


EGEE 102 – Energy Conservation  
And Environmental Protection



Global Warming

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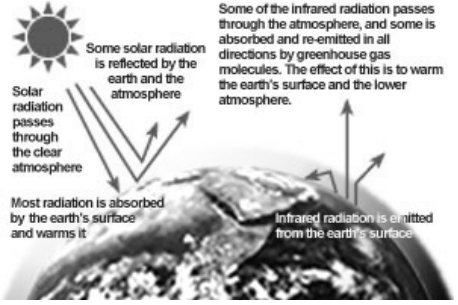
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**The Greenhouse Effect**

Solar radiation passes through the clear atmosphere

Some solar radiation is reflected by the earth and the atmosphere

Most radiation is absorbed by the earth's surface and warms it

Infrared radiation is emitted from the earth's surface

Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the earth's surface and the lower atmosphere.

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Greenhouse Gases

- **Carbon dioxide**
  - combustion of solid waste, fossil fuels (oil, natural gas, and coal), and wood and wood products
- **Methane :**
  - production and transport of coal, natural gas, and oil. Methane emissions also result from the decomposition of organic wastes in municipal solid waste landfills, and the raising of livestock.
- **Nitrous oxide**
  - agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels.
- **hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6),**  
industrial processes

Source: <http://www.epa.gov/globalwarming/emissions/index.html>

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## Global Warming

- Excessive greenhouse gases in the atmosphere due to anthropogenic emissions retains more heat than normal causing the earth's temperature to raise.
- This excessive warming is GLOBAL WARMING.



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## Global Warming Potential

| Gas                               | GWP    |
|-----------------------------------|--------|
| Carbon dioxide (CO <sub>2</sub> ) | 1      |
| Methane (CH <sub>4</sub> )*       | 21     |
| Nitrous oxide (N <sub>2</sub> O)  | 310    |
| HFC-23                            | 11,700 |
| HFC-125                           | 2,800  |
| HFC-134a                          | 1,300  |
| HFC-143a                          | 3,800  |
| HFC-152a                          | 140    |
| HFC-227ea                         | 2,900  |
| HFC-236fa                         | 6,300  |
| HFC-4310mee                       | 1,300  |
| CF <sub>4</sub>                   | 6,500  |
| C <sub>2</sub> F <sub>6</sub>     | 9,200  |
| C <sub>4</sub> F <sub>10</sub>    | 7,000  |
| C <sub>6</sub> F <sub>14</sub>    | 7,400  |
| SF <sub>6</sub>                   | 23,900 |



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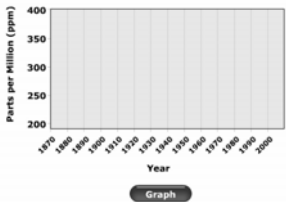
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## CO<sub>2</sub> Changes since Industrialization

Change in global concentration of CO<sub>2</sub> based on ice core samples and actual measurements since 1958.



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### Greenhouse Effect

So, is the greenhouse effect bad?



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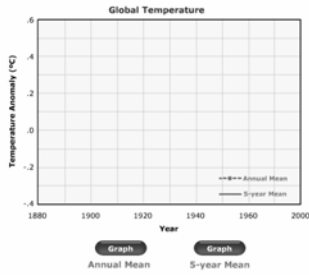
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### Temperature Changes



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### GHG Emissions Increase

- Since pre-industrial times atmospheric concentrations of CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O have climbed by over 31%, 151% and 17%, respectively. Scientists have confirmed this is primarily due to human activity. Burning coal, oil and gas, and cutting down forests are largely responsible.



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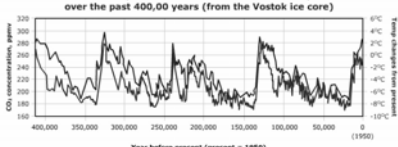
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### CO<sub>2</sub> and Temperature concentration in the atmosphere over the past 400,00 years (from the Vostok ice core)



Year before present (present = 1950)

☐ CO<sub>2</sub> Concentration ☐ Temperature Change

The graph above shows CO<sub>2</sub> and Temperature concentrations in the atmosphere 400,000 years prior to 1950.

1. Does a correlation exist between the CO<sub>2</sub> concentration and Temperature?


☐ YES ☐ NO

2. Prior to 1950, what was the highest concentration of CO<sub>2</sub> reached?

☐ 300 ppmv ☐ 280 ppmv ☐ 260 ppmv ☐ 240 ppmv

3. Prior to 1950, what is the highest temperature reached?

☐ 4° Celsius ☐ 2° Celsius ☐ 0° Celsius ☐ -2° Celsius



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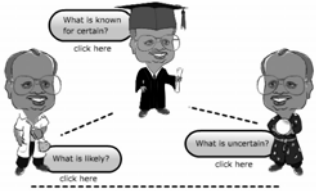
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### So what?





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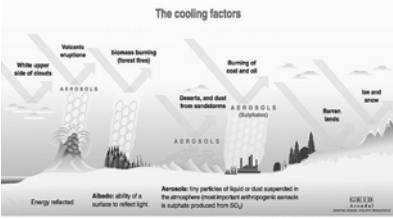
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### Uncertainties - Cooling Factors





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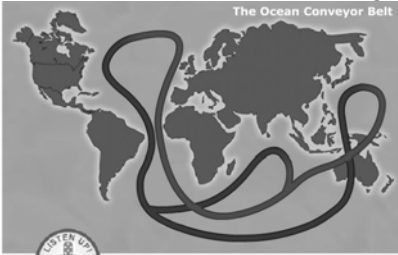
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## Global Ocean Conveyor




The Ocean Conveyor Belt



Click the PLAY button to hear an explanation of the diagram.





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## Global Warming

- Cut your utility bills by purchasing energy-efficient appliances, fixtures, and other home equipment and products. The average house is responsible for more air pollution and carbon dioxide emissions than is the average car.



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## Individual Emissions

- In the United States, approximately 6.6 tons (almost 15,000 pounds carbon equivalent) of greenhouse gases are emitted per person every year. And emissions per person have increased about 3.4% between 1990 and 1997. Most of these emissions, about 82%, are from burning fossil fuels to generate electricity and power our cars.



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## Effects

- Health
- Water resources
- Polar regions
- Mountains
- Forests
- Rangelands
- Deserts
- Coastal Zones
- Agriculture
- International

Required Reading:  
<http://www.epa.gov/globalwarming/impacts/index.html>



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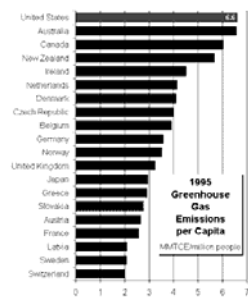
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## Greenhouse Gas Emissions



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## Solution

*Energy Efficiency  
Means  
Doing the Same  
~ or More ~  
With Less Energy.*

Required Reading:  
<http://www.epa.gov/globalwarming/actions/index.html>



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## Class Videos

- The fallacy of Global Warming
- Changing Climates: The Impact.



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## Required Additional Reading

- <http://www.epa.gov/globalwarming/climate/index.html>
- <http://yosemite.epa.gov/oar/globalwarming.nsf/content/ActionsIndividual.html>
- <http://www.giss.nasa.gov/edu/gwdebate/>



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