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*STEAM within the classroom:
solving ecological problems in collaboration*

Our selfishness

How humans are destroying the Earth



Earth in 100 years?

Flying cars exist. People are skiing in the middle of a desert. We are exploring our galaxy, communicating from miles away in a blink of an eye and paying for our groceries with a watch. One might think we already achieved everything.

Is that right though? Don't we still have so many places to explore, so many ideas to put in use, so many secrets to uncover?

The real question is - do we have enough time?

Human impacts on the environment



is huge and we don't even realize it. It's not only about recycling and not wasting plastic, our everyday life affects our planet a great lot, and if we don't try our best to save it, the Earth is not going to hold on much longer. There is already a lot of damage that cannot be undone and we're at fault. The global warming is not something we can fight anymore. The temperature on Earth is rising and it will continue to rise, melting icebergs, changing the ecosystem. Human overpopulation is leading to overconsumption - a situation where resource use has outpaced the sustainable capacity of the ecosystem. Many of us buy more food than can eat wasting not only products, but also energy used to make, refrigerate and transport it, materials used to wrap it.

So how is the Earth going to look in 100 years, if we keep actively destroying it?

Air pollution

What is it air pollution?

Smog is unnatural atmospheric phenomenon, which it is in the coexistence of chemical compounds and dust in our atmosphere. These substances threatens our health and our lives. The origin of the word smog has roots in two English words: smoke and fog.



Types of smog

One of its types is London smog. It consists of sulfur dioxide (IV), nitrogen oxides, carbon monoxide, soot and the already mentioned dust which stays just above the earth. It occurs during the heating season – usually from October to March, when in Poland temperatures are lower and the need for energy is the greatest. During these months we can observe a temperature inversion, which is an atmospheric phenomenon that increases the temperature of the air along with the altitude. A temperature inversion takes place in the thin layer of the atmosphere where the normal decrease in temperature with height switches to the temperature increasing with height. An inversion acts like a lid, keeping normal convective overturning of the atmosphere from penetrating through the inversion.

In the situation when a temperature inversion doesn't occur, in the lowest part of the atmosphere (troposphere), the air closer to the surface of the earth has a higher temperature than the air above. The air is heated by the surface of the earth which is warm from the sun. Then the heated air is lifted into higher parts of the atmosphere by convection. In the situation of inversion, we have to deal with the reverse temperature. It affects the co-occurrence in the atmosphere of such effects as fog accumulation or smog formation.

Types of smog

The second type is Los Angeles smog (photochemical smog). It exists mainly in the summer months, in subtropical zones. It's composed of: carbon oxides, nitrogen oxides and hydrocarbons.



Suspended dust from local sources of pollution

They are a mixture of solid, liquid particles. Due to their high degree of dispersion, they can stay in the atmosphere for a very long time. **Why are they so dangerous to our health and life?** Because they have micrometer size so can they penetrate the respiratory tract to our bloodstream and brain.

Taking into account the health hazard rating the size of the particles is evaluated (the so-called aerodynamic particle diameter). PM2.5 dust contains small particle with size up to 2.5 microns. It is thanks to this small size, they can easily and quickly enter the respiratory tract and then move further causing bloodstream intoxicemia. In Poland, the main sources of such dust are fossil fuel heating systems and road transport.

In turn, PM10 consists of a grains that have a diameter of up to 10 microns. This size allows such particles to penetrate into our lungs. The main source of PM10 dust in the air in our cities is combustion emissions in individual solid fuel heating systems such as coal, wood and biomass and road traffic, especially from diesel vehicles without particle filters.

The health effects of exposure to contaminated air are primarily respiratory and cardiovascular illnesses and are also associated with increased hospitalization and reduced life expectancy.

Suspended dust from local sources of pollution

Due to the current standards and stricter regulations, industry has significantly reduced the emission of dust (especially PM_{2.5}). At present, low emissions play an important role in shaping the local level of air pollution. During the winter our map often showed that the inhabitants of large cities – here on the example of Cracow – are not the only people breathing such polluted air. For a very long time, in the consciousness of many people, Cracow used to be the so called Polish capital of smog. As it turns out, it is often that the inhabitants of the city outskirts as well as the inhabitants of small, charming towns inhale much worse air. Although there are no crowded streets and landscapes that represent industrial chimneys, air quality is often far worse than in the city center itself. Dusts are suspended by the incineration of low quality coal and all sorts waste (primarily plastics) in local boiler houses and individual households. Typically, the emission from these sources is associated with specific seasons throughout the year and lasts several months. Low emissions are also connected with transport, especially where congestion is high.



Suspended dust from local sources of pollution

In order to simplify the presentation of air quality data, European cities use indexes to convert measurements into a single number. In our monitoring system, we use the hourly index – it describes the current air quality from the average hourly measurements.

Officially, this index has 5 levels, ranging from 0 (very low) to >100 (very high) – a relative measure of the amount of air pollution. In Airly, we use the CAQI index where we take into account PM10 and PM2.5 dust.

To highlight the differences in air pollution on our platform, there is a 6-level scale that informs you about the color of air pollution. From the green color that shows that the air quality is very good, to the burgundy color when the air pollution standards are repeatedly exceeded and it is advisable not to be leave the house!

