

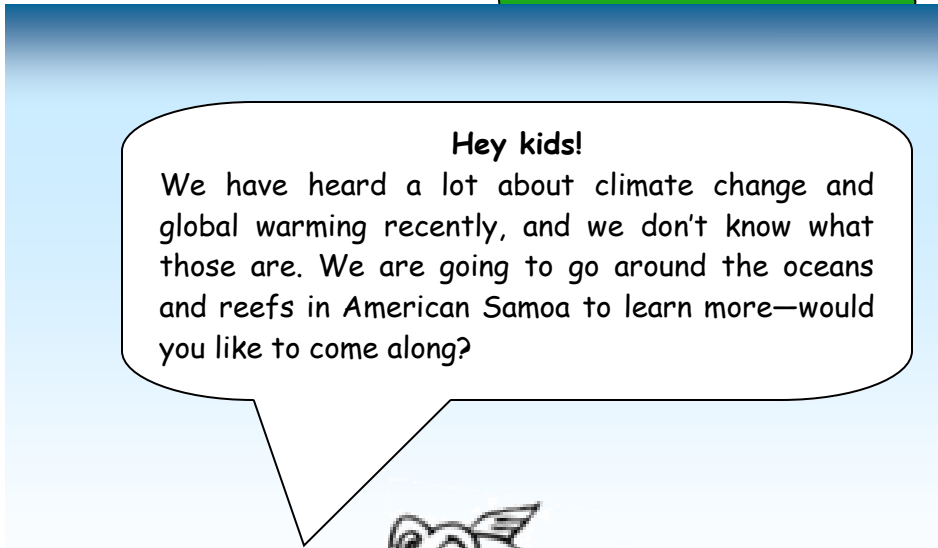
Oceans and Climate Change in American Samoa



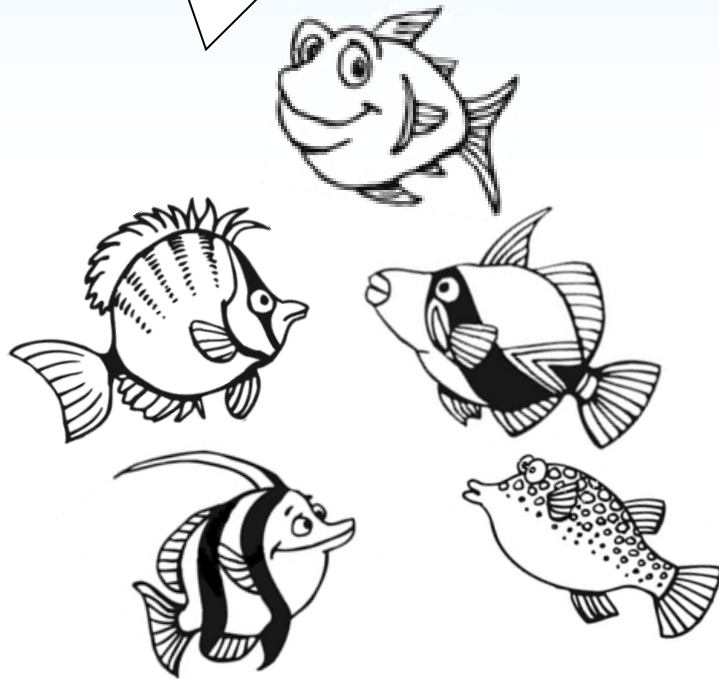
Sponsored by the Governor's Coral Reef Advisory Group

About Oceans and Climate Change in American Samoa:

This book is intended for grades 4-6. It was created to introduce American Samoan students to how climate change will affect oceans in the territory. A companion answer key is available. This book was created by Clare Shelton and the Governor's Coral Reef Advisory Group (CRAG). If you have any questions or to request copies, please contact the Coral Reef Advisory Group at 633-5155 or email info@crag.as



Hey kids!
We have heard a lot about climate change and global warming recently, and we don't know what those are. We are going to go around the oceans and reefs in American Samoa to learn more—would you like to come along?



Climate Change in American Samoa

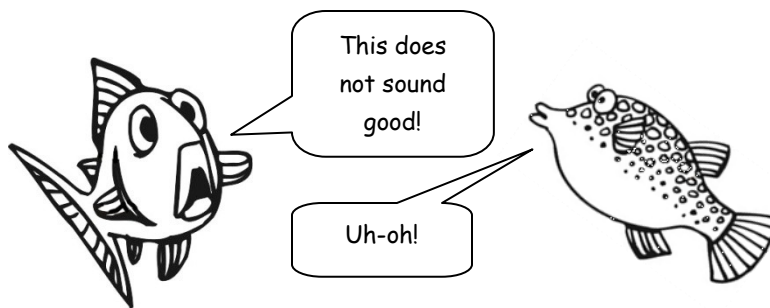
You may have heard people talk about **Climate Change** or **Global Warming**. Do you know what these are?



Climate change is what happens when the climate of the entire Earth changes - this means it gets warmer or colder. Rain, wind, and storm patterns change. This can be natural, or can be caused by people. When it is natural it happens over hundreds and hundreds of years. We are worried about it right now

since human activities over the last 150 years are changing our climate.

Global warming is when Earth's air and the water get warmer. Global warming is one part of climate change.



Climate Change in American Samoa

Fill in the blank spaces with words from the word bank:

Climate change affects the climate of the entire _____.
Climate change means big changes in _____,
rain, and _____ patterns that last for many many years.
Climate change can come from _____ or from
_____ causes. Global _____ is when the
average temperature of the Earth gets warmer. This can be
part of _____ change. Climate change right now is
caused by _____ actions

Word Bank

natural

human

storm

planet

warming

climate

wind

people



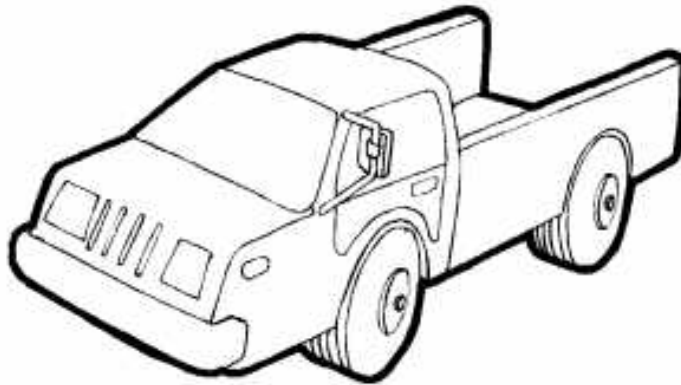
The Greenhouse Effect



People talk about the **greenhouse effect** when they talk about climate change and global warming. What is it? Well, one way to think about it is to imagine a car on a hot day. When you leave the car in the sun with the windows closed, what happens to the air inside the car?

