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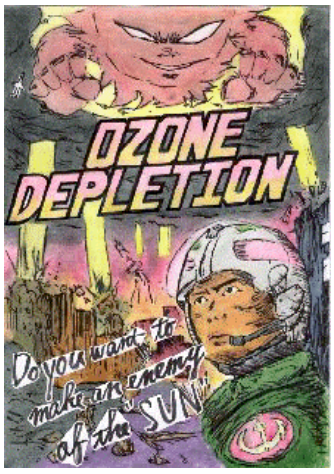
OZONE DEPLETION

Activity Pack for Key Stages 2 & 3

Laura Cresswell & Joe Buchdahl

1999 (updated 2002)



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Introduction

This activity pack has been designed for teachers, and is intended for use by top juniors (aged 9-13 years) taking Key Stages 2 or 3 of the National Curriculum. The aim of this pack is to raise pupils' awareness and understanding of ozone depletion in an interesting fashion.

The pack consists of set of information sheets that introduce pupils to the subject, and various activities to help reinforce knowledge and understanding of the issues.

The information sheets cover the following topics:

- What is ozone?
- The ozone layer
- Ozone depletion
- Why is the ozone hole over Antarctica?
- The Montreal Protocol
- Impacts of ozone depletion
- What can we do?

The information sheets introduce the topic of ozone depletion, followed by activities for the class to complete. These can be undertaken as a series of lessons or all together. They include:

- A word search
- A word match
- A word puzzle
- A set of multiple choice questions
- Making a wall display

The word search, word match and word puzzle exercises are intended to test the pupils' memory of the key words used in the booklet and to reiterate them.

The set of multiple-choice questions tests the pupils' understanding of the topic. It is suggested that they be used at the end of the series of lessons.

The making a wall display activity is designed to encourage children to work together and enhance their creativity skills. It is also an interesting way to stress the problem of ozone depletion to others.

It is hoped that you will find this activity pack both useful and informative. If you have any criticisms, comments or ideas on how to improve the pack, we would be grateful to hear them. You can contact us at the address below:

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ARIC 1999

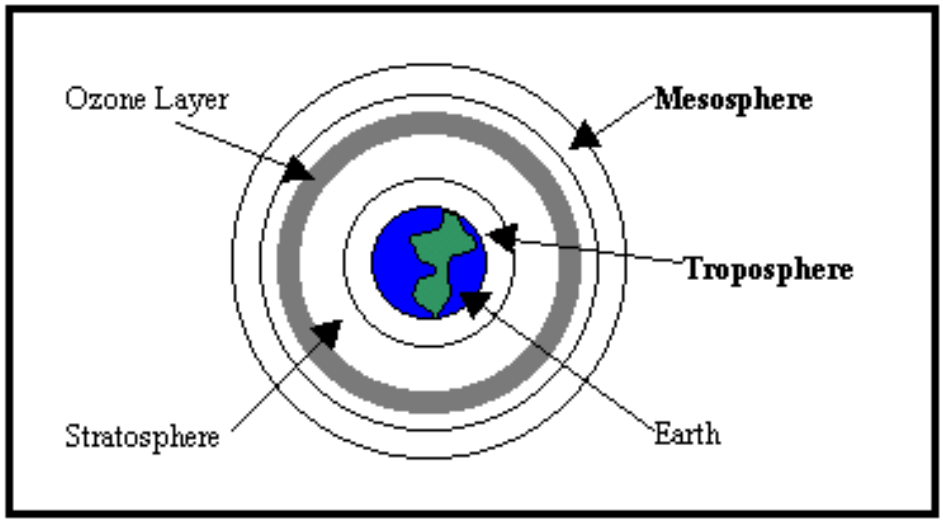
Information Sheets

What is Ozone?

