Learn STEM

Innovative Model of learning STEM in secondary schools

School Education
ERASMUS+

KA220-SCH -
Cooperation partnerships in school education

Reference Number:
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Duration:
31.12.2022 to 30.12.2024 (24 months)

LearnSTEM
Innovative Model of learning STEM in secondary schools

Learning resources

Topic II: "Pollution"
Learning Unit: "Acid Rain – Control acidity and PH values of lakes and puddles liquates in the kitchen and tap water"
by Greece

IEK Kavalas, Kavala, Greece
Kalliopi Ntolou

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Content

1. What is pH?
2. Acids and Bases
3. Why is pH Important?
4. What is Acid Rain?
5. Causes of acid rain
6. Effects of acid rain
7. What can be done?

What is pH?

pH is a determined value based on a defined scale, similar to temperature.

This means that pH of water is not a physical parameter that can be measured as a concentration or in a quantity.

Instead, it is a figure between 0 and 14 defining how acidic or basic a body of water is along a logarithmic scale .

The lower the number, the more acidic the water is.

The higher the number, the more basic it is. A pH of 7 is considered neutral.

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Acids and Bases

Acid-base pairs can neutralize each other like H+ and OH- do in this equation.

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As an operational definition, an acid is a substance that will decrease pH when added to pure water. In the same manner, a base is a substance that will increase the pH of water .

To further define these substances, Arrhenius determined in 1884 that an acid will release a hydrogen ion (H+) as it dissolves in water, and a base will release a hydroxyl ion (OH-) in water.

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Acids and Bases

However, there are some substances that fit the operational definition (altering pH), without fitting the Arrhenius definition (releasing an ion).

To account for this, Bronsted and Lowry redefined acids and bases; an acid releases a hydrogen ion or proton (equivalent to H+) and a base accepts a hydrogen ion or proton.

This means that acids and bases can cancel each other out, as shown in the water equation to the right.

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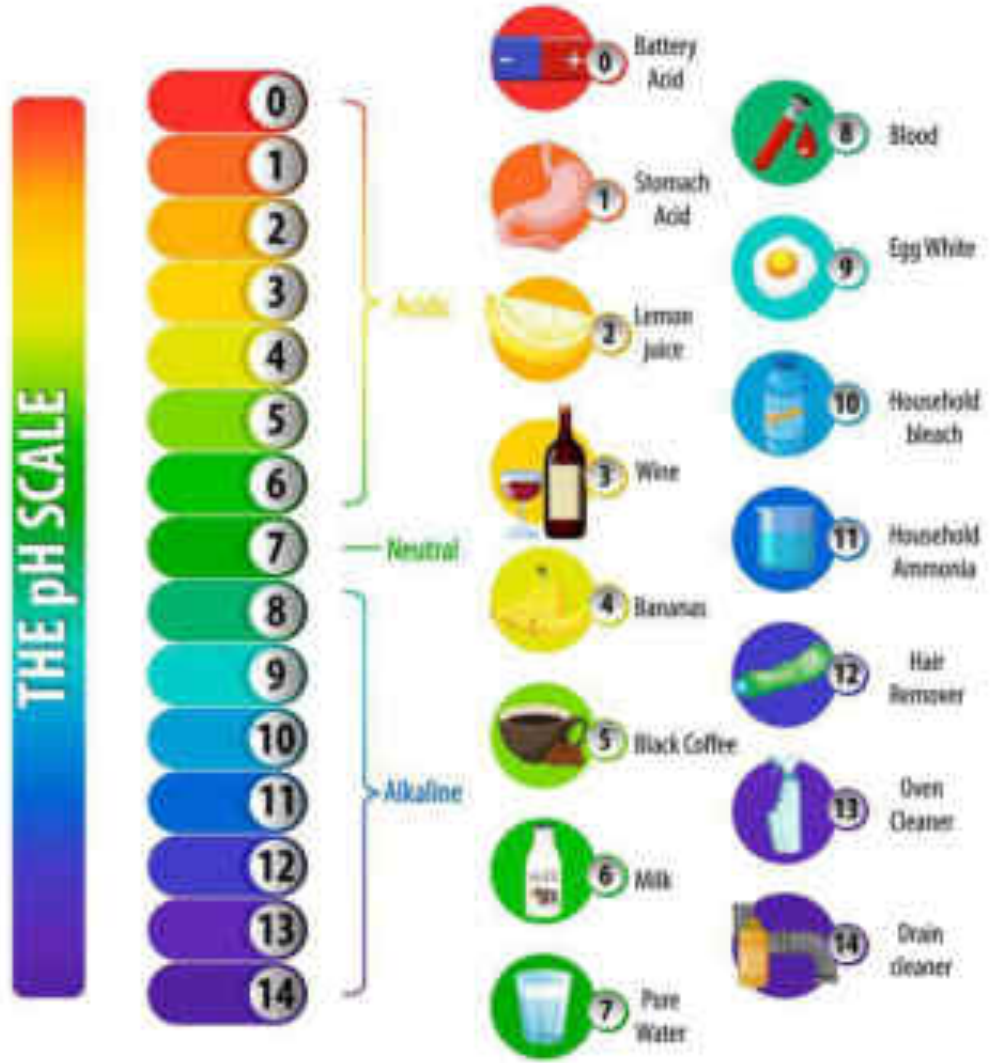
Why is pH Important?