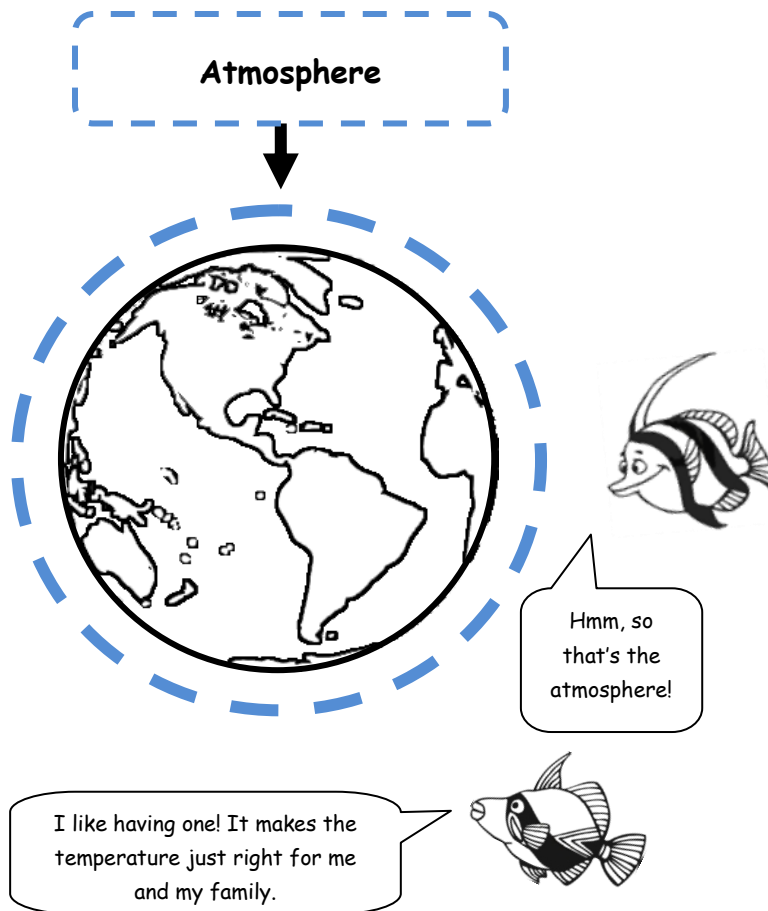
Unscramble the letters below to find out what happens:

Het ria seah pu



The Greenhouse Effect

There are gases in the air called **greenhouse gases**. They help keep the sun's heat close to Earth, so that plants and animals and people can live. They are part of the **atmosphere**. The **atmosphere** is the layer of gases that surrounds our planet. Right now people are putting too many greenhouse gases into the atmosphere. These gases come from many of our everyday activities - like driving cars, using electricity, cutting down trees, and making things in factories.



Normal Atmosphere



8

Energy from the sun travels to the Earth. Look at the **red arrow** to see the **eight** units of energy traveling from the sun to Earth. This is Earth before **climate change**.



3

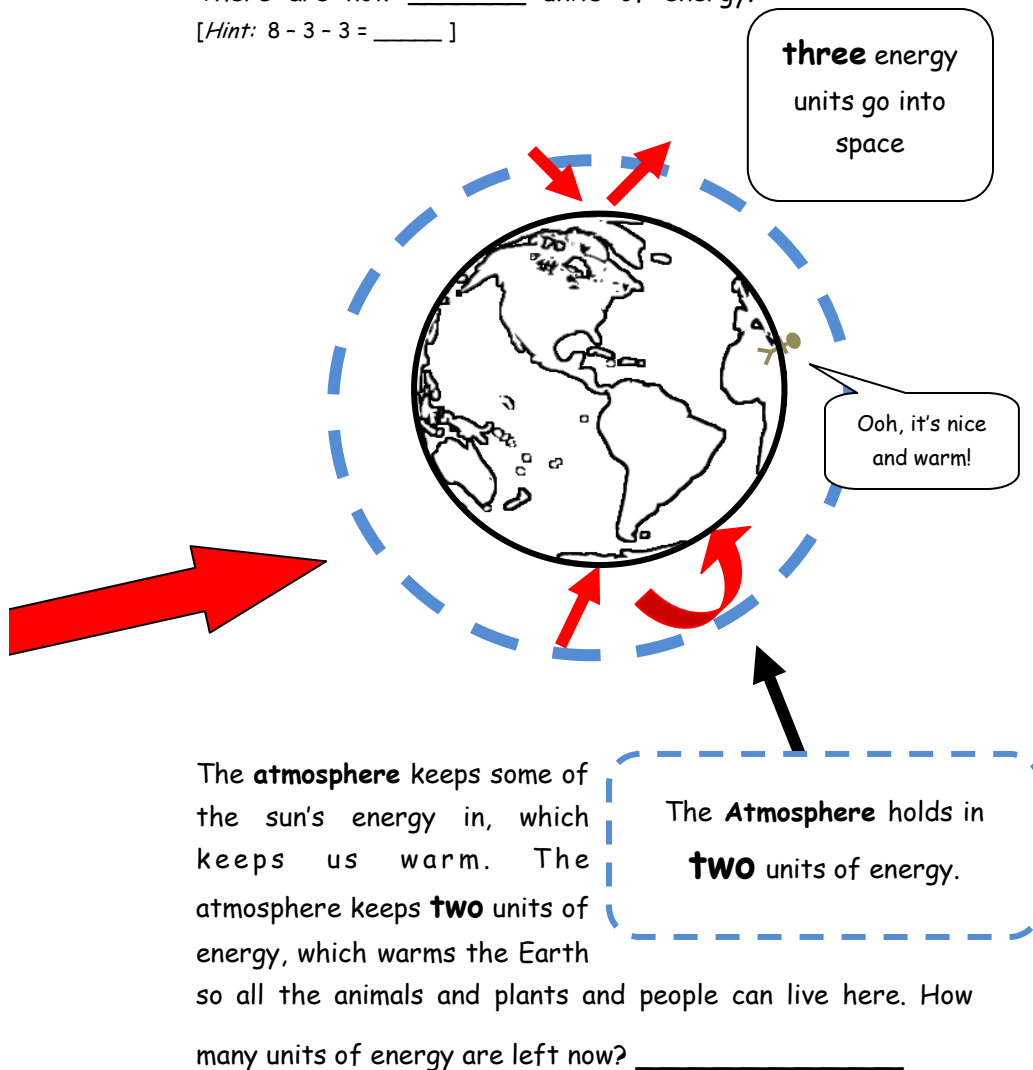
Plants and animals and people use **three** units of the sun's energy. How many energy units are remaining?

Normal Atmosphere

Another **three** units of energy bounce off the Earth and go into space. Look at the **red arrows** to see where the energy goes. How many units of energy are left now?

There are now _____ units of energy.

[Hint: $8 - 3 - 3 = \underline{\quad}$]



Atmosphere with Extra Greenhouse Gases



8

Here is the Earth with **more greenhouse gases** in the atmosphere, like we have **now**. See how different the **atmosphere** is! There are still **eight** energy units that come from the sun.