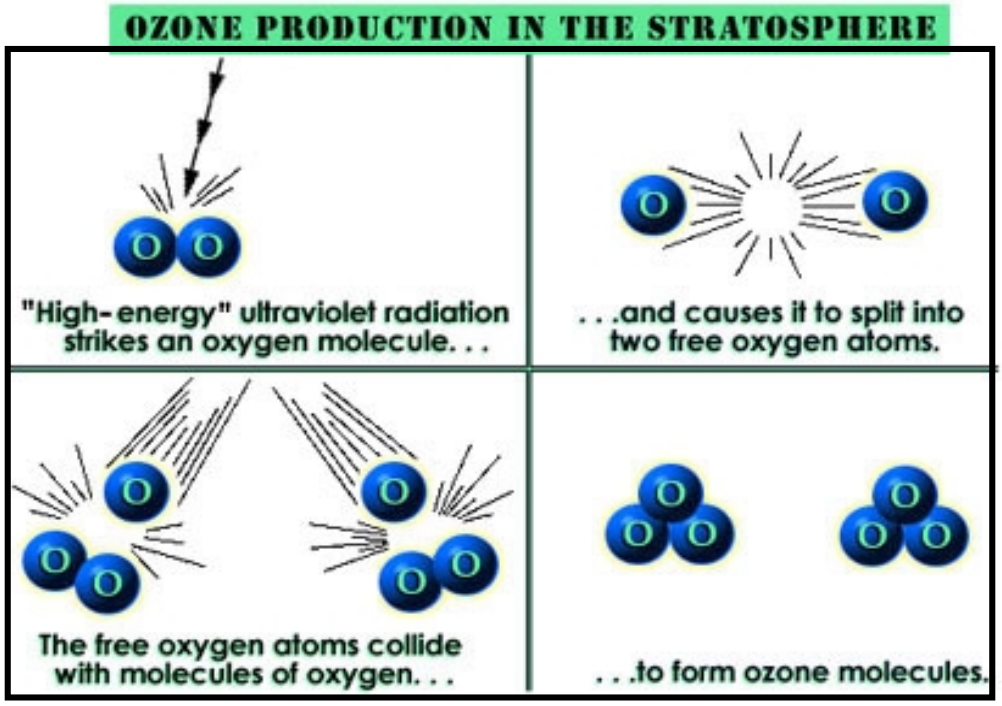
Ozone is a form of **oxygen**. The oxygen we breathe is made up of 2 oxygen **atoms** (O_2), but ozone is made of 3 oxygen atoms (O_3). It is a colourless gas that has a very strong smell.

The Ozone Layer

The build-up of oxygen in the **atmosphere** led to the natural formation of the ozone layer. This layer is found between 19 and 30 kilometres (km) above the ground in the part of the atmosphere called the **stratosphere**.



The diagram below shows how ozone is made when energy from the Sun causes oxygen atoms to split apart.

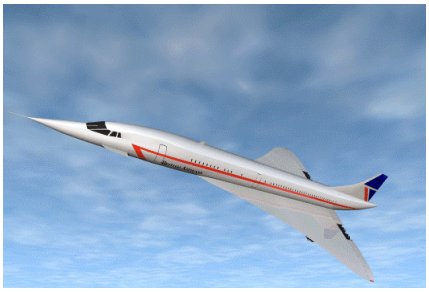


The ozone layer filters out damaging **ultraviolet (UV)** rays from the Sun. Without the natural ozone layer, many living things on Earth would die.

Ozone Depletion

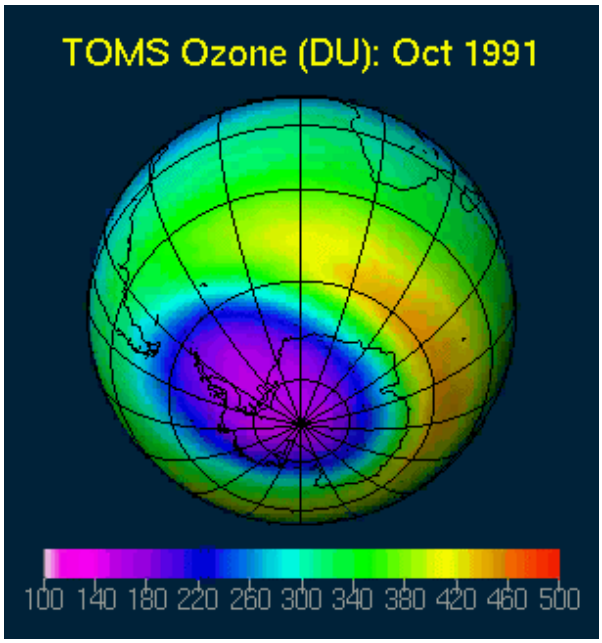
When the atmosphere has no man-made **pollution** in it there is a balance between the amount of ozone forming and the amount being destroyed. There needs to be the right amount of ozone in the atmosphere to stop organisms being damaged by sunlight.

