



UNEP

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Educational, Scientific and  
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UNESCO Associated Schools



WHO



Multilateral Fund  
for the Implementation of the Montreal Protocol

HIGH SKY:

# OZONATION EDUCATION PACK FOR SECONDARY SCHOOLS

## STUDENT'S BOOK





# ACKNOWLEDGEMENTS

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**Head of OzonAction Programme:** Rajendra M. Shende

**Information Manager:** James Curlin

**Project Manager:** Anne-Maria Fenner

**Author:** Saija Heinonen

**Peer Reviewer:** Wayne Talbot

**Project Assistant:** Mugure Kibe Ursulet

**English Editor:** Janet Sackman

**Illustrator:** Glasshouse

**Review Panel:** Lynn Abbey, Luton LYTE; Vinitaa Apte, Bank of Maharashtra; Gustavo Arnizaut, HEAT International; Atul Bagai, UNEP; Luis Betanzos de Mauleon, UNEP; Ezra Clark, UNEP; Bernard Combes, UNESCO; James Curlin, UNEP; Julia Anne Dearing, UNEP; Emilie van Deventer, WHO; Artie Dubrie, UNEP; R. Gopichandran, Centre for Environment Education, India; Donna Goodman, UNICEF; Eva Hamilton, UNESCO; Cecilia Iglesias, ACRA, Argentina; Tim Kendall, John Hampden Grammar School; Tariq Khan, Luton LYTE; Ryan Kirchner, Ruamrudee International School, Thailand; Halvart Koeppen, UNEP; Ana Rosa Moreno, National University of Mexico; Sigrid Niedermayer, UNESCO; Akpezi Ogbuigwe, UNEP; Fabienne Pierre, UNEP; Livia Saldari, UNESCO; Craig Sinclair, Cancer Council Victoria, Australia; Janet Snow, Endangered Wildlife Trust; Morgan Strecker, UNEP; Bridget Vickers, Putteridge High School; Beatrice Vincent, UNEP.



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# CONTENTS



Instructions	p. 1
Scene 1: The ozone layer – the truth!	p. 3
Scene 2: Ozone – good or bad?	p. 6
Scene 3: Ozone depleting substances	p. 8
Scene 4: Protecting yourself and the ozone layer	p. 12
Scene 5: Ultraviolet radiation and health effects	p. 17
Scene 6: Climate change and ozone layer depletion	p. 22
Scene 7: Time is up!	p. 28
Glossary	p. 29





# INSTRUCTIONS

This Student's Book is an integral part of the OzonAction Education Pack for Secondary Schools. It concentrates on the same issues as the Teacher's Book: ozone layer depletion, protection and the health risks of strong ultraviolet radiation.

Before you start this Student's Book, you will need a pen and paper and to know the following:

1. At the end of each section there is a notebook with key questions. You are expected to answer these questions on a separate piece of paper.

2. After completing each set of questions, you will need to check with your teacher or group leader if your answers are correct. Answers are found from clues in the text and from the investigations you already have in your project file. You need to check with your teacher that you have found the correct answers before proceeding to the next section.

3. If you are unsure of a word or term, please check the glossary at the back of the book; there might be clues to help you answer a question if you read through the glossary.

4. You can work in teams or groups to help answer the questions in the time allowed. They will help you to write an article when you have finished. The article can be part of your introduction to the final report your group will be producing as part of this project. You can also act out the script and send pictures or film of your play to [ozzy@unep.fr](mailto:ozzy@unep.fr)



This Education Pack was developed by UNEP OzonAction Programme under the Multilateral Fund for the Implementation of the Montreal Protocol. It is a part of 2008 UNEP's Business Plan.





# SCENE 1: THE OZONE LAYER - THE TRUTH!

You are the new investigative journalist at the Global Times newspaper. After two internships at other papers and a completed course in journalism, you feel confident, but still have to prove yourself.

Remember that this is your trial period for you to get a job in a big newspaper. Your first assignment is to uncover the truth about ozone layer depletion, climate change and their health risks. As your paper's rival has written a circulation-busting article about skin cancer, you have a deadline to prove you have what it takes to make it as a journalist. Your job is to collect the facts as you uncover them. Get it right and you get the job.

Now, let's begin!

Your boss's assistant approaches...

**ASSISTANT:**

You can go in now.

**You:**

Thank you. (Walking into the office) Hello, sir.

The boss looks at you.

**Boss:**

Hello! I have some work for you. This was published yesterday at the Local Times. Look!

**You (READING OUT LOUD):**

Skin cancer cases will double!

**Boss:**

Is it true? Climate change, ozone layer depletion, cancer – just find the truth! Do you think we are all going to die?

**You:**

Well, eventually, yes, sir.

**Boss:**

Keep the smart comments for people who care - that's not necessary with me. Just talk about the article. Can it be true or are they just trying to shock as usual? We need something similar and you specialise in environmental issues. If you don't – then you're a specialist now! Read this article, find out if there is anything good in it, and write a complete article about ozone layer depletion, climate change and health things, whatever is needed for it.

**You:**

Yes, sir, I will. How much time do I have?

**Boss:**

It's 9am now. Have it on my desk in 48 hours.

**You:**

I understand sir.

**Boss:**

Very well. You'd better get to work now; we'll discuss this more tomorrow. Take this newspaper and read the article.





## 48 HOURS LEFT

You go to your table and read the article. Your colleague at the next desk turns to talk to you.



ADEL:

You must be the new one. Hi, I'm Adel. Nice to meet you.

YOU:

Nice to meet you, too.

ADEL:

So, you met the boss already?

YOU:

Oh yes, I did. A tough start. He wants me to write this article on the environment.