3

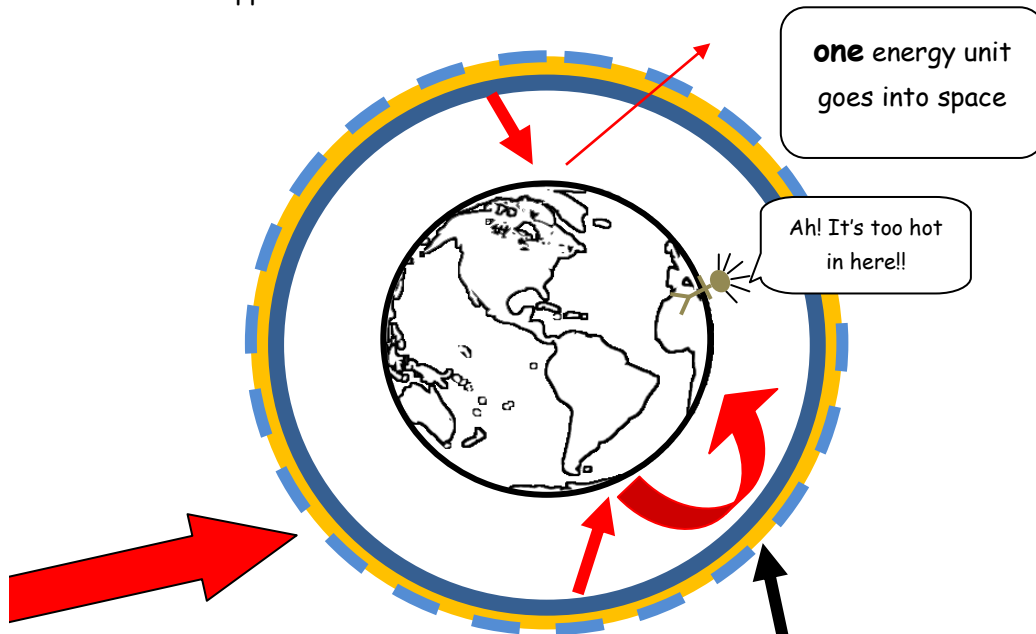
There are still **three** units of energy that are used by plants and animals and people.

With a normal atmosphere, there were **three** units of energy that went into space. Look at the red arrow going into space now - see how much smaller it is? There is now **one** energy unit going into space. How many energy units are left now?

_____ [Hint: $8-3-1=$ _____]

Atmosphere with Extra Greenhouse Gases

With this different atmosphere, more energy units are trapped close to Earth. Here there are **four** energy units trapped close to Earth.



If **two** units of energy make the Earth warm enough for us to live on, what do you think will happen when there are **twice** as many energy units? Write in the box below what you think will happen to the Earth:

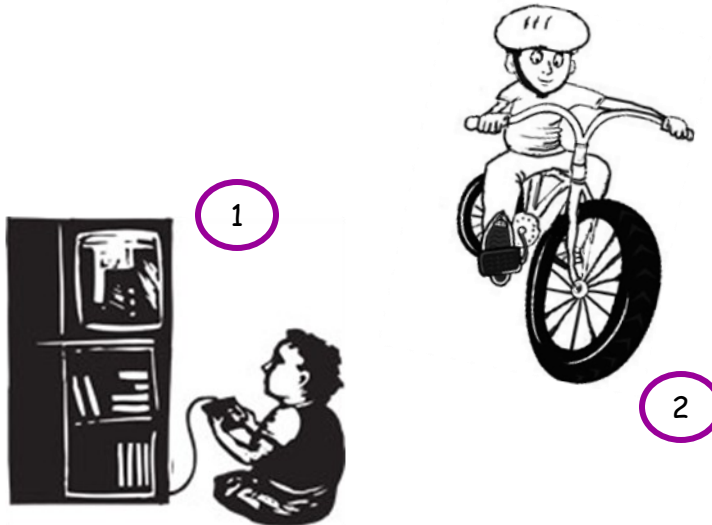
The **Atmosphere normally** holds in _____ energy units.

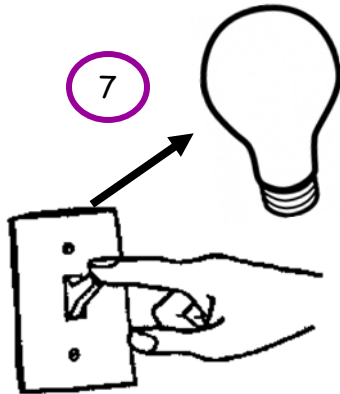
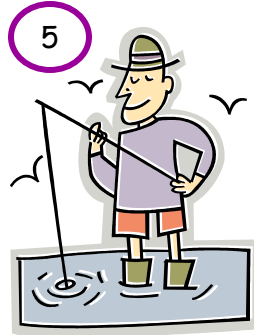
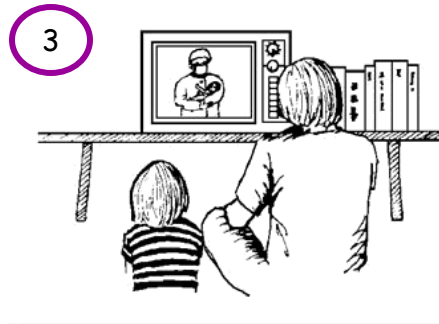
Carbon Dioxide - CO₂

Carbon dioxide, or CO₂, is a **greenhouse gas**. Look at the atmosphere around the Earths on pages 7 and 9 - do you see the difference between the atmosphere on page 7 and page 9? The one on page 9 has more greenhouse gases. When there is more CO₂ in the atmosphere, the Earth gets warmer since less energy can escape through the atmosphere.

But where does CO₂ come from?

CO₂ comes from people - from things we do that use electricity and energy. When you burn gasoline in a car or in a factory, more CO₂ is put into the atmosphere. There is more CO₂ in the atmosphere now since people are driving more cars and using more electricity than before.





CO₂ and Our Oceans

All this extra CO₂ is changing our oceans in **three** major ways:

1. The extra heat is making our oceans **warmer**. This is making it harder for many animals that can't move, like **corals**.



2. This extra heat is also causing the **sea level to rise**. This can be bad since waves will wash away more land and cause more flooding.



CO₂ and Our Oceans

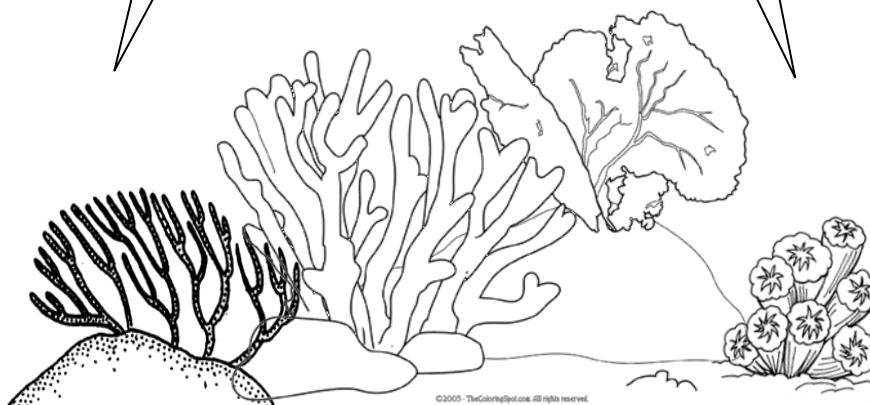
3. Extra CO₂ in the air also means extra CO₂ in the ocean. This is changing the ocean water and making it more **acidic**. An **acid** has a pH lower than 7. Normal ocean water has a pH of about 8, and animals are used to living in water with a pH of 8. A lower pH can be quite harmful, and will make it very difficult for certain animals to live there.



