**Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Period\_\_\_\_\_**

**Note Outline: Climate & Climate Change**

**Objectives**

1. Compare & contrast weather vs. climate.
2. Explain why climates vary. This means I can:
   1. Explain the effect of the following natural events on climate: the sun, volcanic eruptions, latitude, elevation, mountains, large bodies of water.
   2. Explain how the angle of solar radiation causes 3 main climate zones according to latitude: polar, mid-latitude (temperate), and tropical.
3. Describe how tropical moist, dry, moist mid-latitude with mild winters, moist mid-latitude with cold winters and polar climates differ in temperature, precipitation, and amount of vegetation.
4. Diagram the movement of Carbon through the four “spheres” of the Earth’s systems; lithosphere, hydrosphere, atmosphere and biosphere.
5. Diagram the water cycle within the hydrosphere.
6. Apply the terms “positive feedback” & “negative feedback” to ice ages, global warming & climate change.
7. Compare and contrast the greenhouse effect and global warming. This means I can:
   1. Explain why the greenhouse effect is necessary for life on earth.
   2. Explain what 4 main gases are associated with the greenhouse effect and how human activities have altered their levels and contributed to global warming.
8. Explain causes and effects of climate change. This means I can:
   1. Differentiate natural vs. human actions that lead to climate change.
   2. Explain human influence on climate and list several human activities that could be causing global warming.
9. List and describe the effects of climate change on; temperature, sea level changes, severe weather events (storms, drought…), ocean acidification.
10. Describe strategies to limit human impact on climate.
11. Explain the cause and effects of El Nino on currents and climates of Australia and South America.

**Weather vs. Climate**

* **Weather** = Conditions of atmosphere at a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,

or a\_\_\_\_\_\_\_\_\_\_period of time (days).

* **Climate** = Long-term \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of weather (Averaged over 30 years)
* **Example**:
  + What is the current weather in Bettendorf?
  + How would you describe the climate of Bettendorf?

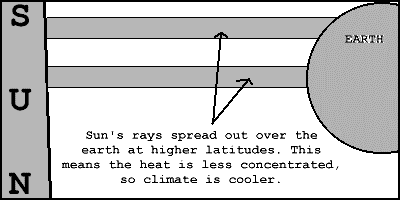
**Factors Which Create Climate Zones**

**Many factors affect climate:**

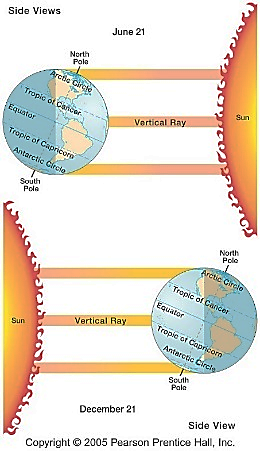
1. Sun
   1. Radiation ***given off*** by the Sun
   2. Latitude affects amount radiation ***received***
   3. Solar radiation ***absorbed*** *or* ***reflected***
2. Volcanic eruptions
3. Elevation (mountains)
4. LARGE bodies of water (oceans)
   1. Coastline vs. inland
   2. Ocean currents
5. Wind (global patterns)
6. **THE SUN:**

**Sun: #1 Radiation *GIVEN OFF* by the sun**

* 1. The amount of radiation ***given off*** by the Sun varies
  2. Sunspots = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that erupt & send solar \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ into space
  3. 11-year cycle.
  4. \_\_\_\_\_\_\_\_\_\_\_\_ sunspots causes\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ temperatures
  5. \_\_\_\_\_\_\_\_\_\_\_\_ sunspots causes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ temperatures
     + “The Little Ice Age” from 1350- 1900 in Northern Hemisphere was due to reduced solar activity. (2oC/4oF lower)



**Sun: #2 Latitude affects radiation *RECEIVED***

1. The further you travel from the equator the cooler it gets. Why?
   * Because Earth is \_\_\_\_\_\_\_\_\_\_\_\_\_ and the sun’s rays hitting at a

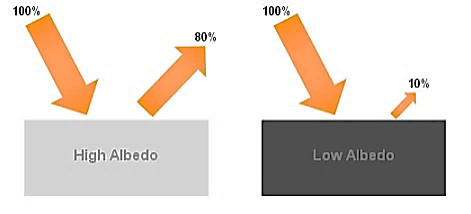
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_latitude are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ,

meaning they are \_\_\_\_\_\_\_\_\_\_ over a greater area.

