



TEACHERS AND RESEARCHERS EXPLORING AND COLLABORATING

PolarTREC Lesson Resource

Making Sense of Data Sets

Denise Hardoy

Antarctic Fish Development Under Future Ocean Conditions

PolarTREC Expedition Page

<https://www.polartrec.com/expeditions/antarctic-fish-development-under-future-ocean-conditions>



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Overview

Denise Hardoy created this resource after spending five weeks embedded with Dr. Anne Todgham's team studying the effects of climate change on Antarctic fishes in 2019. This lesson addresses one of the most difficult aspects of science for students - making sense of data.

Objectives

Success Criteria

- Given a graph, students will write an analysis paragraph of a graph that includes both variables, high and low points, patterns and trends, as well as anomalies in the data.
- Students will construct a scientific explanation based on valid and reliable evidence obtained from sources (including the students' own experiments) and the assumption that theories and laws that describe the natural world operate today as they did in the past.

Analyzing and Interpreting Data

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

Lesson Preparation

- Prior to this lesson, students should be familiar with the scientific method, specifically including data collection.
- Students should have a basic understanding of dependent and independent variables.

Procedure

- Use the attached slideshow (in Lesson Materials) to introduce the lesson.

Engage Phenomenon

- Display the provided graph. Ask students to record what they notice and what they wonder about the data.

Resource Details

Date

21 February 2021

Region

Antarctic

Grade

Middle School and Up

Permission

Download and Share

Location

McMurdo Field Station,
Antarctica

Expeditions

Antarctic Fish Development
Under Future Ocean
Conditions

Author(s)

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Anne Todgham

Related Members

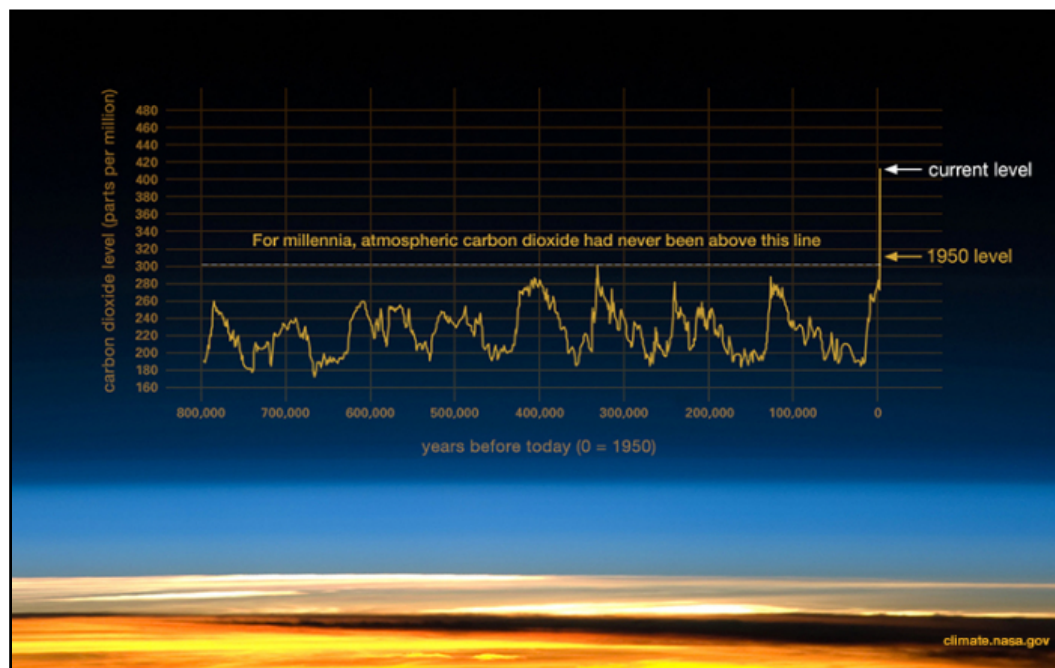
Denise Hardoy
Anne Todgham

Materials

Computers with internet
access

Topic

Tools and Methods
General Life Science



Vostok Ice Core Samples: Graph of carbon dioxide levels from 800,000 years ago to present

