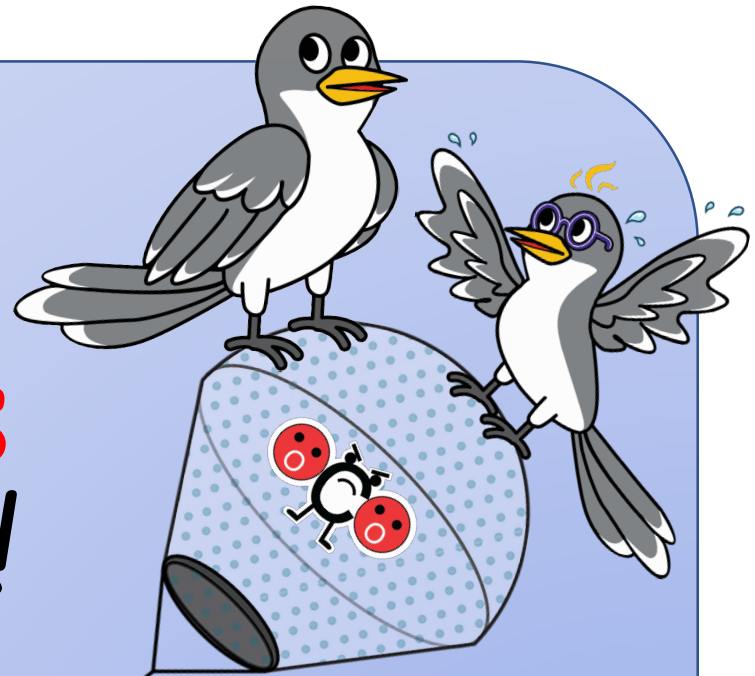


Learn with Maya & Cosmo!

Carbon-**nots** to the Rescue!

Let's save our planet with
Science & Technology!

*Come join our CCS
adventure on Earth!*



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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.

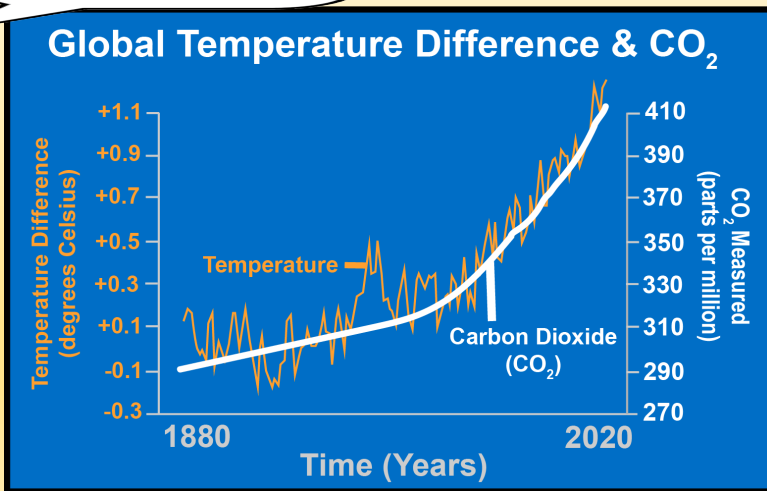
CO₂ can enter Earth's atmosphere when we burn fossil fuels like **coal**, **natural gas**, and **oil**, as well as **trees**, and **solid waste**.

It can also enter the atmosphere as a result of chemical reactions that occur when manufacturing things like **plastic**, **cement**, and **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?

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 !

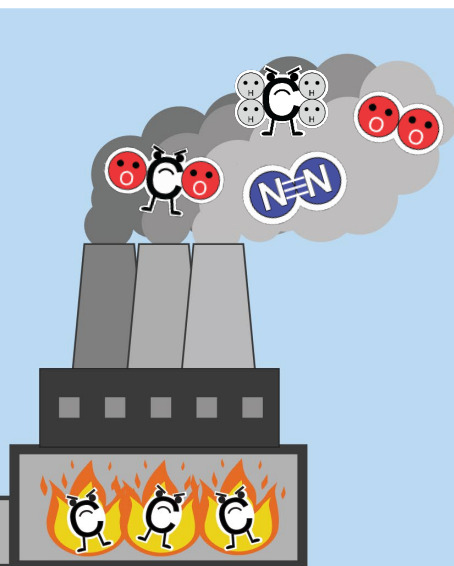


**THAT'S
WHY**
We have a lot
of CO_2
in our
atmosphere!

Cosmo,
**This ISN'T
good!**

The
carbon cycle
is out of
balance!

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



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.