In the 1970s scientists found that **CFCs (chlorofluorocarbons)** could destroy the ozone layer. CFCs are chemicals that have been used in **aerosol** cans and fridges since the 1930s, although they are used much less today.



If CFCs are carried high into the atmosphere, where the ozone layer is, they can destroy ozone by reacting with it in strong sunlight. CFCs have been responsible for approximately 80% of the total ozone **depletion** to date. CFCs are therefore responsible for the majority of ozone depletion, but a number of other substances are known to have the same effect. Supersonic aircraft such as Concorde, for example, release **nitrogen oxides**, which break down ozone.

When CFCs destroy ozone, the natural balance of the atmosphere is upset and more ozone is destroyed than is being created. This allows more ultraviolet rays from the Sun to reach the Earth. The **cells** of living things, including plants, animals and people, can then become badly damaged.



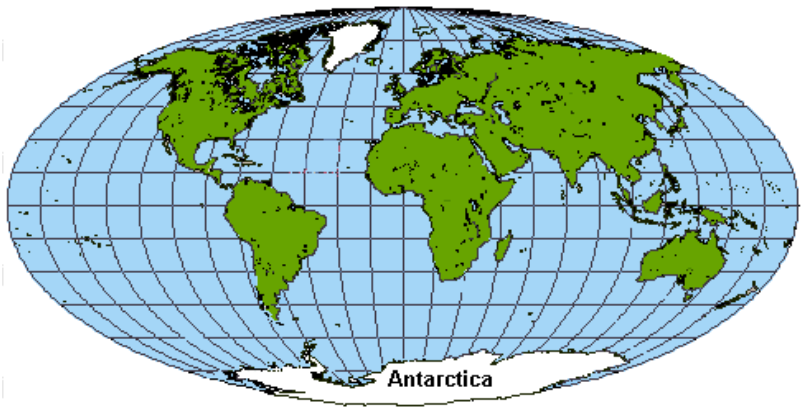
Dr. M. Molina and Dr. S. Rowland first thought of the idea of ozone loss in 1974, but it was not taken seriously. In the spring of 1985, a hole in the ozone layer above **Antarctica** was discovered. This hole has reappeared every spring since this date.

This picture shows the hole in the ozone layer above Antarctica.

Why is the Ozone Hole over Antarctica?

Every spring since the late 1970s a hole has formed in the ozone layer above Antarctica. [Remember that spring in the **Southern Hemisphere** of the world occurs when we have our autumn in the **Northern Hemisphere**, in September and October.] The cold temperatures in the air above Antarctica speed up the destruction of ozone by CFCs. The hole forms because Antarctica is separated from the rest of the world by a natural

A Map of the World



circulation of wind called the Polar Vortex. This prevents the air mixing in the atmosphere and so ozone depletion is concentrated here.

In recent years, the hole above Antarctica has become larger and deeper as more ozone has been destroyed. When summer returns each year, the air temperature rises, the Polar Vortex dies down and the ozone hole repairs itself, only to reform in the following spring.

Man-made emissions of CFCs used to occur mainly in the Northern Hemisphere, with about 90% released in Europe, Russia, Japan and North America. Since new CFCs were banned in 1995, CFCs emissions from these countries has dramatically fallen. As CFCs rise into the atmosphere, winds move them towards the **Poles**: Antarctica in the south and the Arctic in the north.

Although ozone depletion occurs over the Arctic, where air temperature can be very low, there is no strong Polar Vortex, and springtime ozone holes are not as large as in Antarctica.

The Montreal Protocol

With the problem of ozone depletion on the increase during the 1980s, many countries were becoming concerned about the future of our planet. In 1987 the governments of 24 countries agreed to sign the Montreal Protocol on substances that deplete the ozone layer. The agreement means that all the countries involved must cut down their use of CFCs and other substances that deplete the ozone layer. All the countries involved were legally bound to the agreement and aimed to reduce **emissions** of CFCs by 50% by the year 1999.

At a meeting in Copenhagen in 1992 the original agreement was changed to say that all CFCs should be phased out by 1995. Switching from CFCs to alternatives is expensive and so

poorer countries were given an extra 10 years to achieve this.

CFCs have been significantly reduced and most countries now use alternatives to CFCs in aerosols, fire extinguishers and air conditioners. However, fridges have longer lifetimes, and old ones still have CFCs inside their cooling mechanisms. When these fridges are disposed of, the CFCs should be carefully managed to prevent them escaping into the air.

The depletion of the ozone layer is a global problem that can only be prevented if all countries work together.

