the Start Year and the End Year lie within the time period covered by data from the station you have chosen. (hint: don't choose a site with a short data set of only a decade or so) You can review the time period for which data are available for the station by going back up to the list of stations.
- After you make sure all the parameters are correct for the graph, click on Graph Data.

Look at the graph you just made. The top curve is the maximum monthly temperature recorded at the station. The bottom curve is the minimum temperature. The vertical axis on the plot is temperature, in °C. The horizontal axis corresponds to time. In each entry along the horizontal axis, the first two numbers indicate the year and the second two numbers indicate the month. For example, July 1985 is represented as 8507.

1. **Location chosen:** _____
2. **From the graph, does it look like the maximum temperature changed over time? If yes, has it increased or decreased?**

3. **What organization is responsible for this data and is it reliable?**

Go to the bottom of the page and click "view the data set"

<u>**Statistical Analysis of temperature**</u>

To determine whether the difference you see over time is significant or could have happened by chance, you will do a t-test.

- Open an EXCEL spreadsheet.
- Copy the oldest 20 temperature readings into column A of an EXCEL spreadsheet
- Copy the most recent 20 temperature readings into column B of the spreadsheet
- In a cell type in   =TTEST(A1:A20,B1:B20,2,2)
- The p-value number that appears is the probability that the two data sets are the result of chance variation and not a statistical difference. For example, if the p-value = 0.25, there is a 25% chance that the temperature differences are not significantly different, or a 75% chance that they are a result of real differences.
- For most work, a p-value of 0.05 (or less) is acceptable, meaning that there is a 95% chance that the two data sets demonstrate a significant difference.

1. **What is the p-value_____**
2. **What do you conclude from that p-value?**

Place your data on the class table of data. When the class table of data is complete, use it answer the following questions.

3. **Do most locations chosen show an increase or a decrease in temperature?**

4. **Calculate the average change in temperature for all of the locations chosen by the students. _____**

5. **Now think about what the t-test values tell us about each area's temperature change. How should we change our calculation of the average change in temperature with the t-test in mind?**

6. **Now re-calculate the average temperature change with the t-test in mind.**

7. **Did some areas exhibit a cooling trend?_____ Did these locations provide compelling evidence against global warming? Explain**

What is the difference between climate and weather?