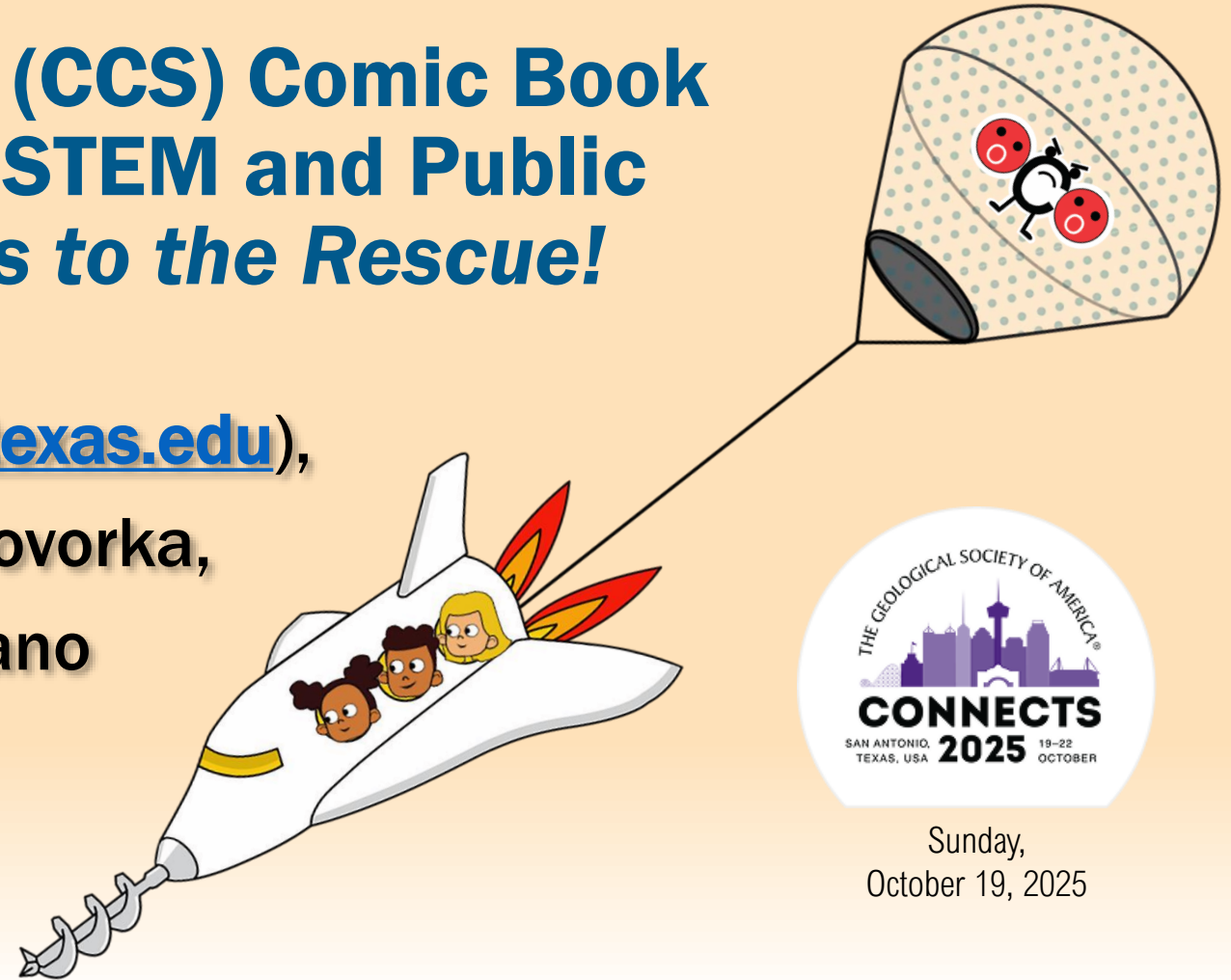


A Carbon Capture & Storage (CCS) Comic Book Created to Sustain Texas STEM and Public Acceptance: *Carbon-nots to the Rescue!*

Dolores van der Kolk (dvdk@beg.utexas.edu),
Francine Mastrangelo, Susan Hovorka,
Valerie Tran, & Angela Luciano



Sunday,
October 19, 2025

Where are we with Carbon Capture & Storage (CCS)?

CCS is accelerating globally

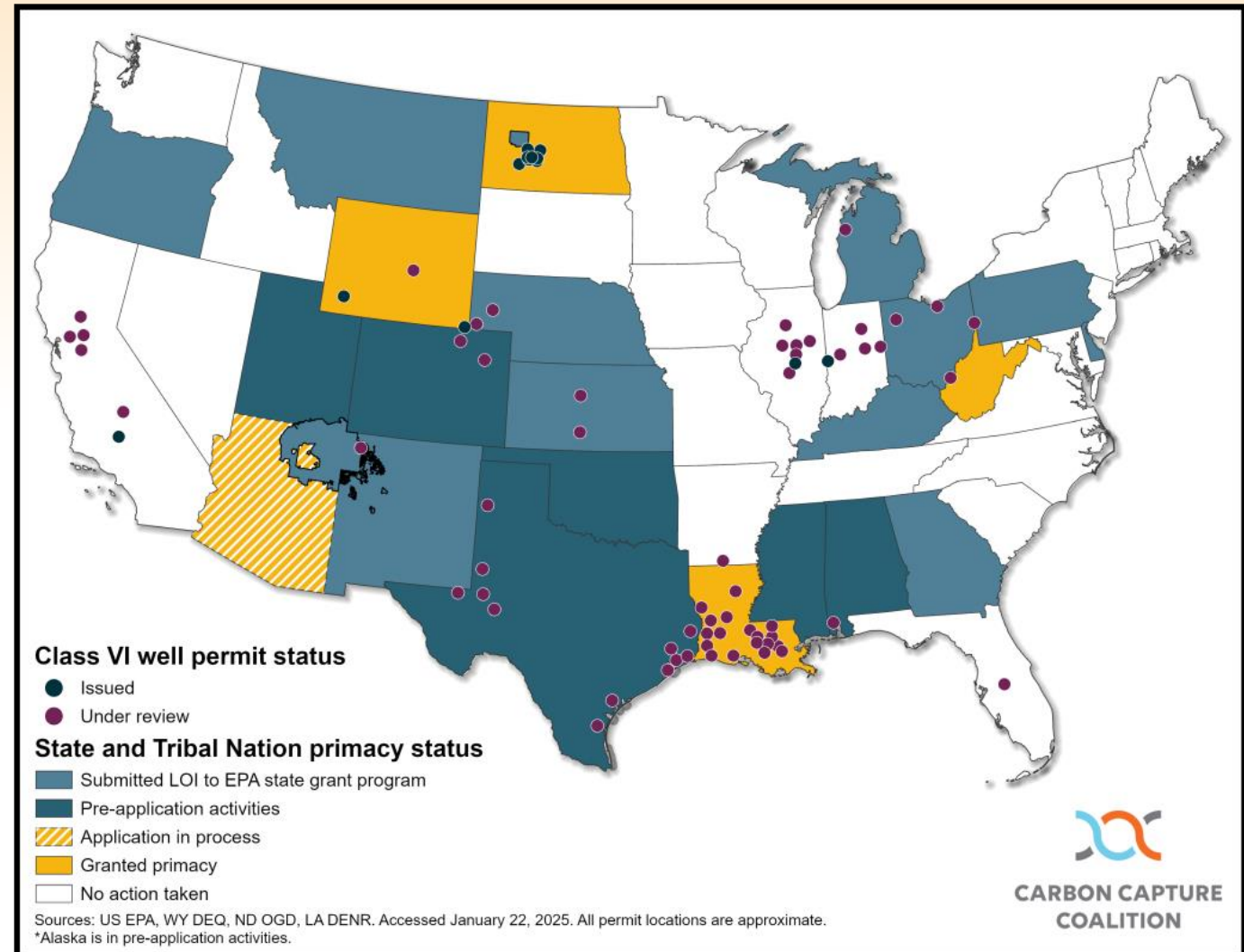
CCS projects are projected to increase as Texas and other states approach CCS primacy