If the pH of water is too high or too low, the aquatic organisms living within it will die. pH can also affect the solubility and toxicity of chemicals and heavy metals in the water.

The majority of aquatic creatures prefer a pH range of 6.5-9.0, though some can live in water with pH levels outside of this range.



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Why is pH Important?

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Why is pH Important?

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As pH levels move away from this range (up or down) it can stress animal systems and reduce hatching and survival rates. The further outside of the optimum pH range a value is, the higher the mortality rates.

The more sensitive a species, the more affected it is by changes in pH. In addition to biological effects, extreme pH levels usually increase the solubility of elements and compounds, making toxic chemicals more “mobile” and increasing the risk of absorption by aquatic life.

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Why is pH Important?

Aquatic species are not the only ones affected by pH. While humans have a higher tolerance for pH levels (drinkable levels range from 4-11 with minimal gastrointestinal irritation), there are still concerns.

pH values greater than 11 can cause skin and eye irritations, as does a pH below 4. A pH value below 2.5 will cause irreversible damage to skin and organ linings.

Lower pH levels increase the risk of mobilized toxic metals that can be absorbed, even by humans, and levels above 8.0 cannot be effectively disinfected with chlorine, causing other indirect risks.

In addition, pH levels outside of 6.5-9.5 can damage and corrode pipes and other systems, further increasing heavy metal toxicity.

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Why is pH Important?

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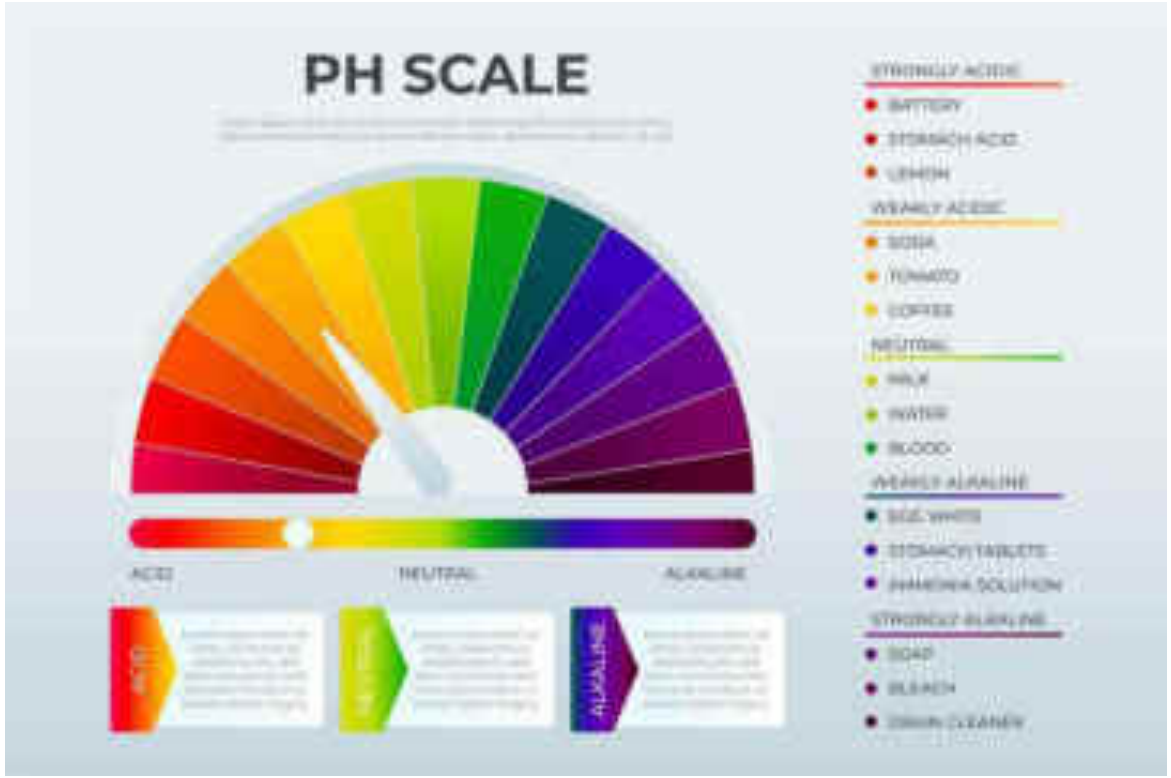