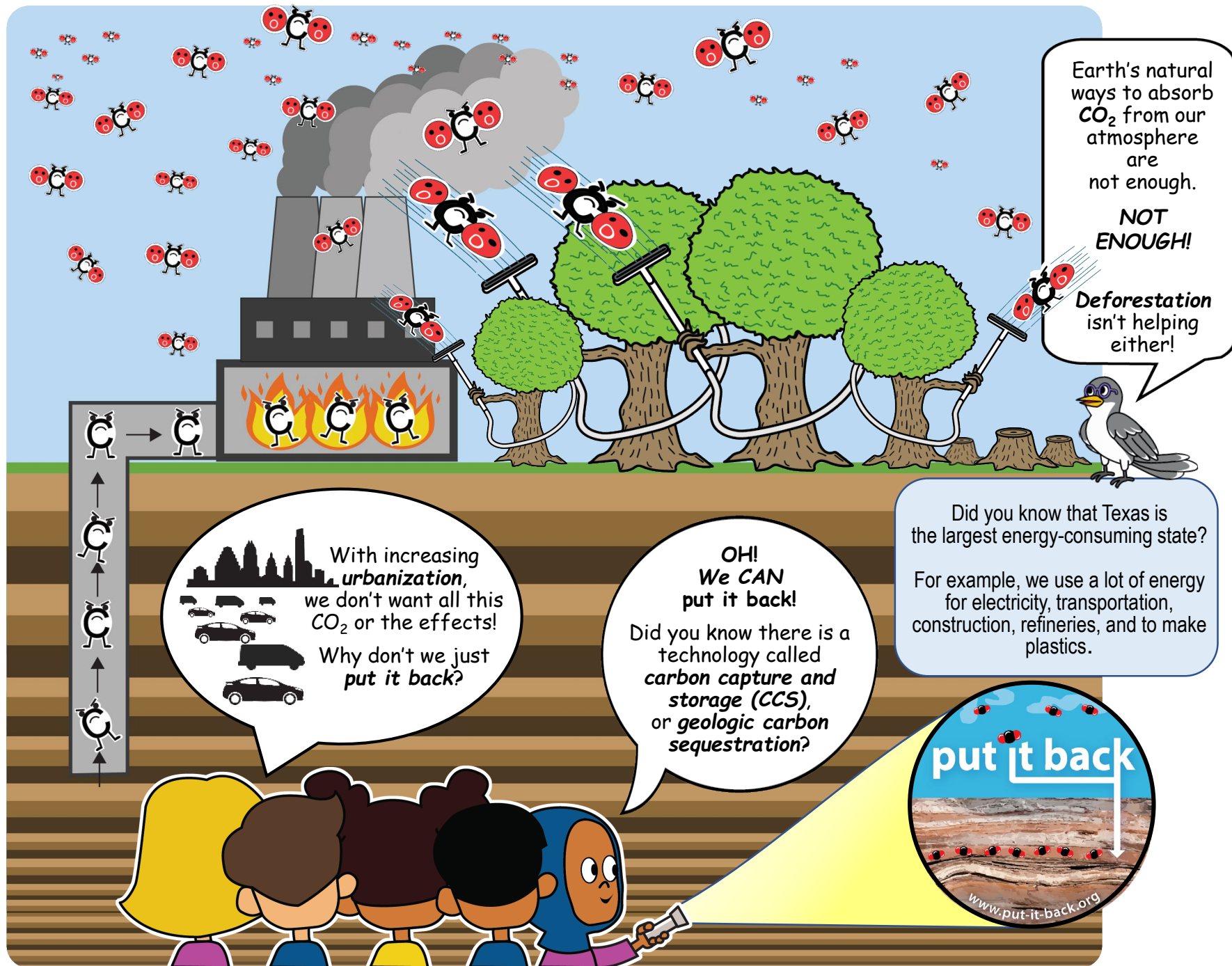


I'm a gas known as
methane.



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.



Earth's natural ways to absorb CO₂ from our atmosphere are not enough.

NOT ENOUGH!

Deforestation isn't helping either!

Did you know that Texas is the largest energy-consuming state?

For example, we use a lot of energy for electricity, transportation, construction, refineries, and to make plastics.

OH!
We CAN
put it back!

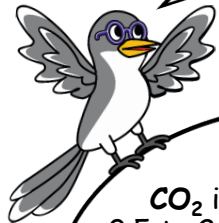
Did you know there is a technology called **carbon capture and storage (CCS)**, or **geologic carbon sequestration**?

With increasing **urbanization**, we don't want all this CO₂ or the effects!
Why don't we just **put it back?**

put it back

www.put-it-back.org

For CCS,
the CO_2 is stored
deep underground,
far, far, **FAR**
below the surface.
DEEP!