- **CCS primacy** removes federal oversight allowing states to regulate and permit Class VI underground injection control wells for injecting carbon dioxide (CO₂)

CCS has a major P.R. problem

The world needs to act, but many do not understand this technology; there is resistance and misinformation to work through

We need ALL ways to communicate how important CCS is to help decrease greenhouse gases in our atmosphere



Current primacy (yellow): West Virginia, Wyoming, North Dakota, & Louisiana



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GCCC's PI, Sue Hovorka, recognized a vital **need for accurate & appropriate CCS information for many stakeholders:**

- state and local government officials, diverse interest groups including workers, unions, landowner organizations, community groups, trade groups, environmental and other interest organizations, and local residents

Vision 1. Create a **TXLA CMC CCS Network**, a “**Phone Book**” to unite **CCS stakeholders** and a way to distribute **newsletters** with CCS resources

Vision 2. Create a university network, and their connections, as valued communicators for providing CCS information in appropriate formats that are both welcome and useful

*Funded by Department
of Energy's National
Energy Technology
Laboratory (DOE-
NETL) project DE-
FE32361*





GCCC's TXLA CMC Hosts CCS Workshop for 6th-12th Grade STEM Teachers

The [Gulf Coast Carbon Center](#)'s *Carbon-not Education & Ambassador Program* empowers teachers to build expertise in carbon capture and storage (CCS) technologies and helps them create and distribute educational resources for K-12 educators throughout Texas & Louisiana



Utilize experts: STEM teachers + CCS Researchers to learn from one another, collaborate, and build products to properly communicate to kids and help spread the word about CCS



Avg. U.S. adult reads at a 7th- or 8th-grade level

Middle School Teachers Requested a CCS Comic Book in 2024



- Created hands-on STEM exercises and resources
- Carbon-not Ambassadors (expert teachers) [summary of the GCCC's day-to-day workshop](#), workshop & distributing materials at Conferences for the Science Teachers Association of Texas (CAST24 & CAST25 – Nov. 13-15, 2026, in Dallas)

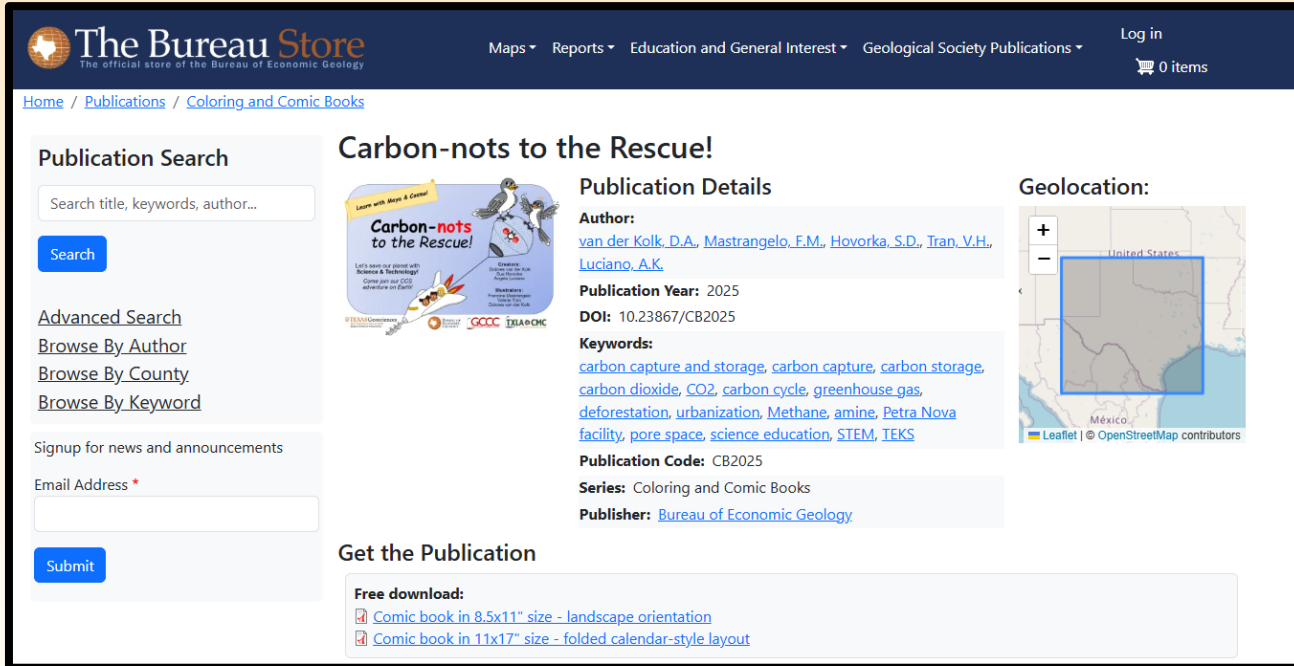
GOALS?

- ✓ Produce a *busy*, “*Mad Magazine*” style, CCS-focused comic book
- ✓ Align, and support, Texas curriculum outlined in Texas Essential Knowledge and Skills (TEKS)
 - 7th & 8th Grade TEKS (S.7.6.A–C & S.8.11.A–C)

Raise CCS awareness and public acceptance:

- ✓ Accessible for teachers
- ✓ Accessible to those in industry
 - Purchase mass productions for school districts or schools near their CCS projects

GCCC's TXLA CMC Delivers a CCS Comic Book



The screenshot shows the 'The Bureau Store' website, which is the official store of the Bureau of Economic Geology. The page displays the product 'Carbon-nots to the Rescue!'. On the left, there is a 'Publication Search' bar and a sidebar with links for 'Advanced Search', 'Browse By Author', 'Browse By County', and 'Browse By Keyword'. The main content area shows the product title, a thumbnail image of the comic book cover, and detailed publication information. The cover features a cartoon penguin and the text 'Carbon-nots to the Rescue!'. The publication details include the author list (van der Kolk, D.A., Mastrangelo, F.M., Hovorka, S.D., Tran, V.H., Luciano, A.K.), the publication year (2025), the DOI (10.23867/CB2025), and keywords related to carbon capture and storage. A 'Geolocation' map shows the state of Texas. At the bottom, there is a 'Get the Publication' section with a 'Free download' option, providing links for two formats: 'Comic book in 8.5x11" size - landscape orientation' and 'Comic book in 11x17" size - folded calendar-style layout'.

