

Lecture 10 CH101 A1 (MWF 9:05 am) Fall 2017 Copyright © 2017 Dan Dill dan@bu.edu

[TP] Which **do you think** is true about the atmosphere?

13% 1. Human activity has added greenhouse gases

13% 2. Reducing water content would lower temperature

13% 3. Reducing greenhouse gas content would lower temperature

13% 4. Temperature will continue to rise

13% 5. 2 and 3

13% 6. 1, 2, and 3

13% 7. 2, 3, and 4

13% 8. 1, 2, 3, and 4

FIGURE 4.4 Atmospheric concentration of CH₄ (ppb), CO₂ (ppm), and N₂O (ppb) gases over the past 2000 years.

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Wednesday, September 27, 2017

For today ...

- Suggestion on working with the textbook
- Complete Ch4: (secs 1, 3, and 4 only): How the atmosphere warms
Think about It e4.4: Collisional heating <http://goo.gl/vQ0Nz>
Think about It e4.5: IR windows <http://goo.gl/I8IGz>

Next lecture: Begin ch5: Chemical reaction, chemical equations

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Suggestion for good use of textbook

5.6 Masses of reactants and products: Stoichiometry (page 137)

Worked Example 5.3 — relative masses of reactants and products

Exercise 5.7 — Relative masses of reactants and products

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Earth's radiation balance

Atmosphere **transparent to visible light**

IR light **emitted** from heated land masses

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e4.4: Heating due to **Greenhouse Gases**

Think about It e4.4: <http://goo.gl/vQ0Nz>



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e4.5: IR **spectral windows**

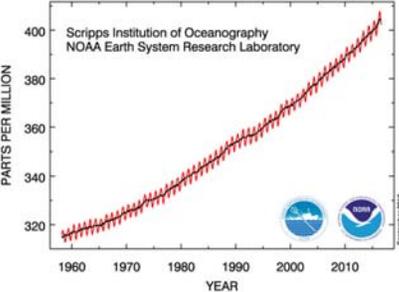
e4.5: <http://goo.gl/I8IGz>



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Atmospheric CO₂ at Mauna Loa Observatory



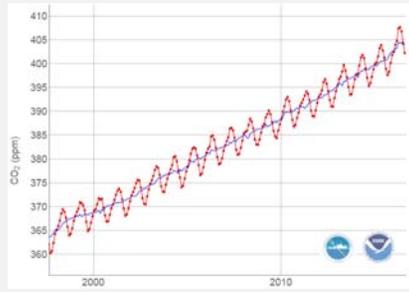
1958: 315 ppm → 2016: 404 ppm
Increase = **89 ppm**, $89/315 \times 100\% = 28\%$



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Atmospheric CO₂ at Mauna Loa Observatory



1997: 364 ppm → 2016: 404 ppm
Increase = **40 ppm**, $40/364 \times 100\% = 11\%$



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1997 → 2016: 40 ppm additional CO₂

40 ppm = 40 μmol CO₂/(mol air)
 Atmosphere is 5.2 × 10¹⁸ kg, 29 g/mol (~ 80% N₂, 20% O₂)
 How many kg of CO₂ added to atmosphere since 1997?
 mol of air = 1.8 × 10²⁰ mol
 mol of CO₂ = 40 × 10⁻⁶ × mol air
 mass of CO₂ = ...
 mol CO₂ × 0.044 kg/mol = ...
 3.2 × 10¹⁴ kg

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[Quiz] Which is true?

- 25% 1. Only methane and other carbon containing molecules contribute to atmospheric heating
- 25% 2. Water molecules contribute to atmospheric heating
- 25% 3. Absorption of IR light by N₂ and O₂ causes atmospheric heating
- 25% 4. Only 2 and 3 are true

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Timeline of Earth's average temperature ...

... since the last ice age glaciation

When people say "the climate has changed before," these are the kind's of changes they're talking about.

<http://xkcd.com/1732/>

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