KOCW KOREA OPEN COURSEWARE

Title: Bio-medi English

What is a Carbon Atom?

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- ✓ **Dictated:** 김나정, 김민겸, 김성도, 문혜린, 박현서

[0:00]

Your notes, I think some of you have the power point, no, that's not, we are not doing that, following that.

So today I have handouts for you.

Everyone will get the lecture notes like this, and you are going to get some questions, vocabulary words.

Okay? This is for your own information.

Today we will talk about these words, so you can use this to answer some questions. I will ask you questions today.

So today I am going to be asking some questions referred to your vocabulary notes and lecture material, okay?

Everyone needs to take one of these and the question sheet.

Okay, attendance.

(Student names…)

Greenhouse gasses. We will going to be talking today a little bit about global warming, okay?

We will follow power point. Today you will also be doing some reading.

Okay? Let's look at the overview, okay? This part here.

Carbon is too much of a good thing bad.

Well, I have something I brought in today, what is this?

(Student Speaking)

Okay, we have some water.

(Student Speaking)
Handkerchief? We'll say this is cloth or fabric, okay?

We have some fabric.

🔊[3:00]

(Student Speaking)

Coke. All right.

What is this product? Wood. Okay, we have some wood.

And? Plastic. Okay, plastic bag.

Well, let's see I take this and... I want to have some coke, so…

All right. Now I just open the [?3:27].

Why? What's the matter?

What will happen if I open this?

It's going to explode or it's going to come out of the bottle quickly.

Why? What is in here making that, making these bubbles?

CO_2. Carbon dioxide. So is there carbon in this drink?

Sure. There's carbon in this drink, carbon dioxide.

That's why it feezes up, right? That's why she doesn't want me to open it.

Because she will be angry. I have to run quickly.

Okay, so there is carbon in this. But there is carbon in many things, carbon doesn't make anything explode, right? Or feeze up?

Let's look at this.

This is the wood. Does wood has carbon in it?

(Student Speaking)

Yes. It does. So it's not feezeing it up.

There's no explosion. How do we know?

How do we know there is carbon in this wood?

What was this before it was wood?

(Student Speaking)

No. A tree. Yeah. It was a tree.

How do trees, what do trees do?

How do they survive?

(Student Speaking)

Photosynthesis. Very good.

We're going to talk today about photosynthesis.

Photosynthesis, how does it work? What does the tree take in?

(Student Speaking)

CO_2. It takes in CO_2. It takes in water. And it takes in sunlight, okay?

So we know that there must be carbon in wood, right?

Because it takes in CO_2.

Okay, there's carbon in that.

Let's see. How about the water?

Is there carbon in this water?

(Student Speaking)

Yes? No? You said yes, why?

(Student Speaking)

That's right. Water absorbs CO_2.

Water is absorbing CO_2 all the time.

[6:05]

If we didn't have water in this planet, well of course we would be dead.

But all the oceans in the world, they absorb, they take in CO_2. They take in CO_2.

If they did not do that, we would have so much CO_2 in the atmosphere, we would die very quickly of course.

Oceans are taking in most of the CO_2. It's taken in by the ocean and it goes into the earth.

And It doesn't get recycled. Okay? Until we dig it up or pull it out.

So yes, there's carbon in water.

This cloth, is there carbon in this?

(Student Speaking)

Sure. There is it. How do we know?

Let's say this is, we'll say this is cotton.

A cotton cloth. How do we know there is carbon?

What is cotton?

What is cotton?

Is cotton an animal? No. What is cotton?

(Student Speaking)

It's a plant. You know that? Cotton is a plant?

Okay, I want you to talk.

Okay? Cotton is a plant, plant is like a tree. A plant does what?

How does a plant, what does a plant do?

What do trees do?

She said, she helped us.

Photosynthesis. Plants, trees take in carbon dioxide, and they give us oxygen, all right?

So if this is cotton, it used to be a living organism. It has carbon in it. Okay?

Let's say this is wool. How do we get wool?

What gives us wool?

양. What is in English? Do you know?

Sheep. Sheep give us wool. Sheep is a living organism, right?

Anything that's living has carbon, right?

Yeah. Cause it takes in oxygen, takes in glucose. Glucose is a simple sugar, has carbon. Okay.

So we need carbon.

All right. So if this is, this is wool, there's carbon in it.

But how about this is polyester?

Polyester made by humans.

🔊[9:00]

Is there carbon in it?

(Student Speaking)

Yes. How do we know?

How about you? Why, if this is polyester, how do we know there is carbon?

How do we make polyester?

Polyester is made, what did you say? Oil. Oil.

And oil is from living organisms. Oil, living organisms they die, rock, layers of rock, sedimentary rock get on top and over millions of millions of years and a lot of pressure pushing down from these layers, and the heat that is inside the earth changes back to petroleum or oil, natural gasses.

And that's how we are able to make things like polyester and man-made clothing items that you wear.