Carbon-nots to the Rescue!

Publication Details

Author: van der Kolk, D.A., Mastrangelo, F.M., Hovorka, S.D., Tran, V.H., Luciano, A.K.

Publication Year: 2025

DOI: 10.23867/CB2025

Keywords: carbon capture and storage, carbon capture, carbon storage, carbon dioxide, CO₂, carbon cycle, greenhouse gas, deforestation, urbanization, Methane, amine, Petra Nova facility, pore space, science education, STEM, TEKS

Publication Code: CB2025

Series: Coloring and Comic Books

Publisher: Bureau of Economic Geology

Geolocation:

Get the Publication

Free download:

- Comic book in 8.5x11" size - landscape orientation
- Comic book in 11x17" size - folded calendar-style layout

Available for **FREE** online

Purchase from Bureau of Economic Geology's Bookstore:

<https://store.beg.utexas.edu/publications/coloring-and-comic-books/cb2025>

- **8.5 x 11** for standard printer, book format (\$1.20)
- **11 x 17** for large reproduction print jobs in a calendar format (cheapest for mass productions at \$0.60)

****Exploring Earth Science
in Texas [Coloring Book](#)****

[Bureau of Economic Geology](#) is a great online resource

***Information Geologist, Linda McCall, who is a great resource for the general public & for educators**

Comic Book Friends

Cosmo, we do
NOT have to
be **SO** hot!

Hot!
HOT!

Oh, gee Maya!
There is a rise in average
temperature on Earth, because there
is **too much** CO_2 in the atmosphere.
TOO MUCH CO_2 !

Character to repeat important messages?

- Observer of Earth Processes & Industry?
- Tie them to Texas in a meaningful way?



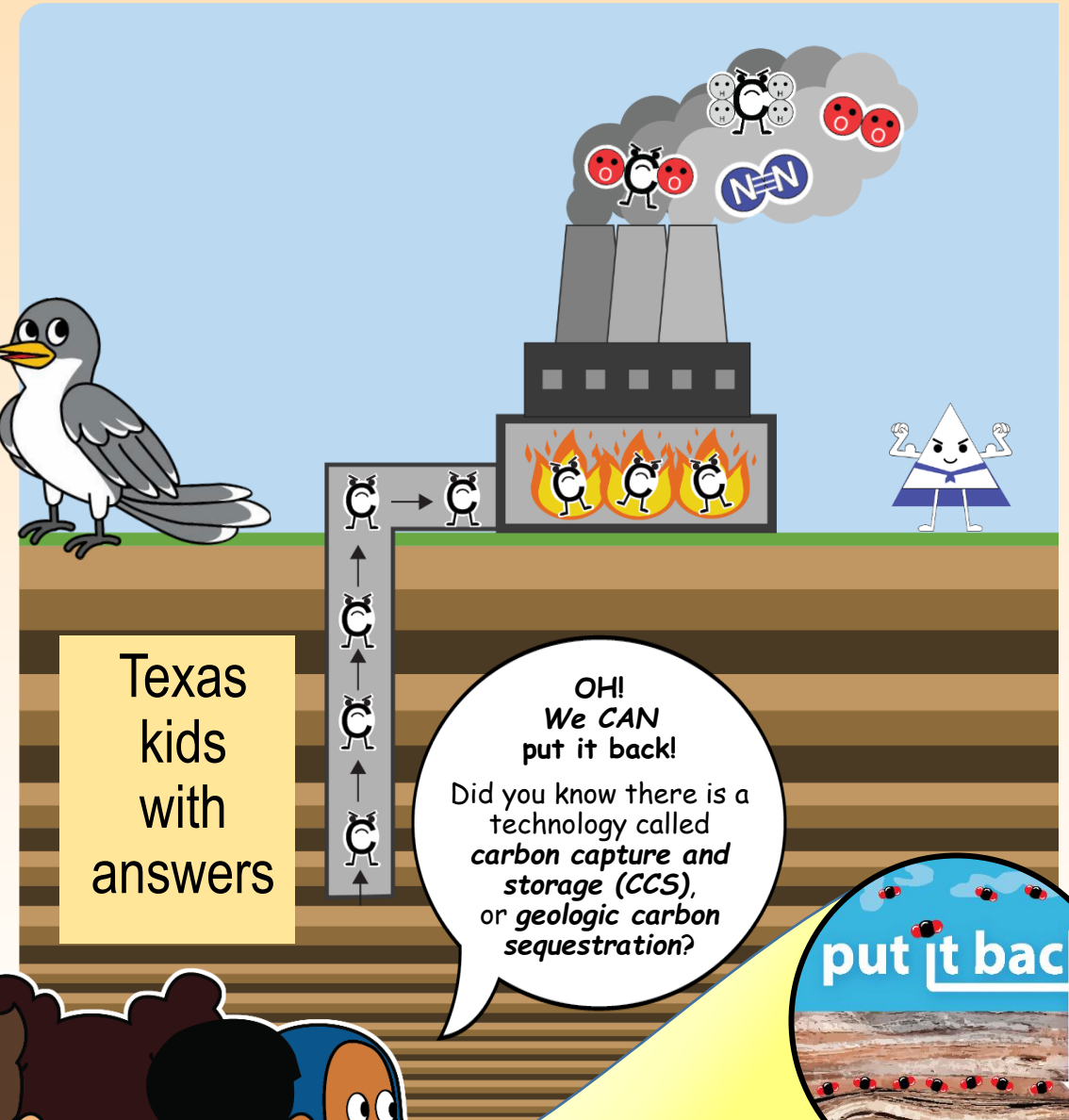
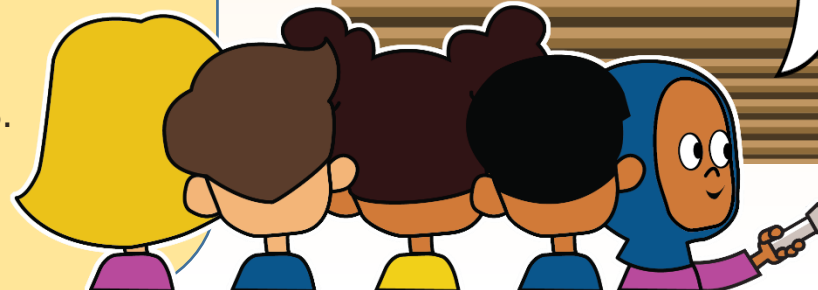
Cosmo and Maya
are the Texas State
Bird known as
Northern Mockingbirds

Mockingbirds are known to mimic a variety of sounds.
Their song is a long series of phrases that they often
repeat 2 to 6 times before shifting to a new sound.



Texas
kids
with
answers

OH!
We CAN
put it back!
Did you know there is a
technology called
**carbon capture and
storage (CCS)**,
or **geologic carbon
sequestration**?



Integrating TEKS as Content

TEKS S.8.11.B

- “Further Explanation

Greenhouse gases can be released and absorbed in various ways. Carbon dioxide enters the atmosphere through burning fossil fuels (coal, natural gas, and oil), solid waste, trees, and other biological materials and also as a result of certain chemical reactions (e.g., manufacture of cement). Carbon dioxide is removed from the atmosphere (or sequestered) when it is absorbed by plants as part of the biological carbon cycle.”