Impacts of Ozone Depletion

The ozone layer acts as our planet's sunscreen, providing a filter to help protect all life forms from the Sun's damaging ultraviolet (UV) rays. Any significant decrease in the amount of ozone in the stratosphere would result in an increase in the amount of ultraviolet rays reaching the Earth's surface. This in turn would

lead to an increase in problems for humans, animals and plants.

Health

The most well-known effect of ultraviolet rays is the reddening or burning of the skin in sunshine. Exposure to ultraviolet rays increases the risk of skin cancer. According to some estimates, a 10% loss in global ozone levels may lead to a 26% increase in skin cancer among fair skinned people.

Ultraviolet rays can also be damaging to our eyes. An increase in the amount of ultraviolet energy reaching the Earth would lead to an increase in eye disorders. **Cataracts**, for example, affect the eye's lens and can lead to blindness. The eyes are much more sensitive than the skin and a 1% decrease in ozone may result in 100,000 to 150,000 additional cases of blindness due to eye cataracts world-wide.

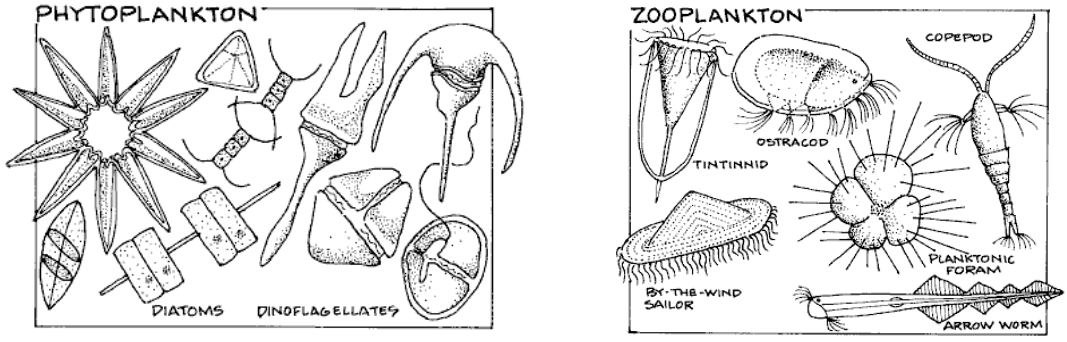
Plants

Many crops and land plants could be sensitive to ozone depletion and harmed by an increase in ultraviolet rays.

Organisms

Ultraviolet light can travel through water. Too much ultraviolet light may kill **plankton** (small plants and animals floating in the oceans). These plankton are an important source of food for many other creatures like fish and whales, which could starve if the amount of plankton decreases.

Plants ***Animals***



What Can We Do?

The Montreal Protocol will go a long way to reduce ozone depletion and repair the ozone hole. However, if there is to be real success in the future everyone must play

their part. There are a number of things that we can do to protect the ozone layer and safeguard our health against the effects of increasing ultraviolet rays.

Protecting Our Health

Sunglasses: glasses that provide 99-100% protection against ultraviolet light will reduce the chance of eye damage.

Clothing: clothes provide excellent protection against sunburn.

A hat: a wide brimmed hat will also offer good protection to the eyes, ears, face and the back of your neck – areas particularly prone to sunburn.

Limit exposure: The Sun's rays are strongest between 10 a.m. and 4 p.m., so limit exposure during these hours.

Protecting the Ozone Layer

We have all played a part in ozone depletion because we did not know that the chemicals we used in everyday life

were destroying the ozone layer. Following the Montreal Protocol, the use of CFCs in new products around the world is being slowly phased out. However, products bought before this agreement are still in use in many homes and offices as they are expensive to replace. When these are thrown away, they should be carefully managed so that the CFCs do not escape into the air.

Glossary

Aerosols: sprays containing fine particles and/or droplets that become suspended in the atmosphere.

Antarctica: an isolated ice-covered continent in the Southern Hemisphere.

Arctic: the regions of land and sea-ice surrounding the North Pole, in the Northern Hemisphere.

Atmosphere: the layer of gases (air) that surrounds the Earth.

Atom: the smallest unit that makes up any substance.

Cataracts: a disease of the eye which affects the lens, and which can lead to blindness.

Cell: the smallest unit of life that makes up all living things.

CFCs (Chlorofluorocarbons): a group of chemicals containing carbon, fluorine and a chloride.