So oil, yes. So there is carbon in this.

What is this?

Plastic. Very useful item. Is there carbon in this?

(Student Speaking)

Yes. And why?

How do we make plastic?

Give you a hint.

Oil. Again. Plastic is made from, it’s a product of oil or petroleum, okay?

So byproduct of petroleum.

So yes, there is carbon.

So these five very different things, all of them have carbon.

Most everything on earth has carbon, right?

Everything that’s living on earth has carbon.

You, for example, do you know that half of your body weight?

Half of your dry body weight is from carbon.

So half of you is carbon. Okay?

Carbon, very very important element to the biosphere, to all life on this planet, this is how life began and it’s what sustains our life.

It is carbon and the cycle that carbon is having.

Okay, the overview.

The element carbon first originating in the stars has become an interval component to life on earth.

Its cycle affecting organic and inorganic elements allows life on our planet to flourish or do well.

[12:00]

As phytoplankton in the oceans and plants on land, combine it wood other elements through photosynthesis, glucose produced.

Okay, phytoplankton, everybody say, vital plankton.

(Student Speaking)

You should say thank you very much to phytoplankton.

Where do you see phytoplankton? Where do they live?

(Student Speaking)

Very good. In the oceans.

Why are phytoplankton, why am I saying we should say thank you to them?

What do phytoplankton give us?

Anybody know?

Oxygen. Oxygen. The most oxygen, the most oxygen produced in this on earth is done by phytoplankton in the oceans. Okay?

Phytoplankton makes up a huge amount of the life cycles in the ocean.

Phytoplankton, tiny tiny little organisms. Okay?

These phytoplankton are eaten by krill. Krill, like small 새우. Okay?

Little shrimp. Kind of like krill. And in the oceans, what eats krill?

Fish. Seals. Penguins. Even there’s one of the largest mammals on earth, the bailing whale. Survives by eating only krill, amazing.

So this food cycle, from phytoplankton, tiny tiny things, phytoplankton, krill, bailing whale. One food chain from tiniest organism to one of the largest, right?

So thank you phytoplankton for our oxygen.

Okay. Anyway, this is how glucose is produced, and I told you we humans, we need glucose, we need oxygen to survive.

Glucose is a very basic sugar, okay?

It’s manufactured and plants. It’s the beginning of a complex food chain on landed in the oceans.

But what’s happening to this, this food chain, the carbon cycle, we have our producers, things that are producing oxygen for us.

We humans we are consumers because we are taking this oxygen.

And we give back what? When we breathe out, we breathe out CO_2. Okay.

So we are consumers. Okay?

And then what’s happening is, what we’re doing now is using too much or giving out too much CO_2. Okay?

[15:10]
The industrial revolution. Long time ago, industrial revolution, what are we building?

Many beginning with f, factories.

We are building many factories.

You are going to (지명), right?

You will see many factories.

Factories, what are they doing?

(Student Speaking)

Produce what?

Well, producing whatever they are making.

But how do these factories, how can these factories, where do they get their energy? Usually?

(Student Speaking)

Burning fossil fuels. Oil. Coal. Oil. Petroleum.

Burning the fossil fuels for energy.

When we burn fossil fuels, what goes into the atmosphere?

CO_2. Here we go. More CO_2.

So since the industrial revolution, a lot more CO_2 is going into the atmosphere.

Thank goodness for the oceans, sucking in the CO_2. Okay?

Since the industrial revolution, the oceans are sucking in a lot of it, CO_2, saving us.

But still in the atmosphere, there is more CO_2 than there was before.

So it's dangerous.

Okay. Today we'll talk about four, the four spheres. And these four spheres on earth is what, is how the carbon cycle operates. Okay?

One sphere is the geosphere. What is the geosphere?

Good. The geo, meaning the earth, geography, earth, so geosphere is earth's crust, under the crust of earth, okay? Or the crust of earth, geosphere.

All right? We'll talk today about the atmosphere.

What is the atmosphere? The air surrounding the earth.

And the hydrosphere? Hydro? Hydrogen?

Good. Water, okay?

So hydrosphere is just all the water on earth, lakes, oceans, rivers.

And the biosphere. What is the biosphere?

(Student Speaking)

Living things. Bio means life, so biosphere is all living things.

All right. We're going to talk about these four spheres today.

And how the carbon cycle is using these four spheres. Okay.

All right.

So right now there are some serious problems with CO_2 in the atmosphere.

We're trying to contain the CO_2.

[18:00]

What's also happening you heard about sure, global warming.

Global warming, what does that mean?

The globe is getting warmer

The earth is getting warmer.

The atmosphere is getting warmer.

How?

How does that happening?

Why?

We are talking about the carbon dioxide and the carbon cycle.

How are things getting warmer?

Carbon dioxide is called greenhouse gas.

We talk little bit later about that.

A greenhouse, what is a greenhouse?

How about you?

Do you know what is a greenhouse?