Permissible standards for air pollution have been established separately by Poland, the European Union and WHO, the World Health Organization.


In Poland, PM10 fine dust standards are set at three levels:

- Acceptable level 50 $\mu\text{g} / \text{m}^3$ (daily)
- Information level 200 $\mu\text{g} / \text{m}^3$ (daily)
- Alarm level 300 $\mu\text{g} / \text{m}^3$ (daily)

On the other hand, the European Union for fine particulate matter PM10 and PM2.5 only set a permissible level, respectively suitable for PM10 – 50 $\mu\text{g} / \text{m}^3$ (daily) and 40 $\mu\text{g} / \text{m}^3$ (mean-year) and for PM2.5 – 25 $\mu\text{g} / \text{m}^3$ (average-year).

Standards for permissible daily concentrations established by the World Health Organization are 25 $\mu\text{g} / \text{m}^3$ for PM2.5 and 50 $\mu\text{g} / \text{m}^3$ for PM10.

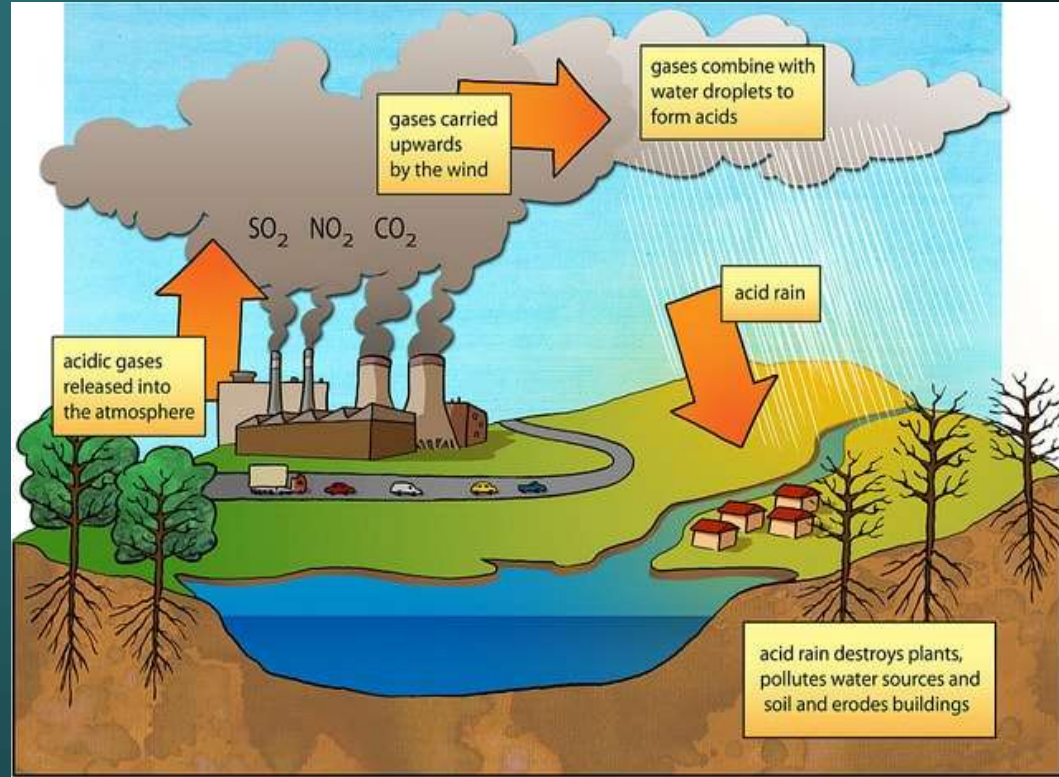




And the chemicals
in the air float up to
the skies, turning
into a cloud...

What is acid rain?

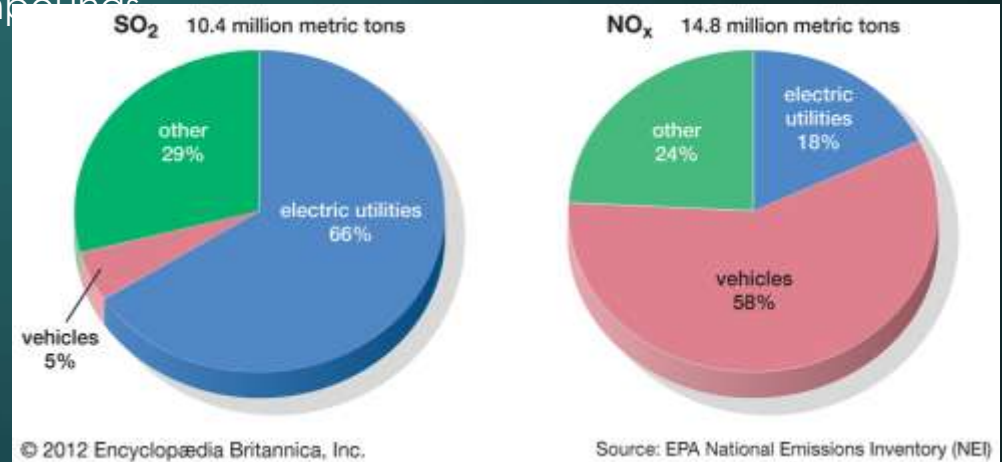
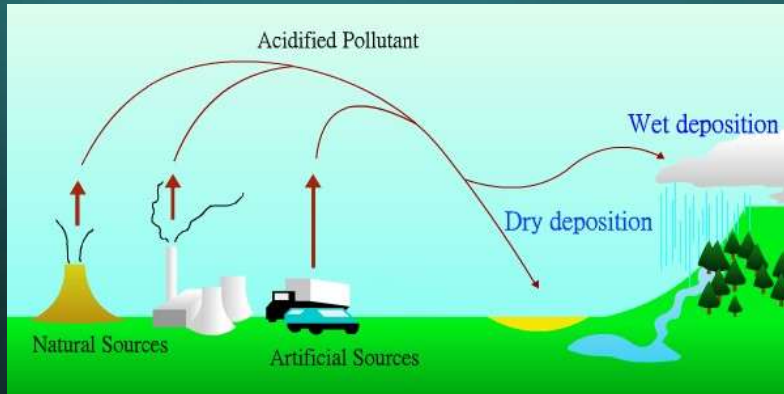
This term include all acidic rainfalls, which are caused by air pollution. Standard rainfalls' ph value is about 5,6 and all rainfalls having less ph value are acidic and causes negative consequences for living and even inanimate elements of the environment.