Uh-oh! This is really scary.
What will happen to all of
us who live in the ocean?

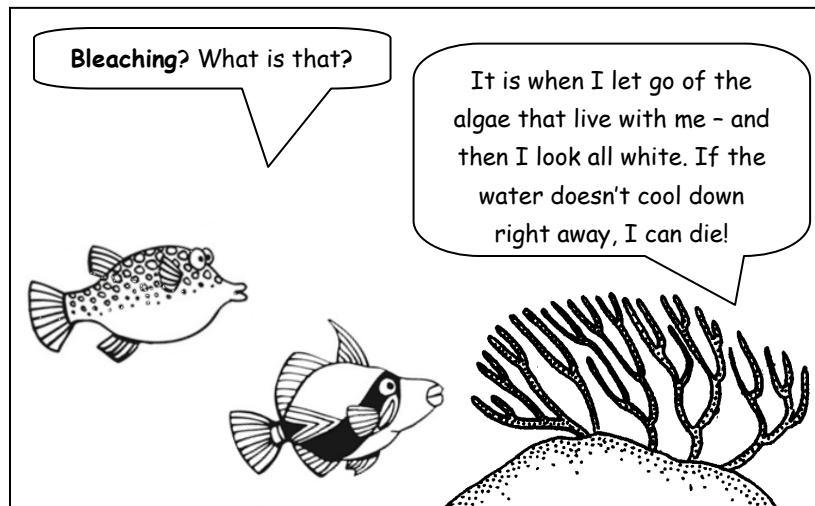
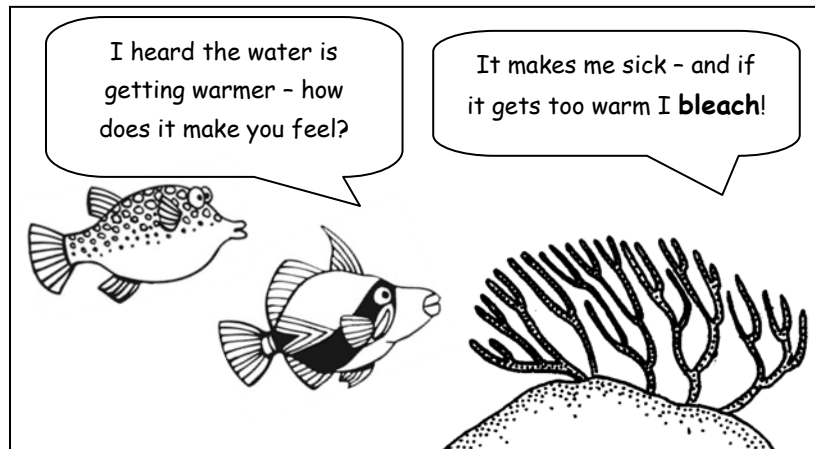
These changes are also affecting our **coral reefs**. Our reefs are important for all of us - they protect our land from big waves during storms and tsunamis. The ocean is where we get lots of our food.

This is bad news for **all** of us!!



CO₂ and Our Oceans

Our fish friends decided to find out what was happening - so they went to talk to the other animals that live in the ocean. First they went to talk to some corals about the warmer water.



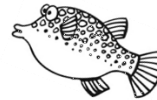
The coral told the fish where to see some corals that were **bleached**. The fish swam over to those corals, and saw some that were bleached and some that were not bleached.

CO₂ and Our Oceans

First, the fish saw the corals that were healthy...



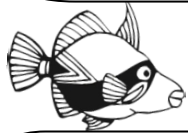
These corals look healthy!



We feel healthy too! Look at our nice **brown** color.

...Then they went to see the bleached corals.

These corals don't look so good. They are all **white**!



We don't feel that good either. It's too hot for us!

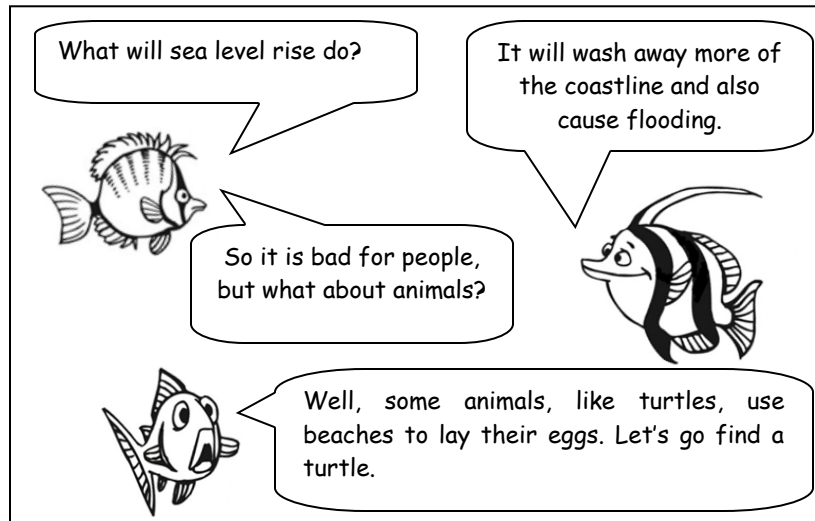
Poor corals! Why don't you move to somewhere with colder water—like farther south in New Zealand or north to California?



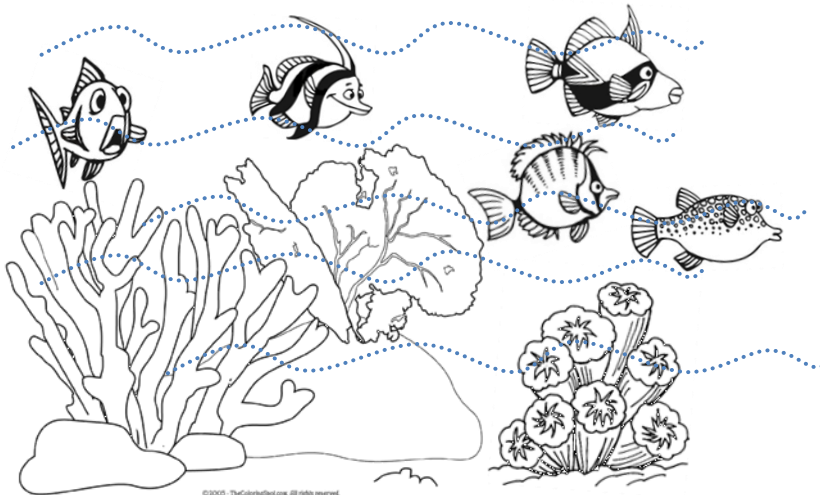
We can't! We grow and live in one place our whole lives and can't move. If the water gets too hot, there is nothing we can do, but lose our color. If this happens we can die! Anyway, water in New Zealand and California is too cold for us.

CO₂ and Our Oceans

After the fish saw the corals and learned how the warmer water will hurt animals, they wanted to know how sea level rise will hurt animals.