ADEL:

He can be really challenging. I know. What are you going to write about?

YOU:

Ozone layer depletion, climate change and health. Could you tell if they are part of the same problem or are they separated?

ADEL:

Climate change and ozone layer depletion? I couldn't tell, I think that one also causes the other. But I really don't know.

YOU:

Hmmm... seems like it's not that clear. I think I'll start with a small survey in the street to see what people really know about these issues.

I can use the answers in my article. I'd better go now,  
I don't have much time.

ADEL:

Good luck!

A few minutes later you are in the street to carry out your plan to stop people with a pen and a notebook to find out what they already know. You ask the following questions. Look at the page and get someone sitting near you to answer the questions. Remember your previous project work – it might give answers.



# YOUR NOTEBOOK - PART 1

*What is the function of the ozone layer?*

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*What is ozone ?*

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*Is there a difference between ozone in the upper and lower atmospheres?  
If so, explain what it is.*

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# SCENE 2: OZONE - GOOD OR BAD?



## 46 HOURS LEFT

You are back in the office now.

ADEL:

I'm leaving now. Are you going to stay for much longer?

YOU:

We'll see. I need to finish the background reading.

ADEL:

Ok. See you tomorrow then!

Studying books about ozone provides a lot of information. You want to confirm this information with someone and decide to call a friend who is a meteorologist. She might know.

YOU:

Hi Jasmine, how are you?

JASMINE:

Hi, I'm good, and you? Are you working hard?

YOU:

Yes, and very little time to get my first article completed.  
I need some help – mind if I ask you a few questions?

JASMINE:

Fire away.





# YOUR NOTEBOOK - PART 2

*All ozone is useful. There is no difference between ozone in the upper and lower atmospheres. Truth or myth?*

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*Where does the tropospheric ozone come from and what does it do?*

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*What are its risks?*

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*How is the ozone layer created?*

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*The atmosphere is divided into layers – what are they?*

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*Which are the most important for ozone?*

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# SCENE 3: OZONE DEPLETING SUBSTANCES



## 36 HOURS LEFT

You start writing the text as you now have the basic facts. Suddenly the phone rings: it's your little brother.

DAVID:

Hi, it's me! How are you?

YOU:

Hi, I'm still at work. It's been a busy day.

DAVID:

Wow, it's already 9pm - you work late! What are you working on?

YOU:

The ozone issue.

DAVID:

Really? I studied the ozone issue in my primary school a few years ago. We met Ozzy Ozone. He's still there on the Internet, he might be of help.

YOU:

Who, Ozzy Ozone? Never heard of him.

DAVID:

Check him out on [www.ozzyozone.org](http://www.ozzyozone.org)

YOU:

You remember that by heart?

DAVID:

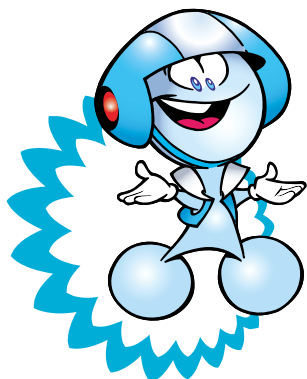
No, it's bookmarked on my computer!

YOU:

Ok, I'll go and have a look. Sorry but I have to get back to work. I'd like to go home soon.

DAVID:

That's fine. Good luck! See you at the weekend.



You open the website your brother gave you. There you find a lot of material: cartoon books, the education pack he talked about, a game and a video. You take a good position in your comfortable chair to watch the video. "Funny chap, this Ozzy Ozone", you think aloud. When the video ends, you fall asleep - the office is dark and quiet as you're the only one there. You find yourself falling to sleep and the little blue molecule continues his story in your dream. You travel through time and space, with Ozzy Ozone guiding you.

You find yourself inside a huge factory building, watching from the ceiling. You notice that people are dressed in a very old-fashioned way.

Ozzy:

Now we are in the 1930s. That's when everything started. This is a refrigerator factory. Ozone depleting substances like these chlorofluorocarbons or CFCs, more popularly known as Freon, were created as safe, non-toxic and non-flammable refrigerants. They were considered as miracle substances because of these qualities, but they were also very stable and inexpensive to produce. The CFCs have had many uses in refrigerators, air conditioners, sprays, solvents, foams and in other smaller applications.

You:

So, for most of the 20th century, we had ozone depleting substances in our homes?

Ozzy:

Exactly! And many homes still have them now in the 21st century.

You:

Is this one of those factories where they started to use CFCs in refrigerators?

Ozzy:

That's right.

You:

In the video you mentioned other ozone depleting substances as well.

Ozzy:

Yes I did. Let's go and see.

In a flash you are in a farm. You float to the barn which is full of hay.

Ozzy:

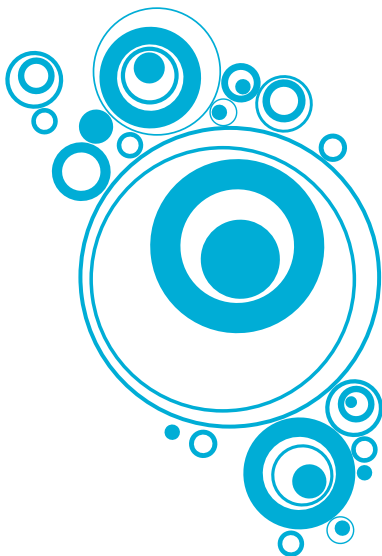
You see that fire extinguisher? It's quite old and it contains halon, which is dangerous to the ozone layer. The farmer uses methyl bromide as a pesticide. It contains bromine atoms, like CFCs contain chlorine atoms, and they both have long atmospheric lifetimes.

You:

Long atmospheric lifetimes - what does that mean?