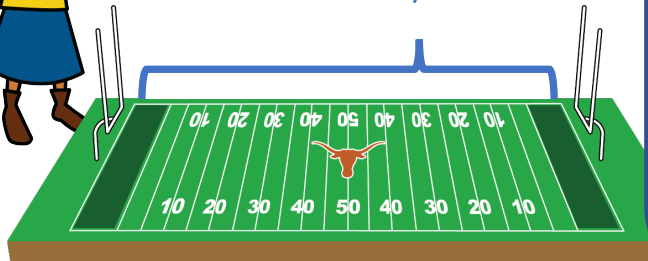


In Texas,
 CO_2 is injected at least
0.5 to 2 miles down below the ground.

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



If we produce
carbon from coal, gas,
and oil underground, we can certainly
take CO_2 generated today and
PUT IT BACK
in the ground to help our
atmosphere!



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...

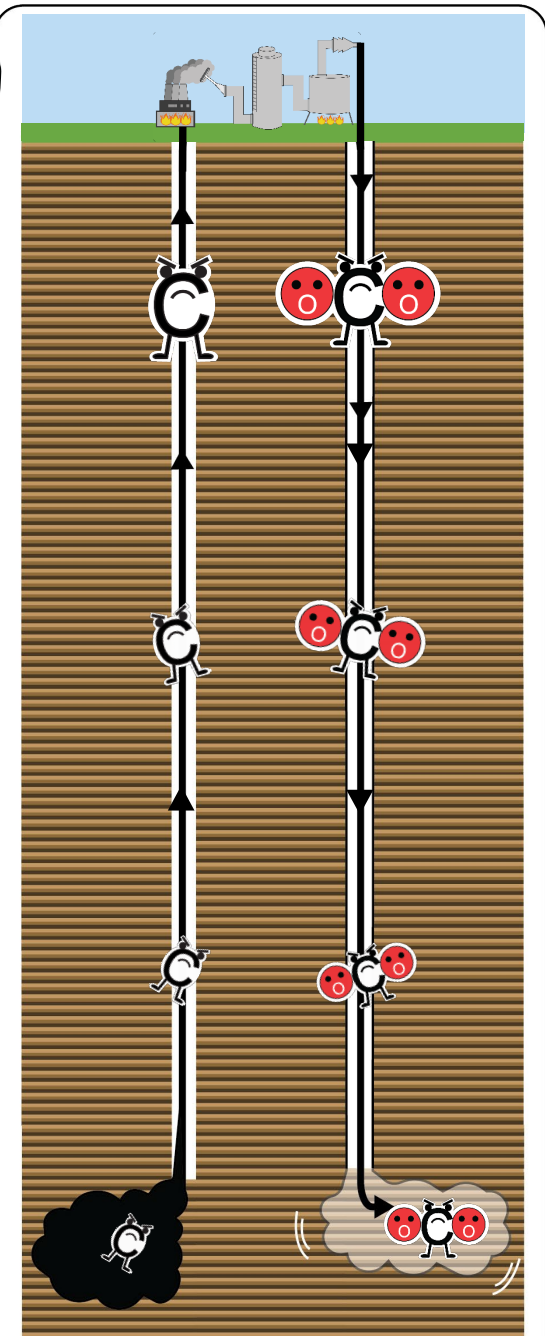
- How many football fields
stacked end-to-end would it
take to get 0.5 miles down
below the surface?