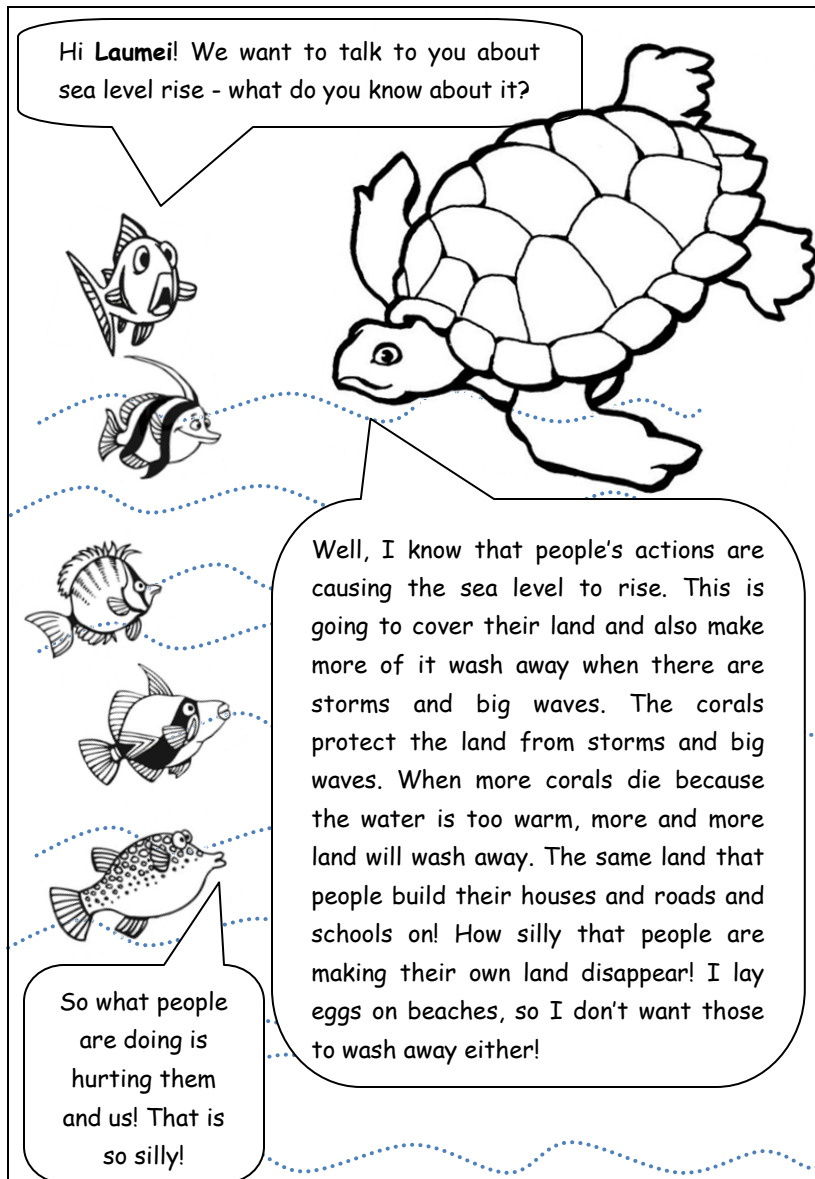


So the fish swam off to find a turtle...



CO₂ and Our Oceans

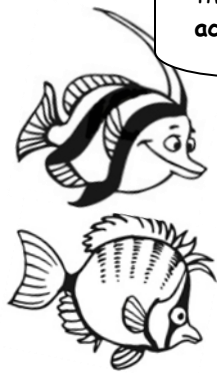
Before long, the fish found **Laumei**, a wise turtle who had lived for many many years.



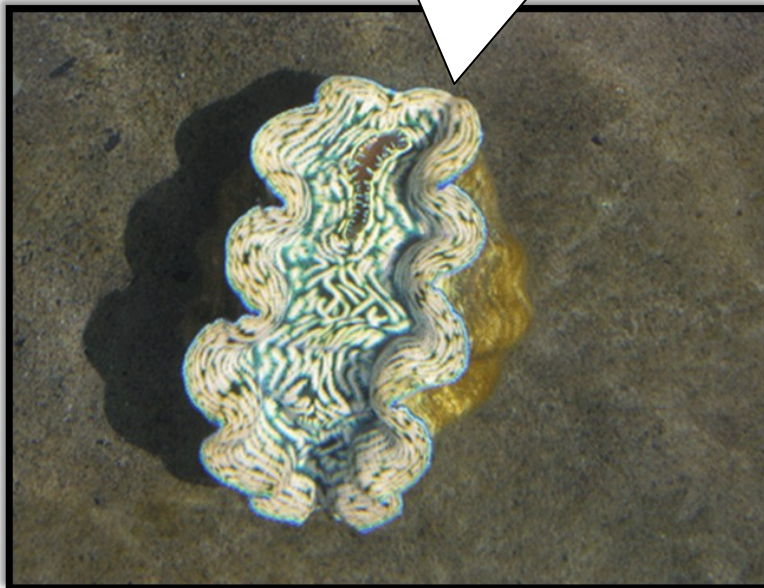
CO₂ and Our Oceans

After the fish learned about **bleaching** and **sea level rise**, they wanted to know what will happen when the oceans become more **acidic**. They knew that corals and animals with shells, like clams, would be hurt the most, so they went to find some coral and clams to talk to.

What does it mean when people say that the oceans are getting more **acidic**?



Well, what happens is all that extra CO₂ that is in the air is also in the oceans. When the extra CO₂ mixes with the seawater, it makes the water more **acidic**. Seawater normally has a pH of 8, and the extra CO₂ decreases the pH. This means that the water acts like an **acid**, and can hurt certain animals that live in it.



CO₂ and Our Oceans

Why does it matter if the pH is lower?

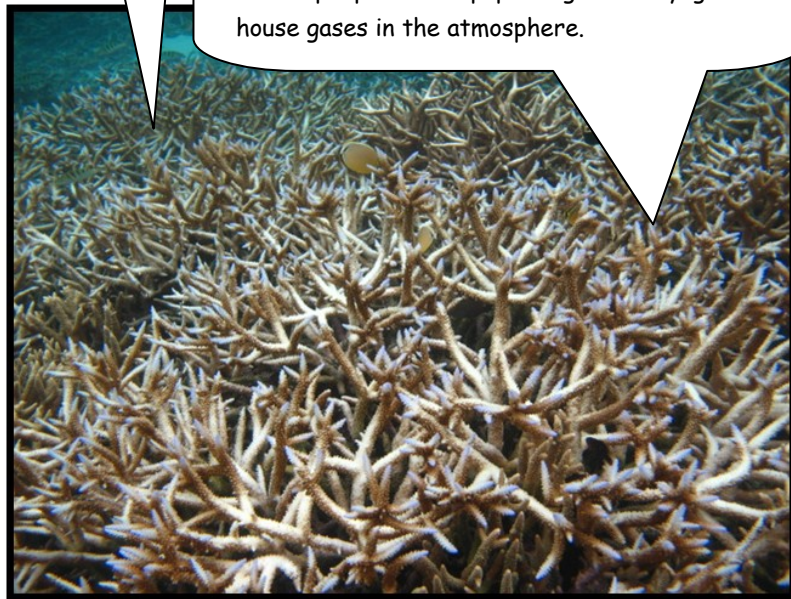


Well, certain animals, like our friend the clam and myself, use minerals in the water to make our skeletons. When the water is more acidic it is much harder for us to make our skeletons.