- Record students' ideas onto the whiteboard, Google Slide, or large poster paper. Sticky notes can also be used.
(Remote alternative: record ideas on a shared digital platform-Digital Post-it note)

Explore

- Have a class discussion about students' ideas. The teacher should provide focus on:
 - Information on how data was collected- analysis of trapped gas bubbles in Ice core samples.
 - Title of the graph (includes both variables)
 - X and Y-axis labels (point out that the Dependent variable is usually the Y-axis)
 - Scale- units used
- Students are then divided into groups (or digital breakout rooms) and assigned a graph to study. (These graphs are from fictitious data). Their task is to provide notes on what they notice and wonder about their new graph.
- Reconvene the entire class and each group presents their findings.

Explain

Now students are going to formalize their findings. The teacher explains how data is used to tell a story (explain the findings of scientific investigation). It provides evidence to support scientific claims.

- Return to the first graph. The teacher explains to students that we will now be writing a formal analysis of these graphs. Start with a "We do it" and analyze the first graph together as a class. This procedure can be broken down into six steps. Getting started on the analysis is

often the most difficult part for students. They don't know where to begin. Following this formula, students can write a clear and concise analysis of the graph. Write the paragraph together as a class.

The first sentence of the analysis

This graph shows _____ (Insert title of graph)

For example- This graph shows the carbon dioxide concentration of Earth's atmosphere from 800,000 years ago to the present.

2. The second part is organized using an acronym that the students can memorize- **HLPA**:

- H: High points- Describe the highest point of data on the graph. Students should not use the words "Highest Point". This tends to make their analysis meaningless to them. Instead, they need to use the wording from each axis. For example: "the highest Carbon dioxide level...." particularly focusing on the dependent variable displayed on the Y-axis.
- L: Lowest points- Now students repeat this process addressing the lowest data points. Again, terminology should be from the Y-axis label, not using the words "Lowest point).
- P: Patterns and trends: This is the most important and difficult part of their analysis. Help students see an overall pattern or trend. Show multiple examples (provided). Explain that patterns are cycles that are repeated, where trends are general tendencies. Provide a sentence frame for struggling students: "The most noticeable trend in this data is...." or "One pattern I observed was"

• A: Anomalies

Students often need an explanation of anomalies. Give examples of one data point that does not fit the overall trend. I tell my students it is when something "Wonky" happens. Maybe there was a snowstorm and scientists couldn't collect data. Maybe a battery died and the instrumentation wasn't working right. Students should understand that real data is messy and that one reason measuring something over such large time scales is important is to pull out the trends and put the anomalies in context.

Again, provide sentence frames as needed for your population of students:

"One anomaly I noticed occurred on day _____ when _____ happened."

3. The final sentence is a conclusion. Students can use the following sentence frame to help write their conclusions or create their own.

"This data might mean....."

An example paragraph might look like this:

"This graph shows the Ice core carbon dioxide levels (PPM) from 800,000 years ago to the present. The highest carbon dioxide level of 420 PPM is found currently. The lowest levels are seen around 680,000 years ago. One pattern I notice is a fluctuation in levels about every 100,000 years. There is a clear trend of drastically increasing carbon dioxide levels in the last 1,000 years. This might mean that humans are contributing to an increase in CO₂ since the industrial revolution."

- Break students into groups to analyze their group graph. This can also be done digitally in break-out rooms.
- Give prompts or use the handout to remind students of each part of the analysis.
- Students should present their analysis to the class for peer and teacher review.
- Use the attached rubric as a checklist for students and for peer review of paragraphs. This review serves as a formative assessment and can take many forms

In-Class Option:

* Create a gallery walk of their work. Give students sticky notes or copies of the rubric to provide feedback.

* If time allows, give students time to review feedback and make edits on their analysis.

