Names: _____ _____

_____ _____

Grade	

Earth's Changing Climate

Pre-Lab Quiz:

Record your answers as well as your reasonings and explanations.

1.
2.
3.
4.

Part 1: The Greenhouse Effect

1. Study Figure 2 on the lab webpage. The peak emission of light that leaves the Sun is in which wavelength regime, ultraviolet, visible, or infrared?

2. Some of the main components of Earth's atmosphere are nitrogen (N_2), oxygen (O_2), carbon dioxide (CO_2), methane (CH_4), and water vapor (H_2O). Using the Photon Absorption tab of the PhET – The Greenhouse Effect simulation linked on the lab webpage, when the Earth's atmosphere is irradiated by visible light directly from the Sun, will any of these five molecules always allow visible light to pass through the Earth's atmosphere and travel to the Earth's surface without interacting with the atmosphere? If so which ones? Will any of these instead sometimes absorb and reemit visible light in varying directions? If so which ones?

3. Once the Earth has absorbed visible light that has passed through the Earth's atmosphere, the light that is reemitted by the surface of the Earth is in the infrared. From Wein's Law below, what is the peak visible emission wavelength of the Sun and what is the peak infrared emission wavelength of the Earth in nm? The Sun has a temperature of 5800K and the Earth has a temperature of 288K. Does this infrared light emitted by the surface of the Earth have more or less energy than the visible light from the Sun that was absorbed by the Earth? From energy conservation, where did this extra energy go?

$$\lambda_{peak}\ (nm) = \frac{2{,}900{,}000}{T\ (K)}$$

4. Using the Photon Absorption tab of the PhET – The Greenhouse Effect simulation linked on the lab webpage, when the Earth's atmosphere is irradiated by light from the surface of the Earth, will any of the five main molecules in Earth's atmosphere always allow this type of light to pass through and travel out to space? If so which ones? Will any of these instead sometimes absorb and reemit this type of light in varying directions? If so which ones; which of these five molecules are greenhouse gases?

5. Study Figure 3 on the lab webpage. Describe how this figure confirms your answers to Questions 2 and 4.

6. Using the main Greenhouse Effect tab of the PhET – The Greenhouse Effect simulation linked on the lab webpage, under 'Atmosphere during…' select 'Ice age' and under 'Options' select 'View all photons'. Watch the simulation progress for a while. Then under 'Atmosphere during…' select 'Today'. What scientifically significant details change? List at least two details. You will need to allow the simulation to settle for a while to see all changes.

Part 2: Changing Earth's Climate

1. On the Monash University Simple Climate Model website linked on the lab webpage, click on 'Deconstruct the Mean Climate'. When prompted, click 'Go to Basic version'. On the lab webpage, read through the example of how to study the effect of a single climate process. Describe the effect of the presence of Clouds on the Earth's climate.

2. Describe the effect of the presence of Oceans on Earth's climate.

3. What effect does the presence of the greenhouse gas CO_2 in the Earth's atmosphere have on the Earth's climate?

4. What effect does the presence of the Hydrological cycle (the presence of the greenhouse gas H_2O in the Earth's atmosphere) have on the Earth's climate?

5. On the Monash University Simple Climate Model main webpage, click on ‘Climate change scenarios’. On the lab webpage, read through the details of how to interpret this page. Between 1955 and the turn of the century, by approximately how many kelvin have the Earth’s continents warmed?

6. Between 1955 and the present day, by approximately how many kelvin has the Earth’s continents warmed?

7. If humans do not reduce greenhouse gas emissions, by what approximate year will most continents on Earth have warmed by 3 kelvin?

8. By what approximate year will most continents on Earth have warmed by 5 kelvin?