Unit 6

Earth's Resources and Human Impact:

How do changes in the Earth's system impact our communities, and what can we do about it?

Student Work Pages

GRADE 7 Core Knowledge Science®

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Earth's Resources and Human Impact

How do changes in the Earth's system impact our communities, and what can we do about it?

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Drought and Flood Headlines

If this page appears in black and white, trace the box outlines in brown.

If this page appears in black and white, trace the box outlines in green.

Michigan's climate: Models project 30% increase in rain and snow, plus rising temps

Source Information:
Keith Matheny, Detroit Free Press, 2019

https://www.freep.com/story/news/local/michigan/2019/06/13/michigan-climate-change-wetter-springs-hotter-summers/1298208001/

Extreme Floods May Be the New Normal

Source Information:
Erika Bolstad, ClimateWire, 2016

https://www.scientificamerican.com/article/extreme-floods-may-be-the-new-normal/

Flash flooding expected in Southern plains as West faces another heatwave

Source Information:
Max Golembo, ABC News, 2020

https://abcnews.go.com/US/flash-flooding-expected-southern-plains-west-faces-heat/story?id=72766884

Warm Weather Poses A Risk For Spring Flooding

Source Information:
Katie Steiner, CBS Minnesota, 2020

https://minnesota.cbslocal.com/2020/03/09/warm-weather-poses-a-risk-for-spring-flooding/

Iowa's New Normal: Constant, Worsening Floods

Source Information:
Isabella Murray, Iowa Starting Line, 2019

https://iowastartingline.com/2019/09/13/iowas-new-normal-constant-worsening-floods/

Rising temperatures and human activity are increasing storm runoff and flash floods

Source Information:
Columbia University School of Engineering and Applied Science, 2018

https://www.sciencedaily.com/releases/2018/10/181022085820.htm

Heat and humidity with more downpours and storms

Source Information:
Fox Western Massachusetts News, 2018

https://www.westernmassnews.com/weather/heat-and-humidity-with-more-downpours-and-storms/video_[illegible].html

More rain, more floods, more often. Why wet basements, swollen rivers are becoming the new spring reality for Illinois

Source Information:
Patrick M. O'Connell and William Lee, Chicago Tribune, 2020

https://www.chicagotribune.com/news/breaking/ct-illinois-floodplains-extreme-weather-20200122-[illegible]-story.html

It's Hot. It's Flooding. Is This the New Normal?

Source Information:
Lizzie O'Leary, What Next: TBD, 2022

https://slate.com/transcripts/[illegible]

Intense Rain Bursts Rise with Heat, Forecast More Flash Flooding

Source Information:
Evan Lehmann, ClimateWire, 2015

https://www.scientificamerican.com/article/intense-rain-bursts-rise-with-heat-forecast-more-flash-flooding/

Flash flood threat for Southern Plains, Midwest as hot weather stretches through Texas

Source Information:
Janice Dean, Travis Fedschun, Brandon Noriega, Fox News, 2020

https://www.foxnews.com/us/flash-flood-threat-southern-plains-midwest-heat-wave-texas-iowa

Higher temperatures increase Sierra snowmelt, raises flooding concerns near Kings River

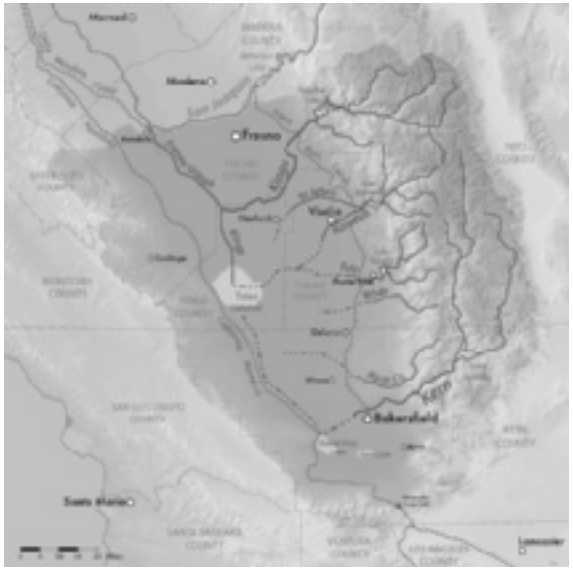
Source Information:
ABC 30, 2019

https://abc30.com/sierra-nevadas-snowmelt-california-rain-flooding/5342566/

Name: _____ Date: _____

Case Site: East Porterville, California

Read About: East Porterville is a town on the east side of the Central Valley of California. Many residents of East Porterville and residents of nearby farms pump water out of an aquifer located beneath the Tulare Basin (the part of the valley where the town is located). Aquifers store water underground. Many aquifers can be refilled when it rains as water seeps through the ground and is stored underground again. Home owners can drill long pipes into the aquifers and pump water out of the aquifers and into their homes. Farmers can also use water stored in aquifers to water their crops.



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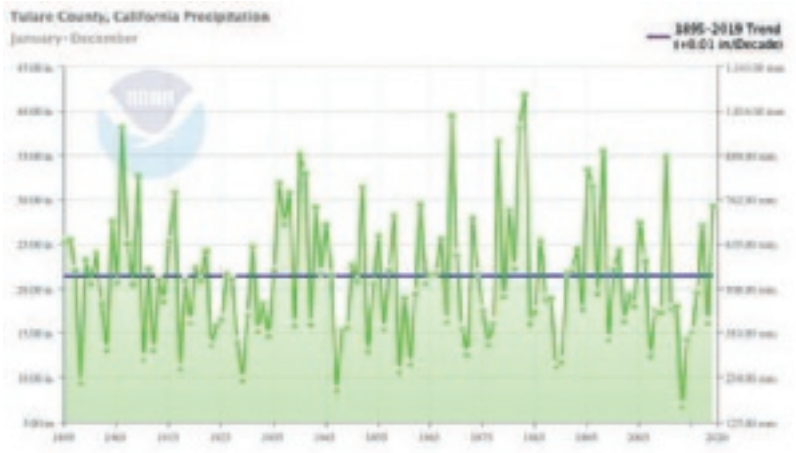
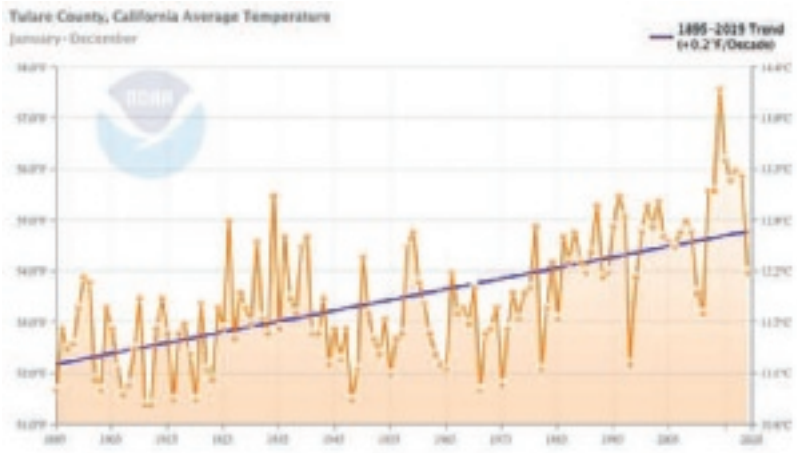


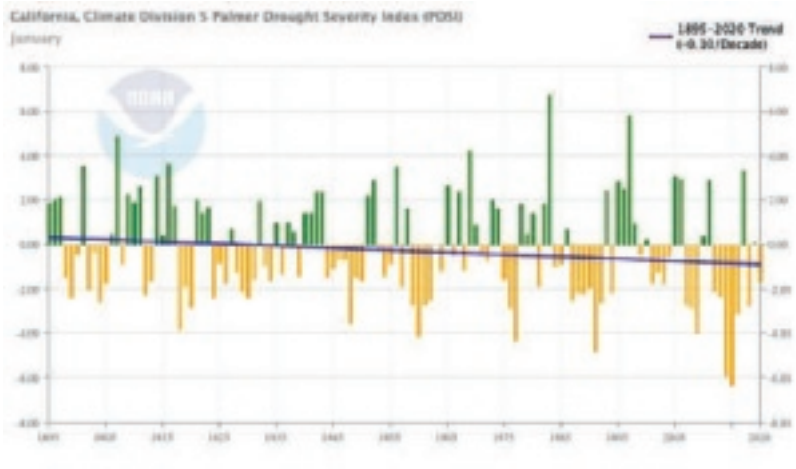
Data Source: NCEI/NOAA

Average Annual Temperature (1895-2020)



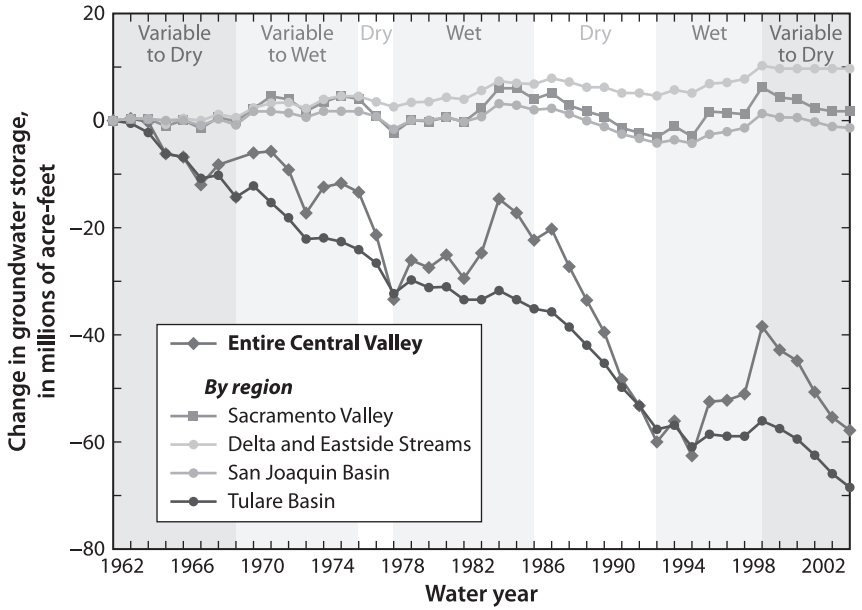
Data Source: NCEI/NOAA

Palmer Drought Severity Index (1895-2020)



Data Source: NCEI/NOAA

Groundwater Measurements



USGS

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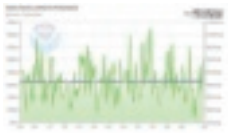
Total Annual Precip.  Data Source: NCEI/NOAA		
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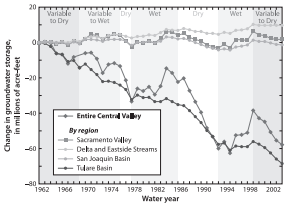
PDSI  Data Source: NCEI/NOAA		
Groundwater Measurements  USGS		

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Name: _____ Date: _____

Case Site: Vicksburg, Mississippi

Read About: Vicksburg, Mississippi is located on the Mississippi River in the "delta" region of the river, which is a flat portion of the Mississippi River Valley. It is not the actual delta of the river, which is further south in Louisiana. The Vicksburg area is well-known for its fertile soil for farmers' crops. It has regularly flooded for short time periods in the past, but farmers are experiencing the longest-lasting flooding events in the last century, which has caused them to lose entire farms or crops for years or more. They have never seen flooding like this before.

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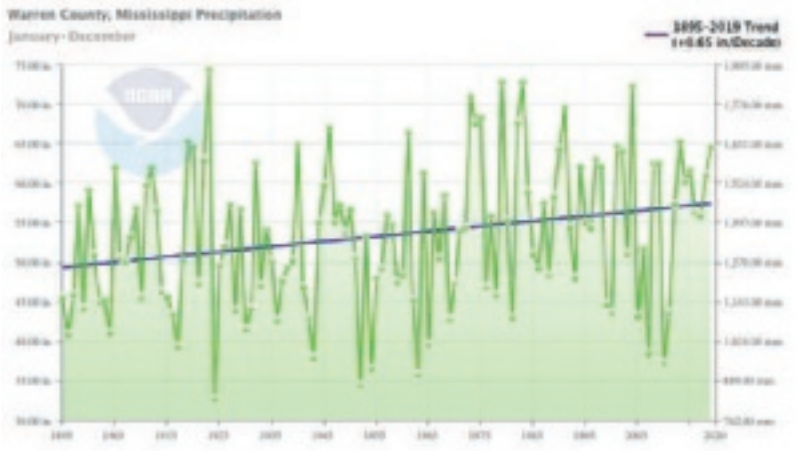
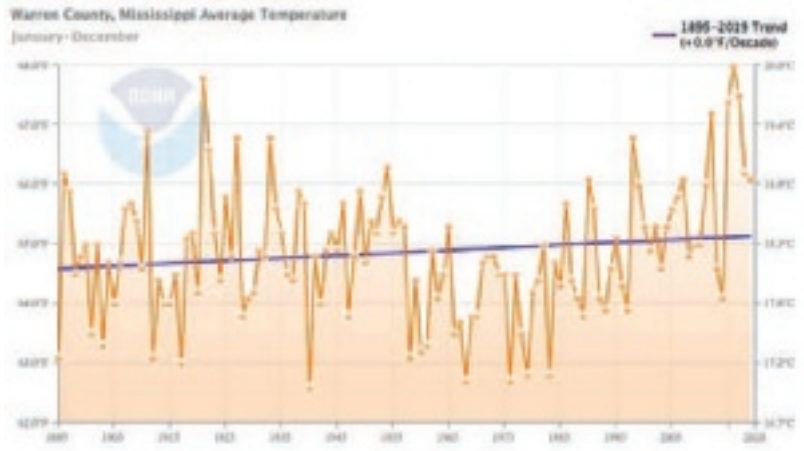


Data Source: NCEI/NOAA

Average Annual Temperature (1895-2020)



