Period 14: Climate Change

14.1 The Enhanced Greenhouse Effect

1) The Greenhouse Effect

a) What is the cause of the enhanced Greenhouse Effect?

b) What is the result of the enhanced Greenhouse Effect?

c) According to the graph of temperature variation, by how many degrees has the average global temperature changed in the past 150 years? ______________

d) What could account for this change in temperature?

e) What is the percent increase in atmospheric carbon dioxide between 1750 and 1996?

2) Natural Climate Variations

a) What three factors cause variations in the Earth’s motion?

b) These three factors combined are known as Milankovitch cycles. What is the result of Milankovitch cycles on global climate?

c) Group Discussion Question: Is it likely that the recent rise in global temperature is the result of a Milankovitch cycle?
14.2 Evidence of Past Climate Conditions

3) Tree Rings as Evidence of Past Climate
   a) How can tree rings indicate past environmental conditions?

   b) Examine the rings in the slice of tree trunk. This tree was felled in Columbus in 2012. Can you correlate the rings with the average precipitation in Columbus over the past 15 years?

   c) Do the variations in the tree’s rings represent changes in climate, in weather, or in both weather and climate?

   d) Data from tree rings can approximate environmental conditions hundreds of years ago using the method of cross matching. Each strip of tree rings represents data from one tree.

      i) Look for patterns in the tree rings that indicate an unusual pattern (several years of drought, etc).

      ii) Match these patterns across several trees so that your tree ring data covers the life span of multiple trees.

      iii) How many years of consecutive data can you assemble? ____________

4) Ice Cores as Evidence of Past Climate
   a) Examine an ice with a magnifying lens. What do you see within the ice?

   b) What information about past climate could be determined by their analysis?

   c) Ice cores collected by the OSU Byrd Polar Center and other researchers provide data on climate more than 100,000 years ago. Why is there an urgency to continue collecting and storing ice cores?
5) **Oxygen Isotope Concentrations as Evidence of Past Climate**

a) What is the difference between the two isotopes of oxygen: oxygen-16 and oxygen-18?

b) Which isotope is heavier?

c) Water with which isotope evaporates from sea water more easily?

d) When in the form of water vapor, which isotope diffuses more readily over land surfaces?

e) Group Discussion Question: Looking at the globe on your table, imagine water vapor containing both oxygen-16 and oxygen-18 evaporating near the equator. Global convection currents cause this warm air to rise to the Earth’s poles.

i) Water with which isotope will condense and precipitate first in the middle latitudes?

ii) Water with which isotope will be more likely to condense and precipitate near the poles?

iii) Imagine this is a cooler glacial age, when the water that precipitates near the poles remains there, locked in ice. What will happen to the usual ratio of oxygen-16 to oxygen-18 in sea water?

iv) How can this ratio be used to determine past global temperatures?

14.3 **Consequences of a Warming Global Climate**

6) **Cloud Formation**

a) What are clouds made of – water vapor, water droplets, and/or ice?

b) Why do clouds form?

c) Why does moisture form on the outside of a cold can of soda? Where does the moisture come from?
d) As the Earth warms, more water vapor will evaporate from the seas.
   i) What effect will increasing water vapor in the atmosphere have on global temperatures? 
      ________________________________
   ii) Does this represent a positive or negative feedback loop? ____________

e) Some of the increased water vapor in the atmosphere will condense into liquid water droplets or ice crystals.
   i) What effect will condensed water vapor in the atmosphere have on global temperatures? 
      ________________________________
   ii) Does this represent a positive or negative feedback loop? ____________

7) **Melting Polar Ice Sheets**
   a) What is the likely effect on the environment of melting ice sheets, such as those in Antarctica and Greenland?

   b) As the temperature warms and melting accelerates, more liquid water will evaporate into the atmosphere. What negative feedback loop in the process of melting ice sheets is likely as more water vapor enters the atmosphere?

8) **Ocean Circulation**
   a) What effect does the Gulf Stream have on the climate of northern European countries, such as the United Kingdom?

   b) Why does the Gulf Stream water in the north Atlantic sink below the ocean surface?

   c) Where does this Gulf Stream water go? Where does it end up?

   d) What could happen to the ocean circulation if large amounts of fresh water from melting ice sheets enters the north Atlantic Ocean?

   e) What would be the result for our global climate?

   f) Group Discussion  Do you think the Earth is a sensitive system – one that is sensitive to changes in its initial conditions?
Name______________________________Section_____________________

Period 14 Exercises:  Climate Change

1)  **Estimating the effect of climate change**

Visit the U.S. Environmental Protection Agency website listed below and read the brochure: Back to Basics. Use the information in this brochure to answer the questions below.


a) According to the brochure, Back to Basics, if humans continue to emit greenhouse gases at or above the current pace, what average global temperature increase is expected by 2100?

b) If we drastically reduce greenhouse gas emissions to year 2000 levels and hold them constant, what average temperature increase is expected over the next 100 years?

c) How will a warming climate affect sea levels?

d) What could happen to sea levels if there are sudden increases in melting rates of ice sheets, such as the West Antarctic Ice Sheet?

2)  **Estimating your contribution to greenhouse gases**

Complete the greenhouse gas calculator at the web site:  
http://www.epa.gov/climatechange/ghgemissions/individual.html

You can answer the questions based on your current lifestyle or that of your family or the lifestyle you expect to have when you have finished school.

a) What are your total pounds of CO₂ emissions per person per year? __________

b) What energy saving actions are you willing to take?

c) How much money and tons of carbon dioxide will these actions save? __________