Have you ever seen a greenhouse?

Okay.

What is inside a greenhouse?

Plants.

Did you go inside the greenhouse?

How did you feel?

(Student speaking)

Heat.

It's warm.

Okay

A greenhouse is made to trap heat, to hold the heat, right?

If you go into a greenhouse, it's going to hotter.

It can be better.

Right? Okay.

Well, what's happening, why do we say co2 is a greenhouse gas.

Co2 traps heat.

It holds heat, okay?

And do the more co2 we have in the atmosphere, the more heat we're going to have.

And the more heat, the higher the temperatures, and the earth is going to be warmer.

You are not going to feel.

It's very difficult for humans to, for us to feel even a small change in the heat, right?.

But it will be warmer, and what will happen is it all affects organisms, things living in the sea, things living on land, and it all affects carbon cycle, the cycle of this carbon.

So then we are going to start seeing more and more problems.

And once the problems start happening, it's going to get quicker and quicker.

We're going to have problems.

So, we have to be careful.

Okay.

Through this lesson today, I want you to understand the carbon cycle better.

I'm sure you all know about it already, some.

The greenhouse effect, and how we can control these problems and what's happening.

Today you should be able to talk about carbon compounds.

You should be able to know the difference between fast track carbon cycle, and slow track carbon cycle.

You should be able to explain photosynthesis and the effects of the food chain.

🔊[21:00]

You should be able to describe the impact of global warming.

I just told you about it.

And then, what can we do to help balance the carbon cycle?

I told you the balance of the carbon cycle balance is getting a little off balance.

And what can we do to make that balance back equal?

Okay.

All right.

Okay, now we will go to reading.

In the lecture, I will let you see there are little Rs for the circle.

That means a reader.

Every time we get to an R, we through the changes, okay?

So, we will start today over here, with you.

You are going to start reading.

You are reading, yes.

(Student reading)

Okay, so what the saying here is very important for us to have understanding about what's happening to our world, what are we doing, how is a man creating this problem.

So, very important to know why.

Okay, next reader.

(Student reading)

Okay, all right.

Chemical reaction, so, today we're going to be talking about photosynthesis.

You all know photosynthesis, and how, it's so important to all life on the planet.

This chemical reaction is that are happening in plants and trees taking carbon dioxide, breaking it down with sunlight, and releasing oxygen back into the atmosphere.

[24:05]

And then humans, living organisms living in oxygen.

And our body is being able to break that down and send back out, carbon in water.

Okay?

This chemical reaction is what keeps life moving, keeps life going.

Also today, we talk about things and die.

Living organisms that die, or decompose, broken down by bacteria or fungi, okay?

Or algae.

And these things get the chemical reactions happen and that process to release co2 back into the environment, okay?

And this process is just a revolving cycle.

Okay, next.

(Student reading)

Okay, good.

So, you can see producers.

We are talking about producers, okay?

Producers producing oxygen, okay?

Plants, trees, like I told you.

These sayings say plants, algae, some bacteria remove carbon dioxide which is inorganic compound and make glucose.

Glucose is needed for energy, energy for plants or trees, or living organisms.

Okay.

Glucose is the simplest organic compound, all right?

Next reader.

(Student reading)

[27:20]

Very good.

So the showing us, giving us some examples what's happening.

Glucose can be changed to cellulose, stored, used to build plant issues, or glucose can be stored starch as stored energy in plants, or other living organisms like that.

Other molecules, they can burn nitrogen, and make aminoacid, proteins.

And you can see how that is essential to all other life.

Life on the planet starts with proteins, okay?

All right.

Going into more photosynthesis?

Next reader?

(Student reading)

Okay, very good.

So, chlorophyll inside plants, chloroplast inside plants these use this structure used to inside plants too for the process of photosynthesis, okay?

Next reader?

(student reading)

Okay, good.

So, we have chlorophyll in the leaves taking in this energy, okay?

Chlorophyll absorbs the energy from the sun, okay?

[30:20]

And then it stored in the celluloid structures, called chloroplast.

It bonds with hydrogen.

And then it can release oxygen into the atmosphere.

She is talking about stomata.

What is stomata?

What are stomata?

The humans have stomata.

Do we have stomata?

No.

So, what has stomata?

Where do you find stomata?

On the leaves.

Stomata, small openings on the leaves of plants and trees.

That's what takes in the carbon dioxide, okay?

Through these openings.

And that's where the oxygen comes out.

So stomata is used for that gas exchange.

The picture you can see.

Coming carbon dioxide, going out oxygen.

The light energy comes in through the chlorophyll stored by, absorbed by chlorophyll in the plant, okay?

The plants also need water.

So we have water coming in the root, okay?

And then oxygen goes out through the stomata after the chemical reaction takes place.

Okay, pretty basic.

Go to questions.

Let's do quickly view what are we talking about.

First, number one, where's carbon found?

Okay, let's see.

병수, where can we find carbon?

