

Ocean Acidification



Youth Climate Institute

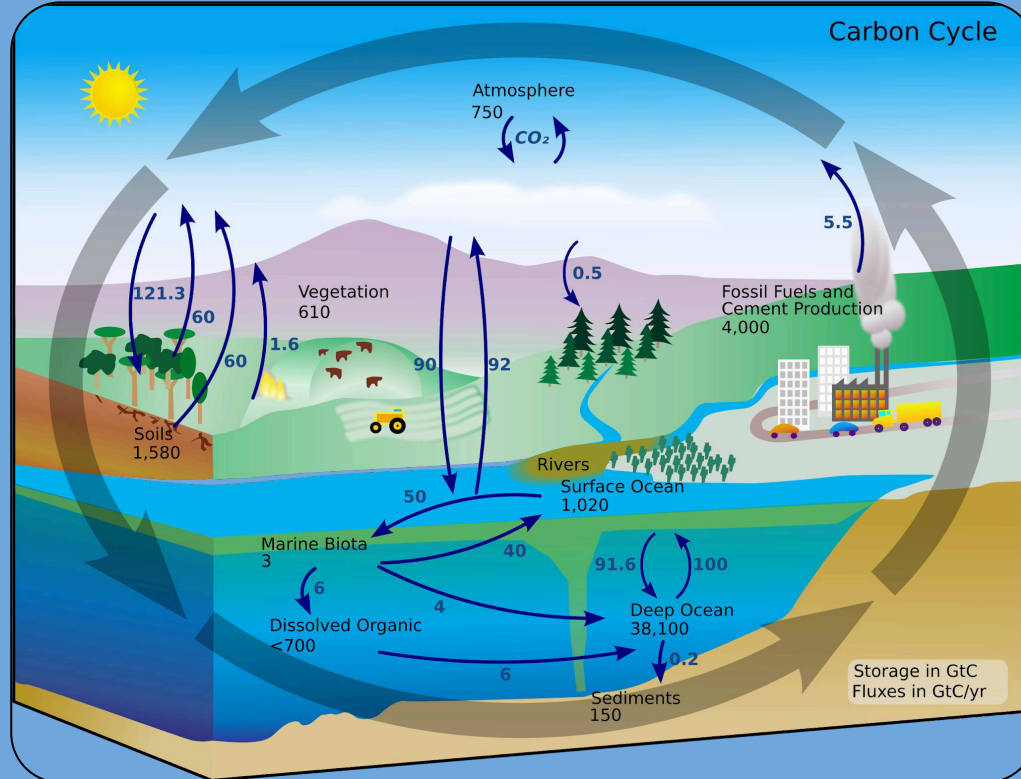
INTRODUCTION

- What is going on in the ocean?
- What is the driving force behind it?