Ozzy:

It means that they survive long enough in the atmosphere to migrate intact into the stratosphere. In the stratosphere CFC molecules are no longer stable. They break up, releasing chlorine atoms that react easily with the ozone molecules. They form oxygen and chlorine monoxide. Chlorine monoxide can then release its chlorine atom which will be free to attack another ozone molecule, breaking that one apart. One chlorine atom can repeat this almost endlessly; the atom can spend nearly a hundred years breaking ozone molecules. It can destroy over 100,000 ozone molecules during that period. The problem is that it destroys ozone faster than it is naturally created again.





You:

Nearly a hundred years?! Does it mean that if we stop using all ozone depleting substances today, in 60 and even 80 years, there would still be chlorine atoms in the stratosphere destroying the ozone layer?

Ozzy:  
Exactly!

You:

Now that's a long time.

Ozzy:

Yes it is. So please help me and my friends by telling people that the use of ozone depleting substances or ODS should be stopped immediately. If you protect us, we will then protect you!

Ozzy flies away and waves to you. Back in the office...

You (WAKING UP):

I will do my best Ozzy! Ozzy? Huh? Where am I?

You look around and notice that the sun is already rising outside. It is past 6am, and your first colleagues will arrive at the office in an hour. You've slept the whole night there! Then you realise that you got a lot of useful information in your dream and you have to write it down quickly before you forget.





# YOUR NOTEBOOK - PART 3

*Which are the most common ozone depleting substances?*

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*What are they used for?*

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*Why were they created?*

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*How are they released into the atmosphere?*

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*What could be done to avoid using ozone depleting substances?*

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# SCENE 4: PROTECTING YOURSELF AND THE OZONE LAYER



## 25 HOURS LEFT

You go out to buy some breakfast and come back to the office.  
Adel arrives soon after you.

ADEL:

Good morning! You're in early. But why are you eating your breakfast here?

YOU:

Don't tell anyone, but I was here the whole night.  
I fell asleep in front of my computer!

ADEL:

Really? Sounds a bit keen to me!!!

YOU:

I know. I didn't plan to stay here. And I dreamt about Ozzy Ozone.  
He told me about ozone depleting substances.

ADEL:

Sounds weird - ozone depleting substances. I thought that  
ozone layer depletion was history.

YOU:

I doubt that, but I have to verify it. I will also have to check if the things  
I heard in my dream are true. Okay, back to business now.

ADEL:

Let's have a cup of coffee together if you have a minute today.

YOU:

Great! I will let you know.

You decide to call the Environmental Investigation Agency first because  
they have apparently something to do with ODS. You have an interesting  
discussion and get all the information you need.

YOU:

Adel - I called the EIA, they confirmed the information I had.

ADEL:

I'm pretty sure that you are the only person I know who gets the facts  
you need in a dream.

YOU:

It was a surprise for me too. But I think I'll sleep here every night  
if my work is done faster that way! Now I will have to find out  
if ozone layer depletion is history or not.

You make another call.

You:

Hello? Is this the OzonAction Branch in UNEP? I'm a journalist, and I need to know everything about ozone layer depletion.



Anne:

Yes this is the OzonAction Branch. Everything? Should I start from the beginning?

You:

Yes please if that is okay with you.

Anne:

Of course! It all started in 1974 when the scientists Molina and Rowland published a study demonstrating the ability of CFCs to break down ozone in the stratosphere in the presence of high frequency UV light. Some nations agreed to ban CFCs in aerosols as a result, but a bigger shock was needed to motivate the whole world to get serious. That shock came in 1985, when ozone levels had dropped to 10% below normal January levels in Antarctica. The evidence of the ozone hole was seen as far back as 1976.

You:

So these two scientists, Molina and Rowland, were the first to understand that CFCs are dangerous to the ozone layer?

Anne:

Basically yes, they even won a Nobel Prize in Chemistry in 1995 for their work in atmospheric chemistry, particularly concerning the formation and decomposition of ozone.

You:

What's the situation today? Is the ozone depletion problem history already, as many people seem to think?

Anne:

Not at all, the situation has only gotten worse. The ozone layer is thinning severely over many regions and countries where people live: parts of South America, Australia, New Zealand and South Africa are particularly affected. Over North America, Europe and Asia the ozone layer is also getting thinner.

You:

Is there the famous ozone hole somewhere?

Anne:

The hole is actually a dramatic thinning of the ozone layer. The biggest ozone 'hole' is over Antarctica. At its largest it is even bigger than the whole continent and Antarctica is not small: it is larger than the size of Europe and just a little bit smaller than South America. Actually, the situation was very bad not long ago; in 2006, not only was the hole the largest in surface area, but also there was less ozone over the Antarctic than ever previously measured. In September 2006 the area of the hole reached almost 30 million square kilometres or 11,500 million square miles.



You:

That sounds serious. How big is it exactly?

Anne:

It's about the size of the whole African continent.

You:

That is huge! Well, I think that I have enough material for this issue now, thank you very much for your time!

Anne:

You're welcome. I'm glad that I could help.

You (to Adel):

Did you hear my comments? You guessed wrong. Ozone layer depletion is not history at all - the situation is actually worse than ever! The ozone 'hole' was even as big as the whole African continent in 2006.

Adel:

Really? Was it over Africa then?

You:

No, no, it was over Antarctica. But the ozone layer is thinning everywhere so it's not only over Antarctica where the problem occurs. I will write this information down, but then I have to search for facts about the Montreal Protocol. After that I might have a minute for a coffee with you!

Adel:

Sure!

After half an hour's research on the Montreal Protocol, you're ready to go for a coffee with Adel.

