POLAR TREC
Learning Resources

Details

Completion Time: Less than a week

Permission: Download, Share and Remix

How Much Data is Enough?

Overview

Given sets of graphable data students will show that various viewpoints can be supported depending on how data is presented and interpreted. These may or may not be accurate or relevant representations of data results over time. This lesson contains basic graphing components, interpretation of information and communication to others of findings depicted in graphs. Teachers may choose to use either the total lesson or bits and pieces depending on student abilities and time constraints. The lesson is also designed so that it can be expanded for advanced students and used as an enrichment activity or a remedial activity.

Objectives

Given a set of data students will:
1. Create an appropriate graph using Microsoft Excel or another graphing program.
2. Answer questions related to the data using the completed graphs.
3. Interpret the information found on the graph, and present either orally or in a written format, their findings
4. Determine the mean, median, mode and range of the data
5. Enrichment Activity: Consider and discuss the question of "When Do Scientists Have Enough Information To Answer a Question?"

Lesson Preparation

See the Resources section for Background information. Use of Microsoft Excel or another computerized graphing program will speed the activity and allow for more than one set of data to be examined. Graph paper and calculator can also be used by the students to get the same results.

If groups are given different data sets, the graphs can be printed or displayed so that the entire class or sev-

Materials

Materials

- Computer (with Microsoft Excel or similar program)
- Link to Data File
- Student Worksheet
- Without computers: Copied worksheets of the data, graph paper, calculator

eral groups can merge their information to come up with findings.

Procedure
1. Download the data set from the materials section.
2. Using your chosen (or assigned by teacher) data section (ex. 1951-1980), construct a graph of the annual temperature anomaly versus the year.
3. Add a trend line to this data. Be careful to observe what is happening to the line.
4. Make a new graph to look at the entire data set (1856-2005). Be sure to plot a trend line on this graph as well.
5. Answer Student Questions in Part I (attached)
6. Complete Graphic Interpretation in Part 2 (attached)

Extension
N/A

Resources
Background Information for Teachers:
The debate exists about the occurrence of climate change and its severity across the globe. Temperature observations from both land-based and ocean-based stations have increased greatly in the last century with tens of thousands of reporting stations presently in place. Using data from P.D. Jones *et al.* and information from the Climate Research Unit (CRU) we will be looking at temperature fluctuations over time. The data begins with readings from 1856 through 2005 and is listing the temperature anomalies, or deviations from a mean. In this case, the mean is coming from the 30-year period 1961-1990. The data is then measured against whether the temperature increased or decreased from that mean and listed as the departure from the mean.

Example: If the mean yearly temperature for the 30-year period 1961-1990 was 65 degrees, the mean from 1856 will be measured against that. If the temperature were lower than the 1961-1990 mean you will get a negative anomaly (negative number), if it is warmer you will see a positive anomaly.

"Hook":
Have you ever looked at graphs on the news or in newspapers where you are told that certain trends are occurring and that something negative, or positive, is going to happen as a result? Using the same set of numbers it is quite possible to make things look just a little different to help push your point of view. This activity will allow you to determine some "right" answers about temperature data and discuss/defend your position.

Tips and Tricks:
Try the activities yourself first! It will greatly reduce the frustrations with using Microsoft Excel, especially for the inexperienced. This activity may also be used in a math class to practice graphing techniques as well as finding the equation of a line.

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Vocabulary:
anomaly: a deviation from the common rule, type, arrangement, mean, or form.
deviation: departure from a standard or norm.
global warming: an increase in the earth's average atmospheric temperature that causes corresponding changes in climate and that may result from the greenhouse effect.
climate change: any long-term significant change in the weather patterns of an area.

Key Questions to Consider with Students
1. How can a set of data be used to represent multiple view points regarding a specific topic?
2. What evidence can be provided to present arguments for or against global warming?
3. Given a set of data, are you able to create a graphic representation?
4. How does the amount of data examined over a given period of time affect the trends observed?
5. How does a person distinguish how much data is needed to accurately display trends over time?

Further Resources:
This lesson is also available in a different format on the CReSIS website:
https://www.cresis.ku.edu/education/wiki/index.php/Climate_Data_-_Middle_School

Jones, P.D., D.E. Parker, T.J. Osborn, and K.R. Briffa. 2006. Global and hemispheric temperature anomalies--land and marine instrumental records. In Trends: A Compendium of Data on Global Change. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A.
http://cdiac.ornl.gov/trends/temp/jonescru/jones.html (source of data in attached Excel file)

Assessment
See attached rubric.