Even minor pH changes can have long-term effects. A slight change in the pH of water can increase the solubility of phosphorus and other nutrients – making them more accessible for plant growth. In an oligotrophic lake, or a lake low in plant nutrients and high in dissolved oxygen levels, this can cause a chain reaction.

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Why is pH Important?

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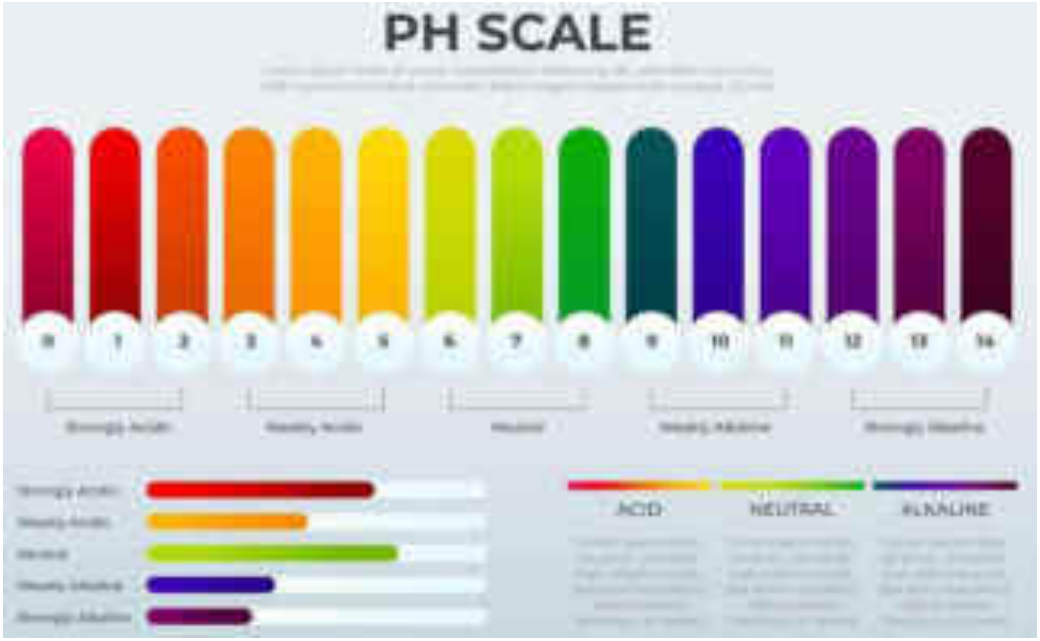

With more accessible nutrients, aquatic plants and algae thrive, increasing the demand for dissolved oxygen.

This creates a eutrophic lake, rich in nutrients and plant life but low in dissolved oxygen concentrations.

In a eutrophic lake, other organisms living in the water will become stressed, even if pH levels remained within the optimum range.