Adel:

What was that protocol you talked about? Did you find the information you searched for?

You:

I did. You will see that ozone layer depletion is not history yet, unfortunately. But the situation is quite well under control.

Adel:

Is it? Well that's great news! How does it work?

You:

It's very simple: the Montreal Protocol was opened for signature in 1987 when it called for all countries to phase-out the consumption and production use of CFCs, halon, methyl bromide and other man-made ODS. The Protocol has set a time limit for this phase out (like my deadline for submitting this article to our boss!). For the developed countries most of the deadlines for total phasing out were met in the 1990s except for one group of chemicals known as HCFCs.



ADEL:

And the developing countries?

You:

They were given more time to aid the transfer of new technologies, so the deadlines for their phase-out are between 2010 and 2030.

ADEL:

What does it mean? That all the dangerous chemicals, these ODS, have to be phased out by - which year?

You:

By 2030. After that no ODS should be produced or consumed.

ADEL:

So most of the chemicals have been phased out already and all the rest will follow soon? But did all the countries in the world sign up to that Protocol?

You:

Yes, most of them did. In January 2008 more than 190 countries had ratified the Montreal Protocol. Together they have phased out more than 95% of the world's ozone depleting substances! That makes it the most successful environmental agreement ever!

ADEL:

That's brilliant. But how is it possible that almost 100% of the ODS has disappeared, but the ozone hole is still huge?

You:

Because the ODS molecules are very stable, they continue doing the damage in the stratosphere for years and years after they have been released. Also some new ODS escape in the atmosphere when recycling is badly done or not done at all. But with the Montreal Protocol the situation is getting better.

ADEL:

Well, cheers to the Montreal Protocol!

You:

Cheers!

You toast with your coffee cups.

You:

So all I have to do next is to update my notes.

You go back to the office.

You:

I'll take a tour around the city to see what people here do to protect the ozone layer. I'm going to interview some vegetable sellers about methyl bromide and the refrigerator sales people and will also find out if recycling is correctly organised. And then I will have a quick early lunch. So I'll be back later to find out if "we all are going to die of skin cancer", like the paper said. See you!

ADEL:

Sounds good. See you later!





# YOUR NOTEBOOK - PART 4

*The ozone depletion problem has already been solved thanks to the Montreal Protocol. There is no ozone hole anymore or at least it's already going much better today than before and everything possible has been done. Truth or myth?*

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*Has everything possible been done in my country? Are some ODS still in use?*

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*Is the ozone layer thinning – if it is, why?*

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*Where is the depletion worse?*

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*What is the ozone hole?*

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*What affects the thickness of the ozone layer?*

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*What difference is the Montreal Protocol making?*

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# SCENE 5: ULTRAVIOLET RADIATION AND HEALTH EFFECTS



## 19 HOURS LEFT

You are back at work and ready to investigate further.

You start by searching for facts about UV rays: it is more practical to know first what they are before you search for the effects they have. You search with the key words “ultraviolet rays” on the Internet and find a lot of websites with information. The problem is to find the reliable sites. You make notes, but want to confirm the information, so you call the World Meteorological Organization.

**You:**

Hello. I'm a journalist writing an article about the ozone layer. I would like to talk about UV radiation with you. First of all, can you confirm that UV radiation has a shorter wavelength than visible light and that we can neither see nor feel the UV rays?

**ALEXIS:**

That is correct.

**You:**

Are there also different categories of UV radiation?

**ALEXIS:**

Yes there are. UV-A rays are the most common because they are not all filtered by the ozone layer. UV-B rays are partly filtered by the ozone layer. UV-C rays are extremely strong but they're filtered by the ozone layer and oxygen and they don't reach us.

**You:**

So, by harming the ozone layer, we also let more UV-B rays pass to the Earth's surface?

**ALEXIS:**

Exactly. It's been shown that for every 1% decrease in stratospheric ozone, the UV radiation reaching us will increase by 2%.

**You:**

And how do you know if there is a lot of radiation if you can't feel or see it?

**ALEXIS:**

There is a tool to measure the level of UV radiation at the Earth's surface. It's called UV Index and it has been developed by the World Health Organisation in collaboration with the United Nations Environment Programme and the World Meteorological Organization (that's us!). It uses a range of values from zero upwards: the higher the value, the greater the amount of dangerous UV rays. Sometimes you can see the UV Index with the weather forecast. Having this information can help the population know how to prepare for the day; depending on the UV Index, you may need to take extra precautions when outdoors.



You:

And what do these dangerous UV rays do then?

ALEXIS:

You should discuss that with my colleague Emilie from the World Health Organization.

You:

Ok, I will call her. Thank you very much for your time.

ALEXIS:

You're welcome, have a nice day.



YOU (MAKING ANOTHER CALL):

Hello. I'm a journalist.

I got your contact details from your colleague Alexis in the World Meteorological Organization. He said that you could help me with the health effects of the UV radiation.

EMILIE:

I hope so. What would you like to know?

You:

Are these ultraviolet rays really so dangerous?

EMILIE:

Yes, they are dangerous to human beings, animals and plants, in fact to almost all living beings on the planet.

You:

In what way?

EMILIE:

When we are exposed to the sunlight, the rays can penetrate our skin and eyes: they affect the DNA that replaces and repairs our skin. When the damage accumulates, through frequent tanning and sunburn for example, the cells can start to mutate into cancer cells. That can lead to skin cancers or eye cataracts. The UV rays can also weaken our bodies' immune system and cause premature ageing of the skin. But most of the serious health problems only appear many years later.

You:

So sunburn is a sign that we got an overdose of UV rays?

EMILIE:

It is a sign, but also a tan is a sign of an overdose. There is no such a thing as a healthy tan.

