Ocean Acidification Toolkit Script

Introduction

Today we are going to be talking about our ocean and why it is important that we keep it healthy. There is a change happening in our ocean right this very second! And it's important we know about it if we are going to protect our ocean and keep it healthy. Maybe you have heard about it before; raise your hand if you have heard of 'ocean acidification'.

(If no one raises their hand)
Great, we will all learn something new today!

(If someone does raise their hand)
Would anyone like to explain what they do know about ocean acidification?

The ocean is a great sponge for absorbing the carbon dioxide from the atmosphere. More and more carbon dioxide is going into the atmosphere from activities that burn fossil fuels like oil and gas. This means the ocean is absorbing more and more carbon dioxide too. When the ocean absorbs this carbon dioxide, it causes changes in chemistry. While the ocean isn't acidic, it increases the acidity of the ocean. We are going to do a few activities to help us understand what ocean acidification is, how it impacts our world and our ocean, and some ways we can keep our ocean healthy together."

Module I - Our Ocean: The Giant Sponge

Introduction

Our ocean is huge! It covers about 70% of our earth, so that means more than half of our earth is ocean! Our air, the land we live on, and our ocean have a very close connection with each other. A gas called carbon dioxide can be found in all of these places and it is one of the things we breathe out. Most of the time we can not even see carbon dioxide, but it has big impacts on the world, especially our ocean. Our ocean works like a giant sponge and is very good at soaking up the carbon dioxide that is in the air.

Instructions

1. ***Students take a deep breath, as an example of regular carbon dioxide. Show the flame from lighter as an example of the burning of fossil fuels that makes uncontrolled carbon dioxide.***

Does anyone know what carbon dioxide is or where it comes from?

Everyone take a deep breath in and out. Some of what you breathe out is carbon dioxide. Carbon dioxide from breathing that we and other mammals, such as whales and carbon, is called regular carbon dioxide. It is from natural processes. Trees and plants use regular carbon dioxide—like this—to make food and grow.

But we know most of carbon dioxide that our ocean soaks up comes from the burning of fossil fuels. Fossil fuels are plant and animal remains from millions of years ago. They have been turned into things human use for fuel today like coal, gas, and oil.

Is breathing regular or uncontrolled carbon dioxide?

When we breathe, this is regular carbon dioxide. It's slower and makes less carbon dioxide than the carbon dioxide from fossil fuels. The more fossil fuels humans burn the more our ocean soaks up. This causes a chain reaction to happen:

- ↑ increased use of fossil fuels
- ↑ increases atmospheric carbon dioxide
- ↶ absorbed by our ocean
- ↑ increased ocean acidification

What are some things you can think of that use fossil fuels?

(Show the flame) This lighter is burning fossil fuels right now to make this flame. Fossil fuels power our cars and produce electricity for our homes. When we burn fossil fuels, it releases carbon dioxide into our air. This kind of uncontrolled carbon dioxide from fossil fuels is from activities we do and greatly increases the amount of carbon dioxide in our atmosphere.

2. Ignite the lighter and hold it up to the balloon filled with air. This balloon will pop.

I have one balloon filled with water to represent our ocean and another balloon is filled with air. Our ocean is very good at soaking up carbon dioxide from fossil fuels and is better at doing this than air. You will see how air and our ocean soak up carbon dioxide differently. I have our balloon filled with air and will hold up this lighter, a fossil fuel, to it. What do you think will happen when I do this?

**If students are sensitive to sound ask them to cover their ears before holding flame to balloon*

We can see that our balloon popped almost instantly, the heat from our fossil fuel melted the rubber, so it popped."

3. Ignite the lighter and hold it up to the balloon filled with water. This balloon will not pop.

"What do you think will happen to our ocean balloon when I hold up the fossil fuel to it?"

"Why didn't our ocean balloon pop, but the air balloon popped immediately?

We can see that our ocean balloon is not popping like the balloon filled with air did. The water in this balloon has the incredible ability to soak up the heat from the flame very quickly. Instead of the flame melting the rubber and making the balloon pop, the water is actually soaking up all of the heat from the fossil fuel, just like the soaks up carbon dioxide from the air.