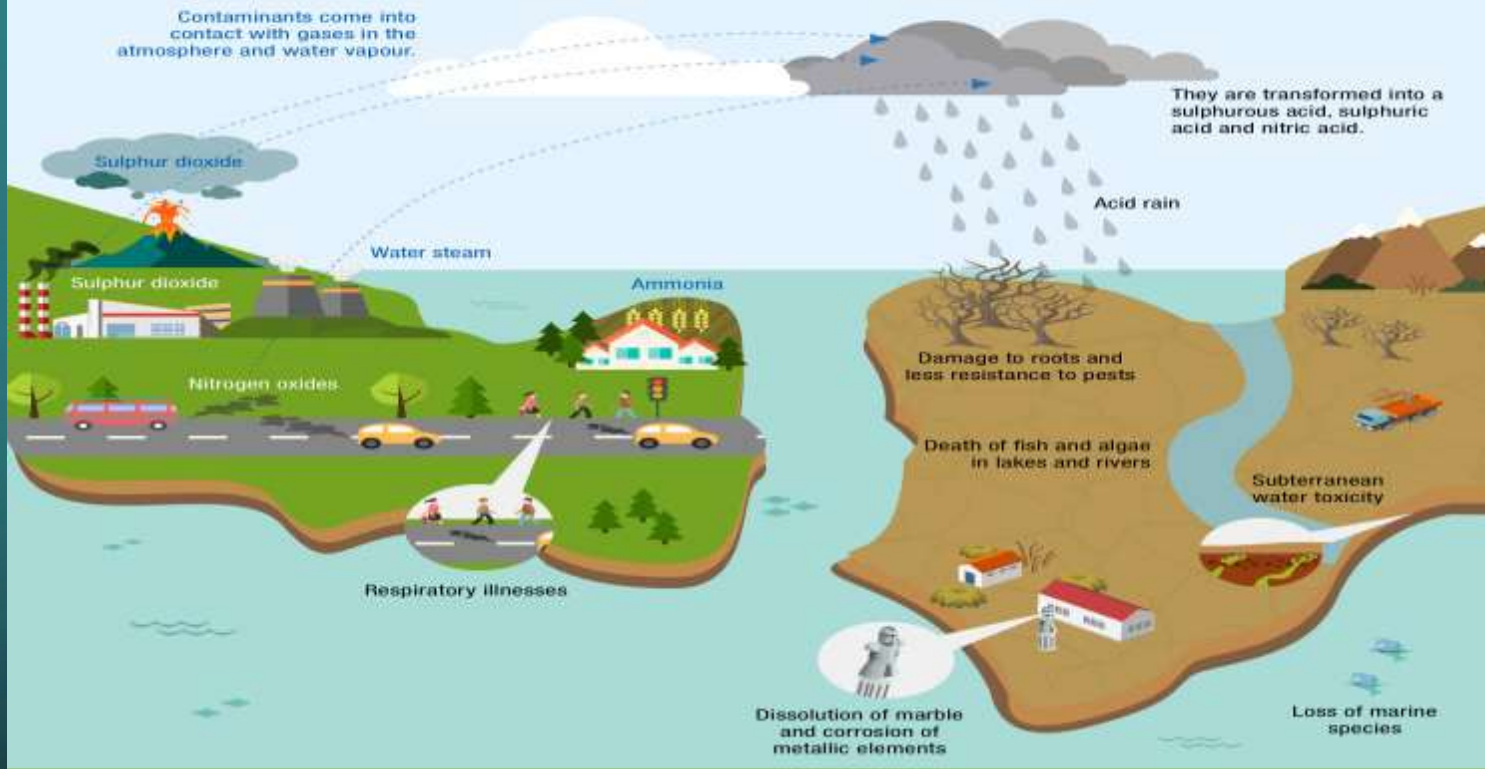
Causes of acid rain

Generally acid rain is caused by harmful chemicals and other pollutions accumulating in the air, specifically in clouds. When water vapour turns into a rainfall and falls on soil and water, takes with itself also all of this pollution.