You:

There is nothing good in UV radiation then?

EMILIE:

Yes there is! We need sunlight and especially the UV-B rays so that our bodies can produce vitamin D. But only 10 or 15 minutes per day is necessary to produce our vitamin requirement and we don't need to expose the whole body; the radiation on our hands and face is enough for the skin to create the vitamin D we need.



You:

How can it be dangerous to other living beings? Plants can't get skin cancer!

EMILIE:

No, they can't get skin cancer but they suffer from the high radiation as it slows down germination and growth and could affect crop yields. Strong radiation also kills plankton in the water. Plankton plays a crucial part in the marine food chain since it is the main food supply for aquatic animals and fish. Some animals can develop skin cancer or eye cataracts.

You:

And the animals are not aware of the danger so they can't even protect themselves! But don't the clouds filter out the UV rays? Should people only be careful when the sky is clear?

EMILIE:

No, that's a myth. A light cloud might filter only 10% of the UV radiation but it blocks the visible sunlight better. Only thick, dark clouds block the UV rays somewhat efficiently.

You:

That I wouldn't have guessed. But are there some groups of people that are more at risk than others?

EMILIE:

Yes, children are especially vulnerable to harmful UV rays because their skin is thinner. In addition, the harmful effects of the sun are cumulative over a lifetime, which means that sun exposure during childhood increases the risk of skin diseases later in life.

You:

So, in summer around midday, parents shouldn't let their children go out?

EMILIE:

Yes but that's not necessarily the only solution. And not only children need protection - everyone does. First of all, if you don't need to be in the sun between the burning hours from 10am to 4pm, avoid it. Secondly, if you have to be outside during those hours, search for the shade. Under a tree there might be up to 60% less radiation than in a sunny place.

You:

So a tree blocks the sunlight more efficiently than the clouds?

EMILIE:

That's right. But you should also cover your eyes and skin to avoid the risk of cataracts and skin diseases. Wear long sleeves, trousers, a hat and sunglasses. Those parts that are uncovered, like your face and hands, should be protected by sunscreen. Also if you are on the beach or want to go swimming outside, you should add sunscreen often; once in the morning is not enough for the whole day.

You:

Thank you, that's very useful to know.  
I have just one more question: could you confirm that the number of skin cancer cases is expected to double?

EMILIE:

Unfortunately that is true. There was a report published in 2007 by the United Nations Environment Programme. It said that between 2000 and 2015 the number of all types of skin cancers is expected to double.

But there is this word "expected", because it doesn't need to be so. It should not be taken as an inevitable, but rather as a warning of what would happen if we do not change our daily habits... but we can change! It's up to us! If we only remember to protect ourselves when the sunlight is strong, we can reduce the risks significantly!

You:

Ok, that is easy to remember! Thank you so much for all this information!

EMILIE:

It was my pleasure. I'm happy if I can pass this important message. We need all the help we can get so you, as a journalist, have an important role to play. Don't forget that!

You (HANGING UP THE PHONE, TO YOUR COLLEAGUE):

Wow, the other article was right! Or at least partly.



ADEL:

Huh?

You:

The number of new skin cancer cases might double during a 15-year period, which is a really short time.

ADEL:

Really? Double? That's a lot.

You:

Also a word of warning for you: now when the summer season starts, watch out for the sun! It's not only a nice warming star, but it sends us dangerous UV rays which can harm us badly. Check the UV Index in the weather forecast. We need to start protecting ourselves!

ADEL:

Okay, I will watch out. Thanks for the warning.

You:

But the article didn't say anything correct about climate change. I need to make sure I have the facts right.



# YOUR NOTEBOOK - PART 5

*A dark or well tanned skin is not at danger; a person with such a skin colour can therefore safely enjoy the sun without any limitations. Truth or myth?*

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*Does a naturally dark skin protect the person against all the negative impacts of UV rays? Why / why not?*

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*Does a tan protect the person against all the negative impacts of UV rays? Why / why not?*

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*What happens to the skin when it's exposed to strong sunlight?*

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*What are the effects of different types of UV rays?*

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*What are the places and times when radiation is the strongest?*

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*How can people protect themselves from UV rays?*

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# SCENE 6: CLIMATE CHANGE AND OZONE LAYER DEPLETION



## 18 HOURS LEFT

You decide to call your contact in UNEP again.

You:

Hello Anne, it's me again.  
We talked on the phone about the ozone layer this morning.

Anne:

Oh hello, I remember you. Is there something else you wish to know about it?

You:

Yes but not about the ozone layer itself; I would like to know if climate change and ozone layer depletion are somehow linked.

Anne:

Yes they are. Many of the ozone depleting substances are also greenhouse gases, for example CFCs and their replacement HCFCs.

You:

Does it mean that the Montreal Protocol has helped fight global warming as well?

Anne:

Yes it does and it has helped quite significantly actually. But there is also negative news: global warming might slow down the ozone layer's recovery. Despite the temperature rise in the troposphere, the air might even cool down in the stratosphere which is favourable to the depletion of the ozone layer.

You:

But the scientists are not exactly sure?

Anne:

No, this is one of the possible scenarios. We must hope that it never happens.

You:

But what an individual can do to stop the negative changes?  
There must be something everyone can do!

Anne:

Oh yes, there are a lot of things! We have everything on our website, if you have Internet access you can read them there.

You:

Thank you, I will. I'll make sure to include some of those actions in my article. I'm beginning to realize how important it is to share this message.

Anne:

Of course, use all of them if you wish. That is why they are there: so that everyone knows what actions to take.

You:

Great! Thank you so much for all your help! Have a nice day!

(HANGING UP)

ADEL:

Did you find out?