What is carbon dioxide (CO₂)?

CO₂ is known as a **greenhouse gas**, since this gas *traps* heat in our atmosphere.

CO₂ has been recorded in the atmosphere in studies since 1958 at the Mauna Loa Observatory in Hawaii.

Higher concentrations of CO₂ are observed due to various human activities.

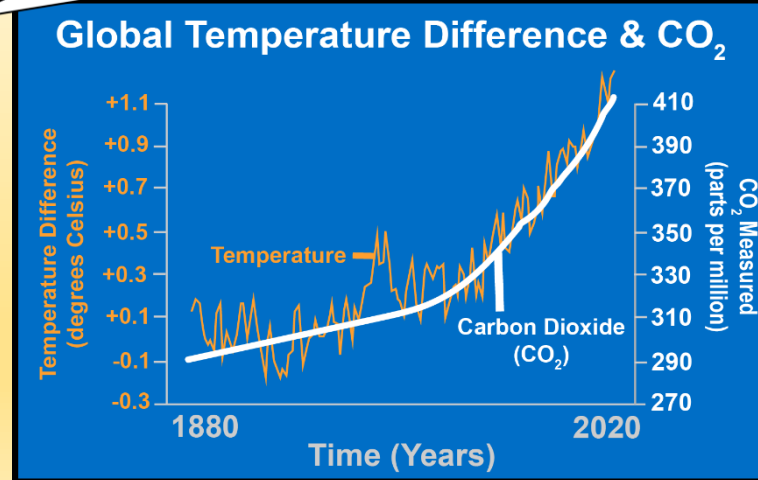
CO₂ can enter Earth's atmosphere when we burn fossil fuels like coal, natural gas, and oil, as well as trees, and solid waste.

It can also enter the atmosphere because of chemical reactions that occur when manufacturing plastic, cement, or steel.



Cosmo,
I am getting too hot
and too thirsty!
TOO HOT!
TOO THIRSTY!

Oh, gee Maya!
There is a rise in average
temperature on Earth, because there
is too much CO₂ in the atmosphere.
TOO MUCH CO₂!



CO₂ comes from a variety of natural sources, but **human-related emissions** have been responsible for an increase in the atmosphere since the industrial revolution.



Oh, dear!
Rising heat causes
**HOTTER HEAT WAVES,
MORE FREQUENT
DROUGHTS, FIRES,
HEAVIER RAINFALL,
and FLOODS!
FLOODS!**

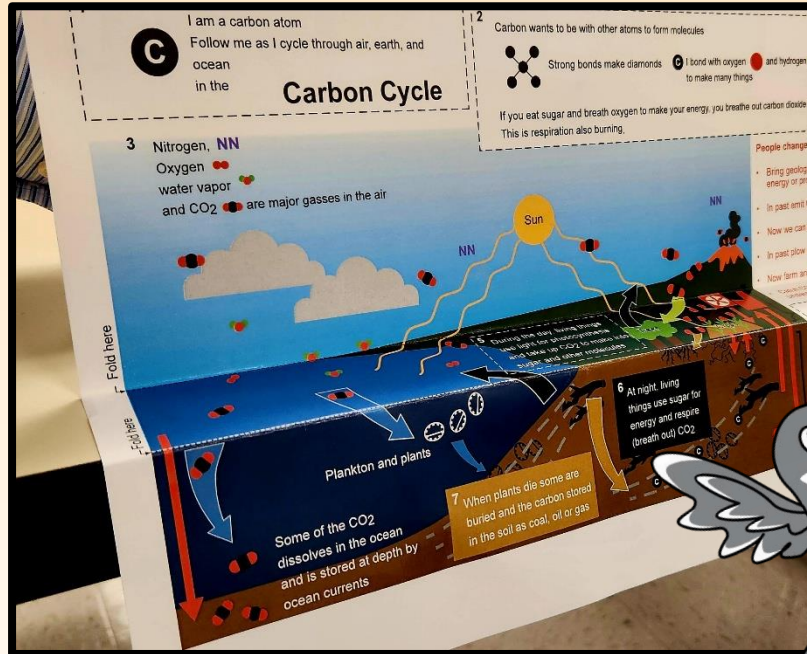
Maya,
it is
getting
HOTTER!!

PEOPLE,
can you stop
letting CO₂ go?
**THIS has to STOP!
HAS TO STOP!**



Hmm...
**WHERE IS ALL
THAT CO₂
COMING
FROM?**

Teacher's Carbon Cycle



Revising a version of this carbon cycle with CCS facility to include in handouts for the comic book handout bundle (coming soon to book store)

I see it every day.
Carbon that was stored in the Earth as coal, oil, or gas is **burned** (combusted) to make energy. The CO_2 that is released mixes with the atmosphere.

CO_2 is also emitted by **chemical reactions** not related to combustion. The production of cement, metals, like iron and steel, and certain chemicals can make

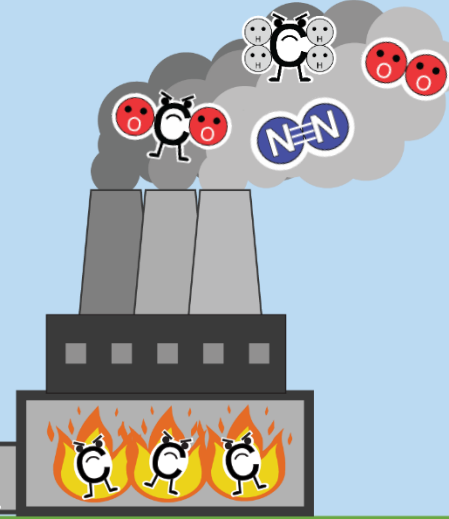
A LOT OF CO_2 !
A LOT OF CO_2 !

THAT'S WHY
We have a lot of CO_2 in our atmosphere!

Ugh!
I don't want to leave my home!

Cosmo,
This ISN'T good!

The **carbon cycle** is out of balance!



I'm a chemical element known as **carbon (C)**, and I am the backbone for life.



On Earth, I am mostly stored in rocks and sediments underground.

Fossil fuels contain mostly **C** and **Hydrogen (H)**. **When fossil fuels are burned or used in industrial processes** C bonds with O_2 to form CO_2 .

I'm an **oxygen molecule (O_2)**, and am essential for living organisms. When burning, I react with **C** to form CO_2 .



I'm **CO_2** , a gas that forms when **C** and O_2 bond.



When high volumes of **CO_2** accumulate in the atmosphere, heat becomes *trapped* there.

I'm a **nitrogen molecule (N_2)**, and I am inert, making me chemically inactive.



I'm a gas known as **methane**.



I am a molecule that contains 1 **C** and 4 **hydrogen** atoms.

I am the 2nd most abundant greenhouse gas after **CO_2** in industrial waste.