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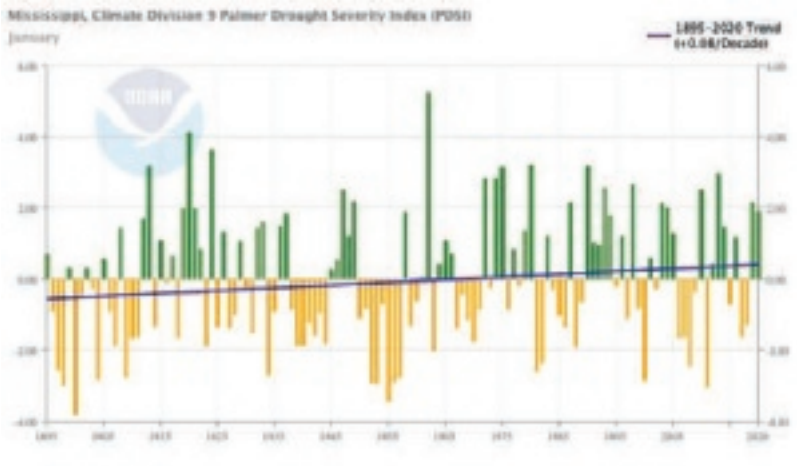
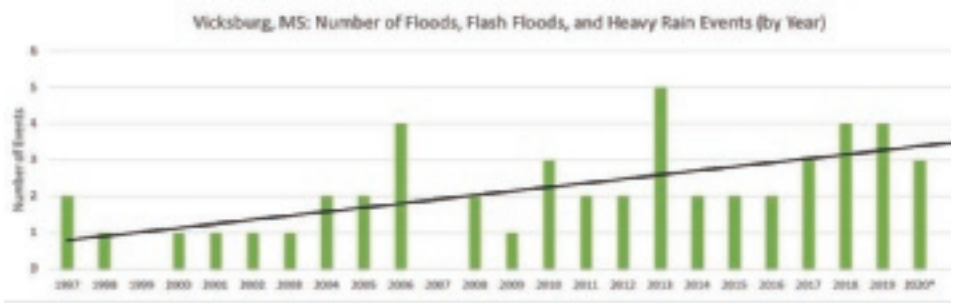
Palmer Drought Severity Index (1895-2020)



Data Source: NCEI/NOAA

Flood and Heavy Precipitation Events



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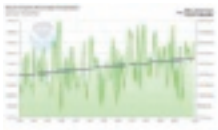
Total Annual Precip.  Data Source: NCEI/NOAA		
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Case Site: Navajo Nation

Read About: The Navajo Nation spans across three states (New Mexico, Arizona, and Utah) and is home to about 175,000 people. The Navajo Nation relies on water from three sources: precipitation, snowmelt from nearby mountains, and groundwater pumped to the surface. While the area has some deserts, it also consists of mountain forests and high mesas. The Navajo Nation has been experiencing unusually drier and hotter years recently, with more and more residents relying on water accessed from community water tanks.

NASA Goddard Space Flight Center CC BY 2.0

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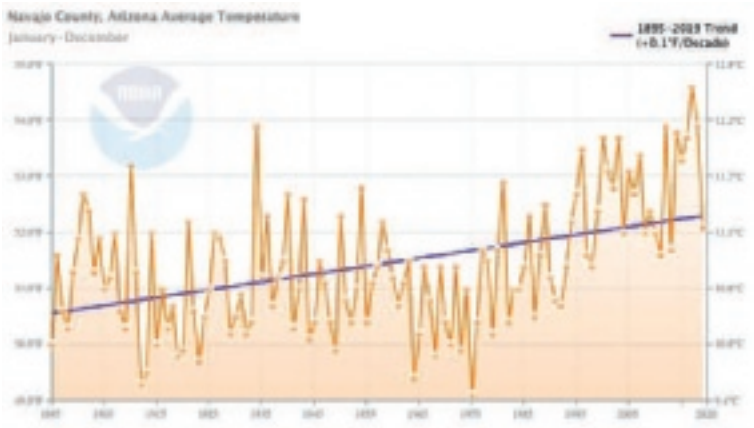

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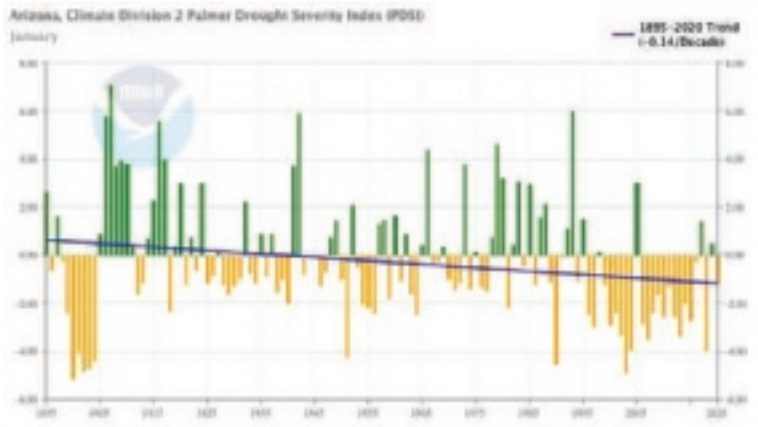
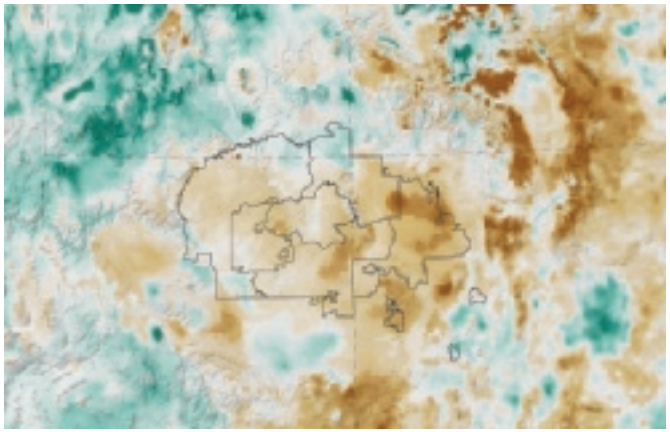


Data Source: NCEI/NOAA

Drought Severity Map



NASA Earth Observatory images by Lauren Dauphin using data from NASA's Drought Severity Assessment Tool (DSET).

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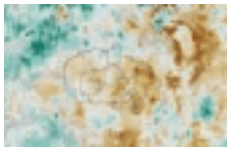
Drought Severity Map  NASA Earth Observatory images by Lauren Dauphin using data from NASA's Drought Severity Assessment Tool (DSET).		

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Case Site: Boston, Massachusetts

Read About: Boston is a large coastal city on the East Coast of the US and home to almost 5 million people. Boston has historically received precipitation as snow in the winter and rain in the summer. Sometimes Boston gets hit with bad storms, such as nor'easters, coming off of the Atlantic Ocean. In recent years, Boston has started to experience more floods, storm surges, and higher-than-normal tides. Storm surges happen when ocean water is pushed onto land from an incoming storm. Tides are daily events during which water levels rise and fall based on the gravitational forces between the moon and Earth. Tides are closely connected to the sea levels on Earth.

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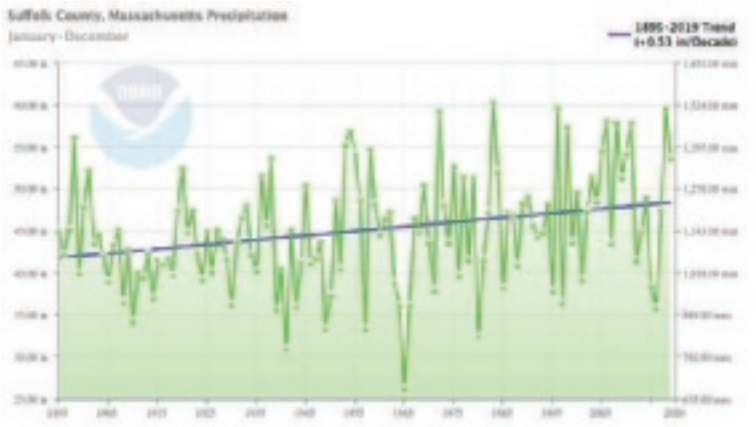

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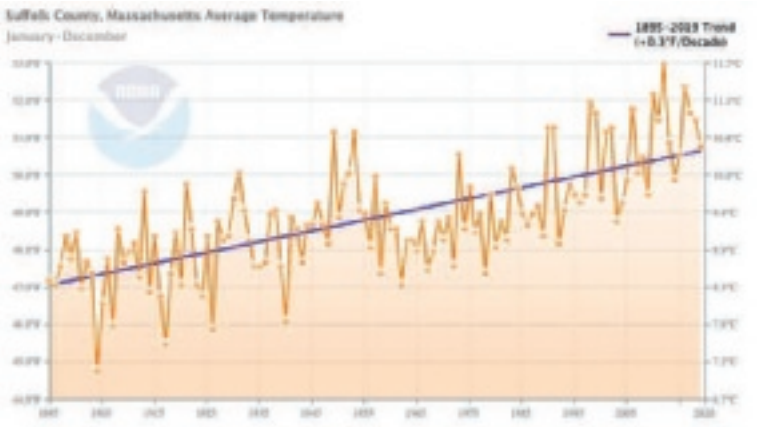

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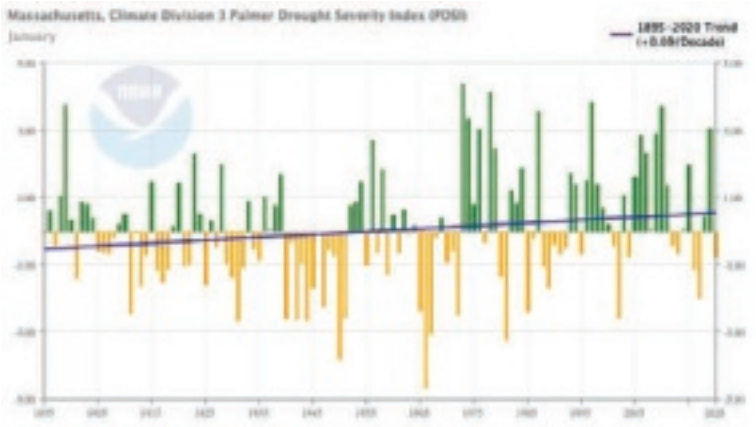
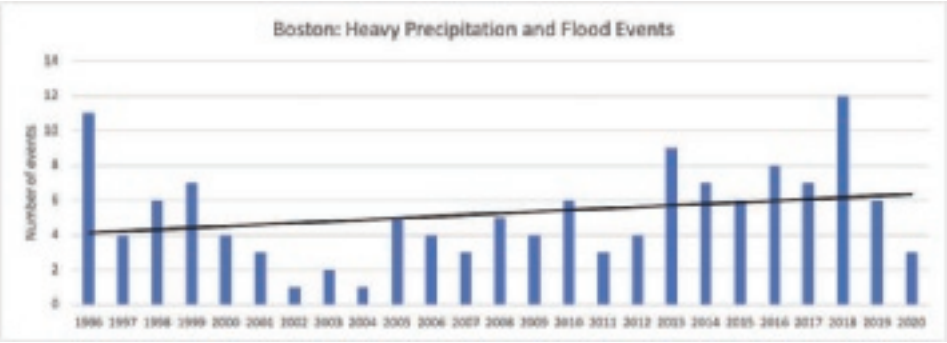


Data Source: NCEI/NOAA

Heavy Precipitation and Flood Events



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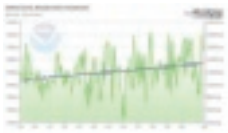
Total Annual Precip.  Data Source: NCEI/NOAA		
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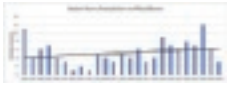
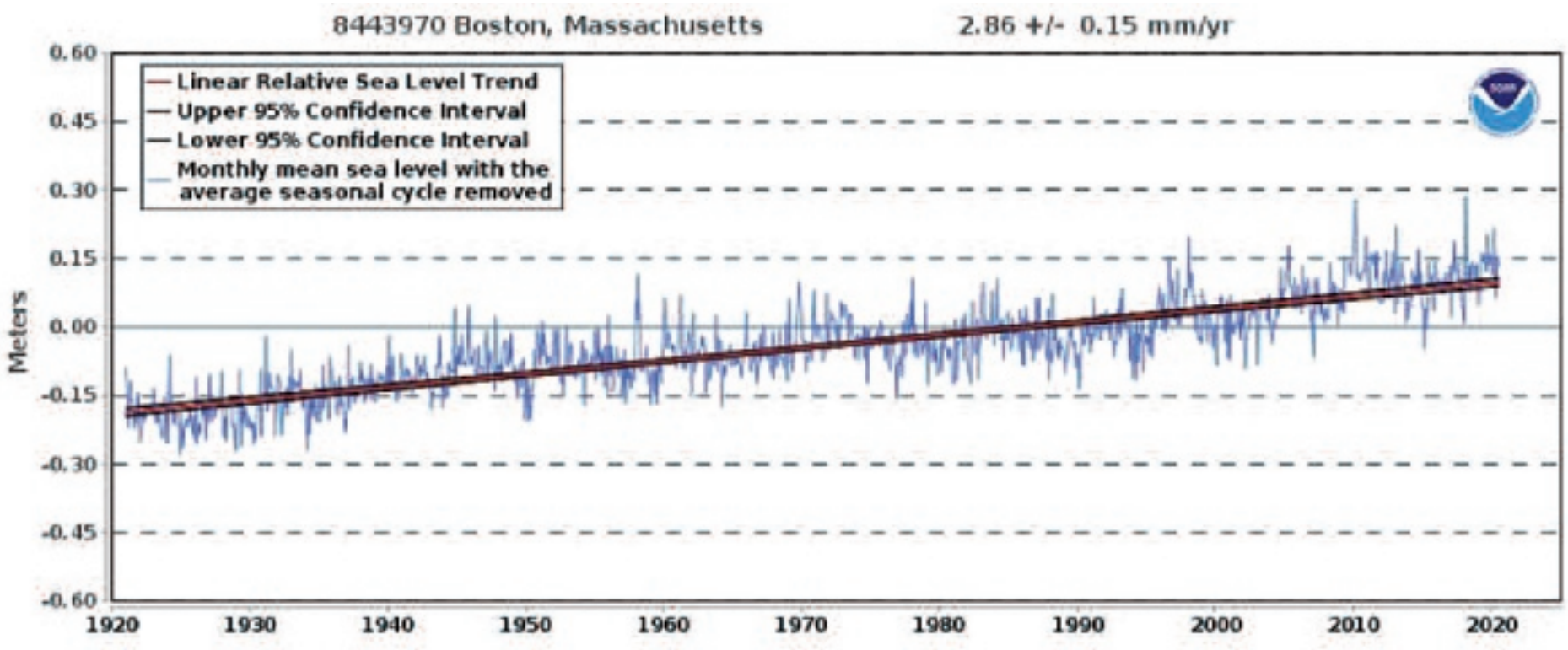
Heavy Precipitation and Flood Events  Data Source: NCEI/NOAA		

Boston is on the East Coast and some of the flood events represented above include "coastal floods" during which sea water floods the downtown area of Boston. Here is one additional piece of data to consider: It is 100 years of sea-level data. The blue line shows monthly mean sea level and the red line shows the trend over time.