Oh no! Is there anything you can do?

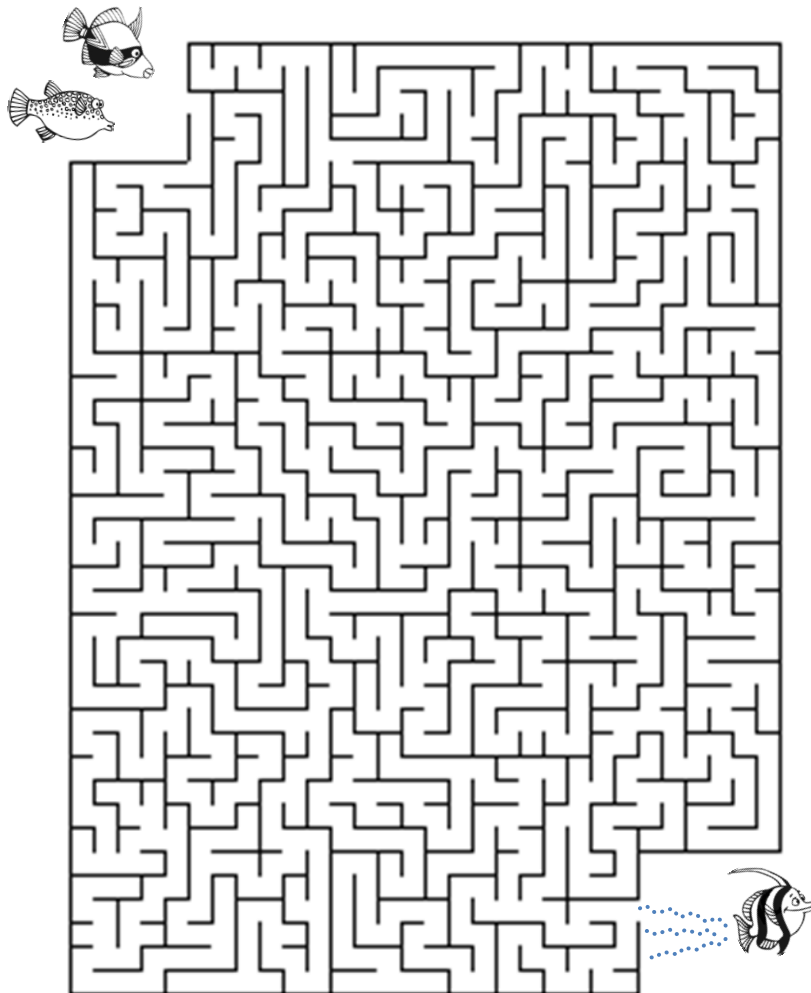


No, since all we need to build our homes comes from the water the only way to make it better is for people to stop putting so many greenhouse gases in the atmosphere.



CO₂ and Our Oceans

The fish were all very sad when they learned that there was nothing to help the shells and the corals. They knew that there were corals and people all around American Samoa, but they didn't know how to let the people know what to do to help the corals. They decided to go ask the brain coral - who is very wise. Help the fish find their way to the brain coral!



CO₂ and Our Oceans

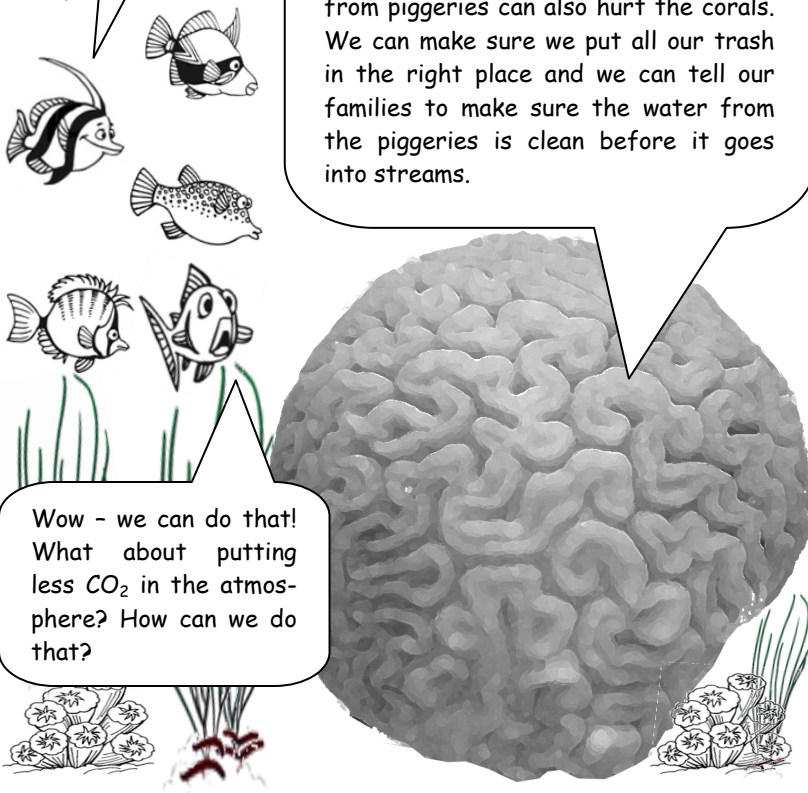
Please Brain Coral - what can people do to help the corals?

People can put less CO₂ in the atmosphere. People can also make the reefs healthier. If the corals are healthy and the water gets really warm, the corals that are healthy may not bleach as much as the corals that are not healthy.

How can we keep corals healthy?

We can keep the water clean. Trash and litter like plastic bags and candy wrappers and shoes can hurt the coral. Other litter - like gasoline and waste from piggeries can also hurt the corals. We can make sure we put all our trash in the right place and we can tell our families to make sure the water from the piggeries is clean before it goes into streams.

Wow - we can do that! What about putting less CO₂ in the atmosphere? How can we do that?



CO₂ and Our Oceans

The wise brain coral told the fish other things that people can do to keep corals healthy. Find all the words in the word search below to uncover the brain coral's message:

U S U S E L E S S E N E R G Y A N D K A
 G S T G R E E N H O U S E G A S E E L P
 A A E H G N I M R A W L A B O L G O O U
 A G T L G R D R I V E L E S S R F C A O
 E L U A E I E U R A L G S H E A A L V T
 H R U F L S L T T Y N F Z G T V I L E S
 F E E A A A S E T A E I L A M G T L A A
 Z I A H L G W E H I P E L U P Y E E U D
 W T D E P U U C L T L A I Y Y D B A B Z
 P X G H B S E F A E F S S N I O Q R Z G
 F C F W P T O U G H C F E X B G Z N K W
 I E M U A L S M S S F T O L U O Z M I O
 L J M M L I T A T V I I R N S L Z O K E
 N S I A A Z R J J A D J D I R A M R P H
 S L X F F T G X I N D C U Y C U Y E A E
 C Y R E G G I P O N G Z W Z Q I T B E S
 R H M V I S J B A L O Q D Q U X T R A H
 Y E W B B Y R O F Y G V S T J N B Y E Q
 C E T Y E A C W J D V U J A U K D V A C
 L N S U C W F Z C W L Q G Z O F G H L D

ALOGO	FUGAFUGA	MALIE
ALUALU	GATALA	PIGGERY
ATMOSPHERE	GLOBAL WARMING	PULE
AVEAU	GREENHOUSE GAS	SAPATU
CARBON DIOXIDE	LAEA	TAFOLA
CLIMATE CHANGE	LAUMEI	TRASH
DRIVE LESS	LEARN MORE	TURN OFF THE LIGHTS
FAISUA	LITTER	USE LESS ELECTRICITY

Brain Coral's message is:

Answer: Use less energy and keep our corals healthy.