You:

Yes I did! They are linked, though they are two different phenomena. I'm just going online to see what actions everyone can take to slow down climate change and ozone layer depletion, if you want to see too.



ADEL:

Yes why not. Hmmmm... *(READING ON THE SCREEN)*  
**With a well-insulated house and by turning the heater and the air-conditioner lower, you save energy and money.**

That's logical.

YOU (READING):

**Choose renewable energies at home.**

ADEL:

Does it mean like wind power, solar power and so on?

You:

I guess so, they are renewable.

**Turn off the air-conditioning when you are not in the room. It saves energy! When you buy a new refrigerator or an air-conditioner, make sure that it doesn't contain CFCs!**

That I knew already.

**And they should be recycled correctly as well.**

ADEL:

**Recycle at home and create compost from your own vegetable waste if possible. It saves natural resources.**

You:

**Avoid heavily packaged products and plastic bags.**

Ah, I do this every time I go to the shops - I take my own bag with me. I find it more comfortable as well because my bag is stronger.

ADEL:

**Buy local and seasonal produce wherever possible. Buying produce out of season means either growing them in greenhouses or importing them, sometimes by air.**

That is true! I have never thought about that before.

You:

**Reconsider your use of the car. Cars are the single biggest source of excess CO<sub>2</sub> and produce other greenhouse gases.**

ADEL:

**Take showers rather than baths and don't use more hot water than you need.**

You:

**Use rechargeable batteries; discarded batteries are highly polluting because they contain heavy metals.**



ADEL:

**Plant a tree in your garden, school yard or community.  
The tree absorbs carbon dioxide when it is growing  
which slows down climate change.**

So that's why cutting down the forests is so bad!

You:

Exactly. Wow, there are many things I can do in my own life, that's a good start. And on an international scale there is the Kyoto Protocol, which is like the Montreal Protocol but adopted to tackle the problem of global warming.

ADEL:

All those ideas look pretty easy. I could do at least half of them starting from now without any problem.

You:

Me too. Well, I will have to write down some facts now that I understand the links between ozone layer depletion and climate change. By the way, the other article was wrong about it! The skin cancer statistic was correct, but they completely mixed the two issues. It's not climate change that causes skin cancer!

ADEL:

Really? That is not good journalism. Oh-oh!  
I hope he's not coming over here...

You see your boss wandering around and searching for someone. When he sees you, he walks towards you in long, determined steps and almost shouts:



Boss:

Change of deadline! I need the article ready by 5pm!  
Bring it to my office then!

You:

Certainly, sir.

He turns away and leaves without saying anything else.

You:

Wow! That leaves me only two hours!  
Now I could use Ozzy to help me to write this!

ADEL:

Isn't our boss adorable? Well you'd better continue working if you're in a hurry.  
I'll let you work in peace.

You:

Ok, I'll check everything once again and finish this. Maybe just to hear that I'm fired! But hey... at least I know about these issues that affect us all. This assignment turned out to be really important... hopefully I can keep my job and publish this article. People need to know!!



# YOUR NOTEBOOK - PART 6

*Ozone layer depletion and climate change are the same thing; releasing carbon dioxide (CO<sub>2</sub>) into the atmosphere causes ozone layer depletion and climate change.*

*Truth or myth?*

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*Is it normal to have greenhouse gases in the atmosphere? Why / why not?*

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*What are the links between these two phenomena?*

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*How does our own behaviour affect both of them, negatively or positively?*

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*How does your school affect both of them, negatively or positively?*

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*How has the Montreal Protocol helped fight global warming?*

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*How could cutting down the forests worsen ozone layer depletion?*

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*Why do you think that the media sometimes give wrong information about environmental issues?*

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# SCENE 7: TIME IS UP!



You have finished your article. You print it and hurry to the boss's office. His assistant tells you that you can go in.

**You:**

Hello, sir. Here is my finished article.

You hand over the article.

**Boss:**

Good. Sit down, I'll read it now.

You watch his face while he reads it. You're worried because you can't tell much about his reaction from his face. Finally he turns the last page. For you it feels like hours though it must have taken only 10 minutes.

**Boss:**

Where did you get all the information from?

**You:**

Some from the Internet, some from books and some directly from people who work on the field in internationally-known organisations. I verified the information from the Internet and books with them.

**Boss (nodding):**

Good. Good. So the Local Times journalist was right with the title but completely lost with his arguments. Well done. You are hired!

**You:**

Thank you sir!

**Boss:**

Come in tomorrow morning at 9. And remember to get the newspaper... I think you'll love the front page!! Kid, you really have something good here. Are you interested in this environmental stuff? I'm thinking... we could have a green column, you know, permanently... I'm guessing people will want to know more. What do you say???

**You:**

Great idea!! Let's do that sir. Have a nice evening!

You leave the office very excited and want to share the good news with someone.

**You:**

Adel! I did it! I have a job now!! I got my own column!!!