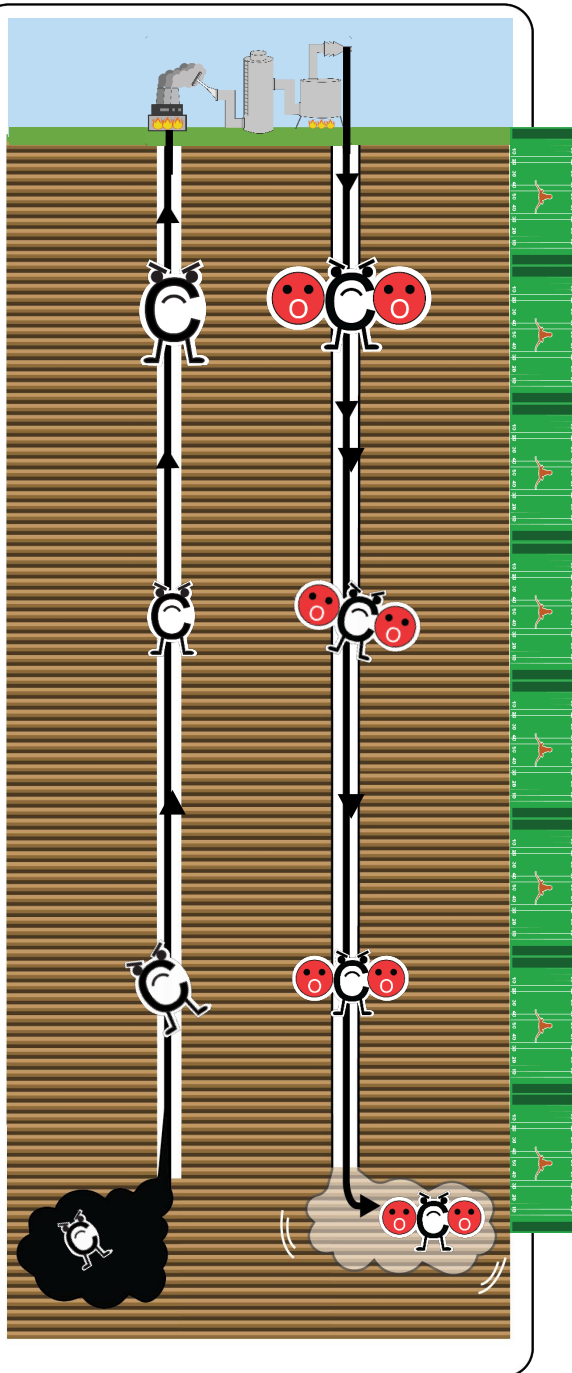
880 yards/120 yards =

_____ 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 = _____





Wow,
that means for
CCS projects, they don't
inject **CO₂** until they have
drilled to at least 7.3
**football fields
down!**

Cool, this
creates
permanent
and safe **CO₂**
storage!

Today's
climate does
not have to
be this way.
We do **NOT**
have to be
SO hot!

Hot!
HOT!

Let's
sequester,
or store
carbon
underground
to decrease
greenhouse
gas!

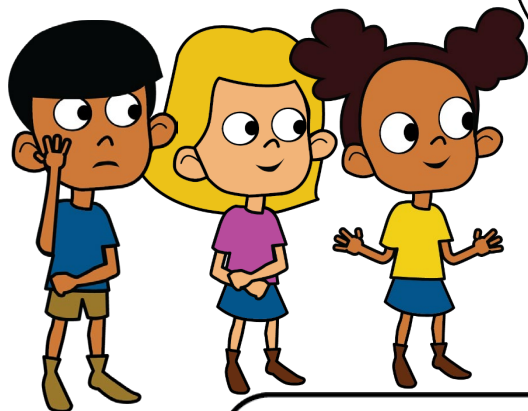
I can't
throw a
football
THAT far!

Did you
calculate the
maximum number
of fields stacked
end-to-end that
it would
take?

What helps decrease greenhouse gases?

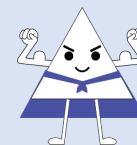
- ☐ Save energy
- ☐ Walk, bike, or public transport
- ☐ Reuse, repair, and recycle
- ☐ Eat more vegetables
- ☐ Waste less food
- ☐ Clean up our environment
- ☐ Make your money count by supporting companies who use resources responsibly, cut emissions & waste
- ☐ Speak up & support activities like CCS

Learn more about actions for a healthy planet here:
<https://www.un.org/en/actnow/ten-actions>



Oh, Cosmo,
HOW do we
separate CO_2 from
all the different
gases released from
industrial
processes?

I'm a salt compound, known as an **amine molecule**.
My job is to absorb CO_2 from industry emitted gases.
I'm useful in the carbon battle! When I'm exposed to
hot temperatures, CO_2 is stripped away from me.