Air pollution causing acid rain could be caused by natural causes like eruptions of volcanoes, fires, or some microbial processes, which release sulphur dioxide and nitrogen oxides into the atmosphere. But mostly human actions like burning fuels, big industries and motor vehicles, and livestock farming, bear responsibility of emissions those chemical compounds.



CAUSES AND CONSEQUENCES OF ACID RAIN



Effects of acid rain

Acid rain is general cause of acidification of environment, which poses huge danger for animals (specially water ones), plants and almost every live beings. Effects of acidification of the earth and water, are really devastating for ecosystems.

Certain areas (specially oceans) may lose biodiversity. For example acidic ph of marine water is harmful to many species, lack of which could modify the food chain and cause extinction of other species, not only marine ones. Acidifying inland waters is also very dangerous to whole environment, because although that's only 1% of the water on the Earth, about 40% of all fishes lives there.

Heavy metals are transported to the ground waters, making them unsuitable for consumption.

Forest plants are prevent by chemicals from properly absorbing water, which makes them weaker and more susceptible to diseases and pests. And, as we know, forests makes most of oxygen on Earth (for example oxygen produced by one 60years old tree could last for 3 persons whole lifes).

This phenomenon causes also a lot of damages in infrastructure, also historical and cultural heritage by corrosion of theirs metal elements and destroying big parts of limestone and marble constructions.



How to avoid acid rain?

Detox water using in factories before spill it to the rivers.

Reducing emission of pollutant gases by using a filters and renewable sources of energy instead of fuels.

Promote innovation and new, ecological technologies.

Plant more green plants and trees.

Reduce consumption of energy in households.

Aware population about consequences of their activities to change their behavior.

Using non-polluting vehicles (electrical ones, bikes etc.) instead of motor ones.

And then the rain
falls...

Water is the most important resource on earth, all life needs it . Our body is made of water in 70%. Sadly our civilization is wasting and polluting water more and more, resulting in many catastrophes, beginning from trash in the ocean and ending on death of many water animals.





Ocean of ... trash

There are 5.25 trillion pieces of plastic debris in the ocean. Of that mass, 269,000 tons float on the surface, while some four billion plastic microfibers per square kilometer litter the deep sea. Every piece is a danger to ocean animals.

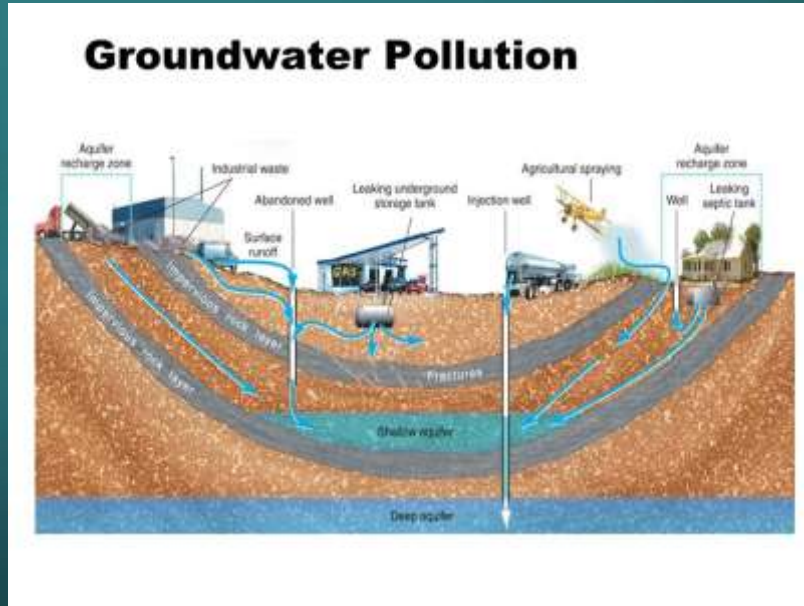


Oil pollution



Oil spills make up about 12% of the oil that enters the ocean. The rest come from shipping travel, drains and dumping, that causes a very localised problem but can be catastrophic to local marine wildlife such as fish, birds and sea otters. Oil cannot dissolve in water and forms a thick sludge in the water. This suffocates fish, gets caught in the feathers of marine birds stopping them from flying and blocks light from photosynthetic aquatic plants.

Groundwater pollution



Groundwater pollution occurs when pollutants make their way through the ground to groundwater. Contaminants found in groundwater cover a broad range of physical, inorganic chemical, organic chemical, bacteriological, and radioactive parameters. Principally, many of the same pollutants that play a role in surface water pollution may also be found in polluted groundwater, although their respective importance may differ.

Chemical pollution

Many industries and farmers work with chemicals that end up in water. These include chemicals that are used to control weeds, insects and pests. Metals and solvents from industries can pollute water bodies. These are poisonous to many forms of aquatic life and may slow their development, make them infertile and kill them.





