
Deliberative Democracy: Carbon Capture

Alignment with Course Content

This module directly addresses energy requirements, equilibrium and kinetics of chemical processes.

Necessary Background Knowledge

- Kinetics
 - Equilibrium
 - Thermochemistry
 - Gases
-

Policy Issue

Based on regional carbon dioxide production, recommend a response to reduce atmospheric carbon dioxide. Using recommended reading **and** further research of your own, evaluate at least three established carbon capture or sequestration methodologies. Suggest a method that would be appropriate for your local area.

Module Goals

Students should be able to:

- Search and utilize published scientific data to construct an argument
- Articulate the importance of kinetics in application
- Articulate what it means for a reaction to be in equilibrium and calculate an equilibrium constant
- Describe the energy needed to push carbon capture reactions in the forward and backward directions

Deliberation Scaffolding

Students should consider:

- What are carbon capture and carbon sequestration?
- What is the average concentration of CO₂ in the air in the 21st century? How have the concentrations of CO₂ changed over the past 100 years? What is the evidence?
- How expensive are the methods?
- How much CO₂ do we need to capture or convert to have an impact and make it a worthwhile procedure?
- What are the reaction rate considerations in the methods?
- Are there chemical equilibrium issues to consider (remember order of magnitude of K_{eq} and LeChatlier's Principle)?
- How much energy is needed to force the carbon capture reaction?
- Are there waste products created in the method? What are they? How much?

Instructor Notes

Implementation Suggestions

- This module could be implemented as either a one-day or two-day module. The worksheet for the two-day module is attached. For an example of a more scaffolded, one-day worksheet see the Desalination Module.

Articles

Media:

[Washington Post 2016- The suddenly urgent quest to remove carbon dioxide from the air](#)

Peer reviewed:

[Science 2016-Rapid carbon mineralization for permanent disposal of anthropogenic carbon dioxide emissions](#)

DOI: 10.1126/science.aad8132

Informative Articles Students Might Find

[Media-Scientists Accidentally Discover Method to Turn Carbon Dioxide Into Ethanol](#)

[EPA-Overview of Greenhouse Gases](#)

[MIT-Carbon Capture & Sequestration Technologies](#)

[Media-UCF Professor Invents Way to Trigger Artificial Photosynthesis to Clean Air, Produce Energy](#)

[MIT-Carbon Capture and Storage from Fossil Fuel Use](#)

[Peer Review-Chilled ammonia process for CO₂ capture](#)

[Media-Can Carbon Capture Technology Be Part of the Climate Solution?](#)

[Media-A Canadian Start-Up Is Removing CO₂ From The Air And Turning It Into Pellets](#)

[Media-Removing CO₂ From the Air Only Hope for Fixing Climate Change, New Study Says](#)

[Media-Generational injustice: Inside the legal movement suing for climate action now](#)

[Media-Capturing carbon: Can it save us?](#)

Media Paper (Multiple-Choice Assignment Ideas)

[Washington Post 2016- The suddenly urgent quest to remove carbon dioxide from the air](#)

The suddenly urgent quest to remove carbon dioxide from the air by Chris Mooney, Washington Post

Example question topics:

- What is carbon capture?
- Are there kinetic challenges in utilizing a particular method?
- Compare the energy required for select methods.
- What methods involve chemical reactions and/or physical processes?

Peer Reviewed Paper (Multiple-Choice Assignment Ideas)

[Science 2016-Rapid carbon mineralization for permanent disposal of anthropogenic carbon dioxide emissions](#)

DOI: 10.1126/science.aad8132

Rapid carbon mineralization for permanent disposal of anthropogenic carbon dioxide emissions by Juerg M. Matter, Martin Stute, Sandra Ó. Snæbjörnsdóttir, Eric H. Oelkers, Sigurdur R. Gislason, Edda S. Aradóttir, Bergur Sigfusson, Ingvi Gunnarsson, Holmfrídur Sigurdardóttir, Einar Gunnlaugsson, Gudni Axelsson, Helgi A. Alfredsson, Domenik Wolff-Boenisch, Kiflom Mesfin, Diana Fernandez de la Reguera Taya, Jennifer Hall, Knud Dideriksen, Wallace S. Broecker

Example question topics:

- What is the major challenge with geologic CO₂ storage?
- What elements present in basalt rock are chemically reactive in this method?
- What are the challenges to scaling up this method?
- How does Figure 3 support the author's claim of the efficacy of this method as a permanent storage for CO₂?

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Deliberative Democracy: Carbon Capture

Leader First & Last Name		Facilitator/Spokesperson First & Last Name	
Recorder First & Last Name		Devil's Advocate/Summarizer First & Last Name	

Question to scientists: Based on regional carbon dioxide production, recommend a response to reduce atmospheric carbon dioxide. Using recommended reading and further research of your own, evaluate at least three established carbon capture or sequestration methodologies. Suggest a method that would be appropriate for your local area.

What do you need to know before you can make an informed recommendation?	Why does this missing piece of information matter? (include social and science rationales)	Who will find 2-3 articles about this concept (at least one per box must be peer-reviewed)?
A.		1. 2. 3.
B.		1. 2. 3.

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What do you need to know before you can make an informed recommendation?	Why does this missing piece of information matter? (include social and science rationales)	Who will find 2-3 articles about this concept (at least one per box must be peer-reviewed)?
C.		1. 2. 3.
D.		1. 2. 3.

Before doing background research, what is your group's initial stance?

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Question to scientists: Question to scientists: Based on regional carbon dioxide production, recommend a response to reduce atmospheric carbon dioxide. Using recommended reading and further research of your own, evaluate at least three established carbon capture or sequestration methodologies. Suggest a method that would be appropriate for your local area.

Evidence to support your science advisory statement:	Source title and journal (or media outlet) AND initials of who found the article	Which lecture topics or textbook chapters cover this material?
A.		
B.		

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Science Advisory Statement (**Deliberate consensus**):

End of Day 2. Thank you for investing your time and energy on this activity!