* Graph analysis is a skill that takes time to develop. If possible, allow time for students to exchange graphs and write another analysis.

Remote Option:

* Post graphs and analysis on a Google doc that is shared with the class. Feedback can be provided in comments.

Elaborate

- The logical next step is to have students become competent at creating their own graphs to analyze. Using graph paper, students will create a graph using any relevant data set.

Be sure students include:

- Graph title- including variables
- X and Y-axis labels
- Units
- Appropriate scale
- Data

Resources**For step by step instructions on building a graph:**

- How to Make a Line Chart in Google Sheets (Step-by-Step) or access the PDF from Productivity spot that explains this procedure in detail at <https://productivityspot.com/line-chart-google-sheets/>
- This can be extended to use a spreadsheet program to create the graph for them.

Evaluate (Assessment)

- Formative: Peer and teacher review of group analysis
- Summative: Students are given an opportunity to independently analyze a graph.

Author/Credits

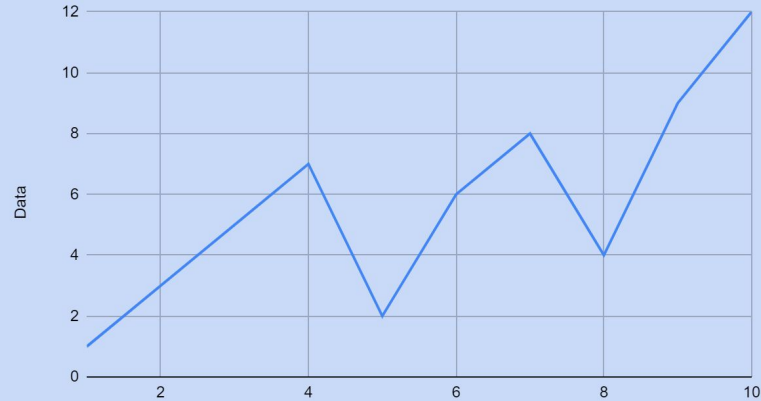
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**POLAR
TREC**

www.polar-trec.com

Graph Analysis

Graphing Data



Polar Trec 2019
Denise Hardoy



Credits

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Learning Goals

Students will write an analysis of given graphs

Success Criteria:

I can write an analysis paragraph of a graph that includes both variables, high and low points, patterns and trends, as well as anomalies in the data.