After seeing this, what do you think if there is carbon dioxide from fossil fuels in our air?

We know uncontrolled carbon dioxide is going into our ocean. We saw how our ocean does when the water balloon soaked up the heat from the flame instead of popping. "

4. Explain uncontrolled carbon dioxide impacts on our ocean.

Uncontrolled carbon dioxide that is soaked up by our ocean causes a chain reaction to happen:

- ↑ increased use of fossil fuels
- ↑ increases atmospheric carbon dioxide
- ↶ absorbed by our ocean
- ↑ increased carbon dioxide in the ocean
- ↑ increased ocean acidification

Increased ocean acidification affects the conditions of our ocean and can make it difficult for marine life and ecosystems to stay healthy. People who rely on healthy oceans are also impacted.

What are some things that our ocean provides us with?

More than half of the air we breathe comes from the tiny plants in our ocean called phytoplankton. Food, water, and air are all very important things for us and the future too. The health of our ocean and us are intertwined. By protecting our ocean, we help ensure our own health as well.

What change is happening in our ocean because of uncontrolled carbon dioxide?

Ocean acidification affects the conditions of our ocean and can make it difficult for our ocean to provide us with all of the things we need.

What can we do to reduce the amount of carbon dioxide that our ocean soaks up?

Since carbon dioxide comes from the fossil fuels like burning coal, oil and gas, there are many things we can do:

- Reduce our electricity use (which comes from the burning of coal) by:
  - Unplugging electronics and turning off lights when not in use
  - Make energy efficient choices
  - Talking to our friends and family about how we can all reduce our use
- Reduce our gas use by:
  - Limiting our use of fuel powered cars by riding a bike, using public transport, carpooling or taking a walk for those shorter trips
  - Use or start a bike or car share in your community
  - Buy local – less gas is used in transporting food and goods when it comes from close by

Solutions

"What can we do personally to lessen future ocean acidification?"

Take everyday actions, like turning off the lights when we are not using them. Or walking instead of taking a car. Our individual choices are important, but we can really make a difference if we work together to find bigger solutions. Does anyone have ideas on what our entire school can do or our other communities?

"What can we do as a community to lessen ocean acidification?"

Tell people about ocean acidification so they know about it. Tell them why it matters to you. Use alternative forms of energy like solar power, use or start a bikeshare or carshare in your community. Come together to create solutions that work where you live.

Module II: Our Changing Ocean

Introduction

Over the past 150 years our ocean has absorbed about 25-30% of the carbon dioxide in the atmosphere. This equates to more than 500 billion tons of carbon dioxide. That is a whole lot of carbon dioxide in a relatively small amount of time. Scientists know that our ocean hasn't experienced this big of a change in such a short period of time in at least 50 million years.

How to visualize 500 billion tons:
If we took a one dollar bill and stacked 1 million of them, it would be a 30-story building A pickup truck or an elephant weighs about a ton. Now replace that 30-story building stack of dollar bills with trucks or elephants. How tall would that be?

Does anyone know what has happened in the past 150 years that released so much carbon dioxide into our air?

We have increased our use of innovations like electricity, cars, and factories that produce uncontrolled carbon dioxide. When our ocean absorbs this uncontrolled carbon dioxide a change happens called ocean acidification.

Let's see how carbon dioxide has changed our ocean over time and think of ways we can innovate to lessen the impacts from this change."

Instructions

1. Fill the 'Past' container with water.

This container is going to represent our ocean 150 years ago. I am going to fill the container with water. 150 years ago, our ocean was soaking up carbon dioxide in small quantities slowly. This is regular carbon dioxide.

What is an example of regular carbon dioxide?

Regular carbon dioxide is released and used when humans and other mammals breathe or decompose. Humans were not using things like electricity or cars 150 years ago, so there was very little carbon dioxide that our ocean was soaking up.

2. Pass out a sample of soda water to each student, have them taste it.

I have passed out a sample of soda water for you to try. Did you know that the tiny bubbles in soda are actually carbon dioxide? What you are about to try is simply water and carbon dioxide.

Can you describe the taste of the soda water? Is it more bitter or sour than regular water?