Credits
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Learning Resources

National Science Education Standards (NSES):

Content Standards, Grades 5-8
Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

Content Standard E: Science and Technology
b. Understandings about science and technology

Content Standard F: Science In Personal and Social Perspectives
e. Science and technology in society

Content Standard G: History and Nature of Science
a. Science as a human endeavor
b. Nature of science

Content Standards, Grades 9-12
Content Standard A: Science As Inquiry
a. Abilities necessary to do scientific inquiry
b. Understandings about scientific inquiry

Content Standard E: Science and Technology
b. Understandings about science and technology

Content Standard F: Science In Personal and Social Perspectives
f. Science and technology in local, national, and global challenges

Content Standard G: History and Nature of Science
a. Science as a human endeavor
b. Nature of scientific knowledge
c. Historical perspectives

Other Standards:
Kansas Science and Math Standards
- 1.1.2 – Designs and conducts scientific investigations safely using appropriate tools, mathematics, technology, and techniques to gather, analyze, and interpret data.
- 1.1.3 – Identifies the relationship between evidence and logical conclusions.
- 1.3.2 – Evaluates the work of others to determine evidence which scientifically supports or contradicts the results, identifying faulty reasoning or conclusions that go beyond evidence and/or are not supported by data.
- 6.2.1 – Investigates the effects of human activities on the environment and analyzes decisions based on the knowledge of benefits and risks.

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- 6.3.1 – Recognizes patterns of natural processes and/or human activities that may cause and/or contribute to natural hazards.

Student Questions

Part I - Graphing Exercise (Using Data Set)

1. Find the following statistical information for your 30-year period. Mean? Median? Mode?
2. Is there a trend of decreasing or increasing temperature or does it remain constant?
3. If temperatures were to continue in this manner, what might you predict for the following 30 years?
4. Plan a short presentation of your data results, your conclusion(s) regarding this data, and your position supporting a claim that your data represents true historical trends in global temperature.

Part 2 - Graphic Interpretation (Using Graphs A-H)

1. Which graph has the lowest recorded temperature anomaly?
2. Which graph shows the lowest overall temperature anomalies?
3. Which graph demonstrates a 30-year prediction into the future?
4. Which graph shows the largest overall annual temperature increase over a 30-year period?
5. Which graph shows the longest record of data?

Going Further

Let's take a closer look at Graph D. You are now going to see how the same set of data can be manipulated to express different points of view.

1. How many years worth of data are used to calculate the trend line on Graph D?
2. How many years into the future is the trend line used to predict?
3. What appears to be the temperature trend from 1941-2000?
4. Does this make sense with the media reports over the last several years?
5. If you were going to create a presentation around this set of data, what types of comments would you make regarding the evidence for global warming?

Now take a look at Graph E. We are going to fill in the missing data from 1971 to 2000. Notice the changes!

1. How many years worth of data are used to calculate the trend line on Graph E?
2. What appears to be the temperature trend from 1941-2000?
3. Does this make sense with the media reports over the last several years?
4. Extend this trend line another 30 years into the future (2030). What conclusions can be made from this graph?
5. If you were going to create a presentation around this set of data, what types of comments would you make regarding the evidence for global warming?

Conclusion

Write a short essay on the activity you have just completed. Be sure to mention the use of data in finding trend lines. What about missing data? What about shifting data just a few points to the right or left? Using the data provided from the Excel file, see if you can make an argument for global cooling. Produce a graph to support this position.

CATEGORY	4 Above Standards	3 Meets Standards	2 Approaching Standards	1 Below Standards	Score
Attention Grabber	The introductory paragraph has a strong hook or attention grabber that is appropriate for the audience. This could be a strong statement, a relevant quotation, statistic, or question addressed to the reader.	The introductory paragraph has a hook or attention grabber, but it is weak, rambling or inappropriate for the audience.	The author has an interesting introductory paragraph but the connection to the topic is not clear.	The introductory paragraph is not interesting AND is not relevant to the topic.	
Position Statement	The position statement provides a clear, strong statement of the author's position on the topic.	The position statement provides a clear statement of the author's position on the topic.	A position statement is present, but does not make the author's position clear.	There is no position statement.	
Support for Position	Includes 3 or more pieces of evidence (facts, statistics, examples, real-life experiences) that support the position statement. The writer anticipates the reader's concerns, biases or arguments and has provided at least 1 counter-argument.	Includes 3 or more pieces of evidence (facts, statistics, examples, real-life experiences) that support the position statement.	Includes 2 pieces of evidence (facts, statistics, examples, real-life experiences) that support the position statement.	Includes 1 or fewer pieces of evidence (facts, statistics, examples, real-life experiences).	
Evidence and Examples	All of the evidence and examples are specific, relevant and explanations are given that show how each piece of evidence supports the author's position.	Most of the evidence and examples are specific, relevant and explanations are given that show how each piece of evidence supports the author's position.	At least one of the pieces of evidence and examples is relevant and has an explanation that shows how that piece of evidence supports the author's position.	Evidence and examples are NOT relevant AND/OR are not explained.	
Closing paragraph	The conclusion is strong and leaves the reader solidly understanding the writer's position. Effective restatement of the position statement begins the closing paragraph.	The conclusion is recognizable. The author's position is restated within the first two sentences of the closing paragraph.	The author's position is restated within the closing paragraph, but not near the beginning.	There is no conclusion - the paper just ends.	