Depletion: a reduction or loss.

Emissions: releases of gases to the atmosphere, like CFCs.

Kilometre (km): 1000 metres.

Montreal Protocol: The discovery of a hole in the ozone layer above Antarctica led to the signing of the Montreal Protocol. This agreement controls the use of gases that have a destructive effect on the ozone layer.

Nitrogen oxides: gases produced when fuel is burnt. They are responsible for some ozone depletion.

Northern Hemisphere: the half of the globe that lies to the north of the equator.

Oxygen: a gas consisting of two atoms of oxygen bonded together. It has no odour or colour and is essential for life on Earth.

Ozone: a gas consisting of three atoms of oxygen bonded together. In the stratosphere ozone absorbs ultraviolet rays and protects life on Earth.

Ozone Layer: the region of the stratosphere containing the bulk of atmospheric ozone.

Plankton: small plants and animals floating in the oceans.

Poles: the northern-most and southern-most points of the Earth, in the Arctic and Antarctica.

Pollution: any harmful substance in the environment.

Southern Hemisphere: the half of the globe that lies to the south of the equator.

Stratosphere: the layer of the atmosphere from the top of the troposphere to about 50km (30 miles) above the ground.

Troposphere: the lowest layer of the atmosphere, stretching from ground level to between 10 - 15km (6 - 10 miles) above the ground.

Ultraviolet (UV) Rays: harmful rays of energy produced by the Sun.