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Factors that Influence the pH of Water

There are many factors that can affect pH in water, both natural and man-made. Most natural changes occur due to interactions with surrounding rock (particularly carbonate forms) and other materials. pH can also fluctuate with precipitation (especially acid rain) and wastewater or mining discharges. In addition, CO2 concentrations can influence pH levels.

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Carbon Dioxide and pH

pH levels can fluctuate daily due to photosynthesis and respiration in the water. The degree of change depends on the alkalinity of the water.

Carbon dioxide is the most common cause of acidity in water. Photosynthesis, respiration and decomposition all contribute to pH fluctuations due to their influences on CO2 levels. The extremity of these changes depends on the alkalinity of the water, but there are often noticeable diurnal (daily) variations. This influence is more measurable in bodies of water with high rates of respiration and decomposition.

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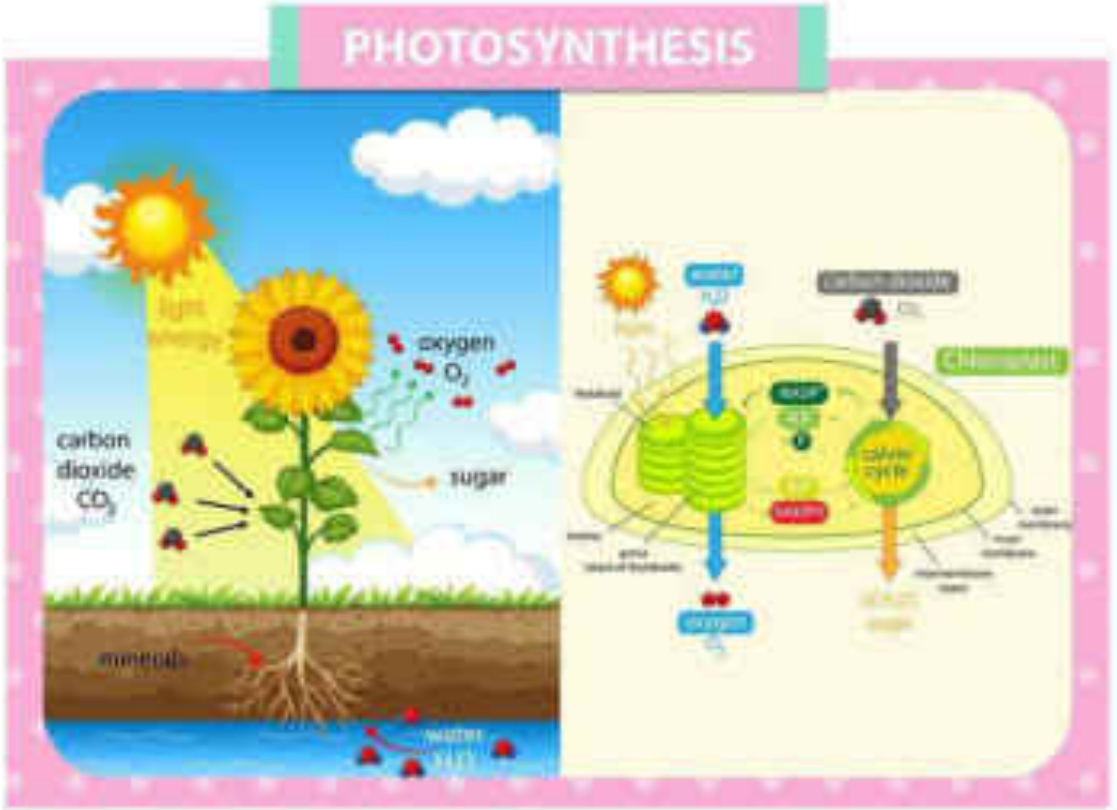