CO₂ and Our Oceans

Which of the activities below do you think make the coral healthier? Put an X under the happy face if the activity makes the corals healthy and an X under the sad face if it does not make corals healthy.

Activity		
Riding your bicycle		
Playing cricket		
Swimming		
Throwing your trash on the ground		
Throwing your trash in the ocean		
Throwing your trash in a trash bin		
Watching TV		
Playing video games		
Going to school		
Walking to church		
Driving to church		
Leaving the lights on when you leave a room		

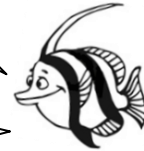
CO₂ and Our Oceans

Here are the answers to the activities you just filled in. Let's talk about the answers with our fish friends:

Activity		
Riding your bicycle	X	
Playing cricket	X	
Swimming	X	
Throwing your trash on the ground		X
Throwing your trash in the ocean		X
Throwing your trash in a trash bin	X	
Watching TV		X
Playing video games		X
Going to school	X	
Walking to church	X	
Driving to church		X
Leaving the lights on when you leave a room		X

CO₂ and Our Oceans

When you do things like ride your bike or run around to get somewhere, instead of driving, you use less CO₂.



If you can walk a short distance, instead of driving, you put less CO₂ into the atmosphere.

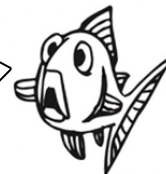
Throwing your trash on the ground or in the ocean means it can hurt the corals. Even if you are not near the ocean, when you throw your trash on the ground, the rain will wash it away to a stream, and then it will flow down the stream to the ocean where the corals live!



Watching TV and playing video games uses electricity, which puts more CO₂ into the atmosphere.



Going to school is good for corals - when you learn lots of new things and know how to take care of your environment, it is good for you and the corals!


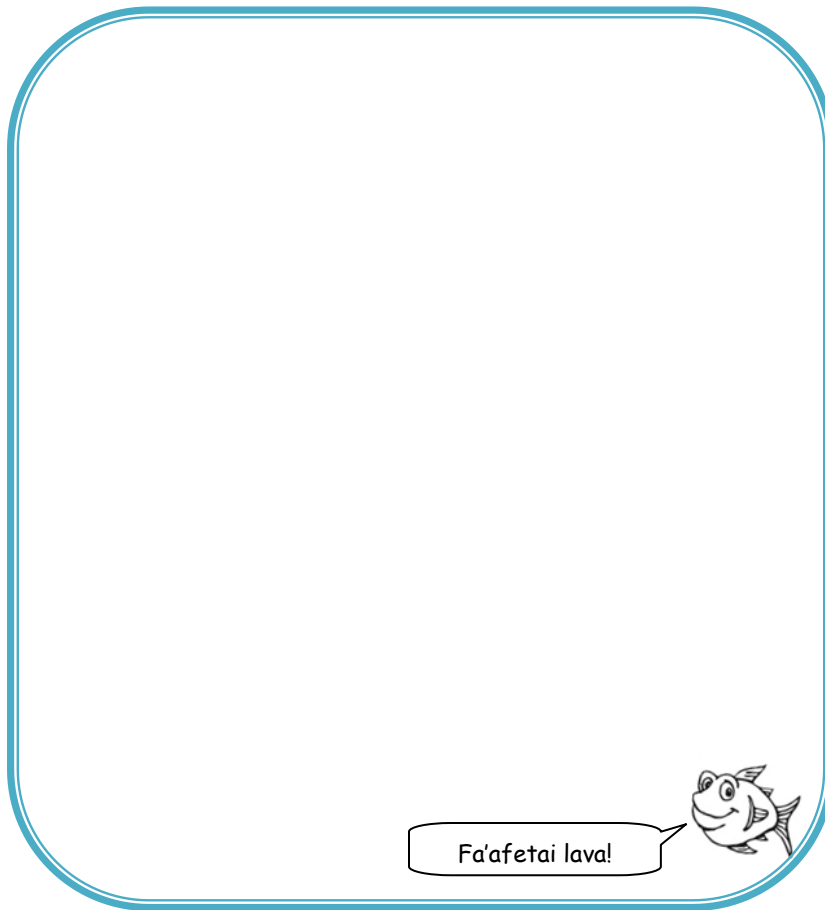


Same as leaving the lights on - if you don't need something that uses electricity, don't leave it on - turn it off!



CO₂ and Our Oceans

The fish were happy there are things people can do to help corals and slow down climate change. The fish want you to promise to help corals and all the animals that need them, like our fish friends! In the box below, write down what you are going to do to help corals and slow down climate change. This can be anything from turning off lights to asking for fewer rides to watching less TV. You can also tell your family, your church and your friends about climate change and how to slow it down!



Fa'afetai lava!

CO₂ and Our Oceans

You learned lots of new words today! Test out what you learned by drawing arrows to connect your new words with their definitions below:

Climate change

When Earth's air and the water get warmer. This is one part of climate change.

Global warming

This is layers of gases that surround the Earth and keep heat close to our planet.

Greenhouse gases

This is what happens when the climate of the entire Earth changes - this means it gets warmer or colder, and rain and wind and storm patterns change. This can be natural, or can be caused by people.

Atmosphere

These are gases that trap heat close to the Earth and make the Earth warmer when there are more of them.

Carbon dioxide/CO₂

This is what is going to happen when the ocean level rises. This can cause more flooding and increase beaches and coastlines washing away.

Sea level rise

This is a type of greenhouse gas that comes from many places. One of those is people's actions - like using electricity and driving.

Acidic ocean water

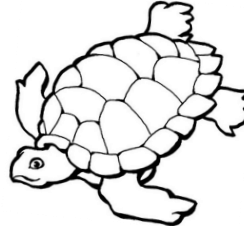
This is what happens when the water corals live in gets too warm. They can live after this, but sometimes many of them die afterwards.

coral bleaching

This is what is going to happen to ocean water and is also going to hurt animals like clams and corals that use minerals in ocean water to make their own skeletons.

Games & Funtimes

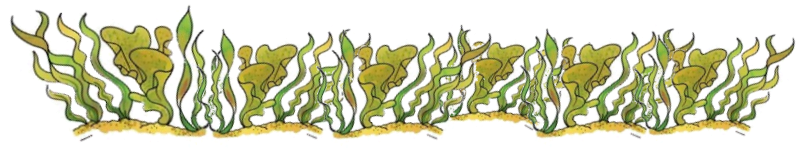
Laumei has wisdom to share with you. To find out what his message is, unscramble each of the clue words below. Copy the letters in the numbered boxes to the boxes with the same number at the bottom of the page.