Unless we flavor the soda water, the bitter and sourness you are tasting is acidity. Carbon dioxide is called an acid gas, because it adds acidity to things when it is absorbed. Think of when someone squeezes a lemon into their water. A lemon has that very sour, bitter taste because it is acidic. The acid in the lemon is what changes the taste of the water. This is similar to what happens during the process of ocean acidification.

Did anyone like the taste of the soda water?

Just like some people do not like soda water or lemon in their water, some sea life does not like when the water has more carbon dioxide.

3. Fill the 'Present' container to the fill line with soda water.
Optional: Use Bromothymol Blue Indicator to show the acidity levels.

This container is going to represent our present day ocean.

Why am I adding soda water to our 'Present day' ocean instead of just regular water like I did in our 'Past' ocean?

Since people are producing uncontrolled carbon dioxide from burning fossil fuels today compared to 150 years ago, our ocean is absorbing more uncontrolled carbon dioxide than it has in 50 million years. Over the past 150 years our ocean has soaked up more than 500 billion tons of carbon dioxide. Part of that uncontrolled carbon dioxide is being absorbed by our ocean, increasing our ocean's acidity, and changing the conditions for life within it.

Which ocean has more acidity, Past or Present? Why?

The uncontrolled carbon dioxide being absorbed by our ocean today is causing an increased acidity. Increased acidity means the conditions of our ocean are changing. Just like some of us didn't not like the acidic, sour taste of lemons, some sea creatures do not like an increase in acidity and are affected by the way sea creatures are able to live. Our ocean and its sea creatures need to be protected from ocean acidification.

Optional: Add Bromothymol Blue Indicator, discuss the color change as differences in acidity.

The bromothymol blue indicator gets less blue with more acidity. In the case of the ocean or this water, with more carbon dioxide.

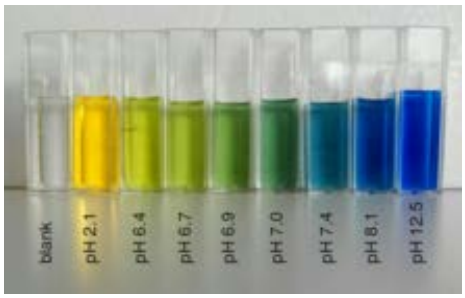

Figure 1: Bromothymol Blue Indicator

What will happen if we continue burning fossil fuels as fast as we are today?

If we continue producing as much carbon dioxide from fossil fuels as we are today, by the year 2100, our future ocean has the potential to become 3 times more acidic than it has in the past.

What can we do to get more people to make choices that lessen ocean acidification?

We need to protect our ocean by lessening ocean acidification. The plants and animals that live in it and future generations depend on everyone making healthy choices for our ocean. Many people do not know what is happening in our ocean. So by telling people, like our friends and family about ocean acidification, we can help lessen acidity in our ocean. By telling them they will learn something new and you will be helping to protect our ocean.

Module III: Swim, Snack, Sink

Introduction

Does anyone know what a crab, an oyster, and snail have in common? They all have shells! Shells are very important to these animals, they are just as important to these animals as our bones are to us. We would not be able to live without our bones, just as these animals would not be able to live without their shells.

The shells of these animals are made of something called calcium carbonate. Calcium carbonate is the building block for shells, just like bricks are for a house. Ocean acidification from the burning of fossil fuels can weaken shells. A marine snail called a pteropod (pronounced teh-ruh-paad) is very sensitive to ocean acidification. The pteropod, also known as a sea butterfly because of its shape, is a really important part of the salmon's diet. The pteropod is sometimes called 'snack of the sea' because so many creatures get a high quality meal from them. We are going to play a game to show us how ocean acidification can affect salmon, pteropods and our marine food web.

Rules

- ½ of players will be salmon (assigned 1 red sticker), ½ of players will be pteropods (assigned 1 white sticker) to be placed in a visible spot (chest, stomach).
- Players will 'swim' around the room (pteropods can make flying like motion while salmon make swimming strokes) until instructor says, 'Snack!' and they must quickly find a fish friend to link up with.
- Salmon can only link up with pteropods that have one (1) calcium carbonate, salmon can not link up with other salmon.
- At any time ocean acidification (the instructor), can 'pause' the game and take away calcium carbonate from pteropods.
- Pteropods with zero (0) calcium carbonate can only link up with a pteropod with 1 calcium carbonate (1 white sticker)
- If they cannot find someone to link up with they 'sink' and are out of the game and head to the 'High CO_2' space
- Fish do not run, they swim, so take it slow!