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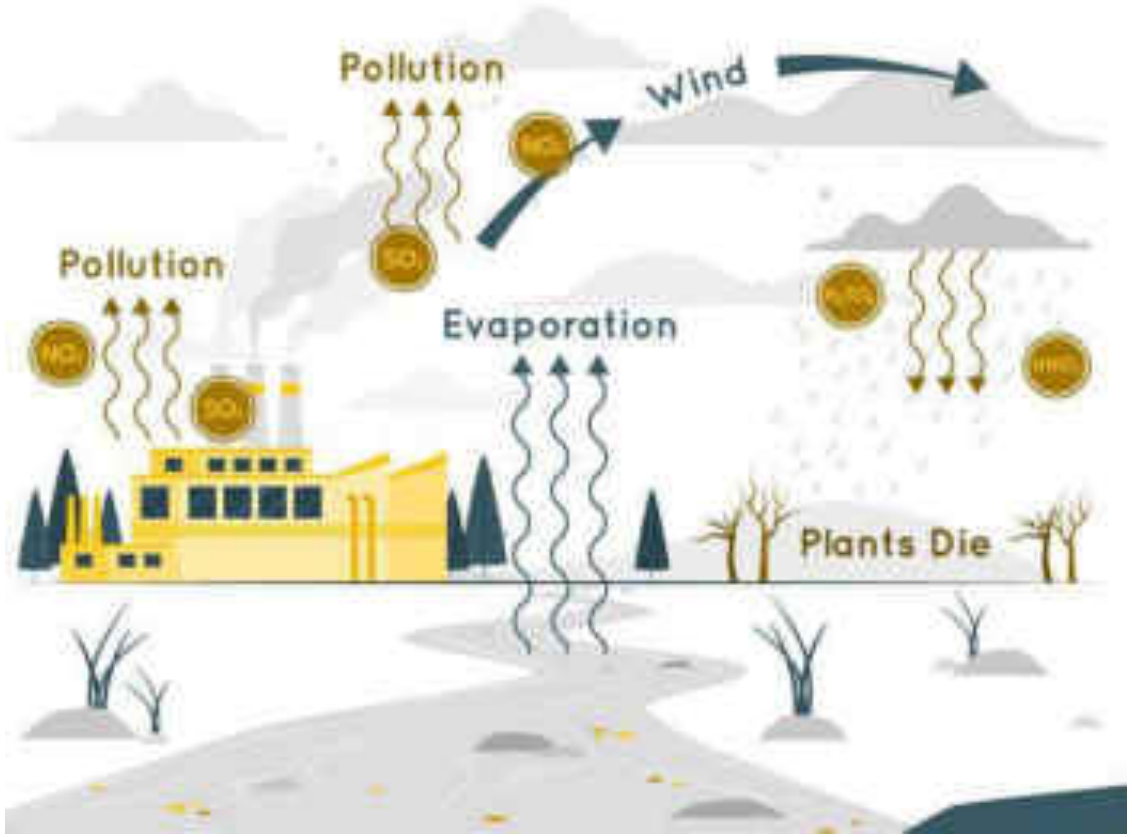
What is Acid Rain?

Acid rain describes any form of precipitation that contains high levels of nitric and sulfuric acids. It can also occur in the form of snow, fog, and tiny bits of dry material that settle to Earth.

Acid rain has an acidity of around 4, which is 1000 times more acidic than normal rain.

Normal rain is slightly acidic, with a pH of 5.6, while acid rain generally has a pH between 4.2 and 4.4.



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What is Acid Rain?

Rain has a pH of approximately 5.65. As raindrops fall through the air, they interact with carbon dioxide molecules in the atmosphere. This creates H2CO3 in the raindrops, lowering the rain's pH value.

A pH level of 5.65, though acidic, is not considered acid rain.

Natural, unpolluted rain or snow is expected to have pH levels near 5.6, assuming a standard atmospheric CO2 concentration of 0.0355%.

Acid rain requires a pH below 5.0.

5.65 is also the pH of water that has equilibrated with the air and has not come in contact with carbonate materials or limestone.

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Causes of acid rain

Rotting vegetation and erupting volcanoes release some chemicals that can cause acid rain, but most acid rain is a product of human activities.

The biggest sources are coal-burning power plants, factories, and automobiles.

When humans burn fossil fuels, sulfur dioxide (SO2) and nitrogen oxides (NOx) are released into the atmosphere. Those air pollutants react with water, oxygen, and other substances to form airborne sulfuric and nitric acid.