# GLOSSARY

<b>Atmosphere</b>	The Earth's atmosphere is the gaseous layer that surrounds the planet Earth. It contains about 4/5 nitrogen and 1/5 oxygen, with a few other gases including ozone. The atmosphere protects life on Earth and it moderates the temperature between day and night.
<b>Atom</b>	An atom is the smallest quantity of an element. Everything around us is made up of atoms. Atoms join together to make molecules, and the molecules join together to make compounds in specific ways to make everything we can see (materials, objects, living beings).
<b>Carbon dioxide (CO<sub>2</sub>)</b>	Carbon dioxide is a colourless gas that contains one carbon atom and two oxygen atoms bound together (therefore it is written CO <sub>2</sub> ). It is present in the atmosphere and plants take it from the air for their own growth. We also release carbon dioxide while breathing out.
<b>Cataract</b>	A cataract is a disease of the eye and, according to the World Health Organization, is the leading cause of blindness in the World. Between 12 and 15 million people become blind from eye cataracts. A cataract causes a partial or total opacity of the lens of the eye. The lens is the transparent part of the eye that regulates the amount of light we need to see clearly. Exposure to UV radiation increases the risk of eye cataracts.
<b>Chlorofluorocarbons (CFC)</b>	Chlorofluorocarbons are chemicals that contain carbon, chlorine and fluorine. The abbreviation for chlorofluorocarbons is CFCs. CFCs are used inside freezers, refrigerators, spray cans and air conditioners. When released into the atmosphere, these chemicals cause ozone layer depletion.
<b>Climate change / global warming</b>	The climate of the Earth is not static, and has changed many times in response to a variety of natural causes. Scientists believe that human activity is the primary driver of recently observed changes in global climate patterns.
<b>Climatologist</b>	A person who studies long-term trends in the climate.
<b>Chlorine monoxide (ClO)</b>	Chlorine monoxide contains one chlorine atom and one oxygen atom.
<b>Compost</b>	Decomposed organic material or new soil, that can be used for plants.

Dobson Unit (DU)	A measure used in ozone research. 1 Dobson Unit (DU) is defined to be 0.01 mm thickness of ozone at 0 degrees centigrade and 1 atmosphere pressure at the surface of the Earth. So if 100 DU of ozone were brought to the Earth's surface, it would form a layer 1 mm thick. The unit is named after G.M.B. Dobson, one of the first scientists to investigate atmospheric ozone.
Energy saving light bulb or compact fluorescent lamp (CFL)	A type of fluorescent lamp. Compared to incandescent lamps, CFLs use less energy and have a longer rated life. The purchase price is higher than that of an incandescent lamp, but the money is gained back in energy savings and replacement costs over the bulb's lifetime. CFLs contain a toxic product called mercury, which means that the lamp has to be recycled after its use.
Environmental Investigation Agency (EIA)	An international campaigning organisation committed to investigating and exposing environmental crime. See <a href="http://www.eia-international.org/">www.eia-international.org/</a>
Foam blowing agents	Chemicals (typically ODS), which are used as propellants with liquid plastic resin in the manufacture of foams. These foams are used in a variety of applications including insulation in refrigerators, buildings, automobiles, in furniture and packaging etc. In the case of insulation materials the blowing agent also functions as an insulating component of the foam.
Global warming	The observed increase in the average temperature of the Earth's near-surface air and oceans.
Greenhouse effect	The greenhouse effect is a natural phenomenon. The Earth's atmosphere acts a little like the glass of a greenhouse, allowing the heat of the Sun to enter and heat surfaces on the planet. These surfaces emit long wave radiation that is trapped near the surface of the planet by greenhouse gases. The greater their quantity, the more the atmosphere and surface heat up.
Greenhouse gases (GHGs)	Gases that warm the Earth by trapping heat in the atmosphere, which leads to global warming. Some greenhouse gases can occur naturally in the atmosphere, while others result from human activities. Greenhouse gases include carbon dioxide, methane, CFCs and others.
Halons	Halons are chemicals that contain bromide, fluorine and carbon. Halons are used for fire extinguishers. As CFCs, halons are responsible for the depletion of the ozone layer. When released into the atmosphere, they become dangerous to ozone molecules.



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Hydrochlorofluorocarbon  
(HCFC)

A molecule containing hydrogen, chlorine, fluorine and carbon atoms. HCFCs are used to replace CFCs because they are not as dangerous to the ozone layer. HCFC is a greenhouse gas.

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Infrared Radiation

Infrared radiation (IR) or infrared, refers to energy in the region of the electromagnetic radiation spectrum at wavelengths longer than those of visible light, but shorter than those of radio waves. Far infrared waves are thermal: the heat we feel from sunlight, a fire, a radiator or a warm road is infrared. Near infrared waves are not thermal: these shorter wavelengths are used, for example, by remote controls for electrical equipment.

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Intergovernmental Panel  
on Climate Change  
(IPCC)

A scientific intergovernmental body set up by WMO and UNEP to provide the decision-makers and others interested in climate change with an objective source of information about climate change.

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Kyoto Protocol

The international United Nations (UN) treaty that is helping to fight against global warming and climate change. The Kyoto Protocol, among other things, sets binding targets for the reduction of greenhouse-gas emissions by industrialized countries.

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Melanin

Melanin is a black, dark-brown or reddish pigment present in the hair, skin and eyes. When exposed to the sun, our skin naturally produces melanin to protect itself from UV radiation. Everybody's skin contains melanin, but not the same amount: dark skin contains more melanin than light skin. However, melanin does not protect efficiently against UV rays and everybody, regardless of skin types, needs additional protection.

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Methyl bromide (CH<sub>3</sub>Br)

Methyl bromide is a gas and a widely used chemical pesticide in agricultural production. It is mainly used to kill parasites and insects. This gas is destroying the ozone layer 50 times faster than CFCs and is also very toxic to humans and animals.

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Molecule

Invisible to the eyes, molecules are the simplest units of any substance that can exist. A molecule consists of two or more atoms bound together. Everything is made of molecules.

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### Montreal Protocol

The Montreal Protocol on Substances That Deplete the Ozone Layer is an international treaty designed to protect the ozone layer. The Protocol has been ratified by 191 countries. In so doing, these countries that have agreed to eliminate their production and use of ozone depleting substances according to the timetable set out in the Protocol. If all countries continue to meet their obligations under the Montreal Protocol, the ozone layer will recover to pre-1980 levels by around the middle of the 21<sup>st</sup> century.

