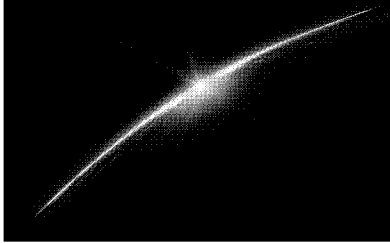


Tuesday, October 5  
The Air We Breathe



"Inebriate of Air – am I – And Debauchee of Dew – Reeling –  
through endless summer days – From inns of Molten Blue"  
- Emily Dickinson

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The Air We Breathe  
Key Concepts

- 1) Earth's atmosphere consists mostly of nitrogen and oxygen.
- 2) Without life, air would have little oxygen; without oceans, it would have more CO<sub>2</sub>.
- 3) Atmospheric CO<sub>2</sub> warms the Earth's surface via the greenhouse effect.

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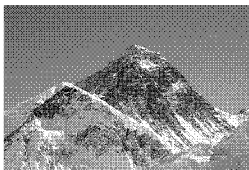
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Air pressure at sea level =  
15 pounds per square inch.

Pressure drops by 50% for every  
5.5 km (18,000 feet) in elevation.



Atop Everest, pressure is  
1/3 its value at sea level.

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Comparative planetary atmospheres:



Mars: low density, 95% carbon dioxide (CO<sub>2</sub>).

Venus: high density, 96% CO<sub>2</sub>.

Earth: moderate density, 0.04% CO<sub>2</sub>.

Why so little CO<sub>2</sub>?

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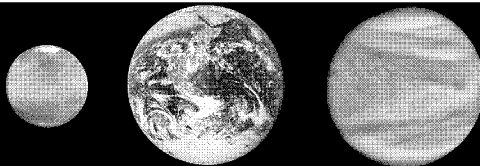
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The oddity of oxygen.



The presence of oxygen (O<sub>2</sub>) is **highly** unusual.

Oxygen combines readily with carbon & hydrogen (burning) and with iron (rusting).

Why so much O<sub>2</sub>?

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Earth's primordial atmosphere was outgassed by volcanoes.

It was like that of Venus today: carbon dioxide, water vapor, sulfur dioxide.



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As Earth cooled from its molten state, H<sub>2</sub>O rained down to form oceans.

CO<sub>2</sub> dissolved in oceans, then precipitated out as calcium carbonate (limestone).



CO<sub>2</sub> is locked up in rocks.

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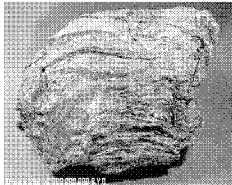
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About 2.7 billion years ago, photosynthetic organisms started pumping out oxygen.



A fossilized colony of cyanobacteria (blue-green algae), 2 billion years old.

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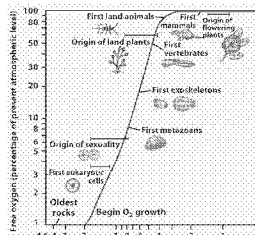
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Oxygen (O<sub>2</sub>) accumulated: ozone (O<sub>3</sub>) formed in the upper atmosphere, absorbing ultraviolet light & permitting life on land.



O<sub>2</sub> is replenished by plants.

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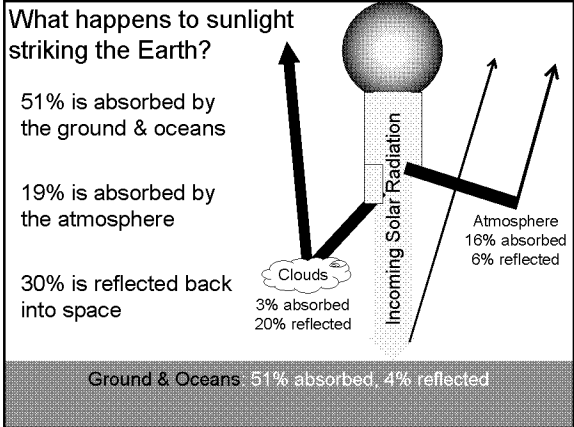
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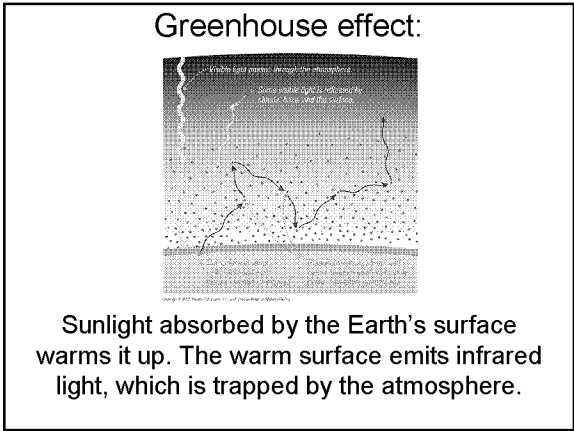
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"Greenhouse gases" = gases transparent to visible light, but opaque to infrared light.

- 1) Carbon dioxide (CO<sub>2</sub>)
- 2) Methane (CH<sub>4</sub>)
- 3) Water vapor (H<sub>2</sub>O)

All these gases are naturally present in the Earth's atmosphere.

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An average day on Earth.

Temperature **WITH** greenhouse effect:

15° Celsius (59° F)

Temperature **WITHOUT** greenhouse effect:

-1° Celsius (30° F)

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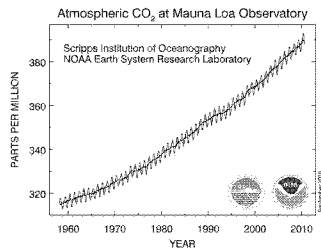
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Burning of fossil fuels & rapid deforestation are raising the level of CO<sub>2</sub>.



AD 1800: 280 parts per million  
AD 2010: 390 parts per million

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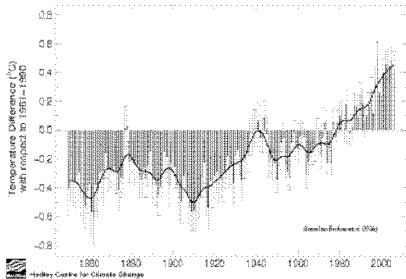
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Global near-surface temperatures:  
Annual anomalies 1850-2006



The average global temperature has risen 0.7° Celsius since the late 19<sup>th</sup> century.

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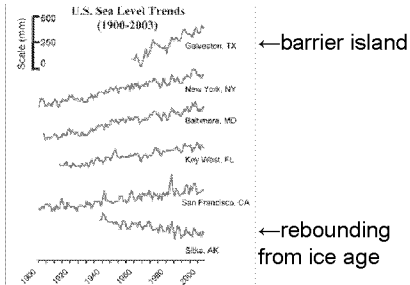
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**Why do we care?**  
Even a small temperature rise can cause a significant rise in sea level.



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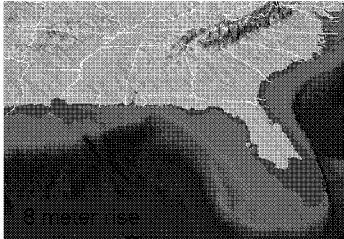
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Melting icecaps & thermal expansion could cause a sea level rise of several meters.



About 25% of the US population lives within 10 meters of sea level.

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Tomorrow's Lecture:  
The Geological Record

Pre-Quiz Reading:  
Chapters 1-4

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