* + - Equator has \_\_\_\_\_\_\_\_\_\_\_\_\_ rays (\_\_\_\_\_\_\_\_\_\_ latitude numbers)
    - Poles have\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ rays (\_\_\_\_\_\_\_\_\_\_ latitude numbers)
  + Because Earth is \_\_\_\_\_\_\_\_\_\_\_\_\_\_ in its orbit around the sun.
* During part of the year, each pole is tilted \_\_\_\_\_\_\_\_\_\_\_\_ from the

sun and receives \_\_\_\_\_\_\_ sunlight.

**Sun: #3 Surface Features determine if radiation is *REFLECTED* or *absorbed***



* 1. What color do you wear on a sunny day to stay cool? Why?
     + \_\_\_\_\_\_\_\_\_\_\_\_\_\_ clothes \_\_\_\_\_\_\_\_\_\_\_\_\_\_sunlight.
  2. What is hotter for your feet on a sunny day; asphalt or cement? Why?
     + Instead of reflecting light, black \_\_\_\_\_\_\_\_\_\_\_\_\_\_ sunlight and becomes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  3. Predict the relative amount (lots, very little) of sunlight reflected for:
     + Snow, Ice? \_\_\_\_\_\_\_\_
     + The poles are cold not just because of their latitude and the low amount of sunlight received, but also

because their ice\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ much of the sunlight that is received.

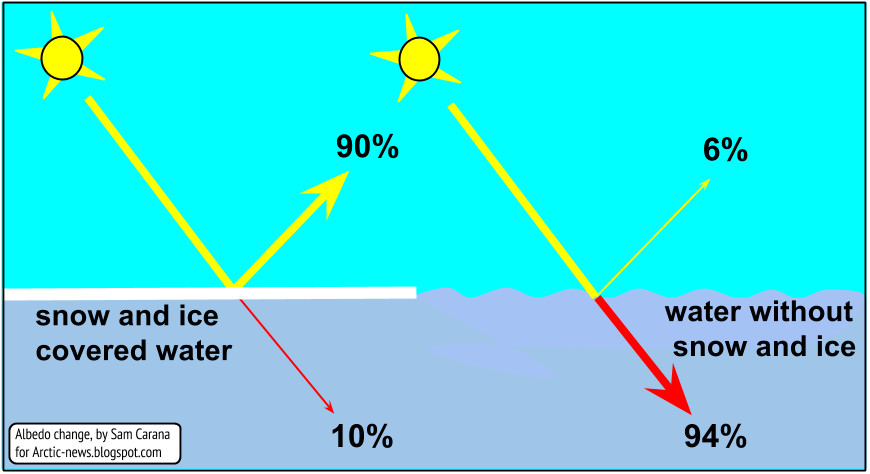
* + - Water, soil, vegetation?\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Positive vs. Negative Feedback Loops**

* **Positive Feedback Loop**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ & makes changes more \_\_\_\_\_\_\_\_\_\_\_.
* **Negative** **Feedback Loop**: Brings system \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Ice Age Positive Feedback Loop**

* 1. \_\_\_\_\_\_\_\_\_\_\_sunspot activity = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ temperatures
  2. Low temperatures = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ snow & ice accumulation
  3. Snow & ice \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ more solar radiation = Earth’s temperature becomes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  4. “Positive Feedback Loop” = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the change and cold temperatures become

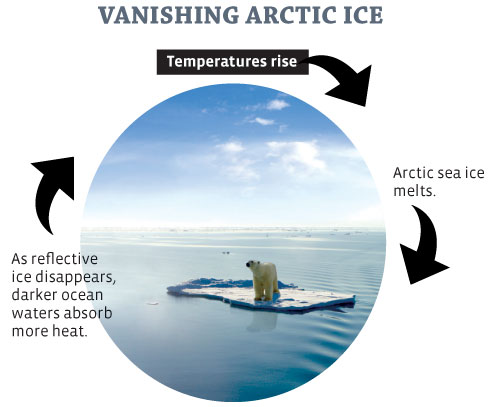


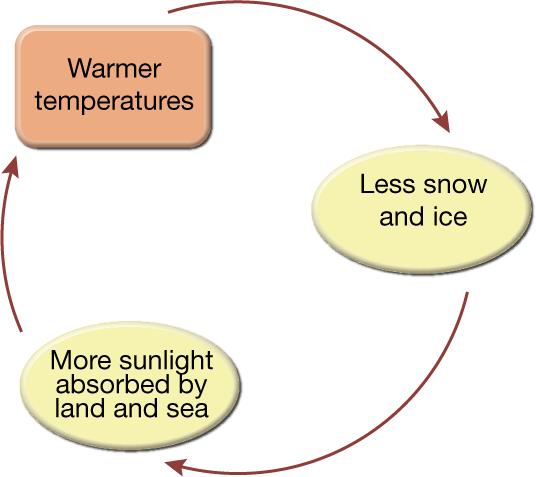
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ during the Ice Age