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### Nitrogen dioxide (NO<sub>2</sub>)

Nitrogen dioxide contains a nitrogen atom and two oxygen atoms. It is a reddish-brown gas (in room temperature it is liquid) with a biting and irritating odour. NO<sub>2</sub> is one of the most prominent air pollutants and toxic by inhalation. NO<sub>2</sub> also plays a major role in atmospheric reactions that produce ground-level ozone, a major component of smog.

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### Nitrogen oxides (NO<sub>x</sub>)

Nitrogen oxides refers to any binary compound of oxygen and nitrogen, or to a mixture of such compounds. All combustion in air produces NO<sub>x</sub>. Natural sources of NO<sub>x</sub> are small compared to emissions caused by human activity. In the cities with a lot of motor vehicles the NO<sub>x</sub> are normally present in large quantities.

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### Nitrous oxide (N<sub>2</sub>O)

Agriculture (cultivating soil, the use of nitrogen fertilizers and animal waste handling) is the main source of human-produced nitrous oxide. Unlike other nitrogen oxides, nitrous oxide is a major greenhouse gas. It is also an ODS.

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### Oxygen

Oxygen is a colourless and odourless gas found in the air. Oxygen is the gas we breathe and it is essential to all forms of life on Earth.

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### Ozone molecule (O<sub>3</sub>)

An ozone molecule has three oxygen atoms. Ozone is a pale-blue gas with a sharp, irritating odour and it is toxic in the lower atmosphere. In the upper atmosphere it is vital for all the life on Earth as it blocks the sun's ultraviolet rays. The majority of ozone is in the stratosphere where it plays a crucial role in preventing harmful ultraviolet rays from reaching the Earth.

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### Ozone depleting substances (ODS)

Ozone depleting substances (ODS) are chemicals responsible for ozone layer depletion: these ozone depleting substances are mainly chlorofluorocarbons (CFCs), halons and methyl bromide.

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### Ozone layer

The ozone layer is a thin invisible shield made of ozone gas. It protects us from the dangerous UV rays of the sun. The ozone layer stands in the stratosphere (upper atmosphere), at an altitude of 15 to 50 kilometres (10 to 30 miles) above the Earth.

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Ozone layer depletion	A number of human activities release in the air some chemicals (ODS) that destroy ozone molecules in the upper atmosphere; while ozone molecules are destroyed in the upper atmosphere, the ozone layer gets thinner and thinner. This is ozone layer depletion. The consequence for us is an increased amount of damaging UV rays reaching the surface of the Earth.
Pesticide	Chemical products that eliminate or reduce the number of harmful pests.
Pests	Insects that damage stored foods, and some soil-dwelling organisms that damage crop roots.
Phase out	Phase out of the ODS means their gradual elimination.
Photochemical reaction	Any chemical reaction caused by absorption of light including visible, ultraviolet and infrared light. Photosynthesis is a common example of a photochemical reaction.
Photosynthesis	Photosynthesis is the chemical process by which plants use the energy from sunlight to turn carbon dioxide (from the air) and hydrogen (from water) into their own nutrients.
Refrigerant or coolant	Refrigerants like CFCs and HCFCs are used to cool air. They are mainly used in refrigerators and air-conditioners.
Renewable energy	Natural resources such as sunlight, wind, rain, wood, tides and geothermal heat are naturally replenished and can be transformed into energy. Solar power, wind power and biomass (wood burning) are probably the most common renewable energies used worldwide. Burning wood contributes to global warming because it releases CO <sub>2</sub> into the atmosphere, therefore it is not the most recommended form of renewable energy.
Skin cancer	Skin cancer is a very serious skin disease that must be treated at an early stage. It starts when the skin cells, confused, behave abnormally and begin growing and multiplying. Overexposure to the sun increases the risk of skin cancer. Skin cancer must be prevented by avoiding sun exposure.
Solvent	A liquid that dissolves a solid, liquid, or gaseous solute resulting in a solution. The most common solvent is water. CFC has been used as cleaning solvent in a liquid form.
Stratosphere	The upper layer of the atmosphere, situated from 15 km to about 50 km (10 to 30 miles) above the Earth.

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Sun burn	Sunburn is an inflammation of the skin caused by overexposure to the sun.
Sun tan	Suntan is a brownish colouring of the skin caused by the production of melanin within the skin on exposure to the sun.
Troposphere	The lower layer of the atmosphere. Practically all the human activities take place in the troposphere and all the water vapour is found there. Most of the clouds are in the troposphere layer.
Ultraviolet (UV)	Ultraviolet radiation is a harmful component of sunlight that we cannot see or feel. Ultraviolet radiation is dangerous for us because it damages our health by penetrating deep into our skin and eyes, and by weakening our immune system. There are three categories of UV rays: UV-A, UV-B and UV-C. UV-B are the most dangerous.
UV Index (UVI)	The UV Index is a tool to describe the level of solar UV radiation at the Earth's surface. It is aimed at alerting people about the need to adopt protective measures against the sun. The UV Index uses a range of values from zero upward. The higher the value, the greater the amount of dangerous UV rays and the potential for damage to our health.
Vitamin D	Vitamin D is an essential substance that helps our body use calcium, needed for bones and teeth to be strong.
Volatile organic compounds	Any organic (i.e. carbon-containing) compound that evaporates readily to the atmosphere at room temperature.

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**[www.unep.org](http://www.unep.org)**

United Nations Environment Programme

P.O. Box 30552 Nairobi, Kenya

Tel.: ++254-(0)20-62 1234

Fax: ++254-(0)20-62 3927

E-mail: [cpiinfo@unep.org](mailto:cpiinfo@unep.org)



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