- What do you notice?
- How might this contribute to the flooding situation in Boston?



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Name: _____ Date: _____

Case Site: Yakima, Washington

Read About: Yakima Valley is a farming region on the east side of the Cascade Mountains. This region grows a large amount of food, including 70% of all apples grown in the US! The Cascade Mountains usually receive snowfall in the winter, and, as the snow builds up, it freezes together. This is called a snowpack. The amount of water stored as snowpack can be measured and converted to "snow water equivalent" (similar to measuring how much rain falls during a storm). In the spring and summer, the warmer temperatures melt the snowpack, and the water runs down the mountains to the Yakima Valley below. This water is used by the towns for drinking water and also to water the crops on the farms.

Part 1: Prepare to Analyze and Interpret Data.

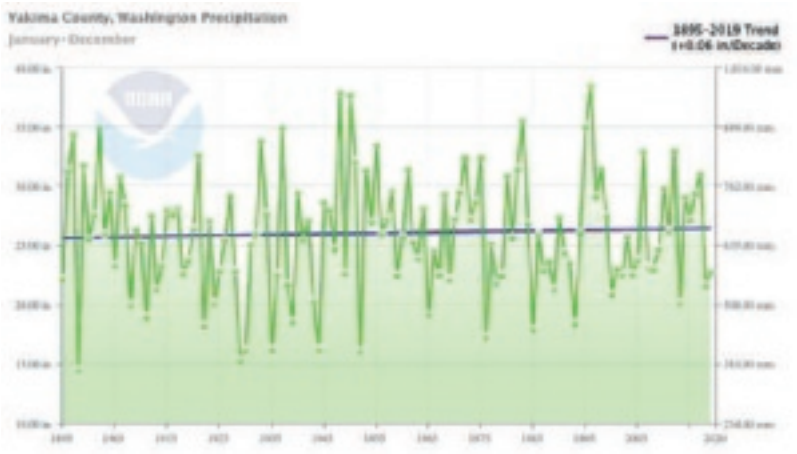
Before you analyze the data, do the following:	Your notes:
1. **Read about the data** sources on *About the Data*. • Consider your purpose: Why are you using this data? How might it help you understand floods and droughts?	
2. What **component of the Earth's Water System Model** does this community rely on and/or have problems within the community?	

Part 2: Analyzing Data. Write or annotate on the graphs on the next page as you consider what you notice or see in the data (WIS) and what it means (WIM).

As you analyze the data, do the following:
3. **Annotate (write and draw) on the graphs "what I see" statements (WIS)** to highlight your observations of the data shown in part 2. Observations might include high points in the data, low points in the data, the direction of data lines, or other observations you might have about the data you see on the graphs or maps. Write the WIS statement directly on the graph near your observation. Draw an arrow to indicate exactly what data or part of the graph you are writing about.
4. Begin **interpreting what you think the data means by writing a "what it means" statement (WIM)** for your case site on the data in part 2. For each of your WIS statements, write a WIM statement as an interpretation of what you see and the data you reference. WIM statements can also include overall trends you see across the data set or specific patterns in the data. Try to describe what the data means to you.
5. Consider what **other types of data** you might want to look at as well or **new questions** that you have. Note those ideas in part 3.

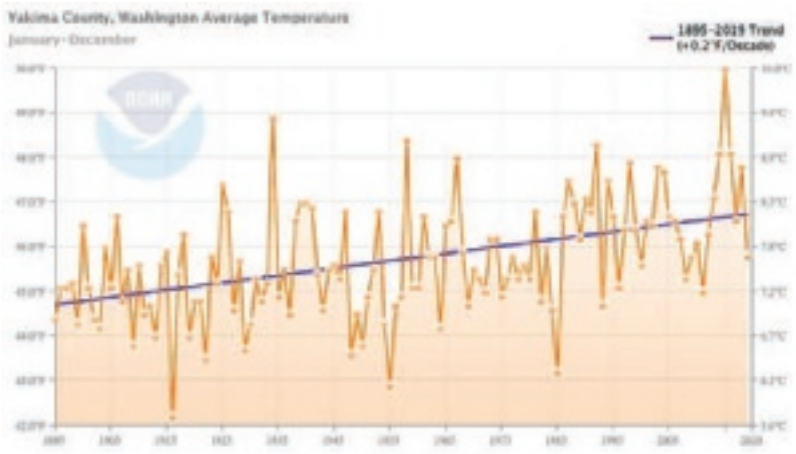
Part 2 continued: Data to Investigate. Write or annotate on these graphs as you consider what you notice in the data (WIS) and what it means (WIM).

Total Annual Precipitation (1895-2020)



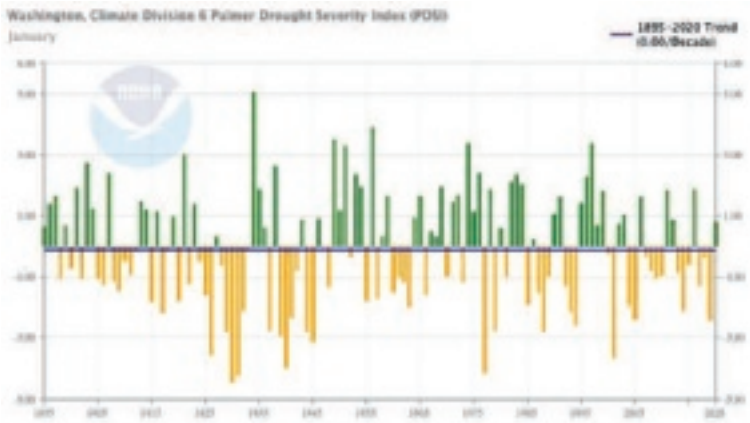
Data Source: NCEI/NOAA

Average Annual Temperature (1895-2020)



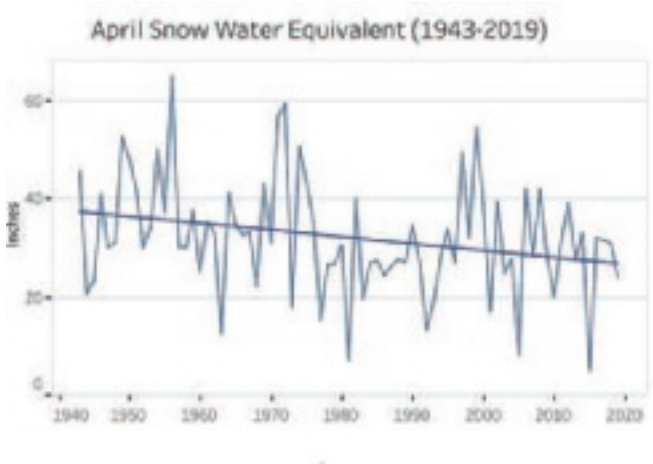
Data Source: NCEI/NOAA

Palmer Drought Severity Index (1895-2020)



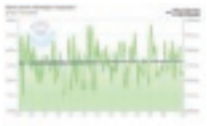
Data Source: NCEI/NOAA

Snow Water Equivalent



Frankson, et al. (2022). Washington State Climate Summary. NOAA/NESDIS. Used with permission.

Part 3: Record Your Graph Captions. Describe what the graph tells you about the location. Summarize your WIS and WIM statements and include the short-term variability and long-term trends in your caption. Record your teammates' captions as well.

Data Source	Data Source Captions	Questions I have:
Total Annual Precip.  Data Source: NCEI/NOAA		
Average Annual Temp.  Data Source: NCEI/NOAA		
PDSI  Data Source: NCEI/NOAA		
Snow Water Equivalent  Frankson, et al. (2022). Washington State Climate Summary. NOAA/NESDIS. Used with permission.		

Part 4: Synthesize All Data Sets. Discuss with your team how and what you will share with the class. Start by sharing your location and a summary of the case site. Use the table below to help you plan what you will share about the data. Be sure to connect the data to problems that the site is experiencing.

Communicate Claims and Evidence	Your Notes:
What claim, if any, can you make about what is happening with precipitation (including droughts or floods) at your case site? How does the data support your claim?	
What claim, if any, can you make about what is happening with temperatures at your case site? How does the data support your claim?	
How will you communicate the patterns and relationships in your data to your peers?	

Name: _____ Date: _____

Case Site: Windom, Minnesota

Read About: Windom is a small farming town in southern Minnesota with about 4,600 residents. It was settled on the Des Moines River in the 1870s. Today, the river is slow flowing and used for canoeing. But in recent years, the town experienced a record-breaking flood—one during which waters reached the same height as a flood 50 years ago. A lot of towns in southern Minnesota are experiencing similar floods.

Part 1: Prepare to Analyze and Interpret Data.

Before you analyze the data, do the following:	Your notes:
1. **Read about the data** sources on *About the Data*. • Consider your purpose: Why are you using this data? How might it help you understand floods and droughts?	
2. What **component of the Earth's Water System Model** does this community rely on and/or have problems within the community?	

Part 2: Analyzing Data. Write or annotate on the graphs on the next page as you consider what you notice or see in the data (WIS) and what it means (WIM).

As you analyze the data, do the following:
3. **Annotate (write and draw) on the graphs "what I see" statements (WIS)** to highlight your observations of the data shown in part 2. Observations might include high points in the data, low points in the data, the direction of data lines, or other observations you might have about the data you see on the graphs or maps. Write the WIS statement directly on the graph near your observation. Draw an arrow to indicate exactly what data or part of the graph you are writing about.
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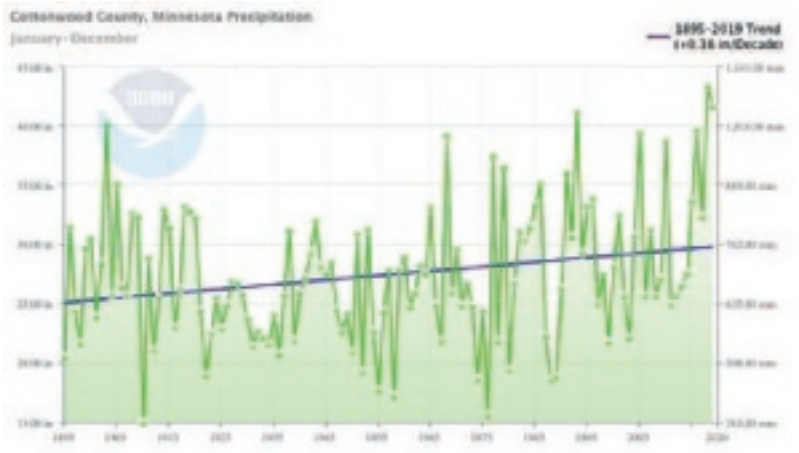
5. Consider what **other types of data** you might want to look at as well or **new questions** that you have. Note those ideas in part 3.

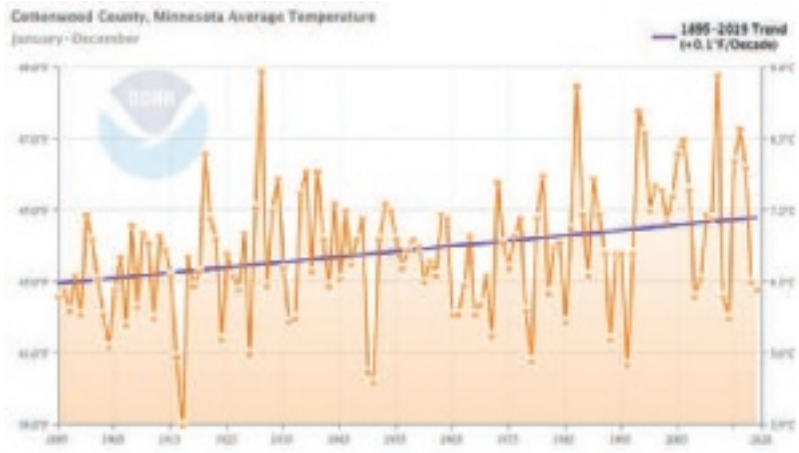
Part 2 continued: Data to Investigate. Write or annotate on these graphs as you consider what you notice in the data (WIS) and what it means (WIM).

Total Annual Precipitation (1895-2020)



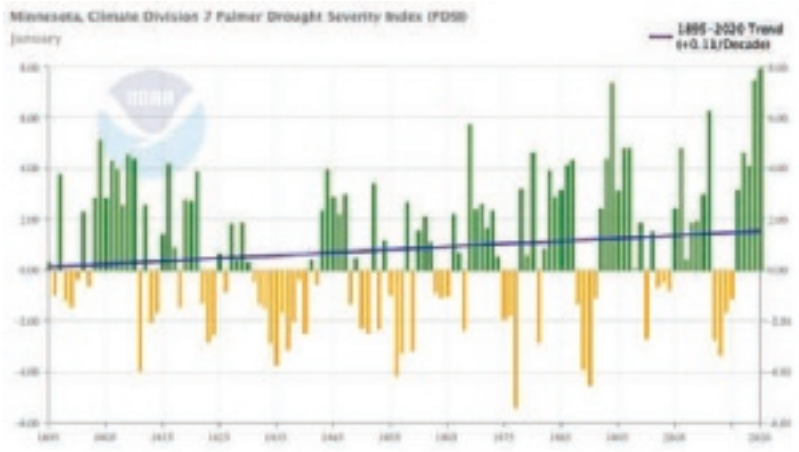
Data Source: NCEI/NOAA

Average Annual Temperature (1895-2020)



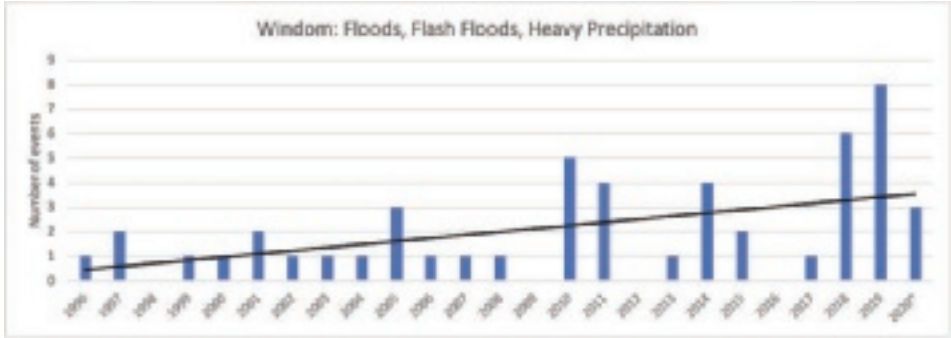
Data Source: NCEI/NOAA

Palmer Drought Severity Index (1895-2020)



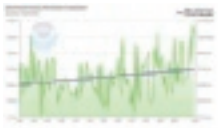
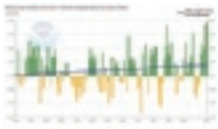
Data Source: NCEI/NOAA

Heavy Precipitation and Flood Events



Data Source: NCEI/NOAA

Part 3: Record Your Graph Captions. Describe what the graph tells you about the location. Summarize your WIS and WIM statements and include the short-term variability and long-term trends in your caption. Record your teammates' captions as well.