NGSS Standards

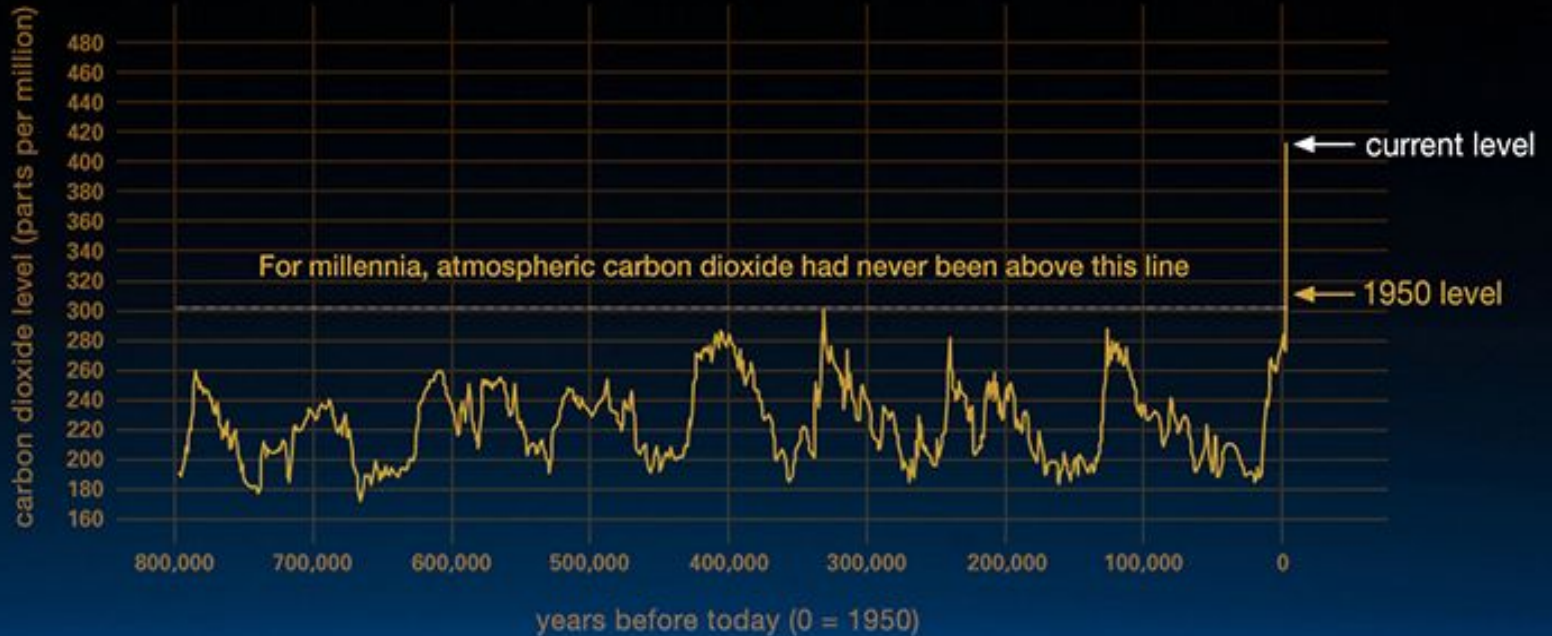
Builds towards:

- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

- Focus on SEP 4:
Analyzing and Interpreting Data

Anchor Phenomenon: What do You Notice? What do You Wonder?

Carbon Dioxide levels from Ice Core Samples from 600,000 years ago to Present



What do You Notice? What do You Wonder?

Carbon Dioxide levels from Ice Core Samples from 600,000 years ago to Present



Title of graph
(includes both variables)

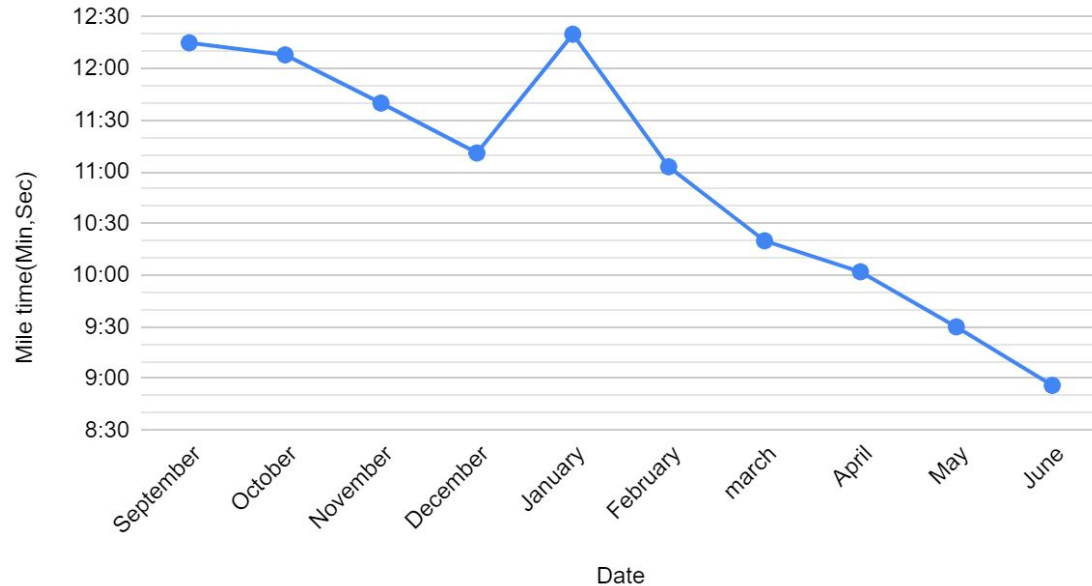
X and Y axis Labels
(Dependent variable is usually the Y axis)

Scale
Units used?