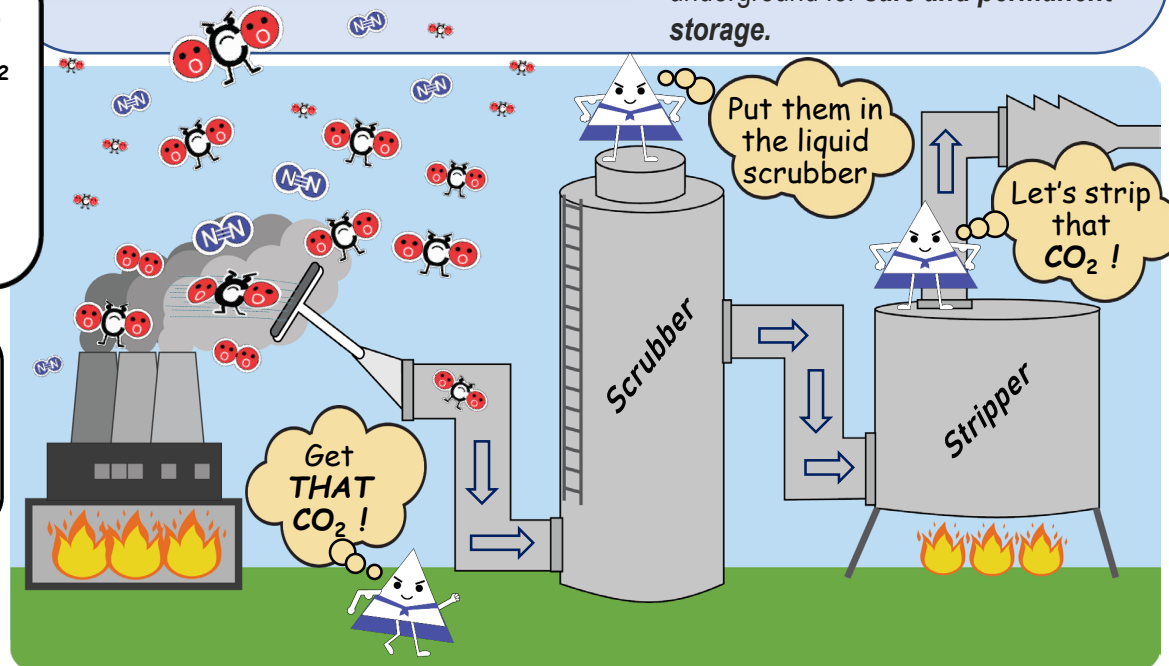
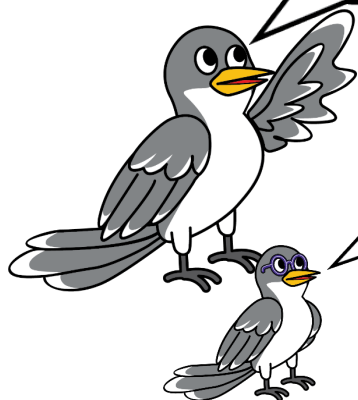
One of the world's largest CCS projects
is in Sugarland, near Houston, Texas.

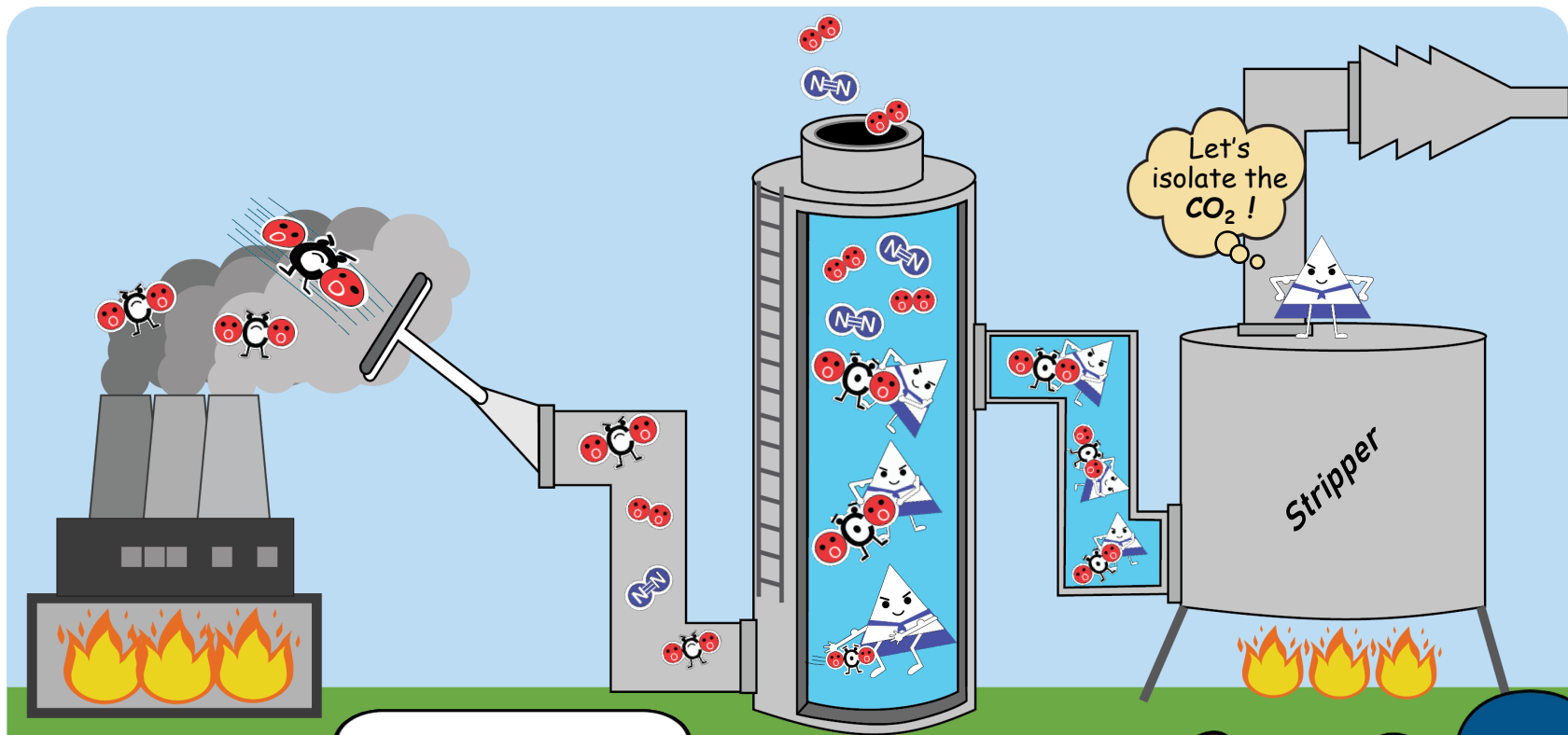
This CCS project, known as the **Petra
Nova plant**, was built to capture 1.4
million tons of CO_2 per year. After
separating and capturing the CO_2 , the
 CO_2 is compressed, dried, and
transported in a pipeline to inject
underground for **safe and permanent
storage**.