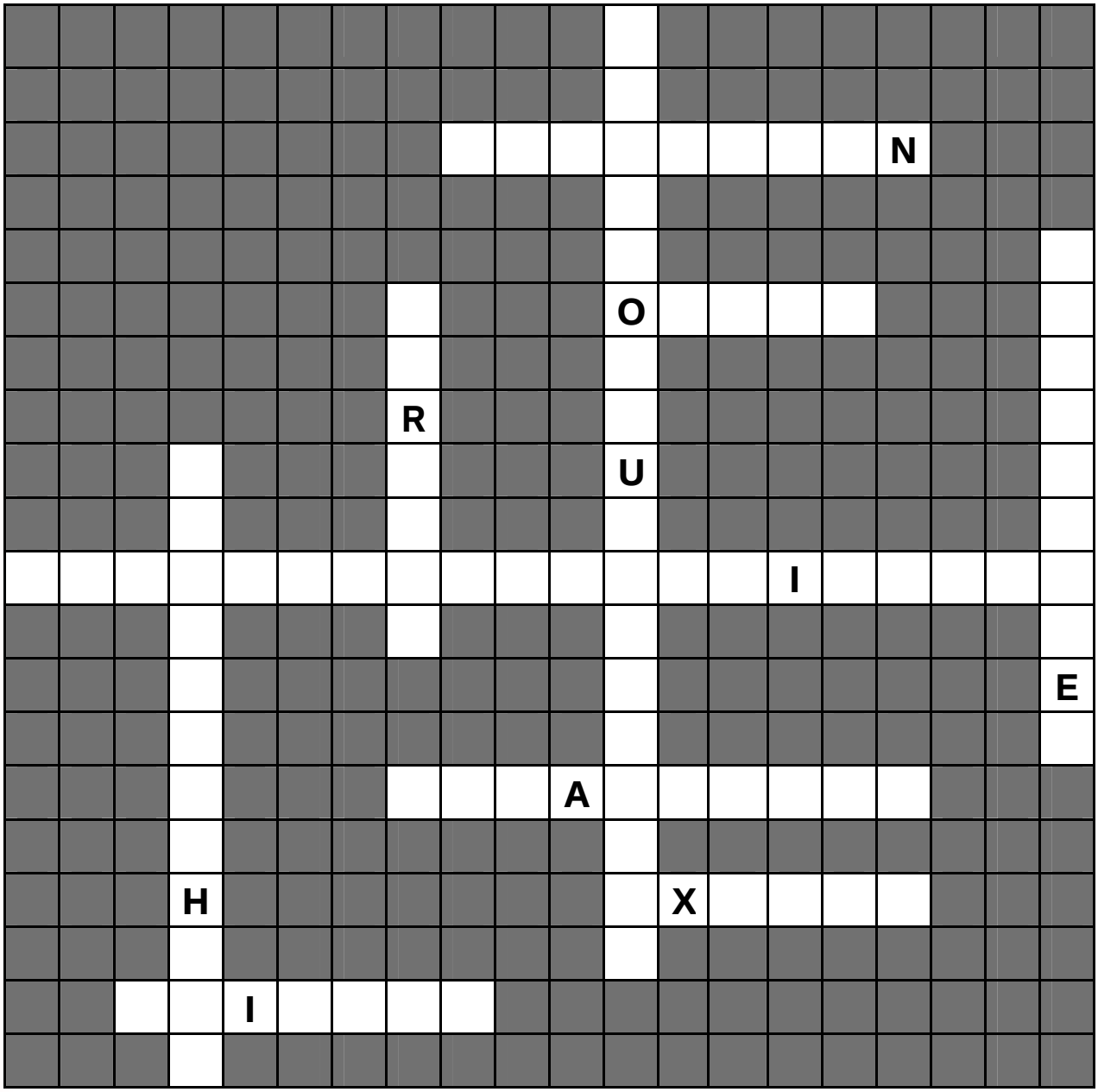
Word Match

The 14 words printed below can be matched up to make 7 new phrases. Match a word from the left hand column with one from the right hand column (left hand first).

OZONE	**VORTEX**
MONTREAL	**CATERACT**
SKIN	**PROTOCOL**
OZONE	**RAYS**
OXYGEN	**HOLE**
EYE	**LAYER**
ULTRAVIOLET	**ATOM**
POLAR	**CANCER**