**Is This Exaggerated Cooling What Is Happening Now? NO!!!**

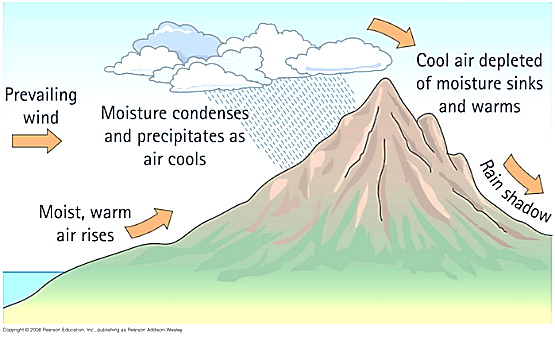
NOW, as climate is warming, the **reverse** is happening:

* + - Warmer temperatures = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in snow & ice coverage.
    - Melting =\_\_\_\_\_\_\_\_\_ & \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ surfaces \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ radiation
    - Less reflection = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Earth
    - Another Positive Feedback Loop - this time causing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_





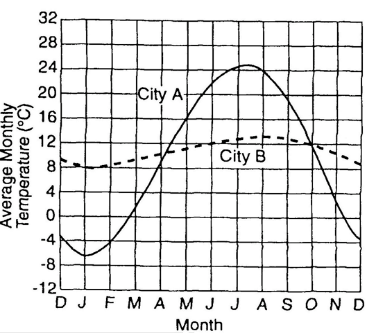
1. **Volcanic Eruptions**
   1. Large eruptions release \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_into atmosphere.
      * Aerosols = small particles
      * Examples of volcanic aerosols: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Aerosols \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_solar radiation and cause \_\_\_\_\_\_\_\_\_\_\_-term \_\_\_\_\_\_\_\_\_\_for only a few years.
      * Short term because the aerosols gradually settle out and don’t stay in the atmosphere.
2. **Elevation (Mountains)**
   1. Mountain climates are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, as atmospheric temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_with height
   2. High elevations may allow\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to form in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. One side of the mountain is\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than the other

****

1. **LARGE bodies of water (oceans, seas)**

The graph below shows the average monthly temperatures for two cities, A and B, which are both located at 41ºN latitude and should receive the same amount of solar radiation.

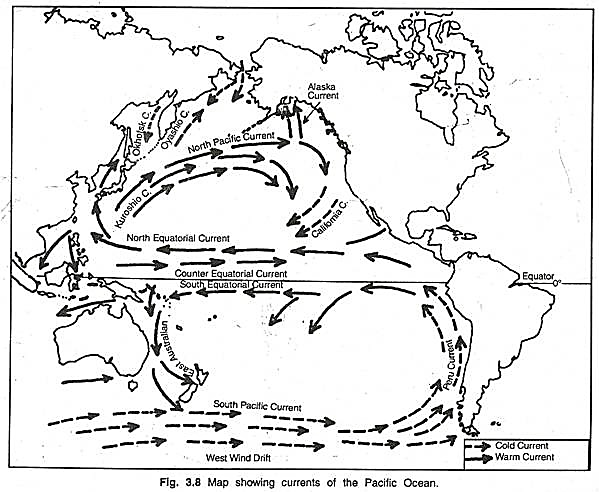
* **Why is there a difference in the average yearly temperature range for the two cities?**

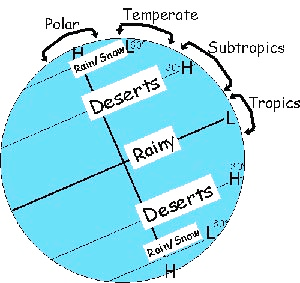


* + - Because City A is located *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* and
    - City B is located near \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  1. **Coastline vs. Inland Climate**
     + Water heats and cools \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than land, therefore it doesn’t get as cold in the winter or as warm in the summer as land does.
     + **Coastline cities** are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by the breezes coming off the water & don’t get as hot in