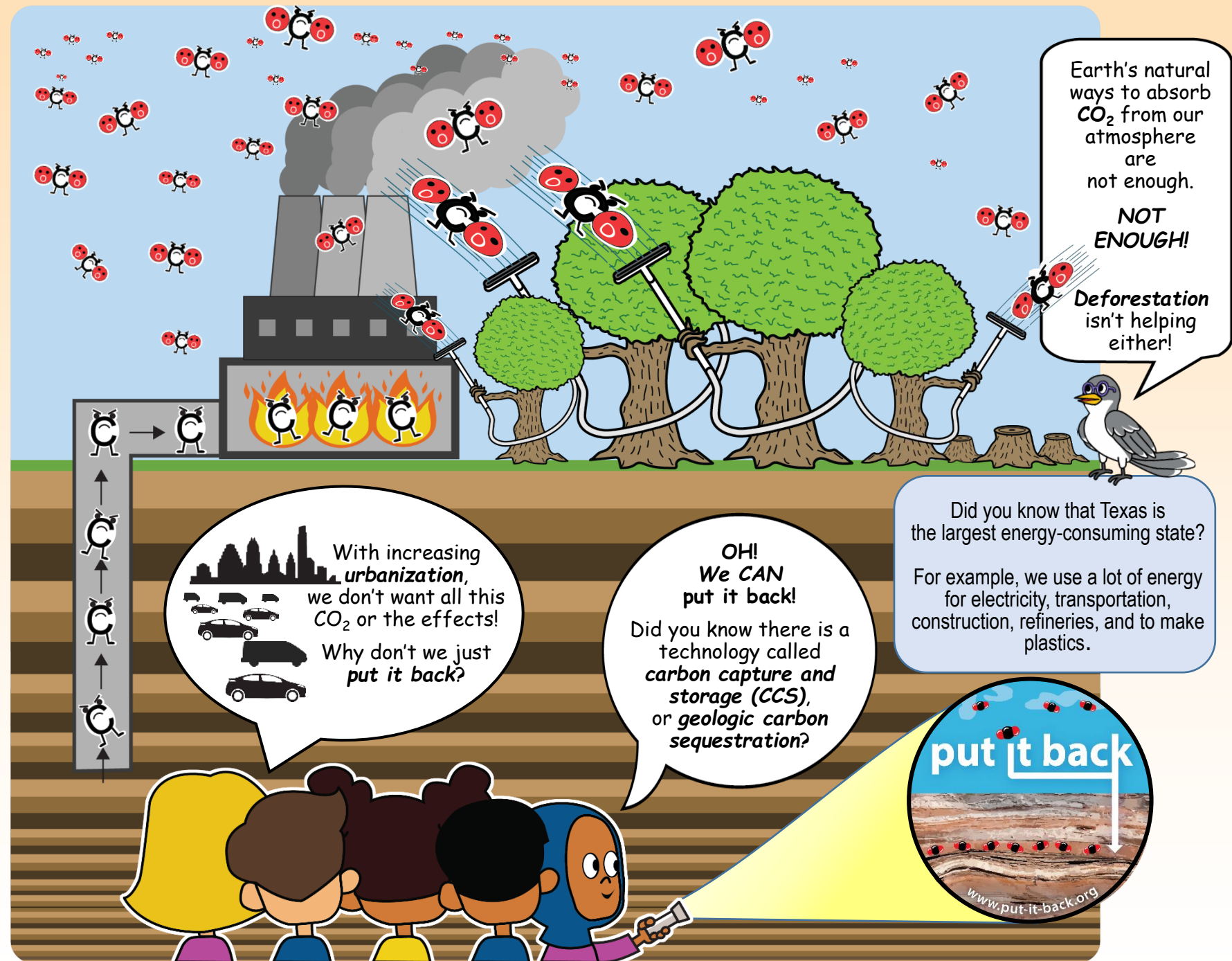
Integrating TEKS Vocabulary Visually

Creative ways to visualize concepts

- Using a vacuum cleaner to suck up CO₂
- Cut trees for deforestation

TEKS S.8.11.A–C Vocab

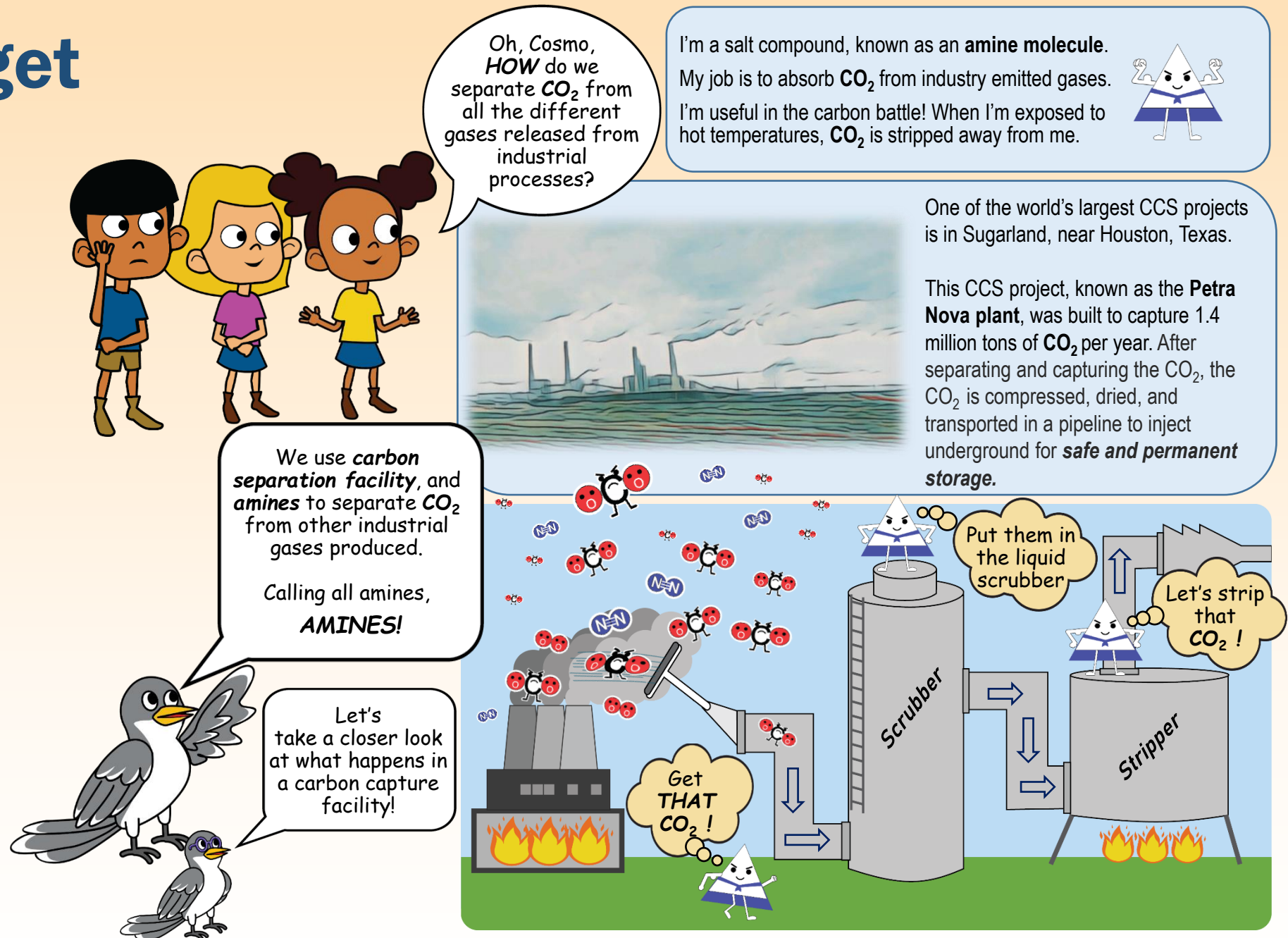
- Carbon Cycle
- Climate
- Greenhouse gases
- Deforestation
- Urbanization