CO₂ Emissions

Carbon Cycle

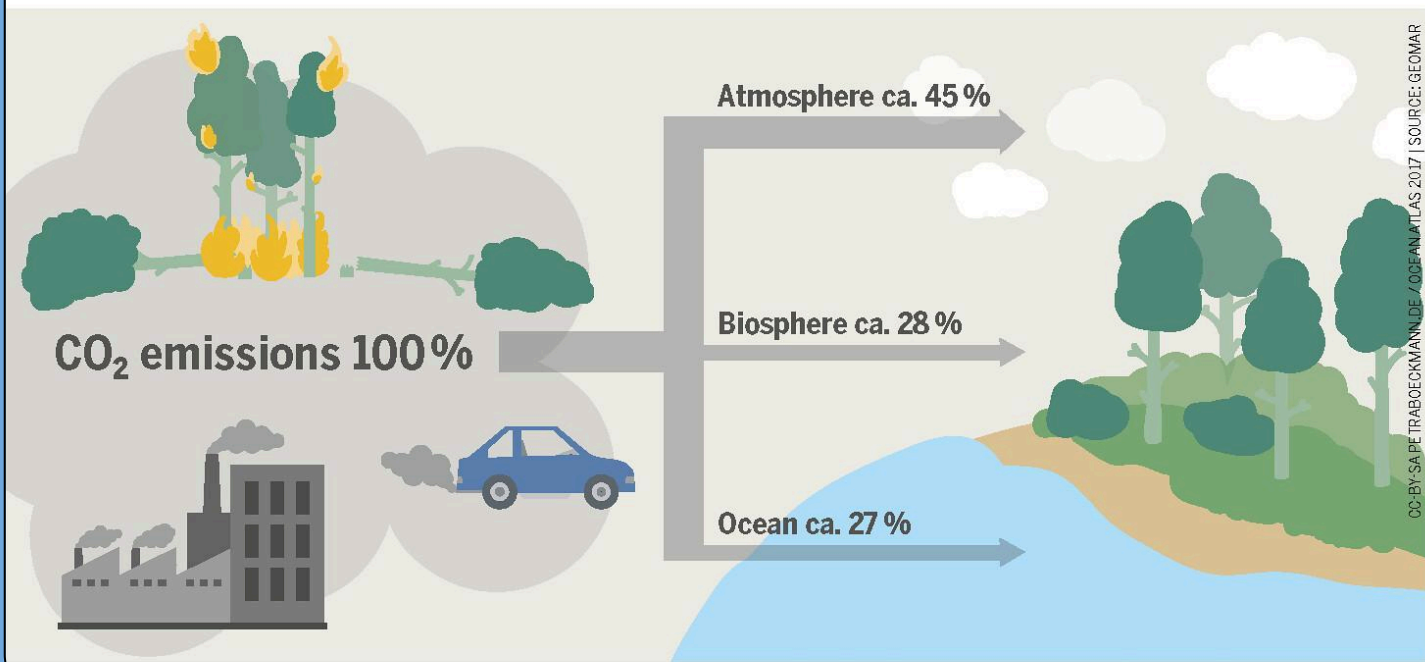


- Where does CO₂ come from?
- How does it move from one place to another?

How does CO₂ get into the ocean?

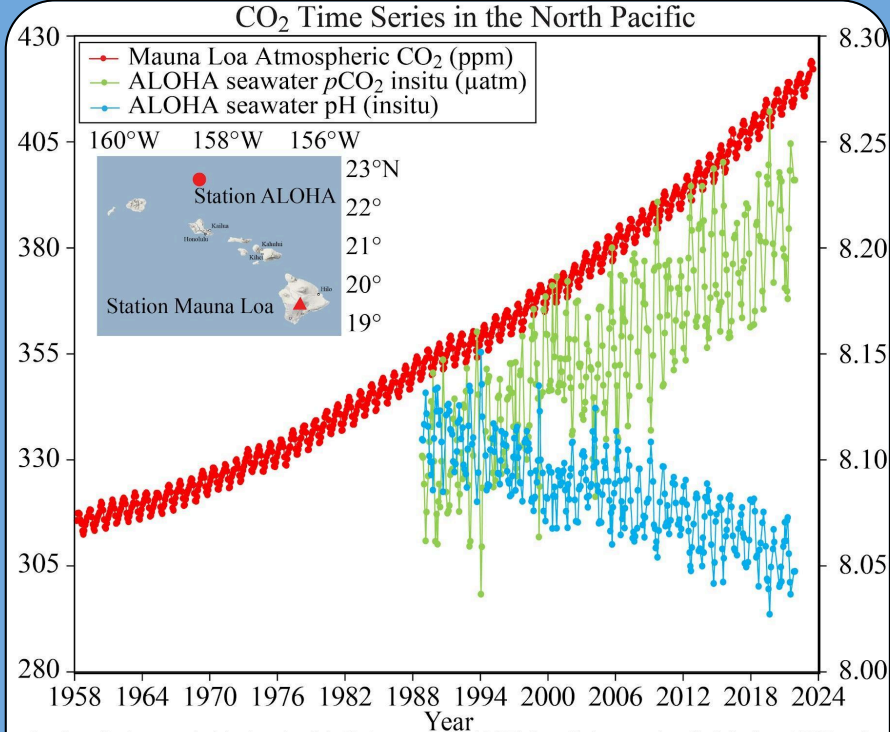
Oceans are considered carbon sinks because they absorb carbon dioxide from the atmosphere

Where Does the CO₂ Go?