We use **carbon
separation plants**, and
amines to separate CO_2
from other industrial
gases produced.

Calling all amines,
AMINES!

Let's
take a closer look
at what happens in
a carbon capture
facility!



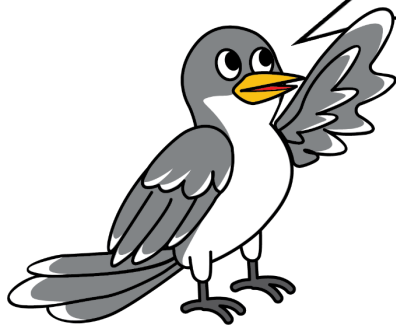


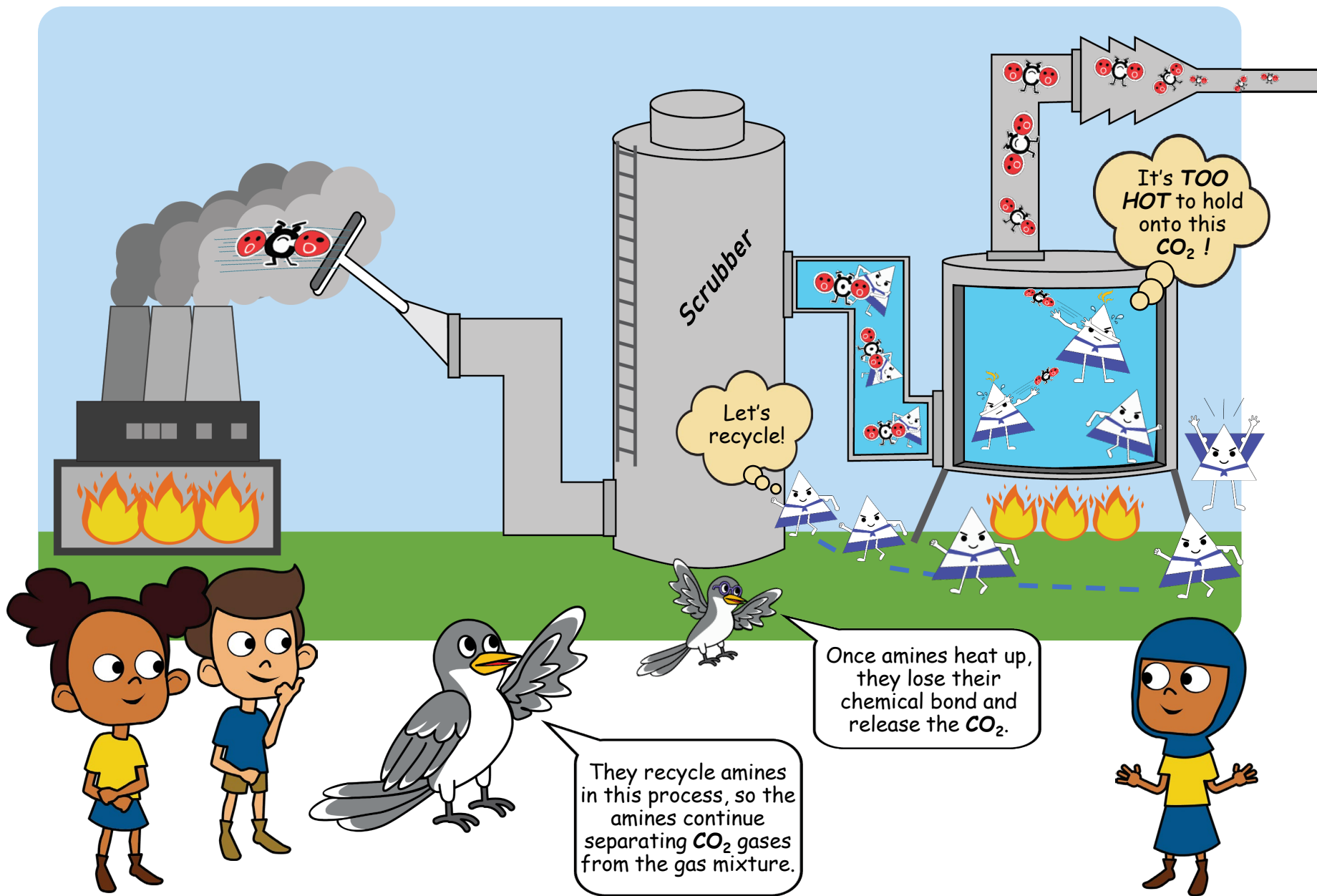
All over the world,
carbon capture facilities
are used to separate CO_2
from N_2 , O_2 , and
other gases.