Breakout- Time to try it yourself

Group 1

My Mile Time(Min,Sec) vs. Date for 2019-2020



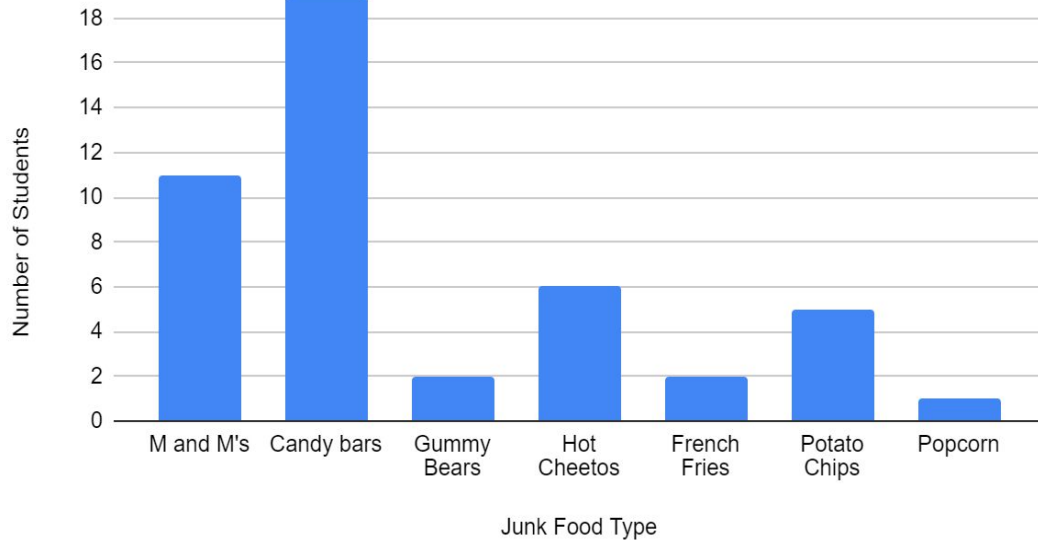
I notice:

I wonder:

Breakout- Time to try it yourself

Group 2

Number of Students vs. Junk Food Preference in Mrs. Smith's classes in March, 2018



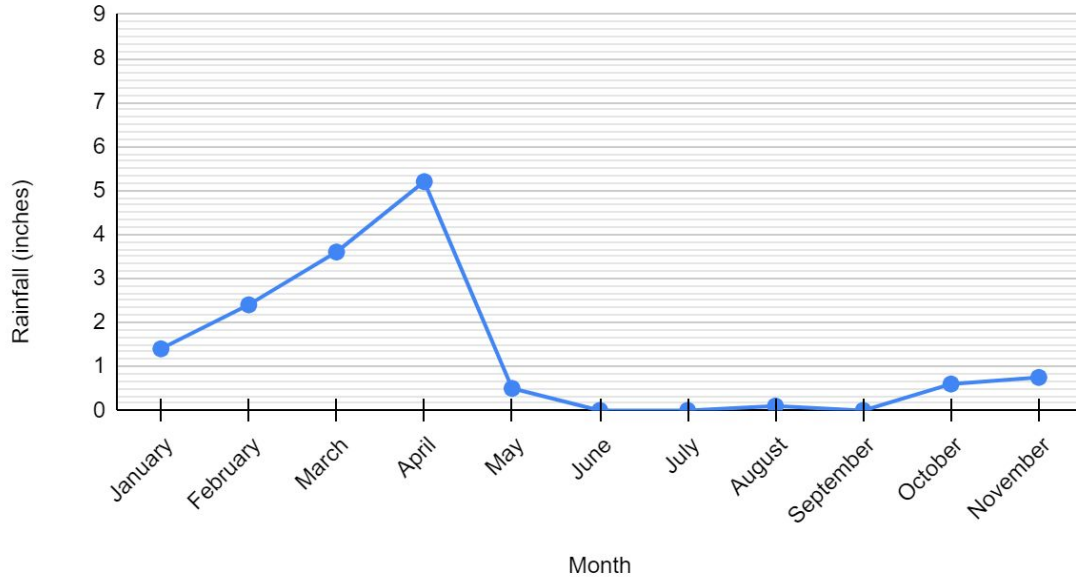
I notice:

I wonder:

Breakout- Time to try it yourself

Group 3

Rainfall (inches) by month 2020 in Lockwood, CA



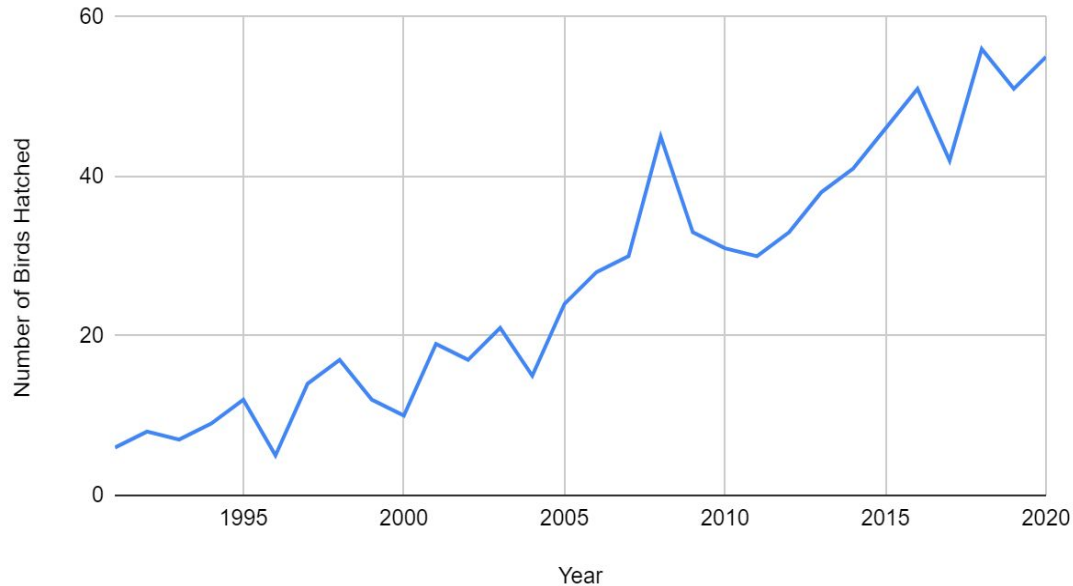
I notice:

I wonder:

Breakout- Time to try it yourself

Group 4

Number of Birds Hatched in Lockwood, Ca from 1991-2020



I notice:

I wonder:

What Did We Notice?

What did we Wonder?

I notice:

I wonder:

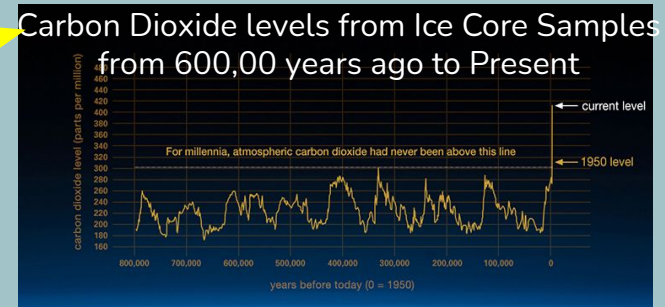
How can we write up a formal analysis paragraph of our graph?

1. Start with the title-
Your first sentence should include the title of the graph.

“This graph shows....(insert title).

Example:

“This graph shows the carbon dioxide levels from ice core samples from 600,000 years ago to the present.”



HLPA

Now you add one sentence for each letter in the HLPA acronym.