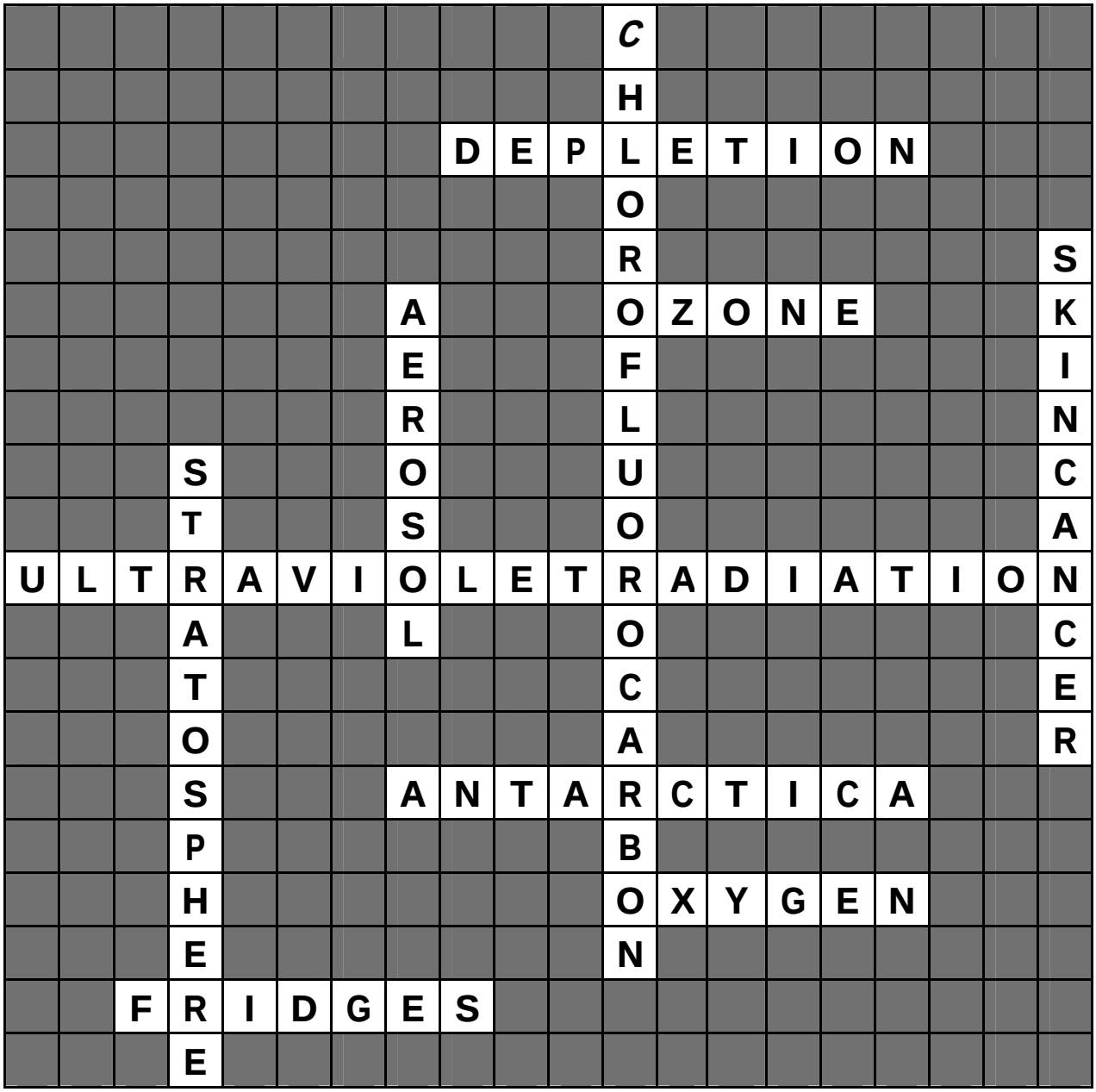
Word Puzzle

See if you can fit the words on the following page into the correct places in the puzzle below.



AEROSOL	ANTARCTICA
ULTRAVIOLET RADIATION	OXYGEN
CHLOROFLUOROCARBON	SKIN CANCER
DEPLETION	FRIDGES
STRATOSPHERE	OZONE

A Teachers copy of the completed word puzzle is printed below…



Word Search

How many of the words printed below can you find in the word search box?

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

AEROSOLS
ORGANISM
CFCS
SKIN CANCER
HEALTH
MONTREAL PROTOCOL
ATMOSPHERE
OZONE
FRIDGES
UV RADIATION
ANTARCTICA
OXYGEN
DEPLETION
STRATOSPHERE
HOLE

Multiple Choice Questions

Tick the correct answer in the box provided.

1. When was the hole in the Ozone Layer above Antarctica first discovered?

a) 1985 ☐
b) 1995 ☐
c) 1950 ☐
d) 1890 ☐

2. What is the name of a common man-made substance that causes ozone depletion?

a) TLC ☐
b) CFC ☐
c) DDT ☐
d) MCC ☐

3. Where is the majority of ozone found in the atmosphere?

a) Thermosphere ☐
b) Troposphere ☐
c) Mesosphere ☐
d) Stratosphere ☐

4. What type of harmful rays are blocked by ozone?

a) Radio waves ☐
b) Infrared ☐
c) Ultraviolet ☐
d) X-rays ☐

5. What type of cancer can the harmful rays in question 4 cause in humans?

a) Lung Cancer ☐
b) Bowel Cancer ☐
c) Skin Cancer ☐
d) Stomach Cancer ☐

6. Which item found in the home may still contain chemicals which can destroy the ozone layer?

a) Cooker ☐
b) Fridge ☐
c) Deodorant ☐
d) Soap ☐

7. Between what heights is the ozone layer found in the atmosphere?

a) 2 -3 Km ☐
b) 0 - 1 Km ☐
c) 19 - 30 Km ☐
d) 70 - 80 Km ☐

8. What is the name of the agreement made between countries to reduce ozone depletion?

a) Environmental Protection Act ☐
b) Montreal Protocol ☐
c) Rio Earth Summit ☐
d) Common Agricultural Policy ☐

9. In what year was the agreement in question 8 made?

a) 1921 ☐
b) 1983 ☐
c) 1974 ☐
d) 1987 ☐

10. How many atoms of oxygen are there in ozone?

a) 6 ☐
b) 1 ☐
c) 3 ☐
d) 2 ☐

Answers for Teachers

1. 1985
2. CFC
3. Stratosphere
4. Ultraviolet
5. Skin Cancer
6. Fridge
7. 19 -30 Km
8. Montreal Protocol
9. 1987
10. 3

Making A Wall Display

Teachers Notes

This activity has been designed to increase pupils' creativity skills whilst teaching the important topic of ozone depletion. It will form an ideal wall display, clearly portraying the damage caused by CFCs.