GREENHOUSE EFFECT

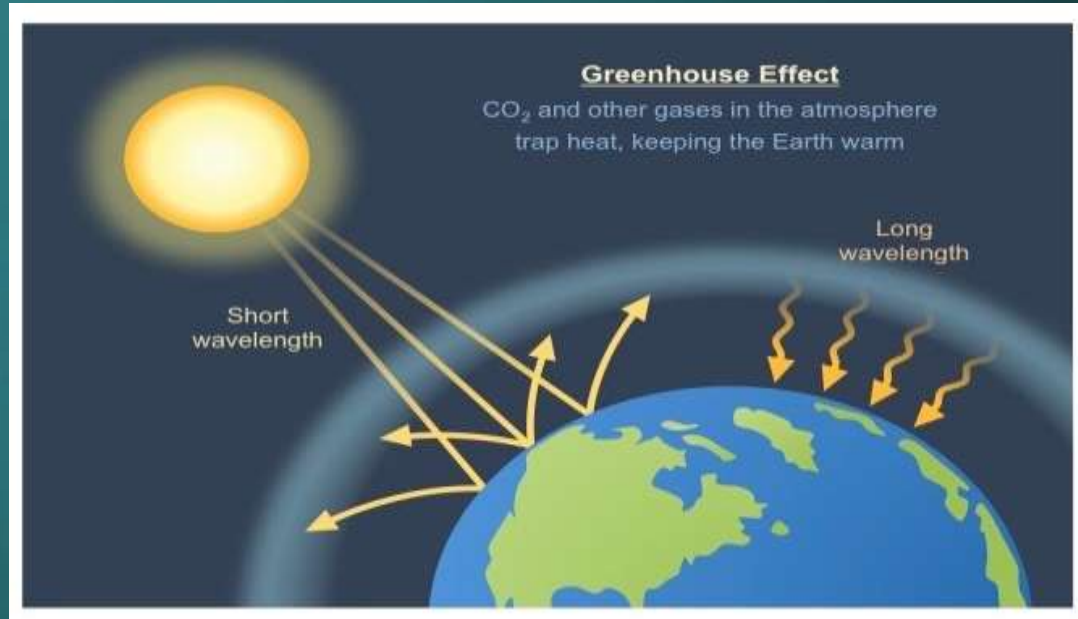
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WHAT IS GREENHOUSE EFFECT

- ▶ Greenhouse effect is a process of gradual transition of temperature on the planet. It occurs when gases in Earth's atmosphere trap the Sun's heat.
It also occurs on the other planets such as Mars and Venus.
- ▶ Greenhouse effect refers to the action of natural factors and the effects of human activities

HOW IS GREENHOUSE EFFECT WORK?

- ▶ You can easily guess that it works pretty similar to a regular greenhouse. The sun shines through the gases (carbon dioxide, methane, freons, ozone, hydrocarbons and nitrogen oxides) in the atmosphere and heats the earth. At night, the atmosphere releasing heat back and the temperature remains around 14 degrees. It's natural and makes life on earth possible.
The problem begins when there is too much greenhouse gases. When it happens the temperature begins to rise and causes global warming.



<https://ib.bioninja.com.au/standard-level/topic-4-ecology/44-climate-change/greenhouse-effect.html>

HUMAN IMPACT ON THE GREENHOUSE EFFECT

- ▶ Because of our economic activity we create a lot of substances that have a bad influence on our planet.
We also abuse natural resources. We cut trees so there is more pollution in the air, We produce more and more CO₂ by using fossil fuels ... Everything we do had a big impact on our future.

There are also things like:

- ▶ Car exhaust,
- ▶ Excessive fertilization of fields
- ▶ Air conditioning,
- ▶ Anaerobic breakdown of organic matter,
- ▶ Aerosols, fire extinguishers,



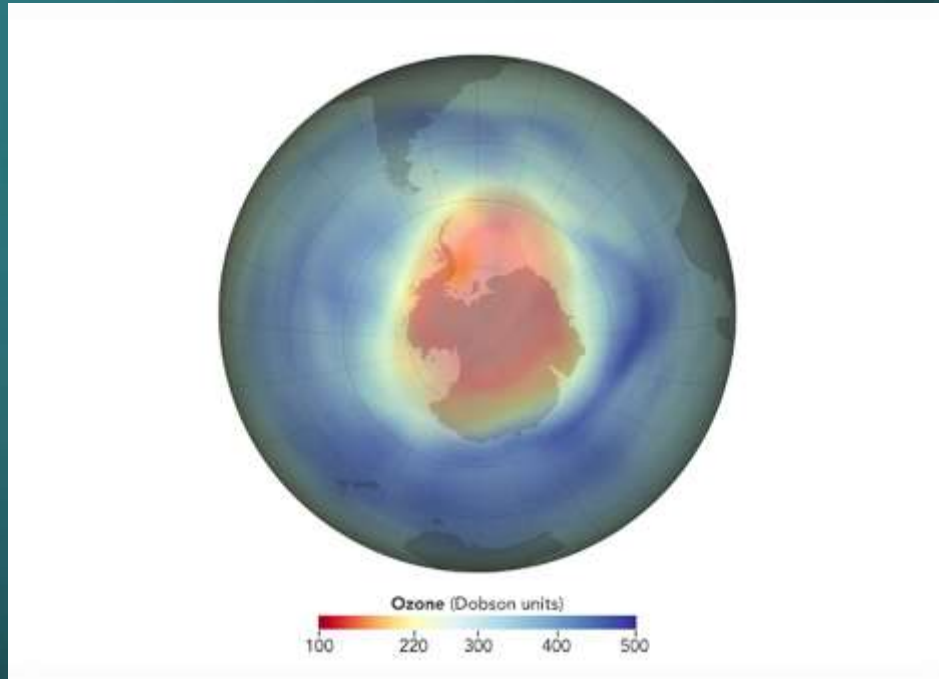


<http://wyborcza.pl/1,75400,19249764,e-misja-co2-zwalnia-goraczka-ziemi-rosnie.html>

