

Title	No Fun in the Sun
D File Number	WA44AD004
Personnel	<p>Roc Moulder Science Agent. 1st Class Degree/PhD Synchrotron Radiation. Deep thinker, ingenious, insubordinate.</p> <p>Kayla Shelley Science Agent. 1st Class Degree/PhD Genetic Manipulation. Intelligent, courageous, sceptical.</p> <p>Von Braun Director of Operations at Daresbury. PhD.s Languages, Cardiac Physiology, Computers. No access to personal file.</p>
Time	12.30
Date	12.08.96
Loaction	A beach in Cornwall, England.
Situation	Beach patrol locates 2 white females, aged 16 & 15 lying in the sun without any protection from harmful UV rays.
Witness Report	<p>Justin Morgan, Lifeguard.</p> <p>"The girls refuse to get out of the sun, they are here on holiday and wish to go home with a nice tan. They will not listen to my advice, they are wearing very small bikinis and no sun tan cream, I can see that there is going to be a bad case of sunburn here.</p>
Action	Call in Special Agents to advise.

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Time	16.30
Date	12.08.96
Location	Director Von Braun's Office
Report	<p>By Director Von Braun.</p> <p>Ozone is a gas found in the upper atmosphere of the Earth where it does a very important job in protecting us from the harmful effects of ultra violet (UV) radiation from the sun.</p> <p>In the 1980s it was discovered that the ozone layer is being destroyed at a rapid rate. Holes in the ozone layer have appeared, first over the Antarctic in the 1980s and the problem is appearing in the Arctic too. Even over the UK there is sometimes a greatly reduced layer of ozone, (the size of the "ozone hole" varies seasonally). This means that we are no longer as protected from the harmful UV rays of the sun. It has been shown that there is a definite link between UV radiation and the incidence of skin cancer.</p>
Assignment	YOU HAVE BEEN APPOINTED AS ASSISTANT SPECIAL AGENTS TO ROC AND KAYLA.
Your Tasks	<ol style="list-style-type: none"> 1. To research and produce a report about the effects of sunlight on human skin. 2. To produce a leaflet which contains 10 ways in which you could protect your body from the harmful effects of UV light. 3. Explain why there are increasing numbers of cases of skin cancer in the United Kingdom. 4. Design a pair of sunglasses for use at altitude whilst doing an active sport such as skiing. State what special features the glasses will have in order to protect the eyes from UV light.

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5. Find out the names of 3 chemicals which are known to damage the ozone layer. What are these chemicals used for? Is there any other substance that could be used instead?
 6. Survey your friends and relatives to find out what brand of suntan cream they use. Make a note of the protection factor and any other special features that it claims to have. Ask them why they chose that particular cream. Present your findings in the form of a chart.
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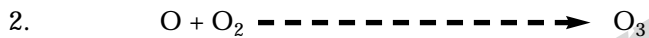
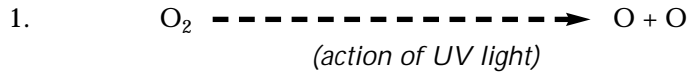
Action

Agents Moulder and Shelley to travel to Cornwall with the results of the investigations carried out above.

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When ozone (O_3) absorbs the UV rays, it warms up the surrounding gases in the atmosphere and this causes temperature differences which make the atmosphere start moving, in fact it causes winds which create the weather patterns all over the Earth.

Ozone is actually made in the stratosphere by the action of certain wavelengths of UV radiation on oxygen molecules. In the UV light, oxygen molecules (O_2) dissociate to form free oxygen atoms ($O + O$). These then react with further oxygen molecules to form ozone (O_3).



This reaction is reversible and ozone itself is broken down to give oxygen molecules and free oxygen atoms.



Equations 1 and 2 show the production of ozone and 3 shows its loss due to chemical reactions. It used to be thought that oxygen atoms combined with ozone to form oxygen molecules:

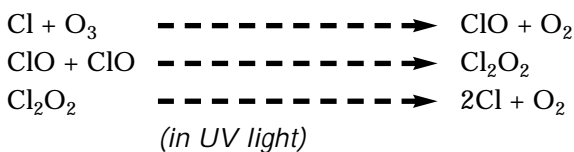


There used to be a balance between the rate at which ozone was made and destroyed.

Now scientists have realised that this is no longer the case. In fact, ozone is removed by more complicated chain reactions which involve pollutants in the atmosphere, most of which come from man's industrial activities. Chemicals such as methyl chloride, carbon tetrachloride and chloro-fluoro-carbons are the main culprits. These chemicals have been widely used in cleaning fluids, aerosol cans and in refrigerators.

Why is the ozone hole over the poles?

If it is industry that is to blame for the formation of the ozone hole, why does the hole form over the polar regions rather than over the heavily industrialised Western continents? The answer lies in the fact that chloro-fluoro-carbons (CFCs) are very inert (unreactive) in the lower atmosphere. It is only when air currents across the globe carry them up to very high altitudes (30km or more) that they break down in the sunlight to produce reactive chlorine compounds. In the winter, the poles are very dark and cold, yet there is a jet stream of warmer winds around the pole which leads to clouds forming high up in the stratosphere. During the winter, these chlorine compounds react on the surface of the clouds and in the presence of sunlight, destroy ozone. The winds keep the chlorine compounds in circulation around the polar regions and there is a cycle of reactions which produce oxygen molecules and leave the chlorine free to react over and over again. Since the chlorine compounds are re-used it is called a catalytic cycle:



This is only one of many reactions taking place in the upper atmosphere.

Practical Investigation

Wordsearch

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

Solve the clues
and find the words

1. Abbreviation for Ultra violet.
2. An agent who can get you 'going places'.
3. The gas which protects us from solar radiation.
4. Region around the north pole.
5. You get one of these in the sun.
6. The colour of light beyond violet in the spectrum.
7. Wear one of these on your head in the sun.
8. The element found in CFCs which damages ozone.
9. Our nearest star.
10. Suntan creams do this for your skin.
11. The layer above the Earth where high clouds form.
12. The upper atmosphere where ozone is found.
13. Rub this on your skin to protect it. (2 words)

Research Project:

Plan an experiment that you could ask the scientists at Daresbury to do in order to find out which aerosol spray deodorants on the market contain CFCs. Set 5 targets for them to meet in their research.

Scientists working at Daresbury Laboratory are researching into the many different and complicated reactions which are taking place to cause ozone to be destroyed.

Synchrotron Radiation from the Synchrotron Radiation Source (SRS) is used to study how oxygen molecules can absorb UV radiation. The machine can be used to model what is going on in the upper atmosphere, here on Earth. They can find out which molecules damage ozone and hopefully try to find a way of reducing damage to the ozone layer.

Computers are also being used to model complex weather patterns so that scientists can predict the behaviour of the gases in the atmosphere and exactly where the ozone is being broken down.



Answers to wordsearch

1. UV
 2. travel
 3. ozone
 4. arctic
 5. tan
 6. ultraviolet
 7. hat
 8. chlorine
 9. sun
 10. protect
 11. stratosphere
 12. troposphere
 13. suntan cream.
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