The CO₂ produced by people (i.e., in addition to natural emissions) is distributed as shown

CO₂ Levels in Ocean



una Loa (https://gml.noaa.gov/webdata/ccgg/trends/co2/co2_mm_mlo.txt) ALOHA (https://hahana.soest.hawaii.edu/hot/hotco2/HOT_surface) pH and $p\text{CO}_2$ are calculated at in-situ temperature from DIC & TA (measured from samples collected on Hawaii Ocean Times-series (HOT) using co2sys (Pellietier, v25b06) with constants: Lueker et al. 2000, KS04; Dickson, Total boron: Lee et al. 2010, & KF: seacarb

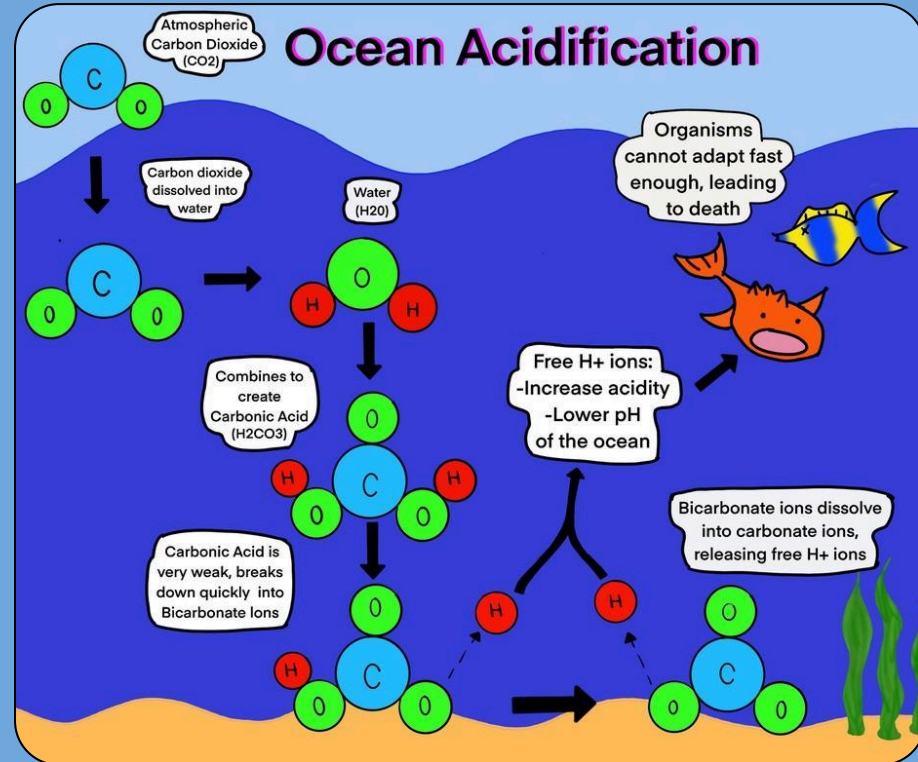
- What has happened to the amount of CO_2 in the ocean since the late 50's?
- What do you notice about the pH?
- What do these values have in common?

Carbon Dioxide in the Ocean

When carbon dioxide dissolves in the ocean it reacts with water molecules to form carbonic acid.

Carbonic acid is then broken down into bicarbonate ions, which dissolves into carbonate ions.

This process releases hydrogen ions (H^+) which make the water more acidic.