EFFECTS

- ▶ One of the main effects is global warming,
- ▶ Sea level rise because of melting glaciers,
- ▶ Extinction of animal species,
- ▶ Migration of climate zones,
- ▶ Heavy downpours,
- ▶ Heat waves,
- ▶ Hurricanes,
- ▶ Drying fertile soils = crop losses

Ozone hole



The ozone layer

Ozone (O₃) itself was discovered in 1830s. 20 years later it's presence in atmosphere was confirmed. It surrounds whole planet Earth and protects living species from harmful ultraviolet rays, such as UVB rays. Stratospheric O₂ molecules react with ultraviolet rays creating ozone gas molecules - therefore ozone layer is being created.

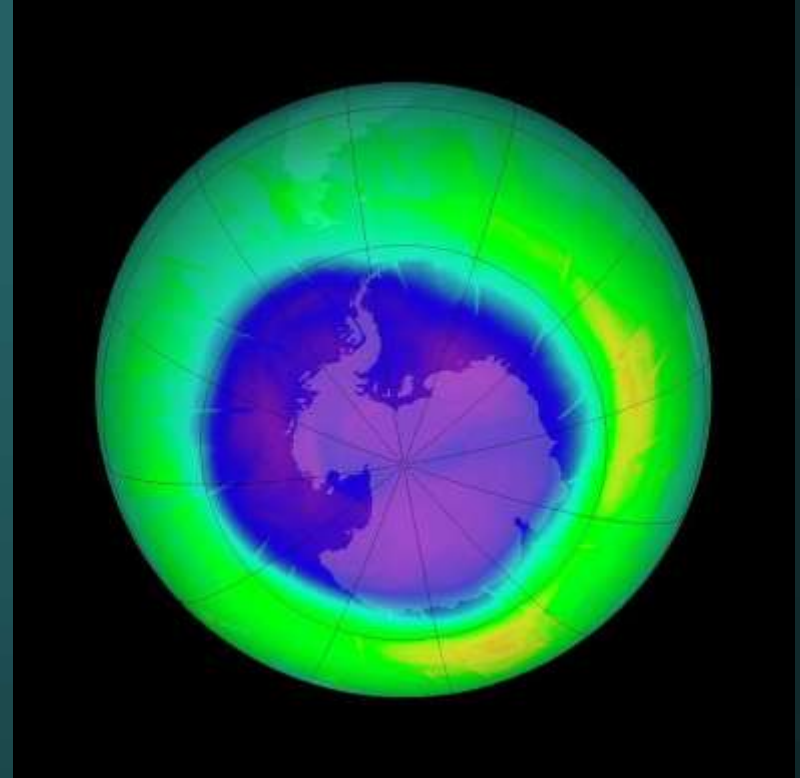


Majority of rays is absorbed by ozone layer during chemical process following which ozone particle splits up to O₂ and O particles. This reaction is constant - wherefores it qualifies concentration of ozone in the stratosphere depending on light intensity.



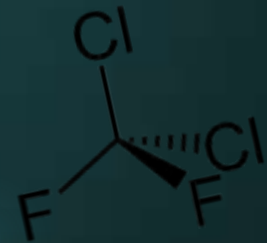
What exactly is ozone hole?

Ozone hole is a decline of ozone intensity in stratosphere. It is located in southern hemisphere, above Antarctica, because light intensity is the lowest at this area. Hole's expanse changes annually - during perpetual day and night cycle. The average extent of ozone hole totals 20 mln square kilometres.



Where does the ozone hole come from?

In 1960s Dichlorodifluoromethane (R-12), also known as Freon-12 and other fluorocarbons came into use. They were present in refrigerators, air conditioners, sprays and deodorants. Human activity increased their massive emission to atmosphere. Bromine and chlorine radicals were released from freons due to UV rays. Afterwards, they reacted with O_3 molecules in stratosphere creating oxides. Lack of ozone molecules thinned the ozone layer above Antarctica.



What would happen, if ozone hole took over entire stratosphere?

Overdose of harmful UVB rays breaks apart genetic material in cells. This casus is very dangerous to small aquatic plants. They are UV-prone, thus UV excess would be fatal to them. Aquatic plant loss would fasten global warming and begin the environmental disaster. Humanity would also suffer from UVB rays. Without ozone layer - we would get sunburnt after 5 minutes on a beach, for instance. What's more - the skin cancer epidemic would begin, collaterally with global cataract illness. Finally - ecosystems, providing food for people, would collapse. This would have meant the end of our civilisation.