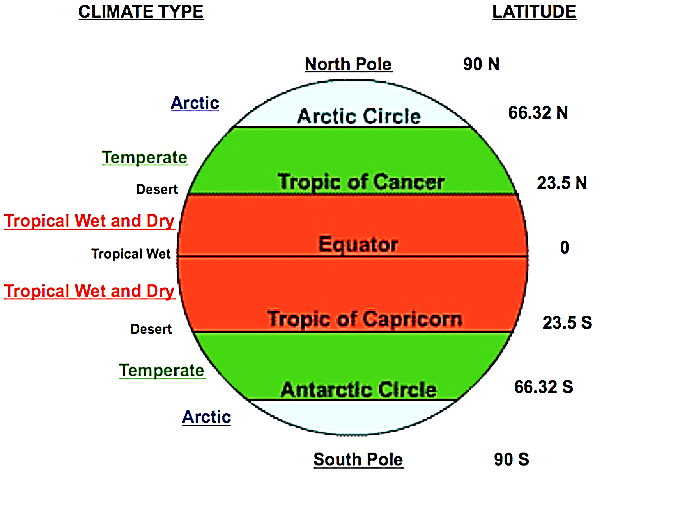
the summer or as cold in the winter. They have a more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ climate

* + - **Inland cities** have a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ climate, both \_\_\_\_\_\_\_\_\_\_\_ in summer and \_\_\_\_\_\_\_\_\_ in winter, than cities on the coast at the same latitude.
  1. **Ocean Currents**
     + Ocean currents move Earth’s heat energy around
     + The effect of ocean currents on the climate depends on the direction the current \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
       - ­­­­\_\_\_\_\_\_\_\_\_\_ the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_ water is moved towards the poles
       - \_\_\_\_\_\_\_\_\_\_ the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_water is moved towards the equator



1. **Wind: Global Wind Patterns**
   1. Global wind patterns which affect \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * \_\_\_\_\_\_\_\_\_rain & \_\_\_\_\_\_\_\_\_\_\_\_\_\_ at \_\_\_\_\_\_\_\_latitudes (ie 0o Equator)
      * \_\_\_\_\_\_\_\_\_ rain & \_\_\_\_\_\_\_\_\_\_\_\_\_\_with little vegetation at 30o Latitude
   2. Mid-latitudes (ie. Iowa) – Our weather comes from the\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. Tropical – Hurricanes come from the \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Climate Classifications**

* ****Based on THREE main characteristics
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – monthly and annual averages

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. **Tropical Moist:** Year-round average temperature above 65oF (18oC)
   1. Between what latitudes is this located? \_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Cause of high temp year-round? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. Cause of moist climate? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. **Dry Climates:** Low/deficient precipitation year-round
   1. At what latitude do most of Earth’s deserts occur? \_\_\_\_\_\_\_\_\_
3. **Moist Mid-Latitude with Mild Winters**
   1. Latitude range? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Cause of Mild Winters?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. **Moist Mid-Latitude with Cold Winters**
   1. Latitude range? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. If the latitude range is the same as the climate with mild winters, describe how the location of the climate with cold winter is different: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. ONLY mid-latitudes 30-60N/S (both mild & cold winters) have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
5. **Polar:** Extremely cold winters & summers
   1. Latitude range? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. What is the **main** reason it is so cold? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**The Four Spheres/Systems of Earth**

Earth can be divided into 4 systems that each has a specific role in keeping Earth going, the storage of carbon, and weather and climate.

The 4 systems/spheres of Earth are:

1. Lithosphere
2. Hydrosphere
3. Biosphere
4. Atmosphere

**Read the last two pages of your note outline and answer the corresponding questions below for each system and for the carbon cycle.**

**Lithosphere**

1. What makes up the lithosphere? (List 4 components)
2. What is the major cycle in the lithosphere?
3. When fossils in sedimentary rocks are put under intense heat and pressure, what do they turn into? Be specific and detailed.

**Hydrosphere**

1. How much of the Earth is covered by bodies of water?
2. What is water in the atmosphere called?
3. What happens when water vapor in the atmosphere is cooled?

**Biosphere**

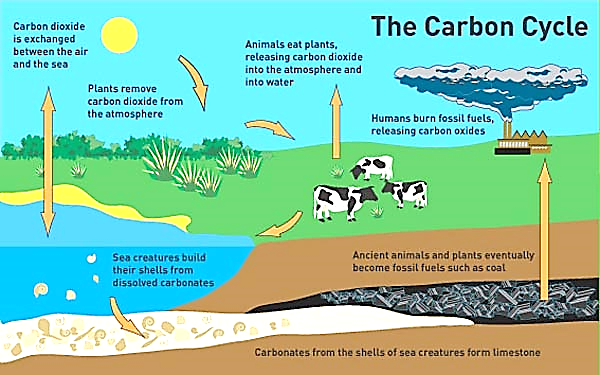
1. List 4 examples of parts of the biosphere.
2. “Bio” means life. Are only living organisms included in the biosphere? Explain.
3. Life cycles and food chains are important cycles found **within** the biosphere. **What cycles from outside** the biosphere are important to the biosphere? List 3.