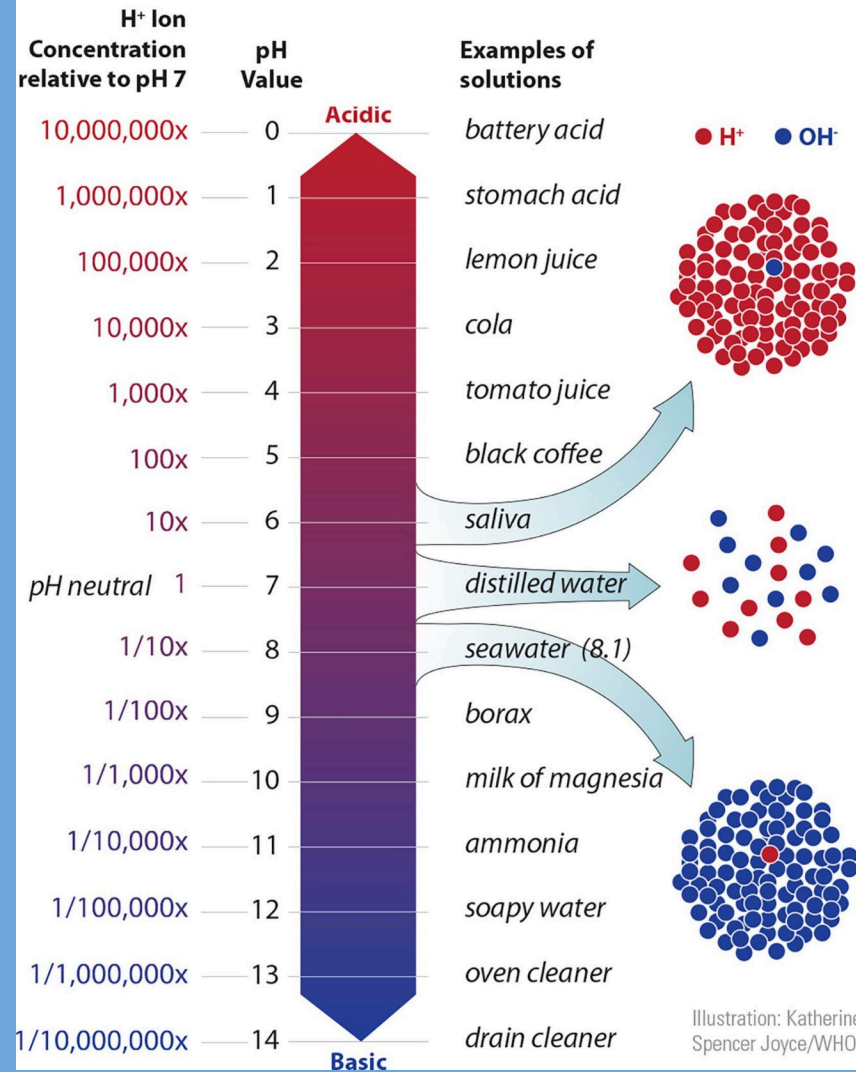


pH Scale

The pH scale is a logarithmic scale that goes from 0 to 14. So, a change between numbers is ten-fold (ten times more than the number before or after it).

Ocean water should be slightly basic with a pH around 8.2 (before industrial revolution)

Today it is around 8.1, which means the ocean is 25% more acidic

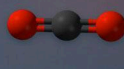


Effects of Ocean Acidification

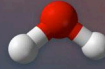
OCEAN ACIDIFICATION

HOW WILL CHANGES IN OCEAN CHEMISTRY AFFECT MARINE LIFE?