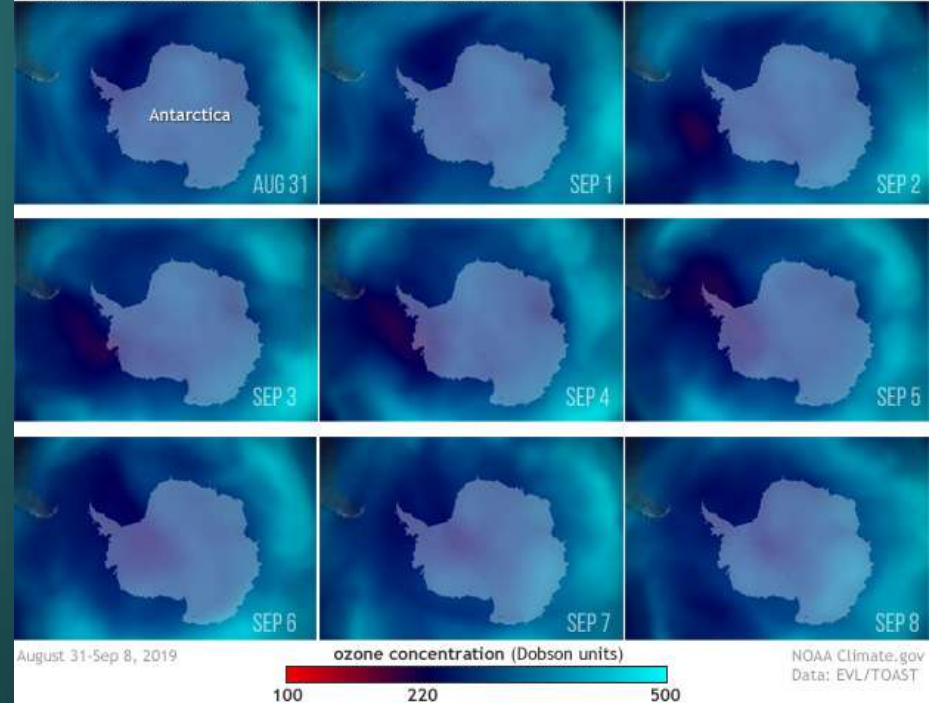


Rescue is on the way!



In 1985 Vienna Convention for the Protection of the Ozone Layer was signed. By virtue of it chlorofluorocarbons were banned of production. Nowadays cosmetics and household products do not contain freons. Changes have been accepted, because companies found chlorofluorocarbon substitutes more profitable. Ozone layer started to heal itself with a rate of 2% per year. According to NASA prognosis - ozone layer is going to be fully regenerated till the end of 2060s.

Southern Hemisphere ozone levels (Aug 31-Sep 8, 2019)



Soil degradation

What is soil degradation?

Process which impairs physical, chemical and biological features of soil. It appears negatively to soil fertility and thereby to affluence.

The most likely soils to impair are sandy ones with thin mould.

Why does soil degradation appear?

- ▶ erosion
- ▶ textural damage
- ▶ overdrying
- ▶ accumulation of water
- ▶ acidification
- ▶ excessive humus decline
- ▶ biological pollution
- ▶ permanent pollution

What does soil degradation produce?

- ▶ loss of productivity
- ▶ decrease crops
- ▶ deterioration of quality crops
- ▶ loss of biodiversity
- ▶ decline of agricultural grounds

What can we do to avoid soil degradation?

- ▶ right agricultural measures
- ▶ use crop rotation
- ▶ counteracting erosion
- ▶ remediation damage grounds
- ▶ use residual primary products
- ▶ reprocessing
- ▶ composting
- ▶ sewage treatment

Bibliography

- <https://oceantoday.noaa.gov/oilintheocean/>
- https://en.wikipedia.org/wiki/Groundwater_pollution#Causes
- <https://www.legjit.ng/1115666-environmental-pollution-nigeria-issues-solutions.html>
- voiceforsharks.blogspot.com/2015/12/our-trash-their-deaths-our-problem.html
- Cembrzyńska J., Krakowiak E., Brewczyński P.Z. (2012). Zanieczyszczenie powietrza pyłem zawieszonym PM10 oraz PM2.5 w warunkach silnej antropopresji na przykładzie miasta Sosnowiec. *Medycyna Środowiskowa – Environmental Medicine* 15 (4), 31-38
- Judy-Rezler K., Toczek B. (2016) Pyły drobne w atmosferze. Kompendium wiedzy o zanieczyszczeniu powietrza pyłem zawieszonym w Polsce. Biblioteka Monitoringu Środowiska, Warszawa
- Kaczmarczyk M., (red.) Niska emisja – od przyczyn występowania do sposobów eliminacji, Geosystem Burek, Kotyza s.c., Kraków 2015, s. 144
- Kłojzy-Kaczmarczyk B., Mazurek J. (2009) Zadania samorządów lokalnych w procesie likwidacji niskiej emisji. *Polityka Energetyczna* 12
- Majewski G., Łykowski B. (2008) Skład chemiczny pyłu zawieszonego PM10 w aglomeracji warszawskiej, *Acta Sci. Pol., Formatio Circumiectus* 7 (1), 81–96
- Markiewicz M., 2004. Podstawy modelowania rozprzestrzeniania się zanieczyszczeń w powietrzu atmosferycznym. Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa.
- PN-EN 14902:2010. Jakość powietrza atmosferycznego. Standardowa metoda oznaczania Pb, Cd, As i Ni we frakcji PM10 pyłu zawieszonego