Time & Budget Crunch

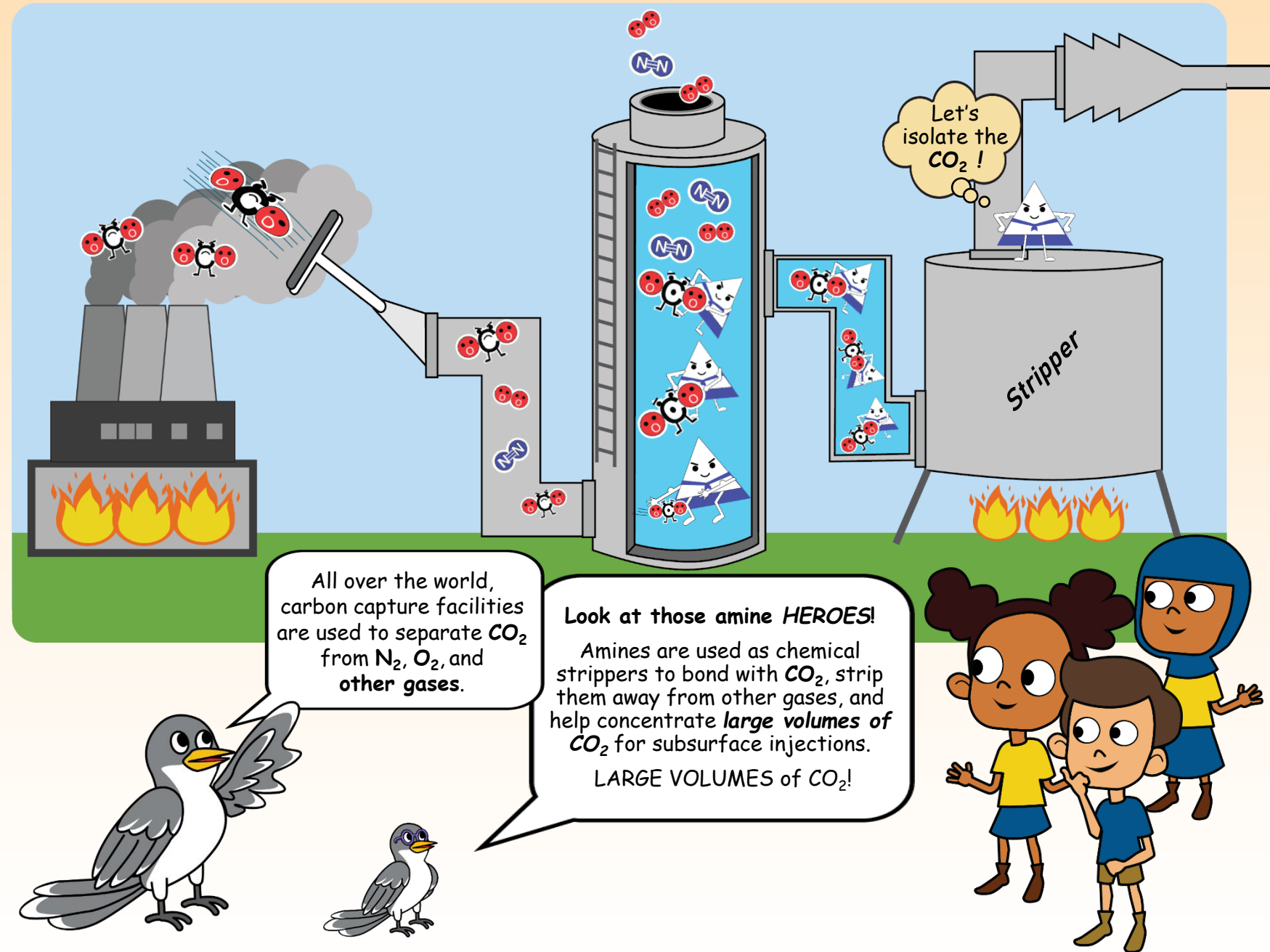
- Requested comic book was not in the original TXLA CMC proposal, but was recommended by the teachers, so there was a limited budget
- Initially given ~ month of time
- Utilized two graphic design illustrators while I was storyboarding at the same time
- We used Illustrator and brought scenes and characters into PowerPoint:
 - Story boarding
 - Speech balloons
 - Layout