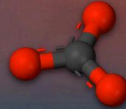
CO₂ absorbed from the atmosphere



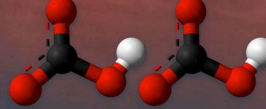
carbon dioxide



water



carbonate ion



2 bicarbonate ions

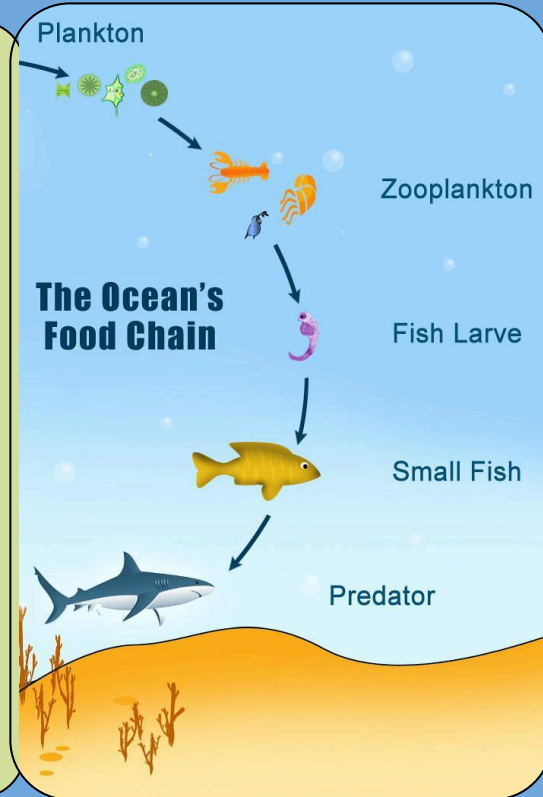
consumption of carbonate ions impedes calcification

NOAA

The bicarbonate ions that are formed take the carbonate ions out of the water, so they are not available for marine organisms to use to make calcium carbonate for their shells and skeletons

Effects of Ocean Acidification

- Prevents oysters, clams, lobsters, shrimp, coral reefs, and other marine organisms from building and repairing their shells and skeletons
- Harms organisms sensitive to changes in pH
- Decreases biodiversity
- Disrupts marine food chains and webs
- Contributes to economic loss for fisheries, seafood industry, and tourism
- Impacts food security



SCENARIO

ACTIVITY

Welcome to the town of Coral City.

Nestled along the rugged coastline, Coral City is a charming seaside town where generations have relied on the ocean. Fishing, oyster farming, and coastal tourism have long been the lifeblood of our community.

But today, Coral City faces an urgent challenge: ocean acidification. It is threatening our marine ecosystems, our livelihoods, and our way of life.

Shellfish are struggling to grow, fish populations are shifting, coral reefs are dying, and the future feels uncertain.

Join us at the upcoming Town Hall Meeting as we come together to understand the science, hear from local experts, and explore real solutions to protect Coral City for generations to come. Your voice matters—help us chart a sustainable course forward.



ROLES



ACTIVITY

Meeting Members:

1. Local energy company
2. Automobile dealership
3. Seafood restaurateur
4. Scuba and jet ski travel/tourism company
5. Marine biologist specializing in coral reefs, mollusks (clams, oysters, mussels, scallops,) and crustaceans (lobsters, krill, crab, and shrimp)
6. Townsperson
7. City Councilor

ACTIVITY



**PROTECT
THE OCEANS**

DIRECTIONS

Town Hall Pre meeting:

1. Obtain a role card and read over the information
 - a. You will be representing that character and not your own opinion
2. Get together with the other members of your team (same role as you) and develop good arguments that you can make during the meeting.
3. If you are on the county council team, think about ground rules you would like to establish at the beginning of the meeting so that the meeting runs respectfully and appropriately.
4. Decide who on your team will present an opening statement and who on your team will present a closing statement. The remaining members of your team will handle questions from other groups or the councilors.

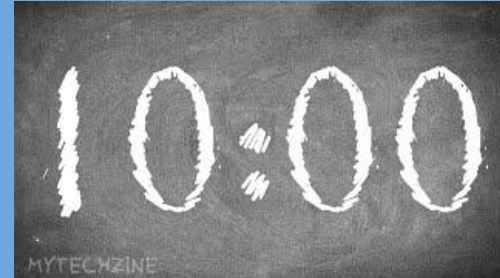
Collaboration Time

ACTIVITY

Get together with other members of your team (same role as you)

- Assign roles within your group
 - opening remarks
 - closing remarks
 - answering any questions
- Determine what you are going to say
 - Your presentation should last 2–3 minutes
 - Use the role card talking points for guidance
- Remember to stay in character

* if you are city council you also are responsible for running the meeting



ACTIVITY



**PROTECT
THE OCEANS**

DIRECTIONS

Town Hall meeting:

1. City council member will start meeting
 - a. Get everyone's attention, and lay ground rules for meeting
 - b. Remind them that the purpose of the meeting is to hear from local experts and explore solutions to protect Coral City from impacts of ocean acidification
2. Each group will present their information
3. When group is done presenting other groups may ask questions
 - a. Remember to be respectful and appropriate
4. City council will end meeting when everyone is done presenting
 - a. Summarize what was said and the steps the city will take

Role Cards

Local Energy Company

Character Traits

Perspective: My company supplies energy to homes and businesses, primarily using fossil fuels, but we are exploring renewable options.