For this activity, all pupils will need access to:

- Scissors
- Coloured pencils or paper
- Glue

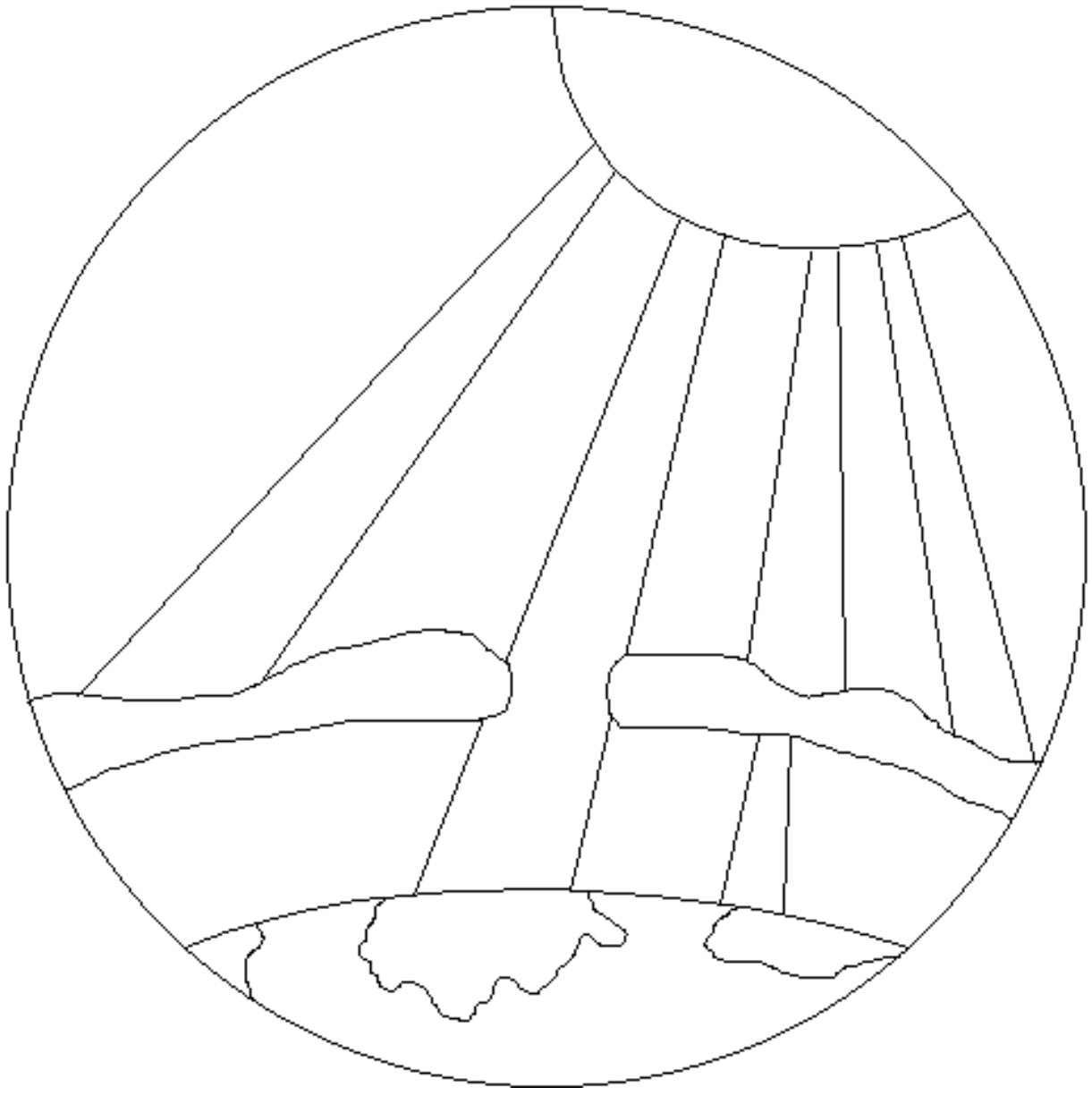
There are three different pictures supplied over the next few pages for use in the wall display.

Each pupil may be given a copy of the "Ozone Depletion" picture and asked to colour it in, or produce a collage. This should be done using appropriate colours so the image is clearly portrayed. Alternatively, a large duplicate of the picture could be made and the class could work together to produce a large collage.

A list of 5 labels has been supplied, with numerous copies on one sheet. The sheet can be photocopied and each pupil given their own set of 5 labels. The labels should be cut out and placed on the "Ozone Depletion" diagram in the correct places. (Answer sheet is enclosed for the teacher.)

To make the display more interesting, children may also be encouraged to cut pictures of aerosols and fridges from magazines and catalogues.

OZONE DEPLETION



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CFCs EMISSIONS

SUN

OZONE LAYER

ANTARTICA

ULTRAVIOLET RAYS

↑
CFCs EMISSIONS

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OZONE LAYER

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ULTRAVIOLET RAYS

Answers for Teachers