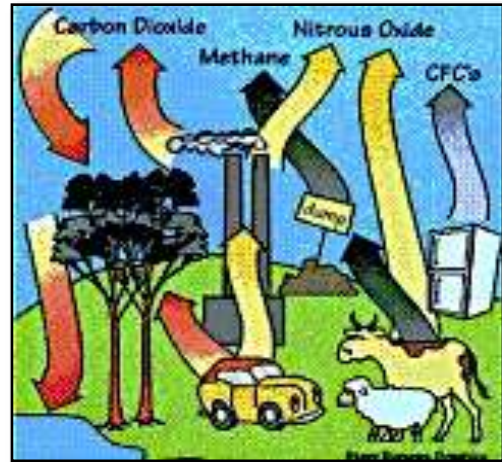# CRITICAL THINKING ACTIVITY:
RESEARCHING ATMOSPHERIC TRACE GASES

Our atmosphere is a layer surrounding the Earth, held in place by gravity and mostly made up of Nitrogen (78%), Oxygen (21%), various other gases making up the remainder. It is the *'remainder'* that we will focus on since it is the concentrations of these **trace gases** that cause the greenhouse gas problem.

Human activities result in emissions of four principal greenhouse gases: **carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O)** and the **chlorofluorocarbons (CFCs)**. Carbon dioxide, nitrous oxide and methane have all increased significantly since the 1800s. The increase began around the time of the Industrial Revolution when we started to burn fossil fuels (coal) in large quantities to power our steam engines for industry, generate electricity, and heat our homes. Today the use of fossil fuel for power and electricity is thousands of times more than what it was in the 1800s. The **CFCs** or **Halocarbons** are not shown here because they were not invented until the 20th century.

All greenhouse gases have what is called a **Global Warming Potential (GWP).** GWPs are based on the heat-absorbing ability of each gas compared to that of carbon dioxide (CO_2). This value is used to compare the abilities of the different greenhouse gases to trap heat in the atmosphere. GWPs can also tell the impact greenhouse gases will have on global warming over different time periods: usually 20 years, 100 years and 500 years. For most greenhouse gases, the GWP declines as the time increases. This is because the greenhouse gas is slowly removed from the atmosphere through natural processes and its influence on the greenhouse effect declines. Some of the CFCs however, have long atmospheric lifetimes and so have a very high GWP.

DATA TABLE: Atmospheric Trace Gases and Climate Change

	CARBON DIOXIDE	METHANE	NITROUS OXIDE	CFCs
Greenhouse Role				
Human Sources				
Natural Sources				
Atmospheric Lifetime				
Present Concentration				
Pre-industrial Concentration				
% of Change				
Global Warming Potential				

ANALYSIS AND COMPREHENSION

1. Which of the four gases on the data table appears to be the largest contributor to global warming? Why?

2. How much have each of the gases increased over time?
   CO_2_____ CH_4_____ N_2O _____ CFCs _____

3. Why is there information missing on the concentrations and increases for CFCs?

4. Which of the 4 gases is used as the standard for the global warming potential? Explain how this system works.

5. Even though there is much less methane, nitrous oxide and CFCs in the atmosphere than carbon dioxide, why are these gases of such 6.

6. Why is the lifetime in the atmosphere a problem if CFCs are no longer being produced?

7. Are any of these gases not good absorbers of infrared energy?

8. Even if there were no further increases in atmospheric concentrations of these gases, why would their impact on climate change still be felt well into the· next century?

9. Scientists know that methane is emitted into the atmosphere by the digestive processes in large grass-eaters, like cattle and sheep, which supply most of the world's meat. How would increased population in developed countries like the U.S. and England contribute to methane concentrations?

10. The industrial age appears to have been the start of the increase for all of these gases, except the CFCs. Explain why that is the case.

11. What does *global warming potential* mean?

12. Explain why scientists say CO_2 is *balanced* in nature.

13. Trees are large, natural sinks for carbon dioxide and release the stored amount into the atmosphere slowly when they die. Why then, is deforestation such a large source of atmospheric carbon dioxide?

14. One natural source of atmospheric nitrous oxide is soils. Why would agricultural fertilizers containing nitrogen compounds be a problem?

15. Rice paddies produce huge amounts of methane. Discuss why Southeast Asia has such high regional methane concentrations. How could this problem be controlled?