Everywhere, very good.

Carbon is in everything.

So, we found out today in all these products that carbon is inside all these.

So, we can find carbon basically everywhere.

Okay.

Next question.

For what purpose do plants use carbon dioxide, 정민?

Why do plants use carbon dioxide?

(Student speaking)

Very good, carbon dioxide for photosynthesis to do that chemical reaction, change carbon dioxide back into glucose, and the oxygen.

All right.

Next one.

What percent of all living organisms' dry weight is made up of carbon?

김정? Where's 김정?

What percent of your weight is carbon?

[33:20]

We talked about this one.

Anybody helping her?

What percent?

Fifty percent, half.

Half of every living organisms' dry weight is carbon.

I told you.

Half of your weight is carbon.

Okay?

Number four, everyone answer this together.

Living things are carbon consumers and producers, right.

We talked about consumers.

Consumers will be humans, other mammals, and other animals, okay?

Producers plant trees, bushes, okay?

Next one.

How is carbon dioxide released into the atmosphere?

We're talking about fast track, carbon cycle.

How is carbon dioxide released into the atmosphere?

태근?

태근, how is carbon dioxide released?

Breathing, good.

Called respiration.

Respiration.

We breathe in oxygen.

We breathe out co2.

So, that's how it's released.

Okay.

Also, through respiration, what is another way?

I told you.

(Student speaking)

From [?35:11].

Okay, but that's slow track.

In the fast track, we have consumers, producers, and there is one more part, decomposers.

And I told you.

Bacteria can, when something dies, it's decomposed.

And that chemical reaction also releases co2, right?

So, through respiration and decomposition.

Okay, very good.

Back to the reading.

Next reader, plants.

Where are we?

You? okay.

(Student reading)

🔊[36:50]

Okay, very good.

Aerobic respiration. We know respiration. It's a basically breathing and she's telling us that this is a global cycle, this cauline cycle is global.

What does it mean?

Well, we breathe out carbon dioxide, it goes into the atmosphere, it can travel a long, long way. Right?

Before it is absorbed by a producer, and or absorbed by the ocean, okay?

So, that's why this is a global cycle happening not in just a little place, but happens everywhere.

Here you can see what we've been talking about.

Here we have some consumers, okay?

And here we have our producers.

Also we have decomposers in this category.

Bacteria, fungi.

Okay, very good, next? In the back? Yeah.

(student reading)

Okay. So basically we depend on this producers.

They are the only things that can break down into carbon compounds for us to survive, right?

We are talking right now about fast track carbon recycling.

Okay.
Next reader.

(student reading)

🔊[40:06]

Okay, very good.

This is saying the same we've been talking about, right?

Decomposers, what are decomposers doing, they are breaking down the chemical reaction, and it's released back into the atmosphere.

Okay, you can see fast track carbon recycling.

Fast track is talking about the consumers, the producers, and the decomposers.

That is fast track recycling, carbon recycling.

Basically photosynthesis, fact track.

Okay, next? Yes.

(student reading)

Okay, so basically it's just showing you the balance again, right?

We have two opposite reactions happening.

We have the producers, we have the consumers and the decomposers, and their opposite reactions.

Photosynthesis and respiration. Completely opposite.

The end of the lecture, you can see the formulas.

Formula for photosynthesis.

Trees and plants, what are they doing?

They take in CO2, six CO2, and they take in waters, six H2O and radian energy, sun's energy, sunlight.

And what is produced? C6, H12O6, what is that? Glucose and oxygen, 6O2.

So we have oxygen.

🔊[42:34]

Respiration exactly opposite, the opposite reaction.

We have C6H12O6, is our glucose.

Plus oxygen, and what do we get? What do we get back?

6CO2, which is carbon dioxide and 6H20, which is water, okay.

So we just have opposite reactions balancing each other out.

But these days, there's too much, we talked about, there's too much CO2 being produced, and that is the problem.

Okay, questions, and then we will take a break.

What produces the most oxygen on Earth?

Let's see, 선아, where's 선아?

선아, what produces the most oxygen on Earth?

I will give you a hint, living in the ocean, tiny, tiny organism.

Begins with P.

Anybody helper?

Phyto plankton. Is anybody listening here?

Phyto plankton. Phyto plankton lives in the ocean, Phyto plankton produces the most of the oxygen that we breathe.

That's why we said thank you to Phyto plankton.

Okay, what is carbon dioxide? There's an easy one.

What is carbon dioxide? 재홍

재홍, what is carbon dioxide?

What is the chemical formula?

C? what is C?

CO2. What is C?

What is this mean?
CO2. What is C?

What is C stand for?

What is C stand for?

Carbon.

What is O?

Oxygen.

Okay, CO_2,

One atom of carbon, two atoms of oxygen, that is carbon dioxide, right?

Carbon dioxide.

Okay, good.

How is carbon dioxide broken down in a leaf?

How is it broken down in a leaf?