**Atmosphere**

1. When it is said that the atmosphere acts like a greenhouse, what does that mean?
2. What are the 2 main gases, and their percentages, in the atmosphere?
3. **Greenhouse gases:**
4. What 3 gases are very good at trapping heat?
5. Greenhouse gases (GHGs) make up what percent of the atmosphere?
6. How much does their concentration need to change to make a difference in Earth’s climate?

**Carbon Cycle**

1. Which “sphere” contains the most carbon, and what is it found in?
2. In what are “hydrocarbons” found, and what are they formed from?
3. Carbon in the **hydrosphere**.
   1. What part of the hydrosphere contains the most carbon?
   2. Describe 2 forms the carbon found in that location.
4. Carbon in the **biosphere**:
   1. How much carbon is found in the biosphere?
   2. In what form is it found? List 2.
5. Carbon in the **atmosphere**:
   1. How much carbon does the atmosphere have compared to the other 3 systems/spheres?
   2. In what 2 forms is most of the carbon in the atmosphere?



**Carbon Cycle Diagram**

**Greenhouse Gases & Their Sources**

There are 4 main greenhouse gases**: CO2, CH4, N2O, & water vapor**

1. **Carbon Dioxide, CO2**
   1. Today, only 5% of CO2 in the atmosphere comes from natural processes such as animal breathing, etc.
   2. 95% of ATMOSPHERIC CO2 comes from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ such as combustion (burning)

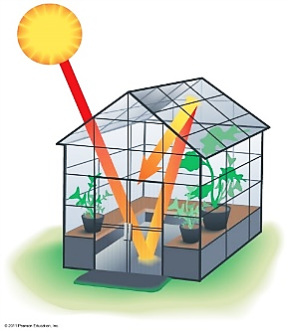
of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_for electricity, transportation, industry…

* 1. Most abundant \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ GHG

1. **Methane, CH4**
   1. Compared to CO2, much less CH4 is in the atmosphere.
   2. BUT it can trap \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ more heat than CO2
   3. YET, it has a\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ lifespan and breaks down
   4. Source of includes; livestock \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, waste decomposition in landfills,

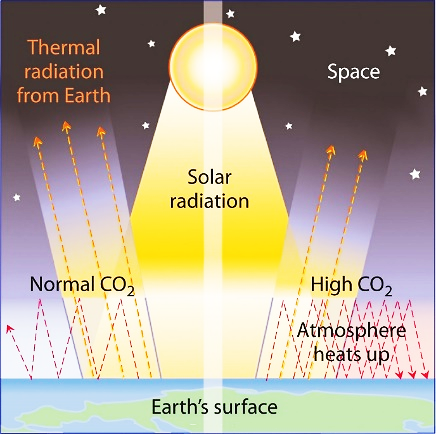
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_…

1. **Nitrous Oxide, N2O**
   1. Only small amount in the atmosphere
   2. BUT it can trap \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ more heat than CO2
   3. Natural sources: Soil and oceans release N2O into atmosphere
   4. Human sources: Agriculture, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in motor vehicles
2. **Water Vapor, H2O**
   1. Is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ GHG in the atmosphere
   2. Has the\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ impact on temperature compared to all the other GHGs
   3. Traps \_\_\_\_\_\_\_\_\_\_\_\_ of all the heat trapped in the atmosphere
   4. Water vapor is constantly \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between the hydrosphere, atmosphere, and biosphere.
   5. Changes in its movement between the four systems could have big impact on the warming and cooling of the atmosphere.
      * Yet, water vapor levels have been constant throughout history, so it doesn’t appear to be responsible for the warming Earth is undergoing.