Interests: Protecting local jobs, keeping energy affordable, maintaining business profitability.

Concerns: Potential regulations that could raise costs or force expensive changes in infrastructure.

Talking Points

- "We are willing to explore greener energy sources but need time and support to transition."
- "Energy costs must remain reasonable for our community."
- "How can we balance economic stability with environmental responsibility?"

Automobile Dealership

Character Traits

Perspective: Our company sells and services cars, many of which are gas-powered, but we are starting to offer electric vehicles (EVs).

Interests: Selling cars, promoting new technology, keeping customers satisfied.

Concerns: Demand for EVs is growing but charging infrastructure is limited; switching production too fast could hurt sales.

Talking Points

- "We support cleaner transportation but need city investment in EV infrastructure."
- "How can we encourage people to switch to electric cars in a practical, affordable way?"
- "We want to help reduce emissions without damaging our local economy."

Seafood Restaurant Owner

Character Traits

Perspective: I depend on fresh, local seafood for my business.

Interests: Protecting the local seafood supply, keeping food affordable and high-quality.

Concerns: Ocean acidification is threatening shellfish populations and fishing industries.

Talking Points

- "I'm already seeing the cost of seafood rise and supplies shrink."
- "How can we protect our waters to ensure future seafood harvests?"
- "If the ocean becomes too acidic, what will happen to my business and our town's economy?"

Water Adventure Company

Character Traits

Perspective: I rely on healthy oceans and marine life to attract tourists.

Interests: Promoting local tourism, protecting the ocean for recreational use.

Concerns: Coral bleaching and loss of marine biodiversity could drive tourists away.

Talking Points

- "If the ocean becomes lifeless, tourists won't come."
- "I support protecting our oceans because it's vital to my livelihood."
- "How can businesses like mine be part of the solution?"

Local Energy Company

Character Traits

Perspective: My company supplies energy to homes and businesses, primarily using fossil fuels, but we are exploring renewable options.

Interests: Protecting local jobs, keeping energy affordable, maintaining business profitability.

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Talking Points

- "We are willing to explore greener energy sources but need time and support to transition."
- "Energy costs must remain reasonable for our community."
- "How can we balance economic stability with environmental responsibility?"

Marine Biologist

Character Traits

Perspective: I study the impacts of ocean acidification on marine life and ecosystems.

Interests: Public awareness, scientific solutions, protecting biodiversity.

Concerns: Ocean acidification is progressing rapidly; action is urgently needed.

Talking Points

- "The data is clear: ocean acidification is damaging marine ecosystems and our local economy."
- "We need to reduce carbon emissions now to slow the damage."
- "There are solutions, but they require community support and policy changes."

Townsperson

Character Traits

Perspective: I live and work here; I care about the health of the ocean and the town's future.

Interests: Affordable living, stable jobs, clean environment.

Concerns: Job losses from rapid industry changes; the health of the seafood I eat and the beaches I enjoy.

Talking Points

- "I want to protect our oceans, but I also worry about my family's financial security."
- "What can everyday people do to help?"
- "I'm looking for balanced solutions that don't leave us behind and raise our taxes."

City Council

Character Traits

Perspective: I represent the people and make decisions that impact the entire community.

Interests: Sustainable development, public welfare, economic growth.

Concerns: Balancing environmental policies with the town's economic needs; securing funding for changes.

Talking Points

- "We need to act on ocean acidification, but carefully and collaboratively."
- "How can we bring businesses, scientists, and citizens together for solutions?"
- "I want policies that protect our environment, livelihoods, and our community."