We talked about photosynthesis.

Here's a picture, how is the carbon dioxide broken down inside leaf?

🔊[46:06]

What is happening?

영균, how is the carbon dioxide goes into the leaf through the stomata?

How is it broken down? What causes that chemical reaction?

(student speaking)

Very good, the sun's energy, sunlight energy comes in and that energy gets from the sun is what its uses to break down the carbon dioxide.

And it's what uses to make that reaction happen.

Okay. Very good.

What is fast track? We talked about fast track, carbon recycling.

What is fast track carbon recycling?
혜수. Where are you?

혜수, can you explain fast track?

There are three different parts to fast track. There are the producers, consumers, decomposers. Good.

So fast track is photosynthesis, basically photosynthesis, but also including decomposers, right?

Where that is happening, that can happen very quickly within minutes, right?

Within minutes, or years.

You breathe in and you breathe out carbon dioxide. Wow! Boom!

There’s one part, already done, right?

That is taken in by plants, zoom, boom, and oxygen coming back out, right?

So that’s what fast track, okay?

Happening pretty quickly, right?

Okay. Following in the reading, I will talk about this next part.

All right. We talked about fast track, we talked about producers, consumers, decomposers.

Now, slow track, carbon cycle.

Beginning today, bebinning a lecture today, I mentioned, we talked a little bit about this slow track.

All right. Most carbon is recycled through the slow track carbon cycle, over millions of years, okay?

[48:34]

Things die, marine organisms die, things living in the sea.

They die, what happens?

Well, they sink, right?

They go down to the bottom of the ocean.

Okay, and they are lying at the bottom of the ocean.

At the bottom of the ocean, there's a lot of silt, and there's a lot of mud.
And over time, it piles up, right?

And it piles up, and it piles up, and it piles up.

And that, we can say, is sedimentary rock.

All right, so we have organisms that die, we have sedimentary rock, and we have millions of years, and then, we have heat, and we have pressure, right?

Pressing down very strong.

Okay, so, what's going to happen for a long time is petroleum is produced

Or, so, most of the carbon on Earth is still in sedimentary rock

All of the rocks have carbon in it, too.

But, sometimes, with heat and pressure in a long time, we get coal or we get petroleum, which are fossil fuels.

Now, these things are just sitting in the Earth with no way to get out, right?

So there's carbon in the Earth, how we (?49:57) get it out?

Well, we drill, right?

We drill into the Earth.

And we can find these resources or we drill, or we mine, mining, right?

Mining, go to the mountain, we may, (?50:14) okay?

Find coal, and we take the coal out, then we use coal.

Coal is used to power, factories, power plants, different things, okay?

Here you can see an oil rig, getting oil out of the ground.

Okay, so, this is the slow track carbon cycle, okay?

And it takes millions and millions of years.

[51:44]

Also, what we can have products like coal, and petroleum, limestone is a sedimentary rock, limestone and, in limestone is a sodium sulfate, okay?

And there's a lot of carbon in here.

All right, also, digging in the Earth, we can find diamond.

What is diamond?

It is carbon, diamond is carbon, right?

It's an allotrope of carbon, okay?

It's a different form of carbon, but diamond is an allotrope of carbon, and we can find that in the Earth, too.

Over millions and millions of years, diamond can be formed.

Or, graphite, okay?

Or, fluorines, and these are three of the allotropes of carbon.

Okay, but before we get into that, I will explain on this slide, think of this number.

Wholly, multi, it's pretty big.

Can anyone say this number?

Oh, let's look, here we have hundred, thousand, million, billion, trillion, this is easy, done it, quadrillion. Four quad, so quadrillion.

Fifty quadrillion tons of carbon on Earth, actually more than fifty quadrillions of carbon on Earth.

🔊[52:40]

OK. That's a lot of carbon.

We know everything on earth has carbon.

Most of this carbon is in sedimentary rocks, just sitting in under the earth, would not being recycled.

I told you, limestone and chalk, calcium carbonate, $CaCO_3$, under the ocean…

You're going to find a lot of limestone.

There's a chemical process happening here, limestone is breaking down the carbon, holding the carbon, $CaCO_3$.

Most of it is in sedimentary rock, but some of it passes through carbon sinks.

Actually, quite a bit of carbon passes through a carbon sink.

What is a carbon sink?

You know, sink?

What is a sink?

Why do we use sinks?

What does a sink hold?

What is a sink holding?

In your house, do you have a sink in your house?

Why? What goes in the sink?

Water.

The sink is holding water.

Basically, a sink, a carbon sink is where water, usually…

Carbon is absorbed, and it doesn't get recycled.

Only it gets absorbed, it goes down into the ground, and it doesn't come back out.

It's not recycled, that's a carbon sink.

The oceans and many bodies of water are carbon sinks.

So, the oceans are the largest carbon sinks.

Of course, and I told you about that.

Without the oceans, we would have much, so much more CO_2 in the atmosphere.

