ESS 200 Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Notes: Global Warming/Climate Change

How are climate models tested?

* “Hindcasting” is used to test new models. Models enter old climate data (e.g. data from the 1970’s) into their climate models and then predict how the climate will change in the following decades (e.g. the 80’s through today). If the predictions match the actual changes in climate, then the model is validated.
* Forecasting. This is the same as hindcasting, except that the modelers use current data and then wait several years to see if their predictions were correct.

How do climate models show that humans are causing global warming?

* Climate modelers include many different types of data in their models (e.g. variation in solar activity, cloud cover, volcanic eruptions, etc.). Greenhouse gas emissions from human activity are one of the types of data that are included. When modelers remove these human-caused emissions from their models, the models no longer accurately predict the climate change (either by hindcasting or forecasting).

What is the difference between *Climate Change* and *Global Warming*?

* Global warming refers to: increasing average temperature of the Earth.
* Climate change refers to: long term changes in temperature, precipitation, wind, ocean currents, and/or other climate characteristics in specific locations.
* Can climate change cause some areas to become cooler? Yes, but most areas will become hotter.

What are the top 4 greenhouse gases, and where do they come from?

* Water Vapor – Evaporation, burning stuff, breathing, global warming
* Carbon Dioxide – 40% from burning fuels to produce electricity; 30% from transportation (cars, trucks, trains, boats, planes); 5-10% from production of cement and concrete; breathing.
* Methane – swamp mud, cow flatus
* Nitrous Oxide – Soil, agriculture, burning stuff

How do greenhouse gases heat up the Earth?

* Visible light travels from the Sun to the Earth’s surface, mostly passing through our greenhouse gases.
* Visible light is absorbed by the Earth’s surface, causing the surface to heat up.
* The warm surface of the Earth gives off infrared waves. Greenhouse gases block many of these infrared waves, keeping them inside our atmosphere and heating up the Earth.

Another cause of current global warming:

* Deforestation

Historical (past) causes of global warming and cooling:

* Changes in Earth’s orbit
* Changes in Solar Output
* Greenhouse gas fluctuations resulting from changes in Earth’s orbit and/or the sun’s solar output (see feedback loops, below).

What are some expected impacts of global warming? Why?

* Sea level rise
	+ Melting snow and ice are flowing into the ocean from the land.
	+ The ocean is expanding due to heating.
* The ocean is becoming more acidic (not good for shelled animals)
	+ CO2 reacts with seawater to form carbonic acid.
* Less usable fresh water
	+ Lower snow pack
	+ Inconsistent precipitation (droughts and floods)
	+ Encroaching sea water
* Decreased biodiversity
	+ Many animals and plants will not be able to adapt to their new climates.
	+ Sugaring Seasons will shorten
* More pests
	+ Small parasites, such as ticks, survive better in warmer temperatures.
* Changes in crop yields
	+ May lengthen growing seasons in cooler climates
	+ In some areas, summer cloud cover has increased, decreasing crop yield.
	+ Temperatures may be too high in warmer climates
	+ Droughts and floods may make farming more difficult
* Discomfort in warmer climates
* Lifestyles Will change (e.g. skiing, ice skating, ice fishing, snowmobiling)

Provide some examples of positive feedback loops that contribute to global warming.

* Snow is white and is therefore good at reflecting sunlight back into space. Global warming causes snow to melt. When snow melts, the darker exposed surface of the earth absorbs more sunlight, causing the Earth to heat up. This melts more snow.
* Heating of the Earth melts permafrost. When permafrost melts, it releases CO2 and methane (CH4), which are both greenhouse gases. [This is what scientists think happened in the past, when the original heating was caused primarily by changes in the Earth’s orbit.]

Diagram of The Carbon Cycle (from Wikipedia):