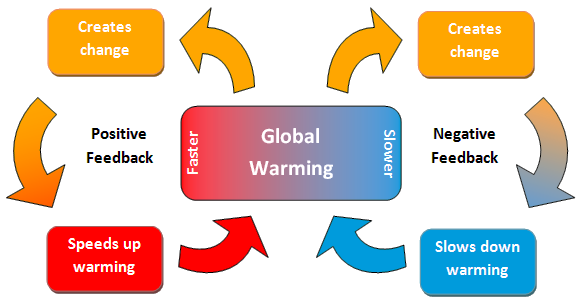
**Greenhouse Effect vs. Global Warming**

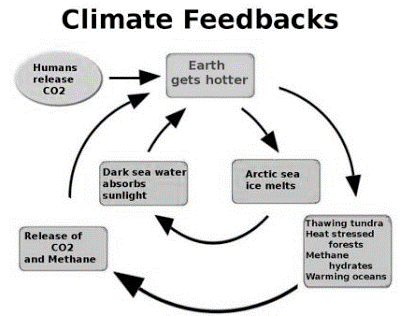
1. **Greenhouse Effect –** 
   1. Traps \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_heat to keep Earth at a habitable temperature
   2. We \_\_\_\_\_\_\_\_\_\_\_\_\_\_the Greenhouse Effect

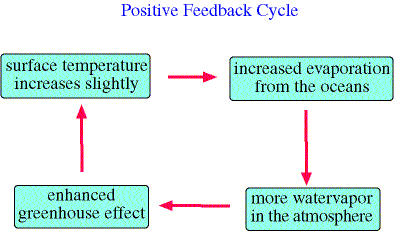
1. **Global Warming**
   1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in Earth’s global temperatures \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_the Greenhouse Effect
   2. Primarily due to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ levels due to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. Since the Industrial Revolution, CO2 levels have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



**Climate Change: Positive vs. Negative Feedback Loops**

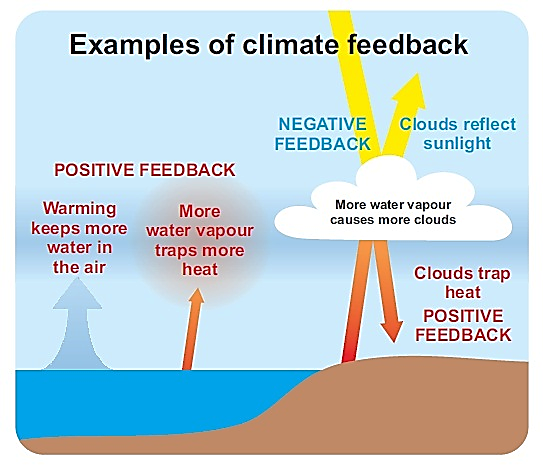


**Positive Feedback – Global Warming**



**?Negative Feedback? – Global Warming**

& more sunlight is \_\_\_\_\_\_\_\_\_\_\_

**Global Warming Debate**

Climate is affected by many factors. It is difficult to predict because:

* \_\_\_\_\_\_\_\_\_\_\_\_\_to test climate in laboratory.
* Use \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to predict.
* Debate – Which of the following will increasing water vapor create?
  + Positive feedback: Increasing H2O vapor will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_and warming will continue?
  + Negative feedback: Increasing H2O vapor will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ causing temperatures to stabilize?

**Effects of Climate Change**

It is believed that increased levels of Greenhouse Gases is leading to the following changes:

1. Temperature changes
2. Sea level changes
3. Weather event frequency changes
4. Ocean acidification changes

**Temperature Change**

1. Both land & ocean temperatures are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Land temperatures are increasing more than water temperatures. WHY?
   1. Water can absorb more thermal (heat) energy \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
   2. Water heats up \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than land.
3. More \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are affecting the mid-latitudes (Us in Iowa!)
4. Amount of sea ice, glaciers, permafrost has \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_due to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
   1. As permafrost thaws it releases CO2 & CH4, BUT it is difficult to know how much is being released – significant or not?

**Sea Level Change**

1. Sea level has \_\_\_\_\_\_\_\_\_\_\_\_ worldwide 12-22cm.
2. As oceans warm, the water particles move faster and the water’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. Melting of glaciers and ice sheets \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, causing sea level to \_\_\_\_\_\_\_\_\_\_\_\_.

**Weather Event Frequency Changes**

1. What is an extreme weather event?
   1. Extreme weather event = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, increased frequency of \_\_\_\_\_\_\_\_\_\_\_\_\_
2. Mid-latitude U.S. changes:
   1. Increased heavy precipitation
   2. Winter snow sometimes now falls as rain.
3. Mediterranean & Africa
   1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ have increased
4. Other:
   1. Hurricanes:
      * Increased hurricane \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (not number of hurricanes) due to \_\_\_\_\_\_ ocean waters
      * Move further towards \_\_\_\_\_\_\_\_\_\_\_\_\_\_ before stopping

**Ocean Acidification Changes**

1. Oceans, as discussed previously, are a natural reservoir for carbon
2. In the past, oceans have been able to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as it was produced.
3. As CO2 is absorbed, the ocean becomes more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   1. Scientists predict increased acidity will affect the formation of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, crabs,

snails, clams and thereby affecting the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_system

1. Oceans will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to keep absorbing CO2 at the rates it is being added to the atmosphere.