This sucks in that CO_2, and it stays in it, it doesn't go and get recycled.

In the slow track, if we mine, we dig in, we pull out, we burn fossil fuels.

That would go into the atmosphere.

Then, it goes into the fast track system.

But that's the problem.

Too much CO_2 in the atmosphere is not good.

[55:15]

So, it can go in the atmosphere, it can be dissolved in the water, carbon sinks, or buried beneath the Earth.

Geosphere, Hydrosphere, Atmosphere.

And also, fast track through living organisms would be the Biosphere.

So, we can see all our spheres.

The slow track, carbon recycling, what sphere?

Geosphere.

Coal, petroleum, those fossil fuels are in the Earth.

So, slow track is happening in the Geosphere.

And the only way we get it out is by mining it, drilling it, or volcanic eruptions.

So, those are ways we can get the slow track carbon out of the Earth.

Slow track, talking about the geosphere.

With all 50 quadrillion tons of carbon, where the heck is it?

Where is all the carbon?

Look at this chart, and you will see.

What is this? Oceans.

I told you.

Without the oceans, we'd be in big trouble, right?

Of all that carbon, 38,000 tons goes through the oceans.

In the carbon sink, in the ocean, succeeding…

It's held in the oceans.

Look at here.

Here's the atmosphere, atmosphere CO_2.

Compare to what is in the oceans, very little!

So you think, “no problem!”

No. Actually, this is a lot.

Coal.

Look at how much is in coal.

That’s why we are burning so much coal, because there are so much there.

Oil and Gas, you can see.

Dead organic matter in the soil.

Land plants, and then us, land animals, not very much.

So, compare to what’s in the oceans, very little other places, but with coal, quite a bit.

Marine sediments, at the bottom of the ocean, dead animals, 6,000.

[58:12]

So, oceans, we are talking about the ocean, the carbon sinks…

Oceans are what keep the balance.

When there’s too much CO_2 in the environment, especially since the industrial revolution, there became more CO_2 in the environment, so the ocean started taking in more CO_2.

The oceans are smart like that.

That’s just how it works, right?

More CO_2 in the atmosphere, the ocean sucks up more.

So, we are lucky.

Without the ocean, sucking up more, after industrial revolution, we’d be in big trouble because there’s more and more CO_2.

If there’s not enough CO_2, if there wasn’t enough CO_2 in the environment, the oceans would give CO_2 out.

If not, CO_2 levels would be much higher than we see now.

Removed CO_2 is replaced by some from the ocean.

So, when we remove CO_2, it gets replaced by the oceans.

When there's too much CO_2, it takes it in.

So, oceans are keeping the balance.

I told you, in the oceans, phytoplankton is in the oceans, making oxygen.

So, when there's not enough, the phytoplankton can make more.

We talked about the allotropes.

Carbon are three allotropes.

Diamond.

We all like diamond.

But why is diamond so great?

You probably all know diamond is very strong.

Diamond is carbon atoms.

They are linked to 4 carbon atoms.

So, very, very strong.

Few weaknesses, many strengths.

First strength.

It's the hardest substance found in nature.

There's nothing harder than diamond in nature, you know that.

Diamond can cut glass, right?

Diamonds.

They are more transparent than any other solid or liquid.

Transparent, you can see through.

Clear, the clarity.

Diamonds are very clear.

The next great thing about diamonds is they conduct heat better than anything.

Diamonds conduct heat better than anything.

Conduct, heat passes through very easily.

Wow, many great things!

🔊[1:00:56]

That's probably why that we have tradition when you get married the man should give a diamond to his wife, right?

You are so thoughtful!

Why is she saying that?

Because you are giving her something that is the strongest, the clearest, and the best heat conductor in the world.

But, what's the problem?

It's very expensive.

Because it's rare and it's needed.

Diamonds are great for cutting, drilling.

Diamond is a very needed thing.

So, it's rare and it's expensive.

So, you have an idea; Cubic.

Cubics are conium.

I will buy for my girlfriend.

And then your girlfriend, she is doing something, and her ring falls or she hits it, and it breaks..?!

So, then you are in big trouble.

Anyway, diamond… very amazing, very amazing carbon allotrope.

🔊[1:02:21]

Another carbon allotrope we can find is graphite.

Graphite is interesting.

It is called a lubricator.

Why?

Because graphite shaped in layers, and these layers are the bond between the layers.

It's very weak, not very strong.

So the layers would slide over each other very easily.

So, it's a lubricant, very slippery.

But as you probably know, what do we make using graphite?

Golf clubs, tennis rackets, airplanes, and automobiles.

This is a lubricant.

Why are we making these things out of the lubricant?

Actually, graphite can be very strong.

Because what we do is, we take these layers and you twist them up.

You twist up the fibers, you roll into fibers, and you twist into threads, and then graphite becomes very, very strong; almost unbreakable.

And, the other thing about graphite is that it's very light.