Right: Introducing our Amine Heroes



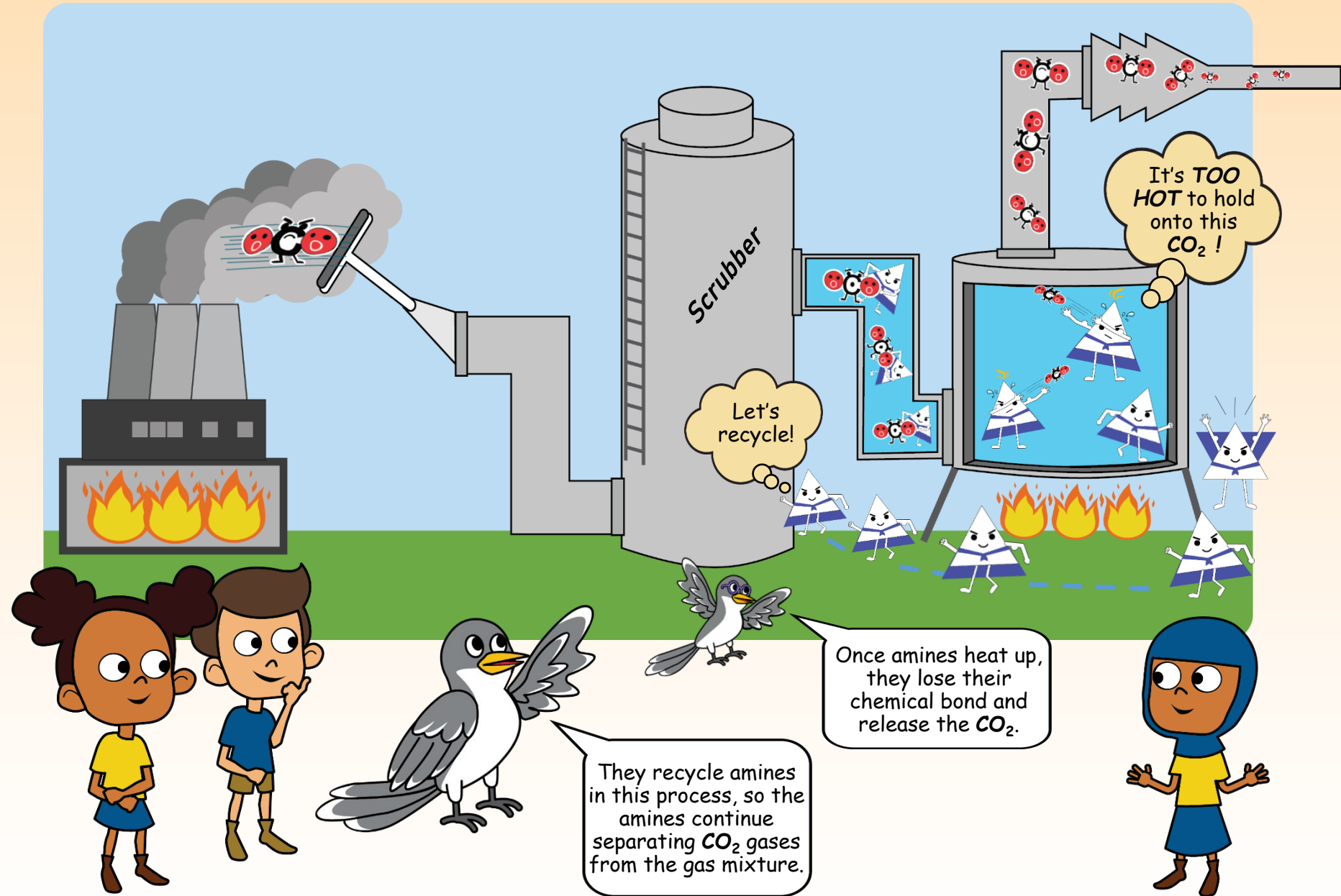
Time & Budget Crunch

- Needed illustrations that could be used repeatedly to decrease drafting hours & adequately handle our time crunch
 - Mockingbirds have a few forms that get rotated and translated different ways
 - Scenes are duplicated, but slightly modified to tell the story around them



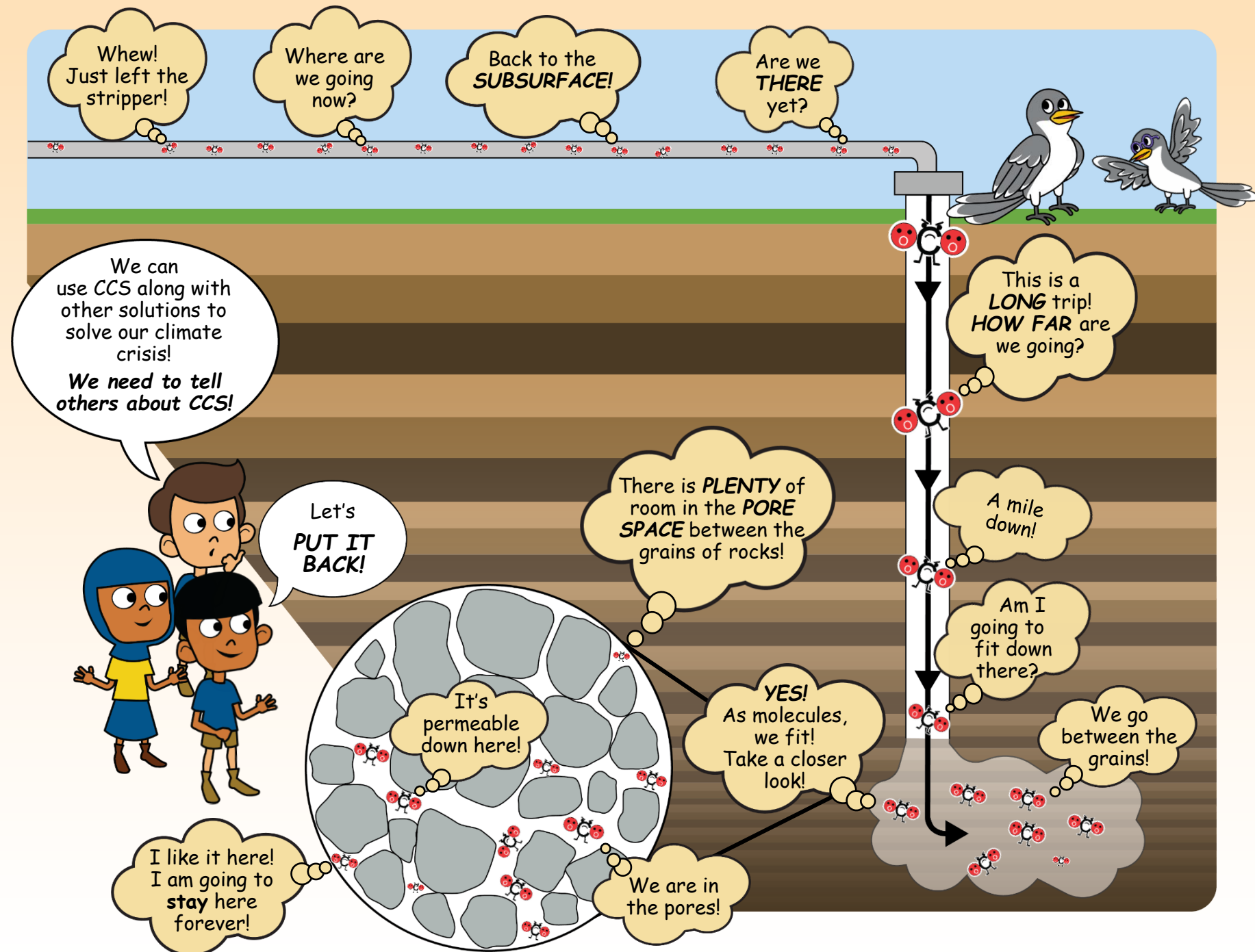
Time & Budget Crunch

- Duplicating and reusing scenes is a common technique to save time and add storytelling effects



Two Versions

- Accommodate this scene across 2 pages in the book and calendar style formats



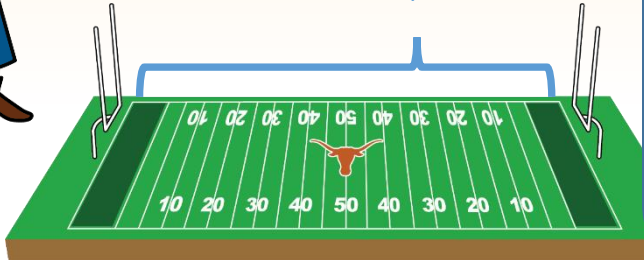
How do we present scale to Texas kids?

Ultimately decided on football fields...

In Texas, CO_2 is injected at least 0.5 to 2 miles down below the ground.

How many football field lengths put end-to-end does it take to show how deep we store CO_2 in the ground?