Look at those amine *HEROES*!

Amines are used as chemical
strippers to bond with CO_2 , strip
them away from other gases, and
help concentrate **large volumes of**
 CO_2 for subsurface injections.

LARGE VOLUMES of CO_2 !





Whew!
Just left the
stripper!

Where are
we going
now?

Back to the
SUBSURFACE!

Are we
THERE
yet?

We can
use CCS along with
other solutions to
solve our climate
crisis!

**We need to tell
others about CCS!**

Let's
**PUT IT
BACK!**

There is **PLENTY** of
room in the **PORE
SPACE** between the
grains of rocks!

It's
permeable
down here!

YES!
As molecules,
we fit!
Take a closer
look!

I like it here!
I am going to
stay here
forever!

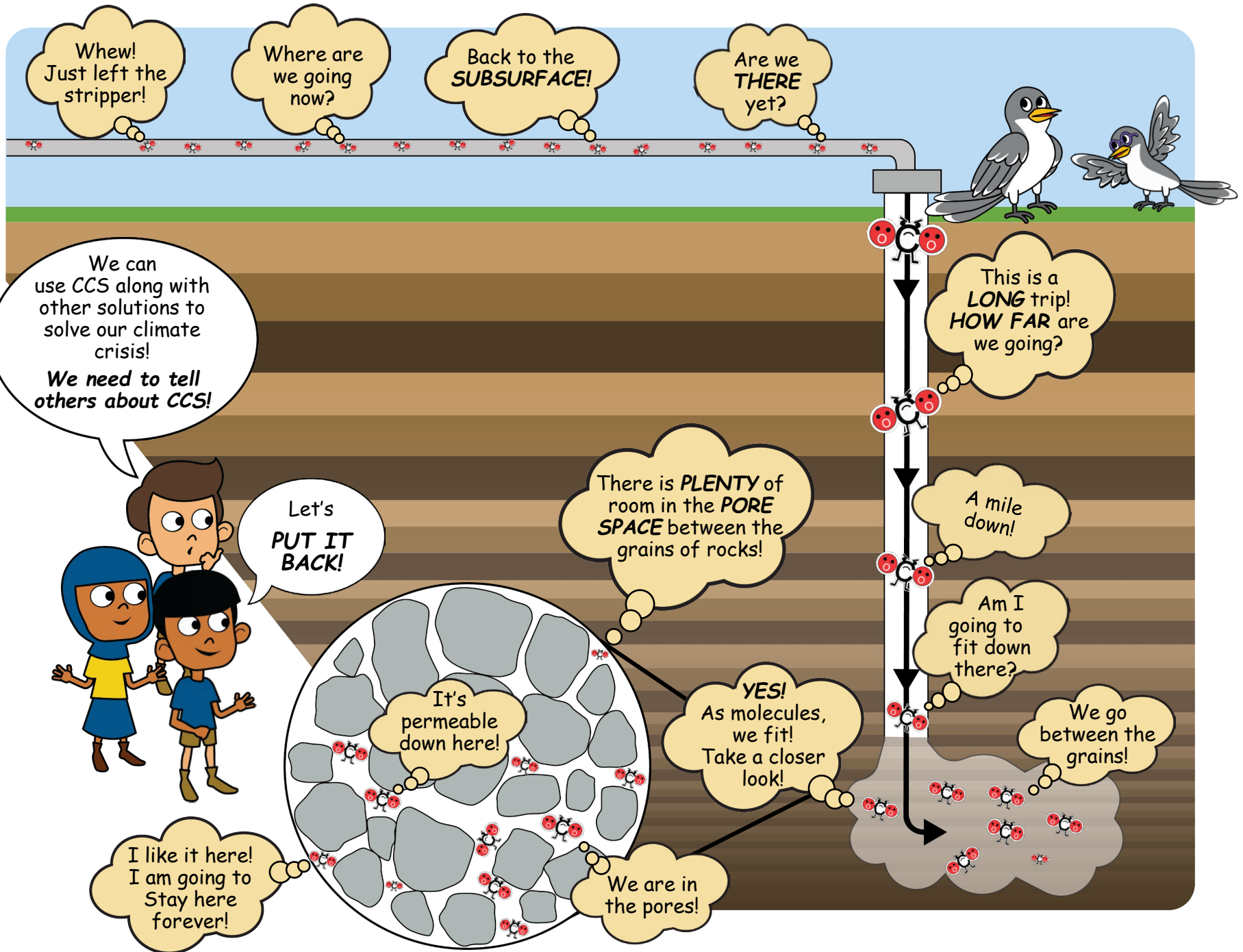
We are in
the pores!