Data Source	Data Source Captions	Questions I have:
Total Annual Precip.  Data Source: NCEI/NOAA		
Average Annual Temp.  Data Source: NCEI/NOAA		
PDSI  Data Source: NCEI/NOAA		
Heavy Precipitation and Flood Events  Data Source: NCEI/NOAA		

Part 4: Synthesize All Data Sets. Discuss with your team how and what you will share with the class. Start by sharing your location and a summary of the case site. Use the table below to help you plan what you will share about the data. Be sure to connect the data to problems that the site is experiencing.

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What claim, if any, can you make about what is happening with temperatures at your case site? How does the data support your claim?	
How will you communicate the patterns and relationships in your data to your peers?	

Name: _____ Date: _____

Temperature and Evaporation Investigation Planning

What question are we trying to answer:

What are the key parts of the setup map to the places we're investigating in the real world?

Key parts of the bottle setups	Purpose (What it represents in the real world)

Independent variable: _____

Control: _____

Dependent variables: _____

Group Humidity and Temperature Lab

Gather the materials needed for your individual bottle setup.

Materials needed for each type of bottle setup:	
Land soaked with water or groundwater	Land in a drought
• 2-L soda bottle (bottom cut off, cap on) • humidity and temperature probe with hook-and-loop fastener • 6 in. clay saucer • wet soil (enough to fill the bottom of the clay saucer) • timer • 2 sticky notes and 1 dark marker	• 2-L soda bottle (bottom cut off, cap on) • humidity and temperature probe with hook-and-loop fastener • 6 in. clay saucer • dry soil (enough to fill the bottom of the clay saucer) • timer • 2 sticky notes and 1 dark marker
★ If your group is increasing the temperature, you will also need 4 hand warmers.	

Read the directions below to complete your lab. If you are using hand warmers to increase the temperature of your bottle, follow the instructions with a star (★) next to them. If you are not using the hand warmers, skip the starred steps.

1. Gather the materials needed for your group's assigned bottle setup.
2. ★ If your group is using hand warmers to increase the temperature, begin shaking the individual hand warmers. Shake the hand warmers for at least 30 seconds and continue shaking until the hand warmers heat up.
3. Place the wet or dry soil in the clay saucer.

4. Secure the humidity and temperature sensor inside of the 2-liter bottle with the display facing out so you can see it.

5. Place the 2-liter bottle on top of the 6 inch saucer.

6. Take an initial reading for the temperature and humidity and record it in your notebooks.

7. ★ If your group is using hand warmers to increase the temperature, lay the hand warmers out next to each other. Try to make the hand warmers lay flat. Carefully place the bottle setup on top of the hand warmers.

8. Start your timer. Record the temperature and humidity of the bottle setup every 2 minutes for 8 minutes.

9. At the end of the 8 minutes, record your final readings in your notebooks.

10. Calculate the change in temperature and humidity. Write the change in temperature on one sticky note. Write the change in humidity on the other sticky note. Post to your class' data chart next to the condition your group tested.

11. Clean up your area by:

- Removing the sensor from the 2-liter bottle.
- Using a towel or paper towel to clean out the inside of the 2-liter bottle.
- Returning the wet or dry soil to the proper containers.
- ★ Returning the hand warmers to your teacher.
- Placing all other materials in their designated areas.

Name: _____ Date: _____

Obtaining Information about Other Components

What we're trying to figure out: Are rising temperatures affecting anything else in the system?

Obtaining Information Checklist	
• Read for the gist—skim the title, headings, images.	What are central ideas or claims made by the scientists who wrote this information?
• Mark the text.	Select methods for marking the text. For example: • Keep track of questions you have in the margins. • Circle key words. • Put question marks by words you want to learn more about. • Underline main ideas.
• Examine any images, graphs, or tables.	Write one sentence about the central point of each image, graph, or table.
Evaluating Information Checklist	
• Identify the claims in the text.	Were the ideas or claims shared supported by evidence? How so or how not?

Conclusion: Are rising temperatures affecting this component of Earth's water system?

Name: _____ Date: _____

Initial Water Story Explanation

Your Role: To create a clear and convincing explanation to others to (1) explain how or why water is changing in one community and (2) support the how or why with evidence.

Consider your Audience: _____

Choose your Format: _____

Think about the Topic: The question it needs to answer is:

How are rising temperatures changing water stories in _____ community?

Be sure your explanation includes:

- Is this normal or not normal for this place? How do you know?
- What does the data say about how things are changing (or not)?
- How or why is this happening in this community?

Helpful sentence starters for constructing your explanation include:

- The sources of water used by this community include. . .
- The temperature data show a long-term pattern of. . .
- The precipitation data show a long-term pattern of. . .
- The other data show. . .
- This means. . .
- When temperatures rise, evaporation is affected by. . .
- This community's water story is affected by. . .

If writing an explanation, use the space below to jot down some notes. Then write your explanation on the next page. If using a pictorial format or diagram, use a blank sheet of paper to plan and draw your ideas.

How are rising temperatures changing water stories in _____ community?

Name: _____ Date: _____

Peer Feedback Instructions

Use this guide to provide feedback on important elements in the explanation.

Important elements of scientific explanations	Peer feedback: Use a colored pencil
1. Does the explanation explain how or why the phenomenon is happening in this community? Does it specifically include the following: a. Does it explain what is happening with water in the community and why it is changing? b. Does it explain what is happening with temperature in the community? c. Does it make connections between rising temperature and changing water sources in the community?	Underline parts where they explain how or why this is happening to the community. • Could their explanation be improved by using more science ideas? If so, which ones and where would you add them?
2. Does the explanation include evidence from classroom investigations (data, labs, readings, videos) to support the science ideas?	Circle examples of evidence. • Could the explanation use more evidence to support it? If so, add suggestions of what evidence could be used and where to use it.

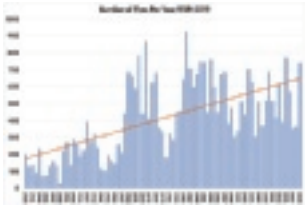
Name: _____ Date: _____

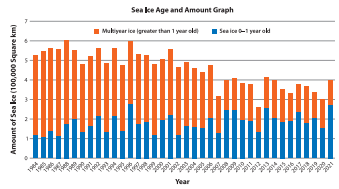
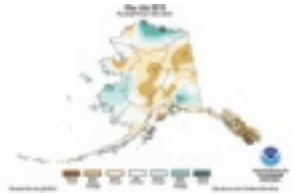
Alaska Graph Notes

We have spent some time reading and listening to claims from a headline from July 2019 and an Iñupiaq whaler. A summarized version of those claims are below:

Alaskan Headline Claims	Alaskan Whaler Claims
Alaska is experiencing bad wildfires. It is dry and hot in the arctic.	Older, multi-year ice is disappearing. There is less multi-year sea ice than before. There is more water where the sea ice should be.

Look at the information provided here and *What Causes Wildfires*? with your group. Think about how these data sources might relate to the claims we saw in the headline and from the whaler. Complete the table below to keep track of your observations, and how claims from the headline and from the whaler might be related.

Data source	Note your observations of the graphs:	Does this relate to the Alaskan headline claims? How?	Does this relate to the Alaskan Iñupiaq whaler claims? How?
Wildfires Graph  AICC/Alaska Fire Service			
Precipitation Graph  NOAA/National Centers for Environmental Information			

Data source	Note your observations of the graphs:	Does this relate to the Alaskan headline claims? How?	Does this relate to the Alaskan Iñupiaq whaler claims? How?
Average Temperature Graph  NOAA/National Centers for Environmental Information			
Sea Ice Age and Amount Graph  Data Source: Walter Meier National Snow and Ice Data Center			
May-July 2019 Precipitation Map  NOAA/National Centers for Environmental Information			

Based on your data, do you think that the phenomena described by the headlines and the whaler are related? Or are these phenomena caused by separate events? What data do you have to support or refute this connection between the claims?

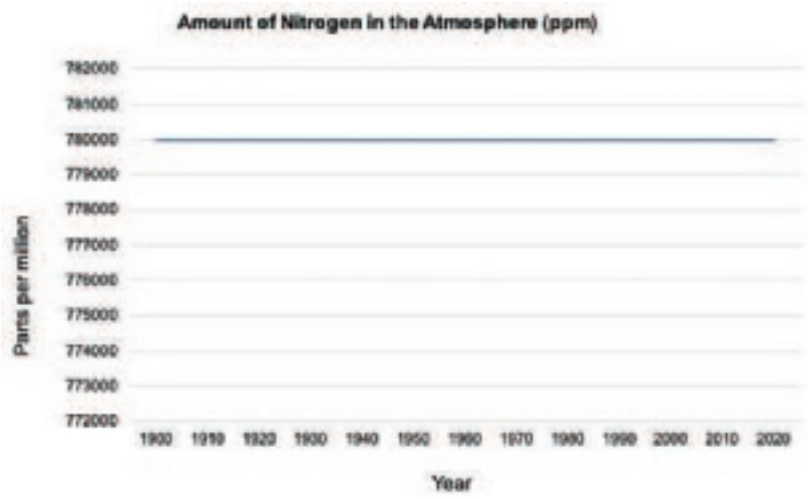
Name: _____ Date: _____

Concentration of Gases in the Atmosphere Over Time

Question we are trying to figure out: *Are changes in the air related to rising temperatures?*

- Step 1: Annotate the graphs on your own. Then share your notes with a partner.
- Step 2: Complete calculations in partners or small groups.
- Step 3: Draw initial conclusions from the data and your calculations.

Nitrogen



Data based on 78% nitrogen in atmosphere. Data source: UCAR

Starting Amount ppm: _____

Ending **Amount** ppm: _____

(Ending - Starting = Change)

Change in ppm: _____

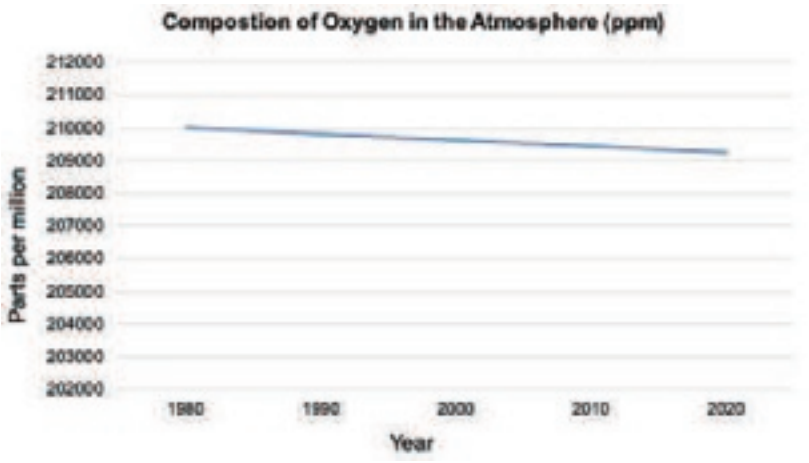
Calculate percent change:

_____ / _____ =
(change) (starting)

x 100 = _____ % change

in _____ **years**

Oxygen



Data Source: Atmospheric Oxygen Research, Scripps Program.

Starting Amount ppm: _____

Ending **Amount** ppm: _____

(Ending - Starting = Change)

Change in ppm: _____

Calculate percent change:

_____ / _____ =
(change) (starting)

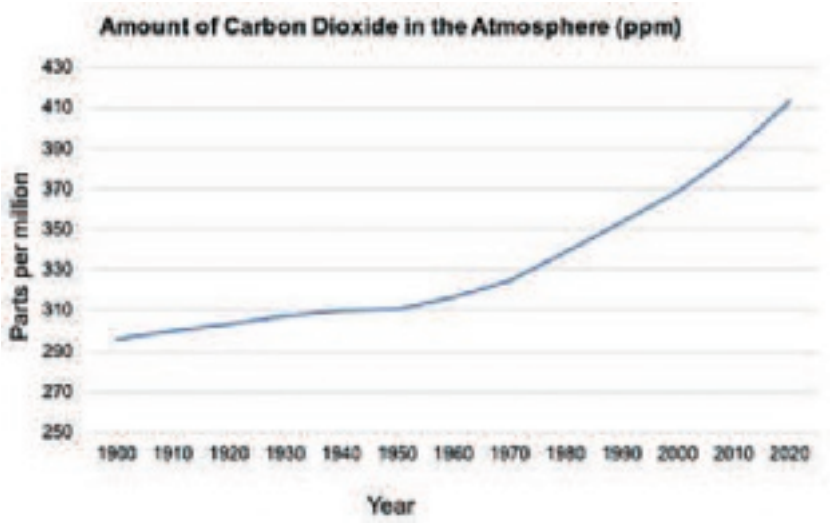
x 100 = _____ % change

in _____ **years**

Water Vapor

Water vapor can be found in concentrations as little as 10ppm in the most arid places on Earth and as much as 50,000 ppm in the most humid places on Earth. The amount of water vapor in the air depends on the temperature and pressure. That is why water vapor changes so much by location. On average, scientists estimate that the global average amount of water vapor has gone up by about 5%, though water vapor is still very challenging to measure.