So, we have this thing what's we twist up these fibers.

We have a very strong and very light product.

And that's why with golf clubs, you want to have a light.

So, you want to have graphite as a great for sports, tennis rackets, golf clubs, and airplanes, of course, flying up in the sky, and automobiles; strong and light.

[1:04:20]

And the last allotrope; Fullerenes.

Fullerenes, as you can see, any molecule composed entirely of carbon, and you can see here, a fullerene, this is called a buckyball, it's another name for this.

Very, very, very strong, and what scientists are studying buckyballs now, fullerenes, is how can we use this strong carbon allotrope.

How can we use it?

What can we do with it?

Like graphite, it's a very good lubricant because it's like a ball.

So, it can act like a ball bearing between molecules, like a lubricant.

Also, they are thinking about, they are trying to trap drugs inside these balls and deliver therapy to people.

Get it inside the body, have the ball break down over time, releasing the drugs.

So, could be a way to deliver drugs.

And another thing that is special about fullerenes or buckyballs; they have ability to block HIV virus from attacking health cells.

That's what they are hoping to do in the future with these buckyballs.

Back to reading.

Let's start with here, "for example", bottom of this page.

Next reader, where are we?

(Student Speaking)

OK, methane.

Methane is another fossil fuel, found in the earth, also you can find methane in the atmosphere.

We will talk about that.

It's the simplest hydrocarbon or alkane, made from hydrogen and carbon atoms.

🔊[1:07:10]

Principle component of natural gas.

Natural gas, another fossil fuel, one of the best.

OK. Good. Next?

(Student Speaking)

OK, very good.

So, we are talking about slow track recycling.

How can we get carbon back into the atmosphere?

We talked about drilling and mining.

Also, we did talk about weathering and erosion of rock.

Wind, rain, water can break down rock.

And when that happens, some of the carbon in the rock can come out into the atmosphere.

We talked about volcanic eruptions.

Once it is out of the earth, then it can go through fast track recycling.

OK. Here you can see methane.

Also, she was just reading the Cattle belch methane from a livestock or emissions from automobiles.

Burning hot fossil fuels, automobiles, we take gas and the gas we burn in automobiles comes out as CO_2.

Cattle belch methane. Interesting.

What is a belch?

If I drink this cola too fast, I'm going to belch.

So, cattle belch methane, livestock, cows, chickens, pigs…

Of course there are many farms, many animals like these that we care for, and when they eat, they belch.

They chew their cud and they belch.

And when they belch, what comes out is methane.

And that methane goes into the atmosphere and it needs to be recycled.

In these pictures, what you can see…

Now, this is the opinion of the person who made these scenarios, but they are showing how a cow eating grass will produce methane through cattle belch.

What they are saying is that the cattle belch methane is broken down in the atmosphere into CO_2 and water, which then gross the grass again.

So, here, we have a natural cycle.

[1:10:31]

Cattle belch methane has gotten a lot of attention by scientists and by people because 16% of the world's annual methane emission is cattle belch methane.

That's a lot.

How can we make that less?

I think we are thinking about it little wrong.

It's not the cattle.

It's us, burning fossil fuels, driving all the cars.

So, if we concentrate so much on this part, I think we should be thinking about this part.

This is very natural, this is unnatural.

This is technology.

But anyway, even so, research is trying to think about how we can make this number less.

And so finding medical treatments, or even changing the diet of these animals, is helping to bring down cattle belch methane into the environment.

But, like we talked about burning fossil fuels here is very unnatural.

And this CO_2 that is produced is not being naturally recycled.

There's nothing natural about this.

So, this is what we need to control more.

[1:11:51]

Here's another fossil fuel, natural gas.

Natural gas is actually very good.

It's a vital part of the world's energy supply.

Very clean.

It's one of the cleanest, safest, and most useful energy sources. Okay?

And we need to use it very wisely.

However, the gas that we have in our cars, the gas that when you go and fill your car, that is not natural gas.

That has a lot of other stuff inside it. Okay?

So, it's not as clean as burning natural gas.

[1:12:30]

All right. Let's go to the last page.

This last page we'll just talking about what we can do, what are the problems and how can we solve them. Next.

(Student Speaking)

Okay, very good. Interesting.

So in the summer and winter we have different levels of CO_2 especially in the northern hemisphere.

Northern hemisphere, there's more land. Right?

So in the summer there's more… more what?

More plants, more trees, right? More leaves because in the summer, that's when everything green.

[1:14:02]

And so during the summer, there's more oxygen being produced and so others, the levels of CO_2 are less during the summer.

But in the winter, it's actually opposite. Because there's not as, not as much photosynthesis happening, right?

Okay. That's what they're talking there, so it can change the climate and it can change the concentrations of CO_2. Okay? Next.

(Student Speaking)

Okay, good. We talked about this, right?

But we are being bad. We are burning fossil fuels, we're burning wood and that's creating more CO_2. We don't want that. Okay, Next.