This is a
LONG trip!
HOW FAR are
we going?

A mile
down!

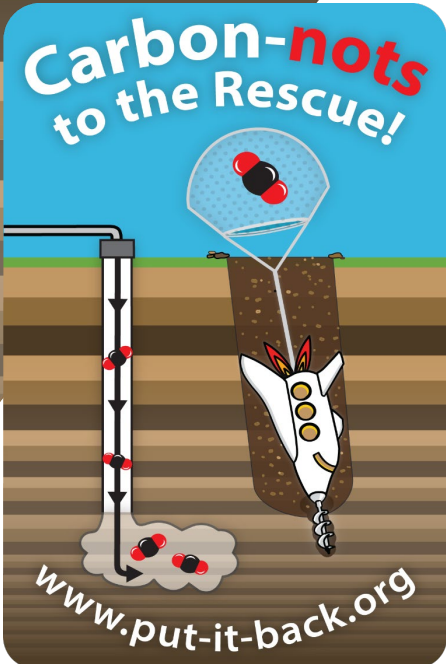
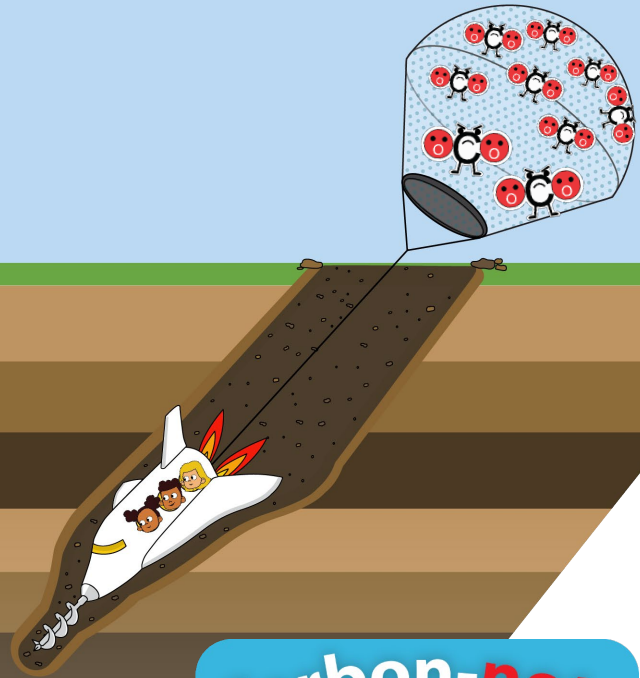
Am I
going to
fit down
there?

We go
between the
grains!



Would you like to become a Carbon-not?

Join us as we commit to decreasing greenhouse gases in our atmosphere by decreasing our carbon footprint, and by supporting carbon capture and storage (CCS). Support CCS today!



To learn more, please visit us at:

www.put-it-back.org

We are located at the
Gulf Coast Carbon Center,
Bureau of Economic Geology,
The University of Texas at Austin



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Photo Credit: Jay McGowan

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.

They are found often in open grounds and with shrubby vegetation (hedges, fruiting bushes & thickets)

Mockingbirds eat mainly insects during the summer, but switch to eating mostly fruit in fall and winter

- **Population:** Stable, not endangered
- **Clutch size:** 2 to 6 eggs (pale blue or greenish white splotched with red or brown)
- **Incubation period:** 12 to 13 days
- **Nesting period:** 12 to 13 days
- **Broods:** 2 to 3

To learn more: <https://www.allaboutbirds.org/guide/>

 **TEXAS Geosciences**
The University of Texas at Austin
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