Carbon Dioxide



Data Source: Dr. Pieter Tans, NOAA/GML (gml.noaa.gov/ccgg/trends/) and Dr. Ralph Keeling, Scripps Institution of Oceanography (scrippsco2.ucsd.edu/)

Starting Amount ppm: _____

Ending **Amount** ppm: _____

(Ending - Starting = Change)

Change in ppm: _____

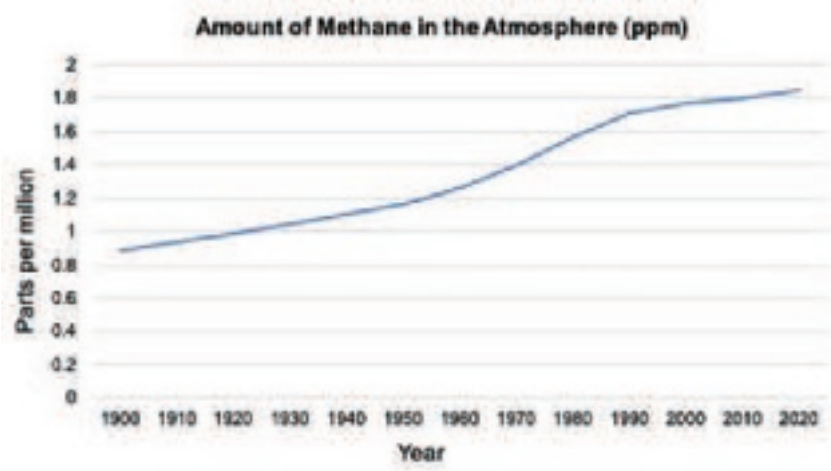
Calculate percent change:

_____ / _____ =
(change) (starting)

x 100 = _____ % change

in _____ **years**

Methane



Data Source: Dr. Pieter Tans, NOAA/GML and Dr. Ralph Keeling, Scripps Institution of Oceanography

Starting Amount ppm: _____

Ending **Amount** ppm: _____

(Ending - Starting = Change)

Change in ppm: _____

Calculate percent change:

_____ / _____ =
(change) (starting)

x 100 = _____ % change

in _____ **years**

Conclusions: How much are they changing?

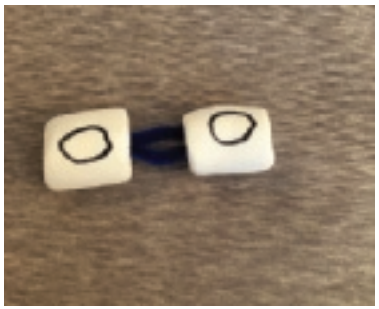
Based on your calculations above, write each gas in the appropriate column below.

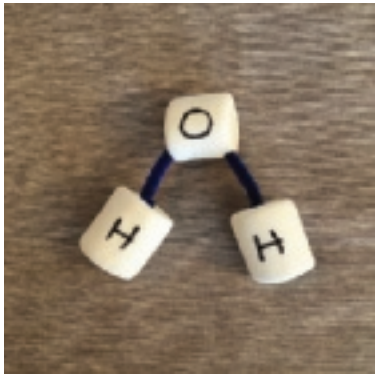
Not really changing	Changing a little	Changing a lot

In your own words, state what you've learned about the concentration of gases in the atmosphere.

Name: _____ Date: _____

Important Gases in the Atmosphere

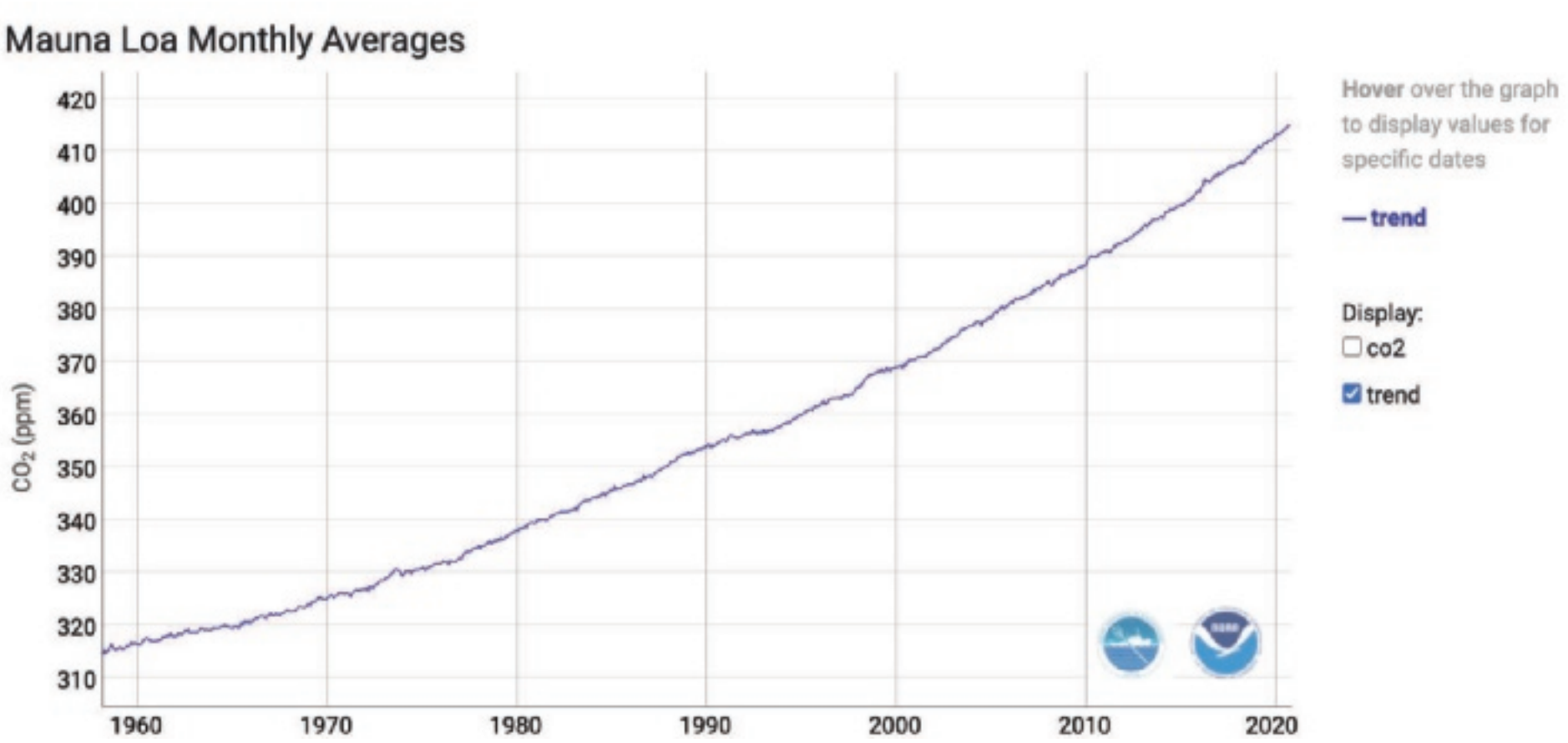
Name & Symbol	**Model**	**Observations** (Investigating with marshmallow models)	**Observations** (From the interactive)
Oxygen gas O_2			
Nitrogen gas N_2			

Name & Symbol	**Model**	**Observations** (Investigating with marshmallow models)	**Observations** (From the interactive)
Water Vapor H_2O			
Carbon dioxide CO_2			
Methane CH_4			

Name: _____ Date: _____

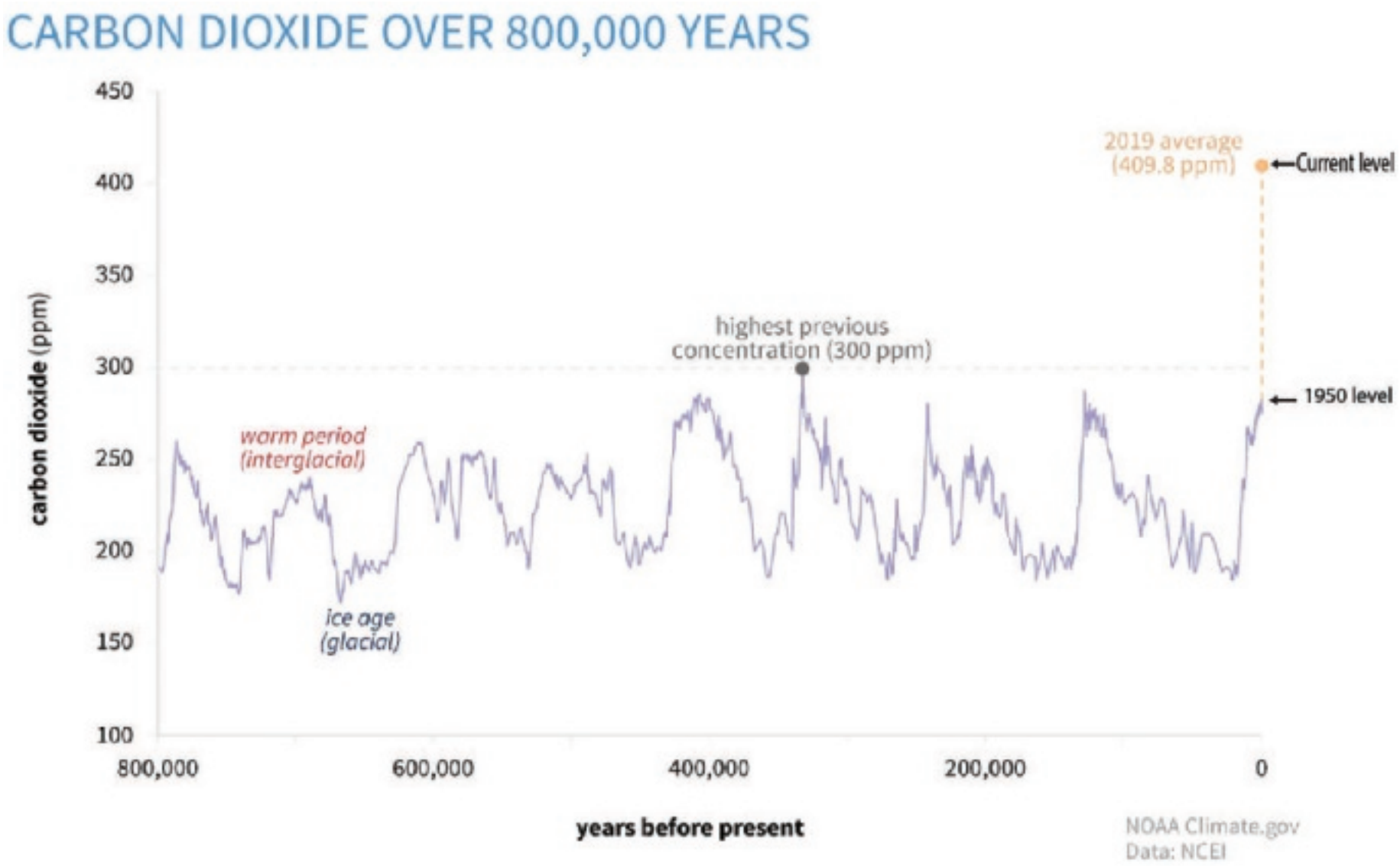
Carbon Dioxide Levels Over Time

Graph 1: Data of carbon dioxide levels, 1950 through present:



Early Systems Research Laboratories/NOAA

Graph 2: Data of carbon dioxide levels reaching back 800,000 years ago:



Climate.gov

Name: _____ Date: _____

Examining Data Over Time

Part 1: Prepare to Analyze and Interpret Data.

As you analyze the data, do the following:
1. Consider your purpose: Why are you using this data? How might it help you understand what we are trying to figure out?
2. **Annotate (write and draw) on the graphs "what I see" statements (WIS)** to highlight your observations of the data. Observations might include high points in the data, low points in the data, the direction of data lines, or other observations you might have about the data you see. Write the WIS statement directly on the graph near your observation. Draw an arrow to indicate exactly what data or part of the graph you are writing about.
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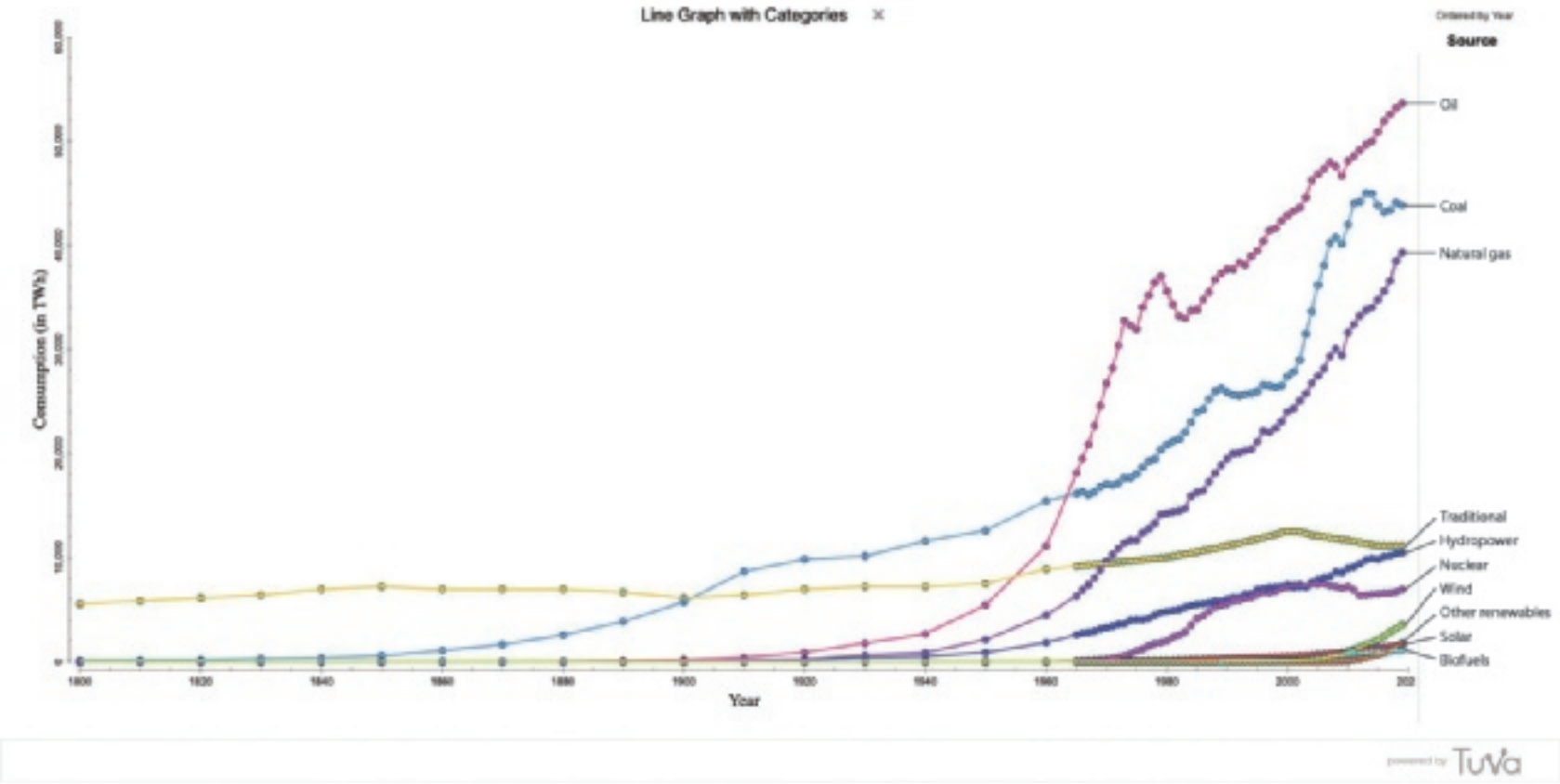
4. Consider what **other types of data** you might want to look at as well or **new questions** that you have. Note those ideas in part 3.