(Student Speaking)

Okay. Deforestation. Forest. What is the forest? Forest. Many trees, right?

Deforest. What is 'de'? The 'de' part.

What does that mean? 'De' means no. No forest.

Taking away, cutting down the trees, cut down the trees.

We're losing oxygen because trees produce oxygen, alright? So that's not good, alright.

Can you continue? You cannot. She has some throat problem. Alright. Next.

(Student Speaking)

[1:17:38]

I told you guys, CO_2 is a greenhouse gas, right?

And note that why it absorbs heat, okay?, from the sun.

It absorbs heat from the sun or from the sun heats up the earth.

The earth gives off the heat and it's absorbed by CO_2 and that causes global warming, closes the globe to get hotter.

Okay, very good. Next.

(Student Speaking)

Okay, so, global warming. Temperatures, are rising right?

When the temperatures rise, what's going to happen.

Well, that's going to affect the balance that we have the carbon cycle is balanced, right?

Well, there are producers and the consumers but if there's too much CO_2, it's going to make planet hotter and that's going to back the carbon cycle which is a huge problem.

We know that oceans absorb a lot of the CO_2. Okay and you can see it in here, what's happening in the oceans.

Well the oceans absorb CO_2 and they dissolve it.

Okay. Dissolved, which is kind of, means it slowly broken down.

And you can see the chemical reaction what's happening when that happens. It forms an acid.

[1:20:00]

And that acid, CACO3 we talked about, it dissolves limestone.

Okay and we talked a little bit about limestone which is a sedimentary rock. Okay?

It dissolves a limestone which helps absorb carbon dioxide and it regulates what is in the atmosphere, the carbon dioxide in the atmosphere.

Okay, last reading.

(Student Speaking)

Okay, very good.

Well this last part just saying some scientists, scientists are very funny people.

Scientists are always arguing and I think that's just part of life, right?

I'm married for 7 years and I argue everyday. Argument is part of life.

Scientists, same. Many scientists disagree but there's always some scientists that say "no..".

"I don't think so", "This is what I think" and that's what makes life beautiful and we can always have our opinion.

But you can see here, some scientists very concerned about global warming and these problems will the carbon in the atmosphere, okay.

Scientists think that even though we have all this carbon that is being absorbed in the ocean and regulating, making this balance good.

They're saying that the oceans cannot keep up with what we're doing, how we're burning fossil fuels and doing deforestation, okay.

Um, so other scientists say "Well, I don't think that so much a problem as long as we do some things" and what do they say? What should we do?

Plant trees, restore habitats. Good. And burn less fossil fuels.

If we do these things, of course we know that will help, right?

And you know in Korea, Mr.이명박 is all in favor of what he says , being green. Right?

Okay and planting more trees [?1:23:00] made a plan to plant so many more trees, many many trees in a next five, ten years or whatever.

[1:23:00]

So, my planning more trees and having more photosynthesis happening we can produce more oxygen which is needed, right.

But I think the number 1 thing is controlling our emissions and that would be like automobiles, factories, okay?

For burning fossil fuels, what we can do instead of burning coal, driving cars. What's the alternative?

Electronic? What do you mean? Ah, electronic cars. Okay.

Electronic cars is a good idea.

But still, when you follow that path, you will see that you're still using fossil fuels at some point.

What's another energy source we can use?

Recycling. Korea's very good at recycling.

Recycling though, if you think about it, alright. We take some plastic, and we recycle it we take some plastic garbage and recycle, make some park bench.

Okay but still it's not natural, it's not in the natural cycle. It's not the carbon cycle, right?

Cause the plastic is never really broken down into the basic elements and circulated back but it's still one but it's not really solving any problems.

So what we can do? What energy source can we use?

Sunlight. Solar energy.

Hopefully in the future. Solar energy, in Japan they're doing a lot of work, right?

With solar energy. Well all over the world, Korea too.

Okay so, solar energy is one option. Wind energy, another option. Hydro energy, right.

We talked about hydro energy because these are natural sources, right?

Fossil fuels are not so natural.

Another thing, you said recycling, recycling is very good.

And I have to say Korea much better than what I see in the United States, United States big country but a little slow on the recycling part.

My mother and father, horrible.

I go home and throw them to the garbage, well that's plastic.

I have to save some tape.

So anyway, Korea is I think doing a good job with recycling.

But what we need to start thinking about is making things that are 'bio-degradable' or 'bio-based' meaning things that when we put them into a landfill, throw them away, they are broken down by decomposers.

[1:26:20]

And when they are broken down naturally this CO_2 goes back into the environment and it gets into the natural cycle.

Okay? And then that all fits in.

But if we're not making bio-based things or things that are biodegradable, what's going to happen.

It'll just going to build up. We're going to have a world full of garbage, right?

So, we have to start thinking, let's get natural, organic things that break down and can go back into the cycle natural cycle or carbon cycle.

Okay? Finished.