120 yards



Let's make some "back-of-the-envelope" calculations:

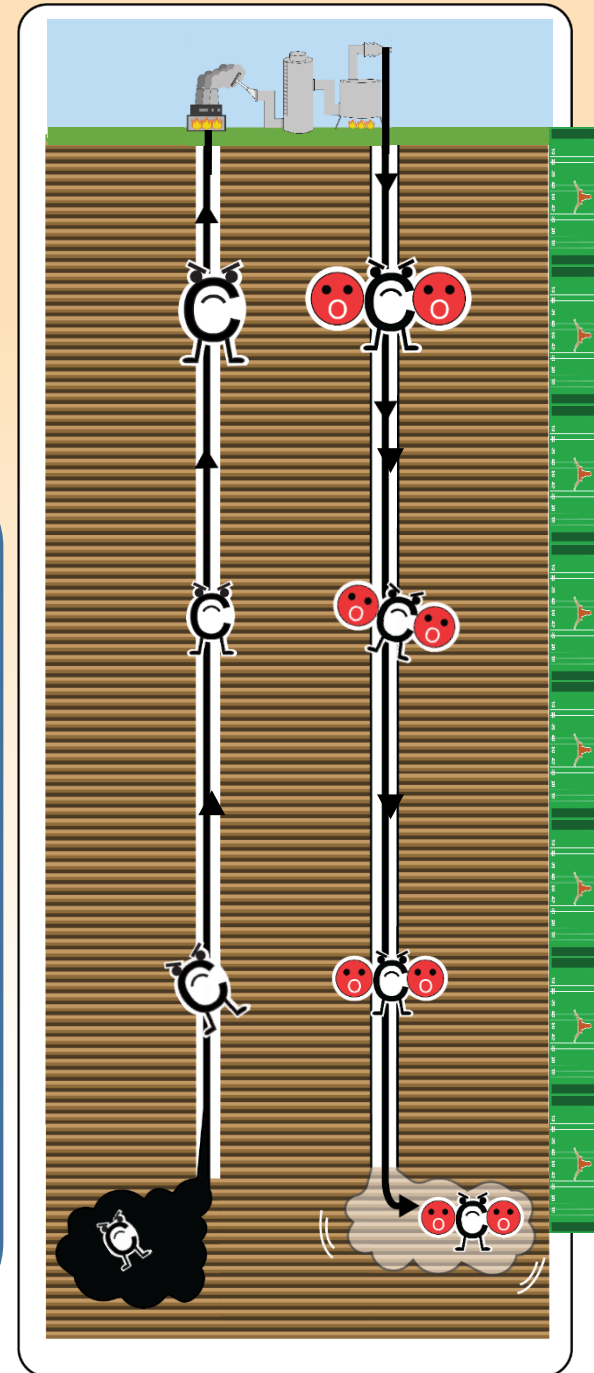
1 football field = 120 yards
0.5 miles = 880 yards
1 mile = 1,760 yards
2 miles = 3,520 yards...

- How many football fields stacked end-to-end would it take to get 0.5 miles down below the surface?

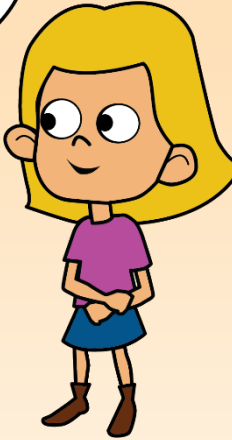
880 yards/120 yards = **7.3** football fields

- How many football fields stacked end-to-end would it take to get 2 miles down below the surface?

3,520 yards/120 yards = **29.3**



Wow, that means for CCS projects, they don't inject CO_2 until they have drilled to at least 7.3 football fields down!



Cool, this creates permanent and safe CO_2 storage!





Helpful Resources & Links

- [Bureau of Economic Geology](#)
- [Gulf Coast Carbon Center](#)
- About [TXLA CMC](#)
- Join the [TXLA CMC network](#)
- [Carbon-not Education & Ambassador Program](#)
- Access to [CCS comic book](#)
- Access to [coloring book](#)

- Global CCS Institute's [Global State of CCS](#) - Where is CCS happening in the world right now?
- [EPA's Underground Injection Control \(UIC\) Class VI Permit Tracker](#)
- U.S. [Roads to Removal](#) Plan
- [GCCC's UNFCCC COP 29 CCS Booth Exhibit](#)

GCCC's CCS

- [Resource Hub](#)
- [Outreach Materials](#)
- [Video Catalog](#)

Special Thanks to 2024–2025 GCCC Sponsors & Representatives who Participated in the Comic Book Review Process



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Special thanks to
DOE-NETL funding
opportunity (DE-FE32361)



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Questions?
Dolores van der Kolk
(dvdk@beg.utexas.edu)

About the Gulf Coast Carbon Center



We seek to impact global levels of atmospheric carbon dioxide (CO₂) by:

- conducting studies, often focusing on the Gulf of Mexico, in regard to geological storage, retention and monitoring of CO₂ in the deep subsurface;
- educating the public about the process of geological CO₂ storage; and
- enabling the private sector to develop an economically viable industry to store CO₂ in the Gulf of Mexico, across the U.S., and globally.

Geologic Characterization



Carlos Uroza

Alex Bump

Timothy
Meckel

Mariana
Olariu

Shuvajit
Bhattacharya

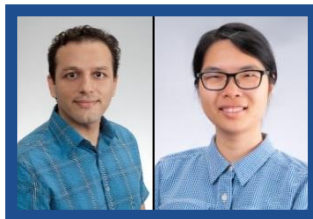
Surface or Deep Monitoring



Susan
Hovorka

Katherine
Romanak

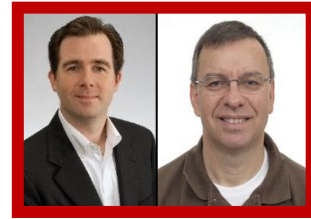
Fluid-Flow Modeling



Seyyed
Hosseini

Hailun Ni

Seismic Interpretation



Dallas
Dunlap

Ramón
Treviño

Energy Economist



Ramón
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Project Manager



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Eddie
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International Research Fellows



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IEAGHG, UK

Charles Jenkins
CSIRO, Australia

2025 GSA Abstract

By Dolores van der Kolk (dvdk@beg.utexas.edu), Francine Mastrangelo, Susan Hovorka, Valerie Tran, & Angela Luciano

The *Carbon-nots to the Rescue* comic book was designed as supplemental material to help middle school science teachers explain new concepts within revised state educational standards for Texas students, known as Texas Essential Knowledge and Skills (TEKS). This comic book colorfully illustrates the importance of science (e.g., elements and molecules in chemistry; pores and permeability within geology) and outlines how innovative technology in Texas, known as CCS, will help decrease atmospheric greenhouse gases. The comic is currently used to help clarify STEM concepts in both middle schools and high schools and is also useful for general audiences. This comes at a critical time as CCS is accelerating, and as Texas approaches CCS primacy. CCS primacy removes federal oversight and allows a state to regulate and permit Class VI underground injection control wells for carbon dioxide (CO₂) sequestration under the Safe Drinking Water Act, which will likely grow in the U.S. and increase business investments.

Riveting content in the comic book aligns well with TEKS standards designed for seventh and eighth graders (TEKS S.7.6.A–C; S.8.11.A–C). By utilizing TEKS S.8.11.B, the comic book narrates how greenhouse gases are released from the burning of fossil fuels (coal, natural gas, oil), solid waste, and trees as well as during various chemical reactions necessary for industrialization (e.g., manufacturing of cement). The comic illustrates how greenhouse gases are absorbed by photosynthetic organisms and how deforestation and urbanization negatively affect the natural balance of the carbon cycle.

Join two Northern Mockingbirds, the state birds of Texas, as they repeatedly share their observations in a Carbon-not adventure with students. See Texas kids and their new feathered friends discuss cutting edge chemical solutions to reduce our carbon output into the atmosphere (e.g., capturing and separating CO and injecting CO underground permanently). **Coming soon:** Delve into new vocabulary and explore student creativity through critical thinking questions, a coloring page for all ages, a vocabulary list, and a carbon cycle exercise made for the classroom and science exploration events. It's time to make this a global phenomenon!