Part 2: Analyzing Data & Record Graph Captions. Write or annotate on the graph as you consider what you notice or see in the data (WIS) and what it means (WIM). Describe what the graph tells you about the location. Summarize your WIS and WIM statements and include the short-term variability and long-term trends in your caption.

Fuel Consumption, 1800-Today



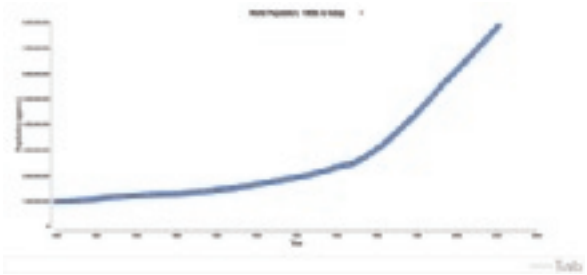
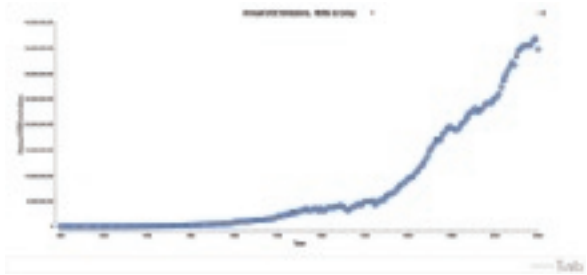
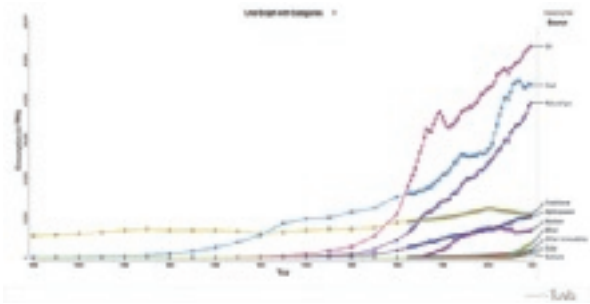
Data Source: Our World in Data

Caption for Graph:

Name: _____ Date: _____

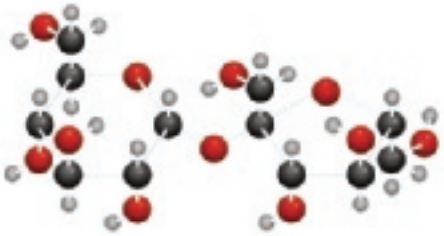
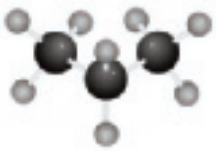
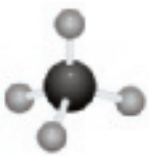
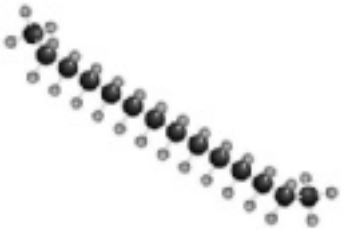
Population, CO_2 Levels, and Fuel Consumption

1. **Analyzing Data.** Write or annotate <u>on the graphs</u> and write down some wonderings you have.

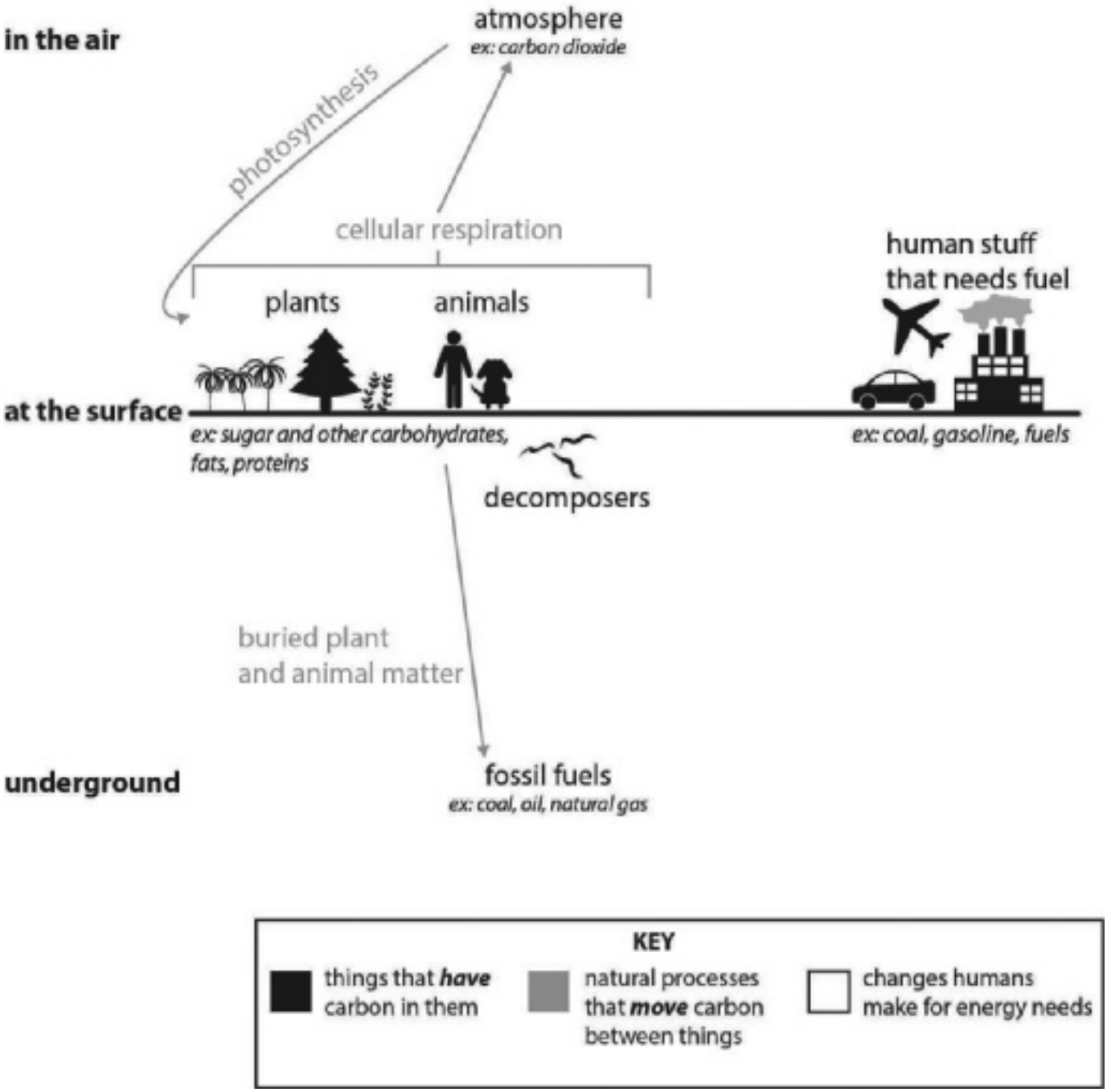
Population 1800-Today	CO_2 Levels in the Atmosphere, 1800-Today	Fuel Consumption, 1800-Today
 Data Source: Our World in Data	 Data Source: Our World in Data	 Data Source: Our World in Data
Wonderings		

2. How would you describe the patterns and trends across all three graphs? What questions do you have now?

Fuel Molecule Cards

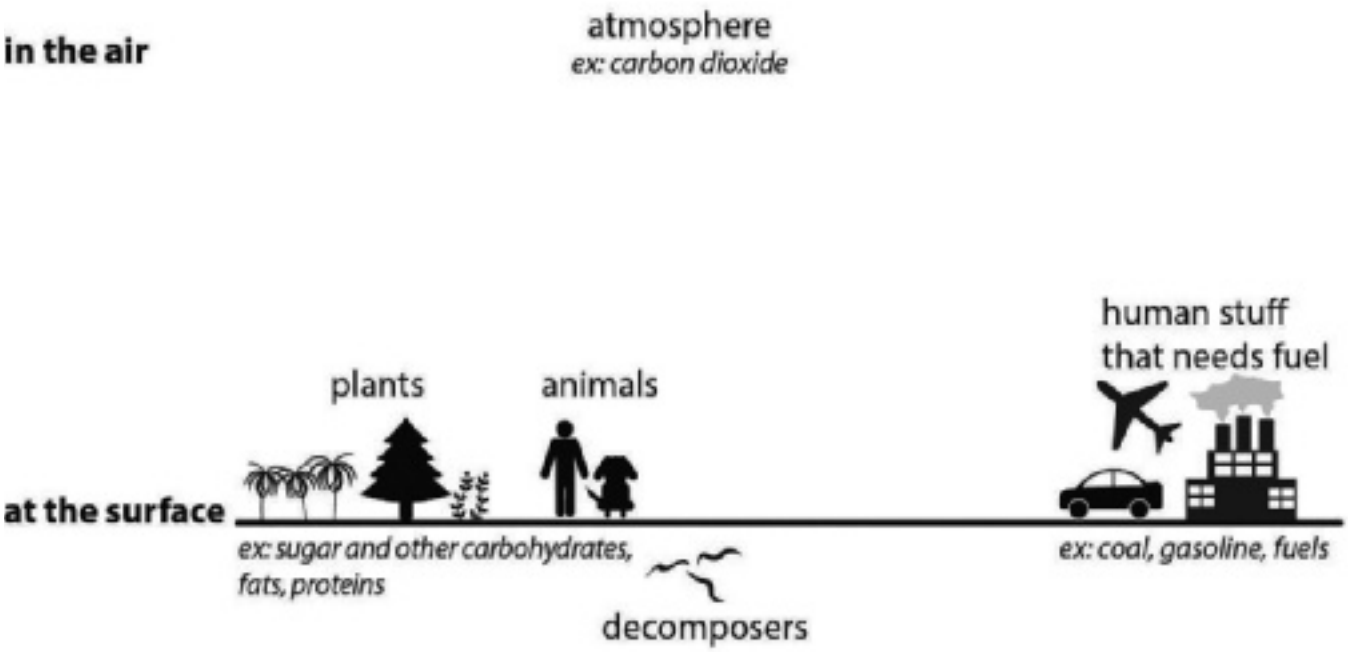
Key  	butane C_4H_{10} 	sugar $C_{12}H_{22}O_{11}$ 
propane C_3H_8 	octane C_8H_{18} 	glucose $C_6H_{12}O_6$ 
methane CH_4 	methanol CH_3OH 	diesel $C_{14}H_{30}$*  * average

Earth's Carbon System



Option 1 in Grayscale

Earth's Carbon System



Option 2

Earth's Carbon System

in the air

at the surface _____

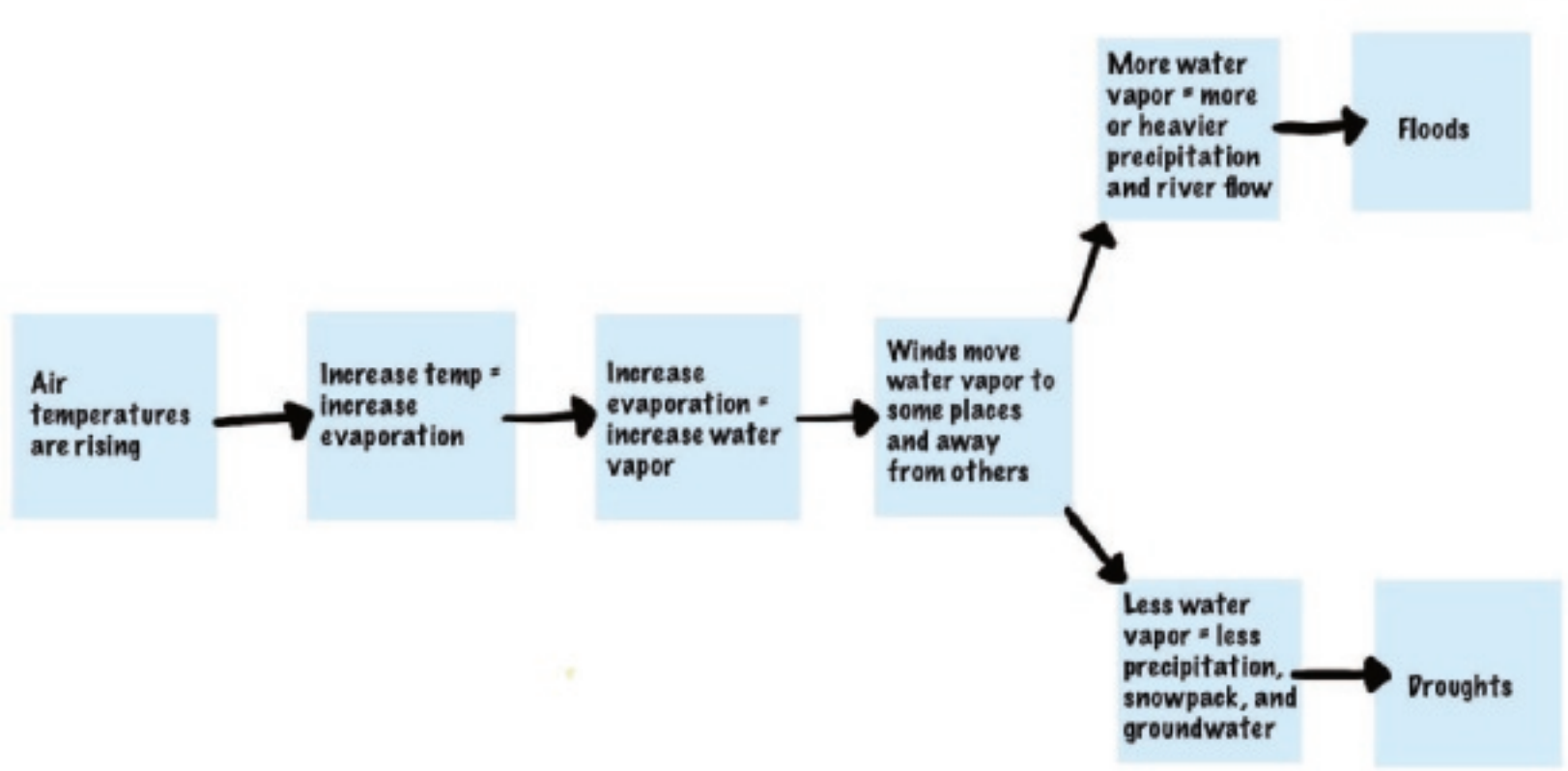
underground

KEY

- ☐ things that ***have*** carbon in them
- ☐ natural processes that ***move*** carbon between things
- ☐ changes humans make for energy needs

Option 3

Cause-and-Effect Diagram



Fossil Fuel Use Cause-and-Effect Diagram

How can fossil fuel use cause a change in air temperatures?