TACEIML HENCAG	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 4	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 4	
LABGOL RIGAMNW	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 5 19	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 19	
HUGRNOEESSE SEGSA	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 7 12	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 12	
SEEROMPTAH	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 15 8		
SAE EEVLL SIER	<input type="text"/> <input type="text"/> <input type="text"/> 3	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 16	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 16
CIACID	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 20 14		
ROLCA HCLAENBGI	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 18 9	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 18	
TURLET	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 6 17		
BINRA LACOR	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 13	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 13	
PEOLEP	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 10		
HETRA	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 2		
MALC	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 11		
SIHF	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 1		



1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20



Games & Funtimes

Here are some of our other underwater friends, except they have mixed themselves up! Help them find their other halves by drawing a line between matching halves.



Where's my right claw?



Where's my tail?



Games & Funtimes

Turn the page to the left to color in the fish swimming all around the reefs.

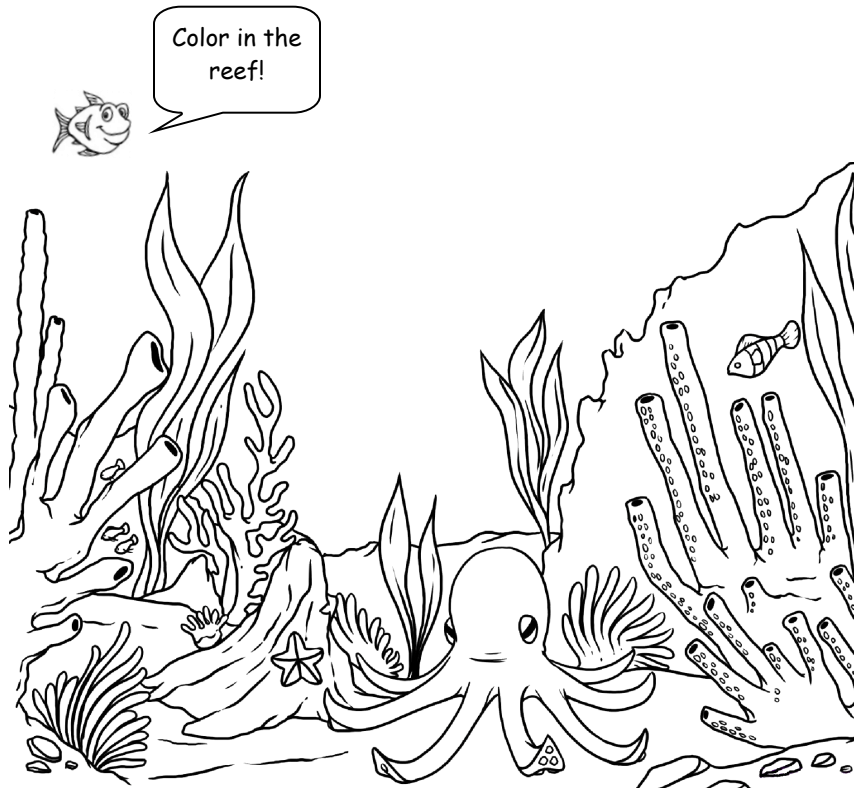


Additional Information

Did you like learning about climate change? If you want to know more, there are many places you can look. Your teacher may have books, and the internet also has a lot of good information and games. A few websites to look at are:

- <http://www.climate.gov/#climateWatch>
- <http://www.teachers.ash.org.au/jmresources/climate/change.htm>
- <http://www.epa.gov/climatechange/kids/>

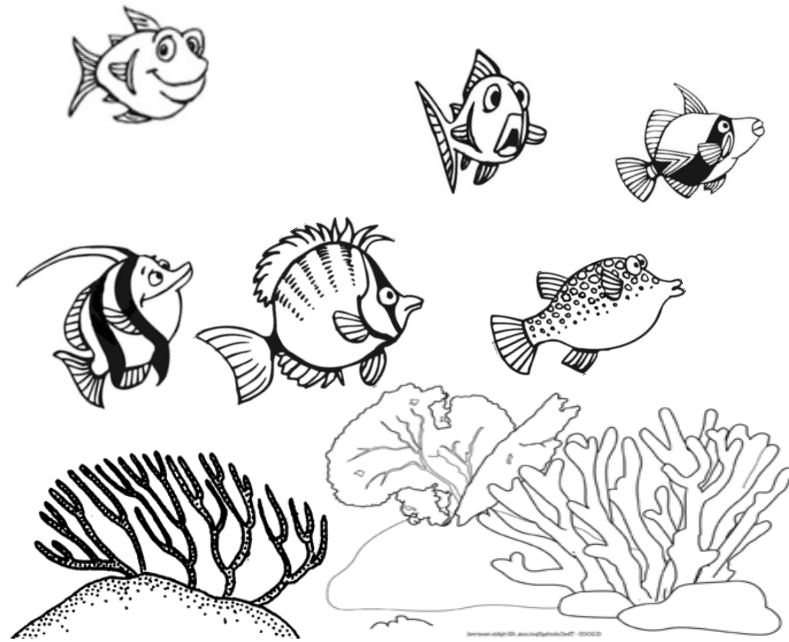
You can also email info@crag.as if you have more questions.



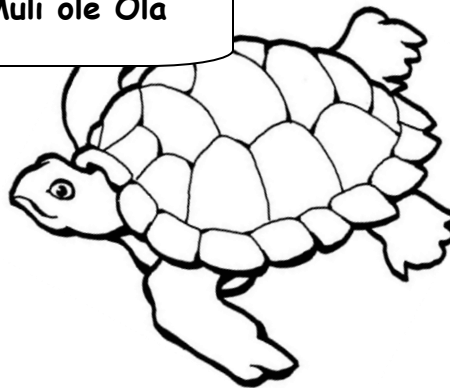
Scramble answers from page 30:

<i>Words:</i>	Carbon dioxide	Brain coral
Climate change	Sea level rise	People
Global warming	Acidic	Earth
Greenhouse gases	Coral bleaching	Clam
Atmosphere	Turtle	Fish

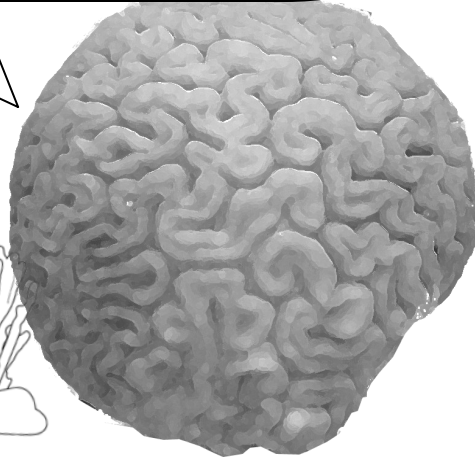
Phrase:
Fa'atotoe Le Muli ole Ola



Fa'atotoe Le Muli ole Ola



Yes Laumei—"to keep for them the remainder of the basket". People should remember that when you make decisions about your environment. The land and the water are your gift to those who follow you. Tell your parents and your friends and your church what you learned today!





© 2014 Governor's Coral Reef Advisory Group
www.crag.as