H Highest point on graph

L Lowest point on graph

P Patterns and Trends

A Anomalies

Highest point

This sentence describes the highest point you see on the graph. It should state the number and when/where the number was taken from. DO NOT use the words “highest point”. Instead, refer to exactly what it is that is high- miles, seconds, etc.

Example:

“The highest carbon dioxide levels are noticed at the current year.”

Lowest Point

The third sentence describes the lowest data point on the graph. Again, DO NOT use the terminology “Lowest Point.” Use what is low.

Example:

“The least concentration of carbon dioxide was recorded around 680,000 years ago.”

Patterns and Trends

Patterns are repeating cycles that you can identify. They may suggest a correlation between variables. They may also show cyclical changes over time.

Trends are gradual increases or decreased in the value of the data points.

Example:

"I notice a pattern of increased then decrease carbon dioxide every 100, 000 years. Then there is a significant trend of increasing carbon dioxide beginning around 1,000 years ago, with the sharpest rise since 1950."

Anomalies

Anomalies are data points that are significantly different from the rest of the data. They can show errors in data collection, or highlight important events. It is important to think critically about the significance of the anomaly. Often, there are no anomalies, and this should be noted as well.

Example:

“There are no significant anomalies in this data.”

Conclusion

The last sentence should tie all of your ideas together. You need to think critically about the story that the data tells. If part of your experiment, you would explain how the data supports your hypothesis.

A good way to start this sentence would be:

This might mean that.....

Example:

"This might mean that humans have had a significant impact on the overall level of carbon dioxide."

Put it together...

Remember, your analysis is a paragraph, not isolated sentences. Put them all together.

"This graph shows the carbon dioxide levels from ice core samples from 600,000 years ago to the present. The highest carbon dioxide levels are noticed at the current year. The least concentration of carbon dioxide was recorded around 680,000 years ago. I notice a pattern of increased then decrease carbon dioxide every 100, 000 years. Then there is a significant trend of increasing carbon dioxide beginning around 1,000 years ago, with the sharpest rise since 1950. There are no significant anomalies in this data. This might mean that humans have had a significant impact on the overall level of carbon dioxide."

Your Turn!

Return to your group. Write an analysis using what you have learned. Remember..

1. This graph shows.....
2. HLPA
3. This might mean.....

Time to share! Post your analysis on the next few pages!

Group 1

Group 2

Group 3

Group 4

Assessment

Analyze this graph on your own

Rubric

Category	1 Point- Below Standard	2 Points Approaching Standard	3 points Standard met	4 points Standard Exceeded	Totals
Topic Sentence	Missing	Includes only subject	Includes both variables	Accurately includes both variables in the correct format	
H-high points	Missing	Includes, but uses words "high points"	Includes, using correct terminology	Clearly explains using correct terminology	
L- Low points	Missing	Includes, but uses words "Low Point"	Includes, using correct terminology	Clearly explains using correct terminology	
P- Patterns & Trends	Missing	Attempted, but not accurate	Accurate, but not detailed	Accurate detailed explanations	
A- Anomalies	Missing	Attempted, but not accurate	Accurate, but not detailed	Accurate and explained in detail.	
Conclusion	Missing	Includes but does not support , "This might mean.."	This might Mean... included and well supported.	Clear explanation or relevance of analysis	
Totals					

Extension: Now it is time to create!

Try making your own graph. Go to <https://productivityspot.com/line-chart-google-sheets/>

Use Google Sheets to do the work for you!

Category	1 Point- Below Standard	2 Points Approaching Standard	3 points Standard met	4 points Standard Exceeded	Totals
Topic Sentence	Missing	Includes only subject	Includes both variables	Accurately includes both variables in the correct format	
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A- Anomalies	Missing	Attempted, but not accurate	Accurate, but not detailed	Accurate and explained in detail.	
Summary	Missing	Includes but does not support , "This might mean.."	This might Mean... included and well supported.	Clear explanation or relevance of analysis	
Totals					