- Add boxes between the two boxes in the template. Each box should represent an idea you figured out that is important in the chain of events.
- Connect the boxes with arrows or lines showing what is related to or causing the next event in the chain.

Cut here

Fossil Fuel Use Cause-and-Effect Diagram

How can fossil fuel use cause a change in air temperatures?

- Add boxes between the two boxes in the template. Each box should represent an idea you figured out that is important in the chain of events.
- Connect the boxes with arrows or lines showing what is related to or causing the next event in the chain.

Name: _____ Date: _____

UCAR Simple Climate Model Observation Tracker

Instructions: Use the table below to do the following:

- Record changes to the emissions rate you think will help with the carbon imbalance.
- Record your predictions.
- Run the simulation and record your observations of the graphed data.

Change to emissions rate	Gigatons of carbon	Prediction of the effects on temperature and CO_2 concentration	Observations of temperature and CO_2 between now and 2100
Eliminate all carbon emissions.	0		
Cut emissions in half.	5.2		

What amount of emissions needs to be cut to reduce global temperatures? _____

What happens to the temperature and amount of atmospheric carbon dioxide if we get rid of all carbon emissions? Is this a realistic goal? Why or why not?

Home Carbon Audit

Investigate your home energy, transportation, and food use. Bring your results to class.

	Circle or Fill in Blank
Appliances	
Do you have Energy STAR appliances in your home?	Yes / No
Lighting	
Do you use energy efficient light bulbs?	Yes / No
Does everyone in your household turn off the lights when they leave a room empty?	Yes / No
Water	
How often is the shower in your house used each day?	_____
How many loads of laundry does your household do each week?	_____
Electronics	
Does your household turn off the TV when they are not watching it?	Yes / No
How many hours are TVs on in your house each day? Multiply the time by the number of TVs in your house.	_____
Does your household turn off video game consoles when they are not in use?	Yes / No
How many hours each day does your household play video games?	_____
How many of your household's chargers for cell phones, iPods, and MP3 players remain plugged in when not in use?	_____
How many hours a day are computer(s) used in your household?	_____
Trash and Recycling	
How many bags of garbage does your household dispose of each week?	_____
Does your household recycle paper products?	Yes / No
Do you recycle plastic?	Yes / No
Does your household recycle cans?	Yes / No
Air Conditioning	
How many rooms does your home air condition in the summer?	_____

Transportation

How do you get to school each day?	Car/Bus/Walk/Bike/Other
How many times a week does your household use a car?	_____
How many times have you flown in an airplane in the past year?	_____
What kinds of cars does your household drive and how many?	Small car/Hybrid _____
	Midsize _____
	Large SUV/Truck _____

Food

How many individual servings of wrapped food does your household eat each day? (Such as chips, cookies, candy, and pretzels)	_____
What kind of food does your household eat?	Vegan, vegetarian, everything
How many times a week does your household eat at a fast food restaurant?	_____

Name: _____ Date: _____

Carbon Reduction Solution Matrix

The problem we are wanting to help to solve: _____

Evaluating the solution against our criteria and constraints:

Solution	Criteria:	Constraint 1	Constraint 2	Constraint 3	Constraint 4	Constraint 5	Constraint 6

Solution	Criteria:	Constraint 1	Constraint 2	Constraint 3	Constraint 4	Constraint 5	Constraint 6

Name: _____ Date: _____

Evaluating Community Solutions

Part 1: Sort solutions into how they work. Consider if the solution is rebalancing carbon in some way or if it is providing some community adaptation for conditions that are already changing in the community.

Reduce carbon emissions	Takes carbon back out of atmosphere	Has other community benefits beyond rebalancing carbon

Part 2: Record new ideas and new questions you have.

New ideas I gained from reviewing this community plan	New questions I have about community plans

Name: _____ Date: _____

Community Resilience Plan: Project Planning Sheet

Part 1: Changes in Our Community

Based on the evidence you've seen, list the changes that are happening in the community. Think about who the change might impact the most. This will help you define the problem and who it impacts in your community.

Changes we are experiencing now or may experience in the future	Community members who may be most impacted

Part 2: Identify Stakeholders and How They Could Be Affected

Think about our community stakeholders. How will they be impacted by the problems in Part 1? Imagine yourself as one of these people. What would you be worried about the most?

Stakeholder	Ways they may be affected	What they may worry about

Part 3: Science Ideas and Evidence

Look at your class's checklist. Given the changes you listed above and the people they impact most, consider how you will inform your audience about the causes of the problem. How will you convince them, using evidence, that this problem is happening or will happen in the future and how they could be affected.

Science ideas to share	Evidence to make make our plan easily understandable to others

Part 4: Choose a Mix of Solutions

Look at your class's criteria checklist and think about the problems in your community. What mix of solutions do you want to include in your community resilience plan?

List solutions for your community to contribute to the long-term rebalancing of carbon (see Carbon Solution Cards)	Why is this solution a good one for your community? Make a short convincing argument.

List solutions for your community to be better prepared for changes happening now (see Water Solution Cards)	Why is this solution a good one for your community? Make a short convincing argument.

What are some potential issues you may encounter with this mix of solutions? Will they help all members of the community? Could they negatively impact some community members?

Part 5: Peer Feedback

Exchange your plan with a member from another group. Take on the role of a skeptical community member. Ask questions to challenge the plan. This will help the group consider how they can improve their plan and how to better communicate it. Then, make suggestions to help their planning.

Reviewer's Name: _____

Agreed Upon Criteria	Pretend to be a skeptical community member. What questions do you have to challenge the plan?	Now take on the role of a thought partner. Make suggestions for how to improve the plan.
Tells people about the problem(s). Evaluate Parts 1 & 2		
Teaches people about what's causing the problem. Evaluate Part 3		
Directs people to solutions. Evaluate Part 4		
Other:		

Name: _____ Date: _____

Designing a Community Resilience Plan: Teacher Feedback

What an effective plan does	What we should include	Questions a community member may ask to challenge the plan	Suggestions for improvement
Tells people about the problem(s).	• Our community will experience more drought or flood, or both. • Some seasons might become drier or wetter than before. • Some areas or some people in our community might be at more risk or more impacted.		
Teaches people about what's causing the problem.	• Carbon dioxide is building up in the atmosphere. • Carbon dioxide traps energy in the atmosphere that causes temperatures to rise. • Warmer temperatures means more evaporation and water vapor in the atmosphere, but it doesn't fall evenly. • Photosynthesis is one way to take CO_2 out of the atmosphere but there are also ways to reduce putting it in the atmosphere. Some combination is necessary to solve the problem.		
Directs people to solutions	• Share solutions their community can take to help with long-term carbon rebalancing. • Share solutions their community can take now to deal with the community water and/or heat problems. • Give people more than one way to help. • Include different actions that different people can take in different situations.		

Name: _____ Date: _____

Reviewing Our Driving Question Board

Look through the list of questions from our DQB. Mark questions that you think the class has answered by putting different symbols next to each question:

- We did not answer this question or any parts of it yet: **O** or **?**
- Our class answered some parts of this question, or the ideas we developed help me see how I could now answer some parts of this question: ✓
- Our class answered this question, or using the ideas we developed, I could now answer this question: ✓✓

Question	Mark

Question	Mark

Pick three of the questions you think the class has answered and write or discuss what you think that answer would be. Answer in the space below or on a separate sheet of paper.

Name: _____ Date: _____

Science Literacy Exercise Page 1 Use with Reading Collection 1

Roadmap for Reading

This week's reading collection focuses on evidence of changes in weather and climate. The selections include a brief comic debate about whether these changes are due to human activities.

Collection 1: "Floods and Droughts" consists of five selections.

1 Historical Evidence of Climate Events
2 Piecing Together Earth's Climate History
3 Straw Men and Logical Fallacies
4 Climate Maps
5 Water, Water, Everywhere

As you read:

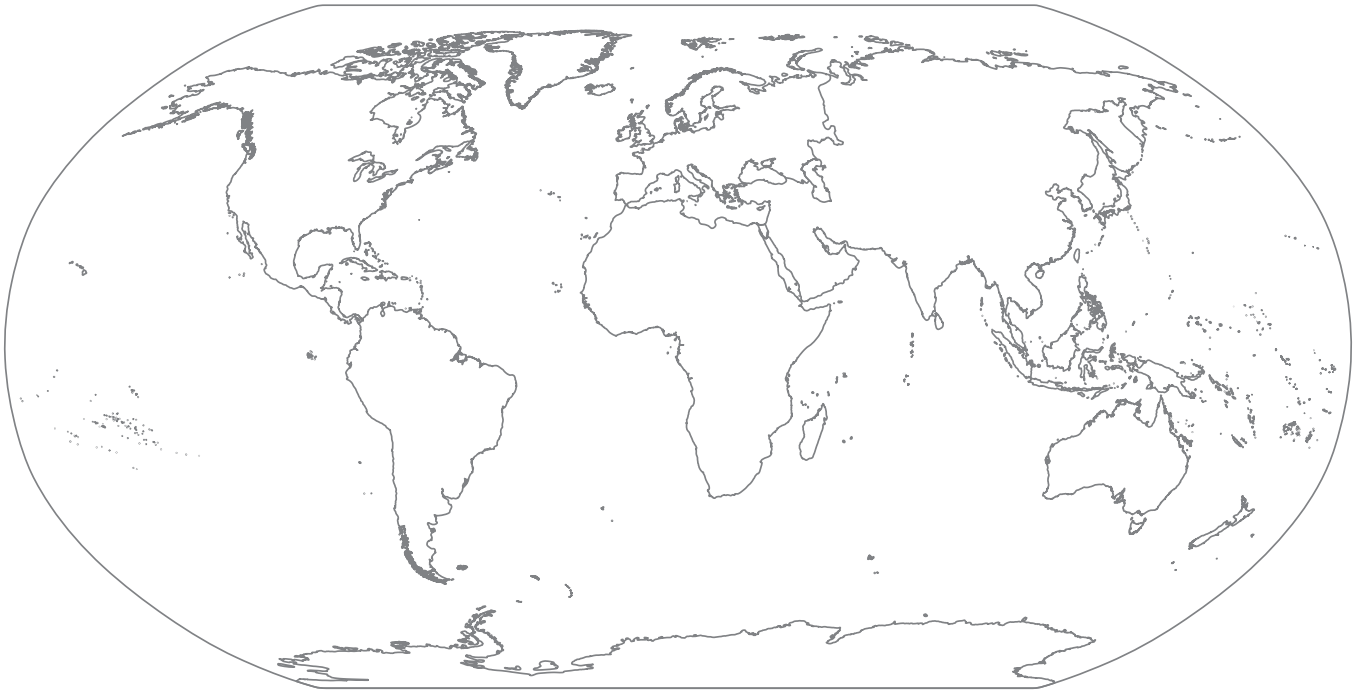
- Consider the general purpose of each part: is it a description, an explanation, a procedure, or an attempt to persuade?
- Consider how data, images, and graphics support the narrative text and how narrative text clarifies the data, images, and graphics.
- Consider how what you read relates to the scene with Elijah and his grandparents from the Preface.

Written Response

Your writing exercise is to annotate a map with evidence of weather events and climate changes in Earth's history, as described in Collection 1.

- Use the template on the reverse of this page, or draw and label your annotated map on a separate sheet of paper; attach this page to the front of it when you turn it in.
- The map need only show the outlines of continents, but make sure you include the title.
- Reflect on what you read, and identify weather events and climate events in this collection. Write brief summaries around the map, and draw lines to point to the places the events occurred.
- Make sure your descriptions include the year(s) an event happened or about how many years ago a change occurred.
- Before you begin, review the criteria in the Evaluation Guidelines that follow to help you clearly understand the expectations of the exercise.

Where and When on Earth?



Evaluation Guidelines

Element	1	2	3	Feedback
Content	Content contains inadequate detail with only one or two labels with some stated inaccurately.	Map includes at least three mostly accurate weather events or changes in climate by year or years ago.	Map includes four or five labels, accurately identifying weather events or changes in climate by year or years ago.	
Relationship of text and map	Relationship of text to the map is unclear or not accurate.	Linking lines pointing to places on the map are mostly accurate.	Linking lines clearly connect the written labels with the correct location on the world map.	
Design	Major improvements are needed in the design of the text labels, lines, and arrangement to fill the page.	All but one of the following are well executed: text positions, linking line positions, and overall use of the page.	Text and linking lines are attractively arranged, and the text is easy to read. It fills the whole page well.	
Grammar and mechanics	Five or more errors are present in capitalization, punctuation, and spelling.	A few errors are present in capitalization, punctuation, and spelling.	No errors are present in capitalization, punctuation, and spelling.	

Additional Feedback Notes:

Name: _____ Date: _____

Science Literacy Exercise Page 2 Use with Reading Collection 2

Roadmap for Reading

This week's reading collection focuses on global warming and its effects on Earth's water systems. The selections include a journal entry from a fictitious participant in an effort to measure the effects of sea level rise on a Pacific island nation.

Collection 2: "Rising Temperatures, Rising Seas" consists of four selections.