**Strategies to Limit Climate Change**

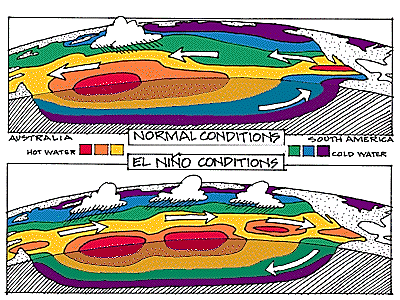
Strategies are aimed at \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ emissions. Strategies include:

1. Using energy sources that do not emit carbon; \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. International awareness, but there is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between developed vs. developing nations.
   1. Developing nations.
      * They have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to pay for the controls needed. Money spent to limit greenhouse gas production would hurt their efforts to their citizens and country out of poverty.
      * Developing countries argue that the current climate change was caused by developed countries – developed countries should pay.
3. Developed countries:
   1. Think developing nations would have an economic advantage if developing countries don’t have to follow the same regulations.
4. Personal awareness
   1. What is YOUR “carbon footprint”? How can you decrease it?

**REVIEW: Upwelling** (Prior to Discussing El Nino)

**Upwelling**: Upward motion of ocean water

* 1. Cold because it originates at the bottom of the ocean
  2. Usually occurs on the west coast of continents in the area of trade winds
  3. Rich in nutrients, supports abundant marine life
     1. Good fishing off of Peru & California

**El Nino** 

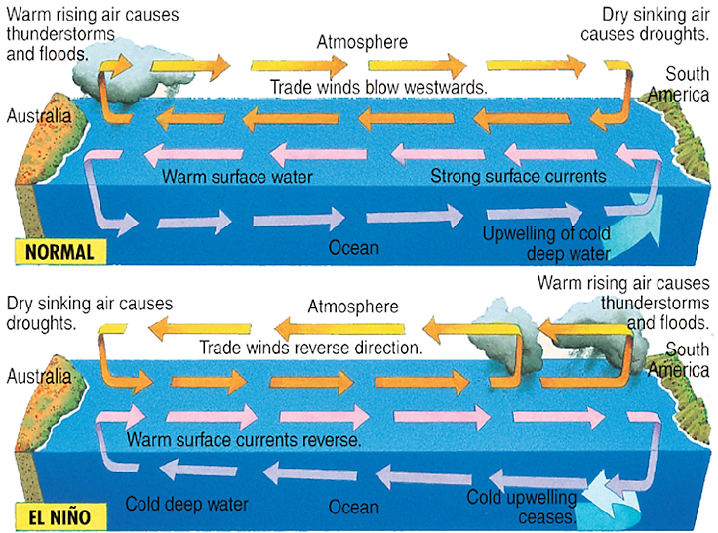
1. El Nino is an unusually \_\_\_\_\_\_\_\_\_\_\_ ocean current off the \_\_\_\_\_\_ coast of \_\_\_\_\_\_\_\_\_\_America
2. **Cause** of El Nino:
   * 1. Equatorial winds blow from\_\_\_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
     2. This is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the normal equatorial winds
     3. The winds push \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_air east towards \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Effects on **climate of South America**:
   * 1. Causes the \_\_\_\_\_ coast of South America to be \_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_ than normal
     2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Commercial fishing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
4. **Climate changes in United States**
   1. Brings \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to California & SW U.S