- <https://airly.eu/en/everything-you-should-know-about-air-pollution>
- <https://solarimpulse.com/img/thematicpage/air-pollution-header.jpg>
- https://s3.amazonaws.com/marquee-test-akiaisur2rgicbmpehea/xQBxzccBRy6arZcPbO9c_smog7.jpg
- <https://airly.eu/static/c093583ba2cf3974c3deeee3b4c8ee02e/14dee/smog-definicja-skutki-i-przyczyny-1.jpg>
- <https://i.wpimg.pl/O/644x429/d.wpimg.pl/1490480852--1240739978/krakow-smog-smog-w.jpg>
- www.theozonehole.com
- www.nasa.gov
- smoglab.pl
- <https://interestingengineering.com/10-ways-humans-impact-the-environment>
- https://www.nationalgeographic.org/topics/resource-library-human-impacts-environment/?q=&page=1&per_page=25
- <https://www.ck12.org/earth-science/agriculture-and-human-population-growth/lesson/Agriculture-and-Human-Population-Growth-HS-ES/>
- <http://www.energy-physics.com/2013/07/Human-Activities-That-Harm-The-Environment.html>
- <https://www.businessinsider.com/heres-what-earth-might-look-like-in-100-years-if-were-lucky-2017-11?IR=T#for-example-the-temperature-in-the-arctic-circle-soared-above-freezing-for-one-day-in-2016-thats-extraordinarily-hot-for-the-arctic-those-types-of-abnormalities-will-start-happening-a-lot-more-5>
- <https://www.environment.gov.au/climate-change/climate-science-data/climate-science/greenhouse-effect>
- <https://climatekids.nasa.gov/greenhouse-effect/>
- <https://www.climateralityproject.org/blog/what-greenhouse-effect>
- <https://www.epa.gov/acidrain/what-acid-rain>
- <https://www.livescience.com/63065-acid-rain.html>
- <https://www.nationalgeographic.com/environment/global-warming/acid-rain/>
- <https://www.britannica.com/science/acid-rain/Chemistry-of-acid-deposition>
- <https://www.environment.nsw.gov.au/topics/land-and-soil/soil-degradation>
- <http://www.fao.org/soils-portal/soil-degradation-restoration/en/>
- <https://www.conserve-energy-future.com/causes-effects-solutions-soil-degradation.php>
- <https://www.worldwildlife.org/threats/soil-erosion-and-degradation>

- <https://www.nrdc.org/stories/water-pollution-everything-you-need-know?fbclid=IwAR11RT4K05PWSI4nTIPsPMHIXtqgcbiTh4Fx5ALNgSyaTnZnq3o4GCbOQUw>
- <http://www.kimointernational.org/de/action-areas/pollution-from-oil-and-gas/?fbclid=IwAR3jsFrf1MrXH6TATOh2rYRPeVTu2dAOL-PN49guxunAnVUFI29CSY-Tdxc>
- https://pyramidenvironmental.com/december-2017-newsletter-approaches-environmental-assessments/?fbclid=IwAR1HyEEKjIFsRcJbVrunLOML5y_fUYabL3PYWpo6hQTJMAx1IWu5ocDyEMA
- <https://www.ewg.org/tapwater/sourcesofwaterpollution.php?fbclid=IwAR3jsFrf1MrXH6TATOh2rYRPeVTu2dAOL-PN49guxunAnVUFI29CSY-Tdxc>
- https://oceana.org/blog/special-hospital-saves-sea-turtles-dying-ocean-trash-7?fbclid=IwAR1r0_DQ1fn21A10xYH61Pj2YSgOJ7aLngc8HFXAkIT0CqpnPuH6gH5O4ic
- https://virgoandco.co.uk/blogs/virgo-magazine/water-pollution-and-the-textiles-industry?fbclid=IwAR0gTztI9DFpbNT0HCK7qhXn-mt_FxcacMADpE45simEnDaqfM97JiKaAk
- http://bymnews.com/photos/displayimage.php?pos=-124206&fbclid=IwAR0yYs1_1K99EJfkBKf2skFVJgTn-0fLznSq2lkCqCOMXPPfoGN0ozHB9vA
- [https://pl.m.wikipedia.org/wiki/Degradacja_\(geologia\)](https://pl.m.wikipedia.org/wiki/Degradacja_(geologia))
- <https://www.kalendarzrolnikow.pl/2846/przyczyny-i-skutki-zakwaszania-gleb-oraz-jak-im-przeciwdzialac>
- <https://poradnikogrodniczy.pl/zakwaszanie-gleby.php>
- <https://www.agropolska.pl/uprawa/nawozenie/przyczyny-i-skutki-zakwaszania-gleb,157.html>
- <https://sciaga.pl/tekst/9113-10-przyczyny-degradacji-gleb-oraz-ich-ochrona>
- <https://www.farmer.pl/produkcja-roslinna/zniszczona-struktura-gleby,75257.html>
- http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=BIOREWIT_Slides_Lectures_PL.pdf
- <https://brainly.pl/zadanie/9105361>
- <http://jestemnaptak.pl/artykul/utrata-bioroznorodnosc>