After Game

"What happened when ocean acidification came into the game?

The pteropods lost calcium carbonate they needed for more salmon to be able to link up with them. Less calcium carbonate meant fewer healthy pteropods, making it more challenging for a salmon to link up with a pteropod.

Could ocean acidification affect how many pteropods are available for salmon to eat?

Salmon rely on pteropods for food. The less calcium carbonate that is available to pteropods the harder it is for them to build their shells and survive which can be food for salmon.

Could ocean acidification lessen the amount of salmon/food our ocean provides us with? How might ocean acidification affect the amount of food our ocean provides us with?

Pteropods are a foundational part of the food web, and effects on them will ripple up to salmon and the other fish we rely on. Pteropods can be thought of as the beginning of our marine food supply, if they are affected by this ocean change marine and human life can be as well as we are all interconnected.

How can we responsibly manage our ocean to protect it for future generations?

Tell your friends, family, and community members the changes our ocean faces and what we can do to lessen the amount of carbon dioxide that ultimately ends up in our ocean.

Module IV: Senseless Salmon!

Introduction

Did you know salmon have a better sense of smell than a dog? Salmon travel very long distances using their sense of smell for direction. They are very unique because they will live in saltwater and freshwater. They also use smell to sense danger and their 'home' river. Scientists are discovering that ocean acidification can cause salmon to have a dulled sense of smell. Smell is very important to salmon and their survival. We are going to do an activity that shows just how important senses are.

Can you name all of our senses?

Sight, Taste, Touch, Hearing, and Smell. All of these are very important to us. If you were to lose one of your senses it would make it harder to do things. To see what it is like for a salmon to lose their sense of smell, we are going to see what it is like to lose one of our senses and do something that would normally be easy.

Instructions

- Pass out a blindfold to each player
- Divide groups of 4 -6 players
- 1 player will not be blindfolded and will serve as the spotter for the group and give directions by using only their voice (without guiding with touch).
- The spotter will have the blindfolded players arrange themselves from shortest to tallest
- The team that does this the fastest is the winner!

Discussion

What did the blindfolds or not being able to use touch to direct the blindfolded players help you realize about how important a sense of smell is to salmon?

The blindfolds represented how important losing a sense is. A salmon's sense of smell is just as important to them as our eyesight is to us. Just like the blindfold masked your ability to see, ocean acidification masks a salmon's ability to smell.

If salmon had a dulled sense of smell because of ocean acidification how could this affect people?

More than 3.5 billion people depend on the ocean for their primary source of food like salmon, other fish and shellfish.

How can we protect marine life, such as salmon and ecosystems, like the rivers and ocean they live in?

Ocean acidification is able to change many things in our ocean. We can help to lessen ocean acidification by reducing the amount of carbon dioxide we produce from fossil fuels.

Ocean Acidification Pledge

I have brought a pledge today to ask you to help protect our ocean. Taking this pledge will make you an Ocean Ambassador! The pledge shares things we can do to help lessen future ocean acidification. Every time you do one of these things, check it off your list! Some of the solutions for ocean acidification include telling your friends and family what you learned about ocean acidification so they will know what is happening in our ocean too. You, your family, and your friends can make a difference together by reducing the uncontrolled carbon dioxide in the air. Ride your bike or take a walk instead of driving a car, buy local food, and turn off the lights when you are not using them.

Raise your hand if you turn off the lights when you leave the room.
Do you make sure your whole family turns off the lights in the whole house?
How many people ride their bikes?
Do you ever go on bike rides with friends or family?
Does your school have a bike to school day?

It is possible to help our ocean but we need everyone to participate in lowering the amount of carbon dioxide we produce. Let's help our ocean and the sea creatures that call it home. While it is possible to make a difference with these individual actions, we really need to work together in our communities to find bigger solutions.

Think about what our school and community can do. Who has ideas?