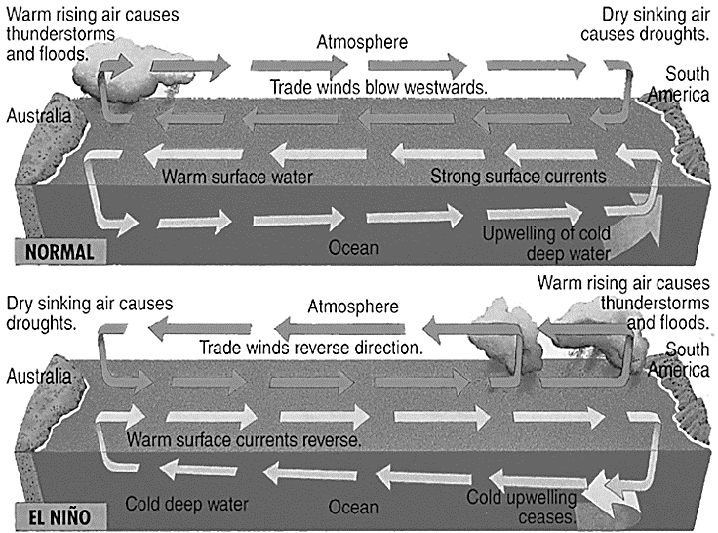
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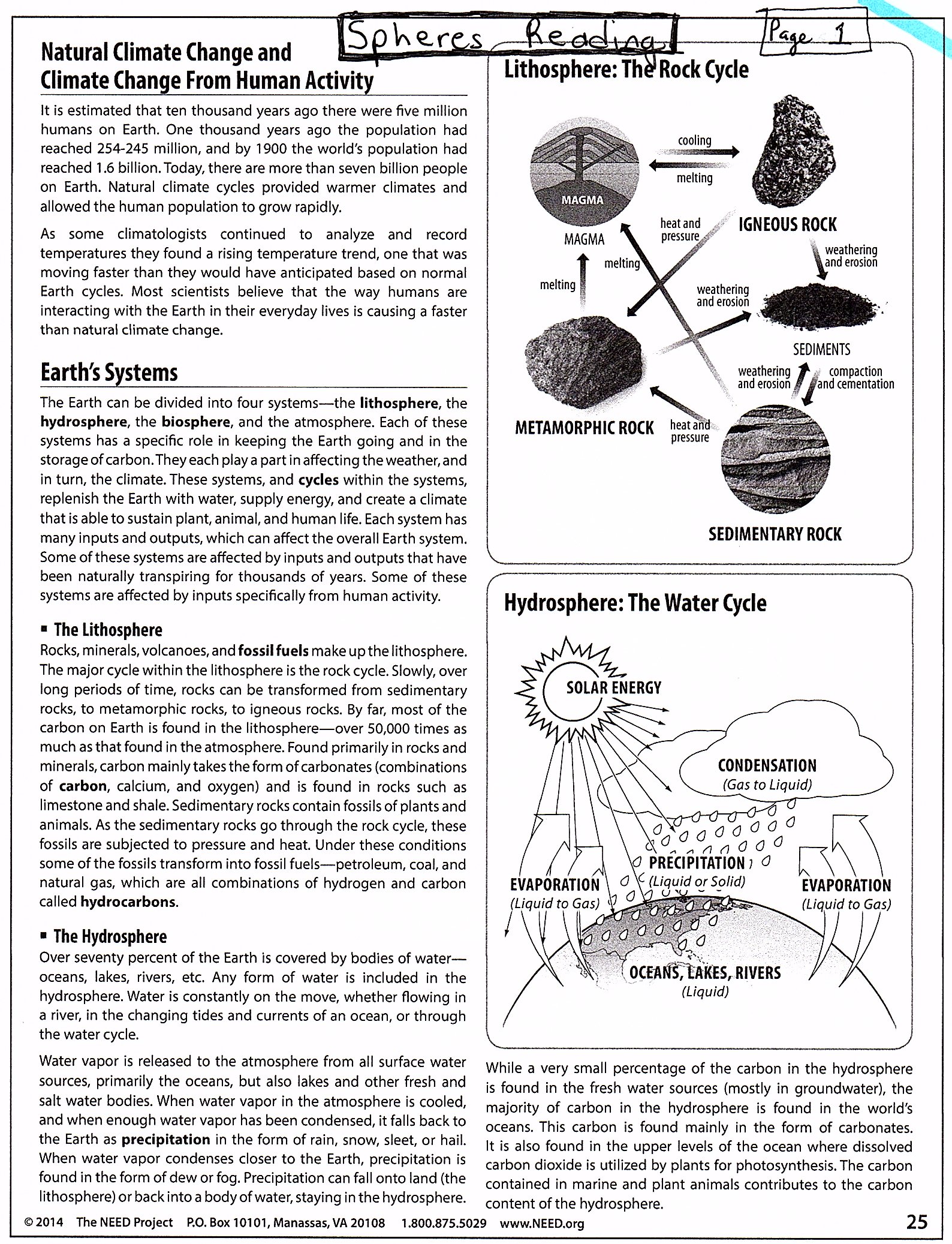
* 1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ winters for all of U.S., including Iowa
  2. BENEFIT of El Nino: Upper winds \_\_\_\_\_\_\_\_\_\_\_\_\_\_tropical disturbances from becoming

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, at least in the SE

1. Climate **changes in Australia:**
   1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ instead of the usual rain
2. **SUMMARY of all the climate changes**:
   1. Brings \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to normally dry places
   2. Brings \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to places that normally have lots of rain





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