1 The Difference Between 1.5ºC and 2ºC
2 Tough Times in Tuvalu
3 Causes of Sea Level Rise
4 Effects of Warming Water

As you read:

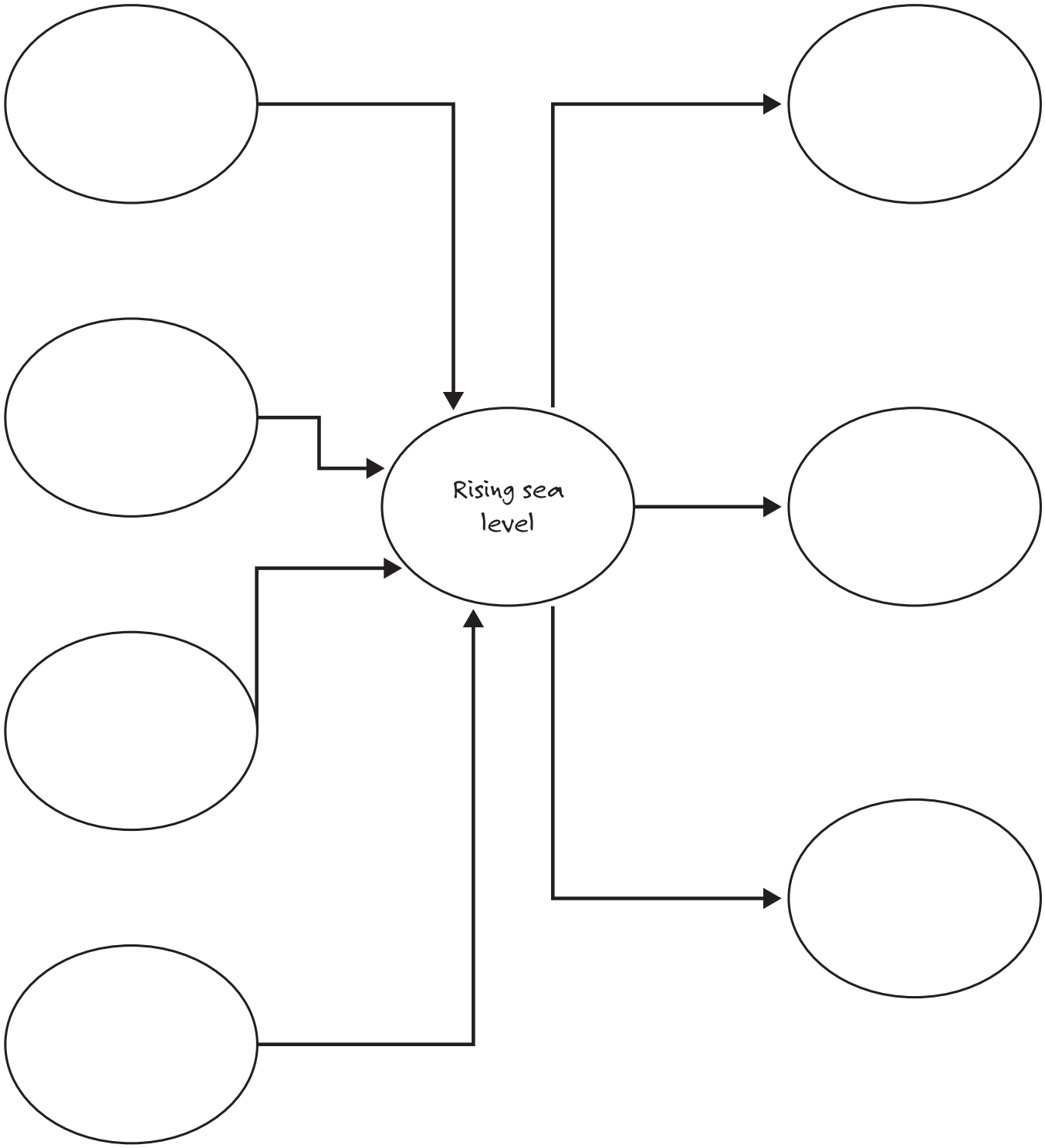
- Consider the general purpose of each part: is it a description, an explanation, a procedure, or an attempt to persuade?
- Consider how data and graphics support the narrative text and how narrative text clarifies the data and graphics.
- Consider how each part of the reading relates to the scene described in the Preface.

Written Response

Your writing exercise is to draw a cause-and-effect graphic organizer that summarizes information about the rising sea level in this collection.

- Using the template that follows as a model, draw your graphic organizer to fill one side of a separate sheet of paper; attach this page to the front of it when you turn it in.
- Review the reading selections to find causes of rising sea level. Write them in the bubbles on the left.
- Based on your reading, write effects of rising sea level on the right.
- Use arrows to point from causes toward effects.
- Add color to make the relationships even more clear. Check the connecting lines and text to make sure they are attractive and readable.
- Make sure you include your graphic organizer's title.
- Before you begin, review the criteria in the Evaluation Guidelines that follow to help you clearly understand the expectations of the exercise.

Rising Sea Level: Causes and Effects



Evaluation Guidelines

Element	1	2	3	Feedback
Content	Concept map includes minimal causes and effects with several inaccuracies and without scientific terms.	Map includes most of the important causes and effects accurately, using at least one science term.	Map includes four causes and three effects of sea level rise accurately, using scientific terms appropriately.	
Relationships of details	Organization of the details on the map is unclear or not accurate. The title is missing or incorrect.	Linking lines between the text bubbles are mostly clear and point in the correct direction. The title is correct or has a small error.	Causes are on the left, and linking arrows point to the bubble in the center. Arrows from the center bubble point toward the effects on the right. The title is correct.	
Design	Major improvements are needed in the design of missing text, shapes, arrows, and arrangement to fill the page.	All but one of the following are well executed: title, details, and shapes are attractive and easy to read; color is used effectively to show organization of concepts. Design fills the whole page effectively.	The title, details, and shapes are attractive and easy to read. Color is used effectively to show organization of concepts. Design fills the whole page effectively.	
Grammar and mechanics	Five or more errors are present in capitalization, punctuation, and spelling.	A few errors are present in capitalization, punctuation, and spelling.	No errors are present in capitalization, punctuation, and spelling.	

Additional Feedback Notes:

Name: _____ Date: _____

Roadmap for Reading

This week's reading collection focuses on the causes and effects of rising temperatures in Earth's atmosphere. The selections include numerical data from which you can see patterns in the text and on graphs and maps.

Collection 3: "Temperature and Changes in the Atmosphere" consists of five selections.

1 Cows and Methane
2 Carbon Cartoon
3 Volcano Emissions: A Lot of Hot Air?
4 Climate and the Water Cycle
5 The Hurricane Blogger

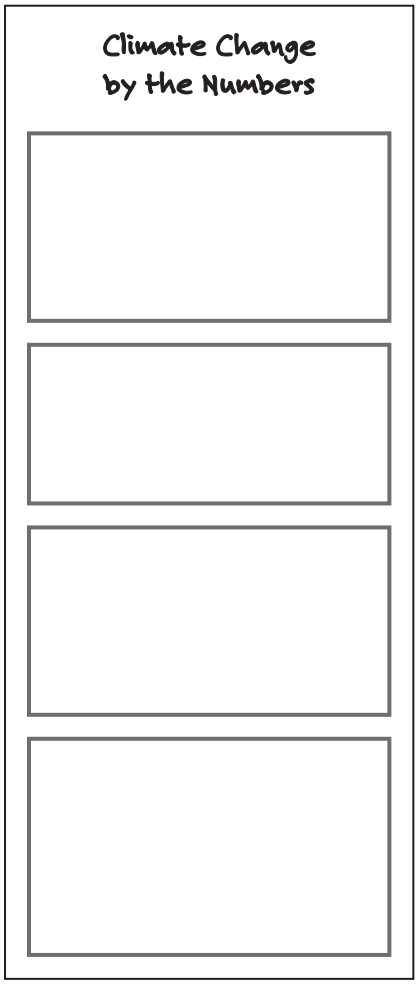
As you read:

- Consider the general purpose of each part: is it a description, an explanation, a procedure, or an attempt to persuade?
- Consider how numerical data and graphics support the narrative text and how narrative text clarifies the data and graphics.
- Consider how each part of the reading relates to knowledge you gained from the previous part.

Written Response

Your writing exercise is to develop a data-packed infographic highlighting some of the numerical information in this collection about the atmosphere and global warming. Design your infographic on a separate sheet of paper; attach this page to the front of it when you turn it in.

- Select at least four pieces of numerical information from at least three selections.
- Create a text box for each fact, placing the boxes in the order they appear in the collection.
- Add a sentence of commentary or explanation about each fact you present.
- Visually emphasize words or numbers you want your readers to pay close attention to.
- Before you begin, review the criteria in the Evaluation Guidelines that follow to help you clearly understand the expectations of the exercise.



Evaluation Guidelines

Content

- There are four well-chosen facts with numerical data to support understanding the science in this collection.
- Cause-and-effect relationships are clear.
- At least three readings are represented.
- The concepts are in the same order that they appear in the collection.

Text

- The text is clearly worded in complete sentences.
- Either bold lettering, underlining, or highlighting is used for emphasis.
- Spelling, grammar, and punctuation are correct.

Design

- Each text box has its own color.
- The text is easy to read and consistent in style, leading to an overall pleasing appearance.
- The title is prominent and well placed.

Additional Feedback Notes:

Name: _____ Date: _____

Roadmap for Reading

This week's reading collection focuses on the sources of greenhouse gases and their effects on the atmosphere, ocean, and people. The data reveal cause-and-effect relationships and patterns over time.

Collection 4: "People and Greenhouse Gases" consists of four selections.

1 Potential Causes of Changing Climate
2 Ocean Acidification
3 Overlooked Sources of GHGs
4 A Climate Refugee

As you read:

- Consider the general purpose of each part: is it a description, an explanation, a procedure, or an attempt to persuade?
- Consider how data and graphics support the narrative text and how narrative text clarifies the data and graphics.
- Consider how each part of the reading relates to knowledge you gained from the previous part.

Written Response

Your writing exercise is to create a news headline for each of the readings that would catch the attention of online newspaper and magazine readers. Each headline should reveal a cause-and-effect relationship or pattern over time.

- Compose your headlines on a separate sheet of paper; attach this page to the front of it when you turn it in.
- Your headlines should be different from the selection titles in the Student Reader.
- Use the numbers 1–4 of the selections to identify them.
- Make sure the facts or conclusions of your headlines are accurate.
- Match the tone of each headline to the reading, and make sure each headline is understandable.
- Before you begin, review the criteria in the Evaluation Guidelines that follow to help you clearly understand the expectations of the exercise.

Evaluation Guidelines

Element	1	2	3	Feedback
Content	Contents of headlines are difficult to match to the selections; the product has three or more factual errors and other confusing language.	Headlines are adequate in summarizing most selections or citing important takeaways; contents are mostly accurate, having no more than two errors; headlines are mostly free of unintended meanings or other confusions.	Headlines summarize the selections well or cite one important takeaway, are factually accurate, and are free of unintended meanings or other confusions.	
Appeal and appropriateness	Most of the headlines are not suitable for general audiences and bear little resemblance to the tones of the selections.	Headlines will not offend but do not all match the tone of the selection; only two of the four will appeal to readers.	Headlines are in good taste, match the tones of the selections, and will catch the attention of the general audience.	
Word count	All headlines are less than two words or more than ten words.	A few headlines are more than ten words.	Each headline has between two and ten words.	
Grammar and mechanics	Product contains six or more errors in grammar, punctuation, capitalization, or spelling.	Product contains three to five errors in grammar, punctuation, capitalization, or spelling.	Product contains fewer than three errors in grammar, punctuation, capitalization or spelling.	

Additional Feedback Notes:

Name: _____ Date: _____

Science Literacy Exercise Page 5 Use with Reading Collection 5

Roadmap for Reading

This week's reading collection focuses on ways to slow global warming. The proposed solutions have both pros and cons for you to weigh. The final selection returns to the scene set in the Preface and acknowledges the weight of evidence that global warming is caused by humans.

Collection 5: "Solving the Problem of Climate Change" consists of five selections.

1 What Does It Cost?
2 Letting the Ocean Be a Better Carbon Sink
3 Electric vs. Gas Cars
4 Green or Greenwashing?
5 Consensus

As you read:

- Consider the general purpose of each part: is it a description, an explanation, a procedure, or an attempt to persuade?
- Consider how data and graphics support the narrative text and how narrative text clarifies the data and graphics.
- Consider how what you have learned in this unit about climate change prepared you to interpret what you are reading.

Written Response

Your writing exercise is to complete a thoughtful paragraph that reflects on what you read in the Preface and in the readings in Collection 5, as well as all you have learned in this unit.

- Compose your paragraph on a separate sheet of paper; attach this page to the front of it when you turn it in.
- Choose one of the following topic sentences as your claim.
    - *The costs of dealing with global warming can be met now or by future generations.*
    - *Debating the facts about reducing global warming is a helpful way to understand the options.*
    - *In the end, Mike found the evidence of climate change caused by humans to be persuasive.*
    - *My attitude toward climate change has changed. Here's how.*
- Build on the claim in the topic sentence to complete a well-reasoned argument. Use details and data from the reading selections in your paragraph's supporting sentences.
- Before you begin, review the criteria in the Evaluation Guidelines that follow to help you clearly understand the expectations of the exercise.

Evaluation Guidelines

Element	1	2	3	Feedback
Content	Product is an inadequate paragraph; it shows little understanding of climate change and possible solutions.	Product demonstrates an adequate completion of a structured paragraph but is weak in alignment with the claim about climate change in the topic sentence.	Paragraph contains thorough support of the topic sentence/ claim, citing specific, relevant details about climate change from the reading selections.	
Supporting sentences (details)	Product contains incomplete sentences or details irrelevant to the paragraph topic.	Product contains complete sentences, but too few, or is lacking in support from the reading, or there is an unclear relationship with the topic sentence.	Paragraph contains at least six complete sentences, encompassing three major points from the reading that support the topic sentence.	
Organization and transitions	Statements possess little clear relationship to the topic sentence or each other.	Key supporting details are present, but transitions are absent or choppy.	Ideas appear in an order that helps the argument make increasingly more sense.	
Grammar and mechanics	Six or more errors are present in punctuation, capitalization, and spelling.	Three to five errors are present in punctuation, capitalization, and spelling.	Fewer than three errors are present in punctuation, capitalization, and spelling.	

Additional Feedback Notes:

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Editorial Director

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