Winds may spread these acidic compounds through the atmosphere and over hundreds of miles. When acid rain reaches Earth, it flows across the surface in runoff water, enters water systems, and sinks into the soil.

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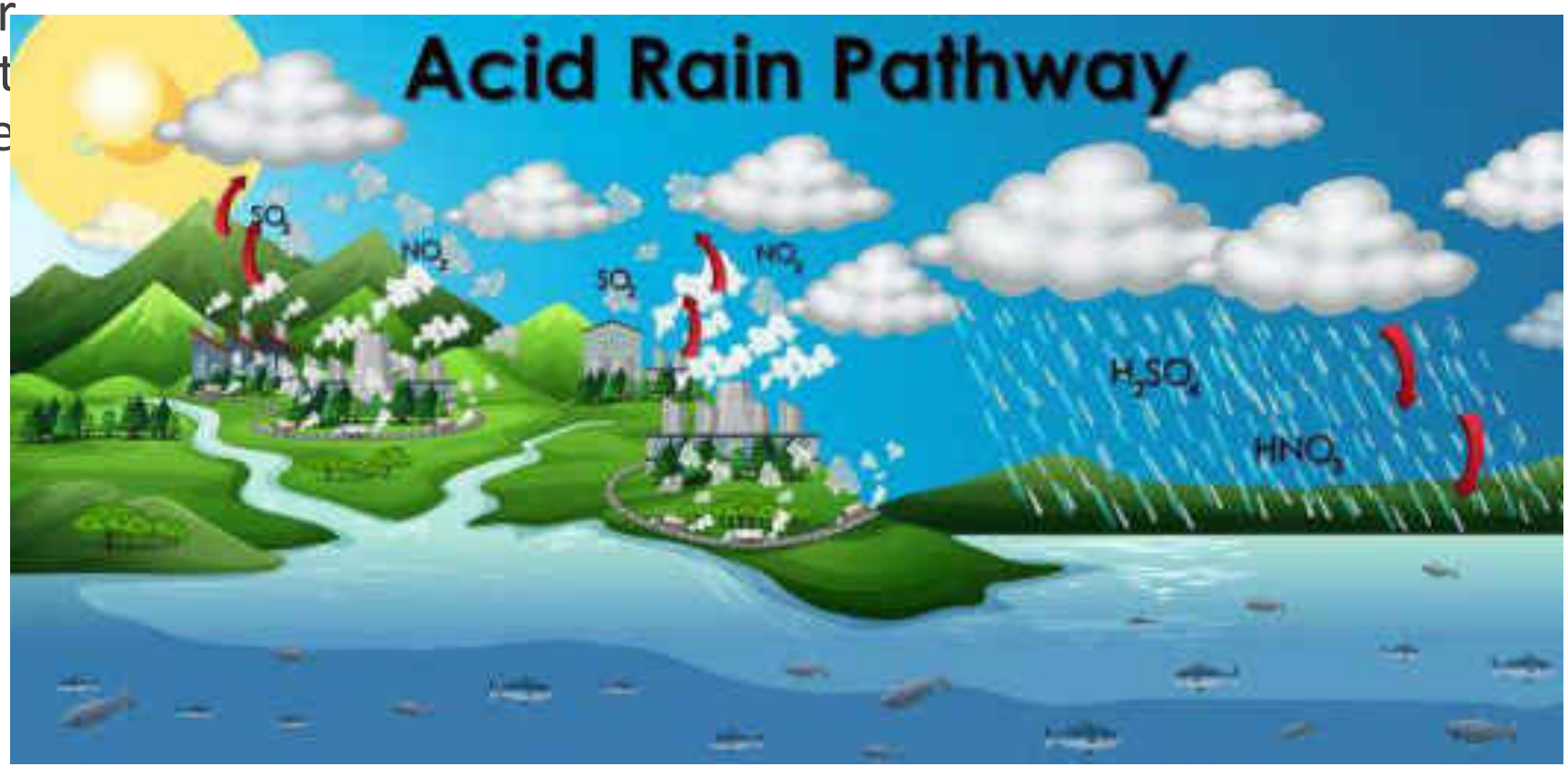
Causes of acid rain

The following infographic might help better understand what acid rain is and what are its effects:



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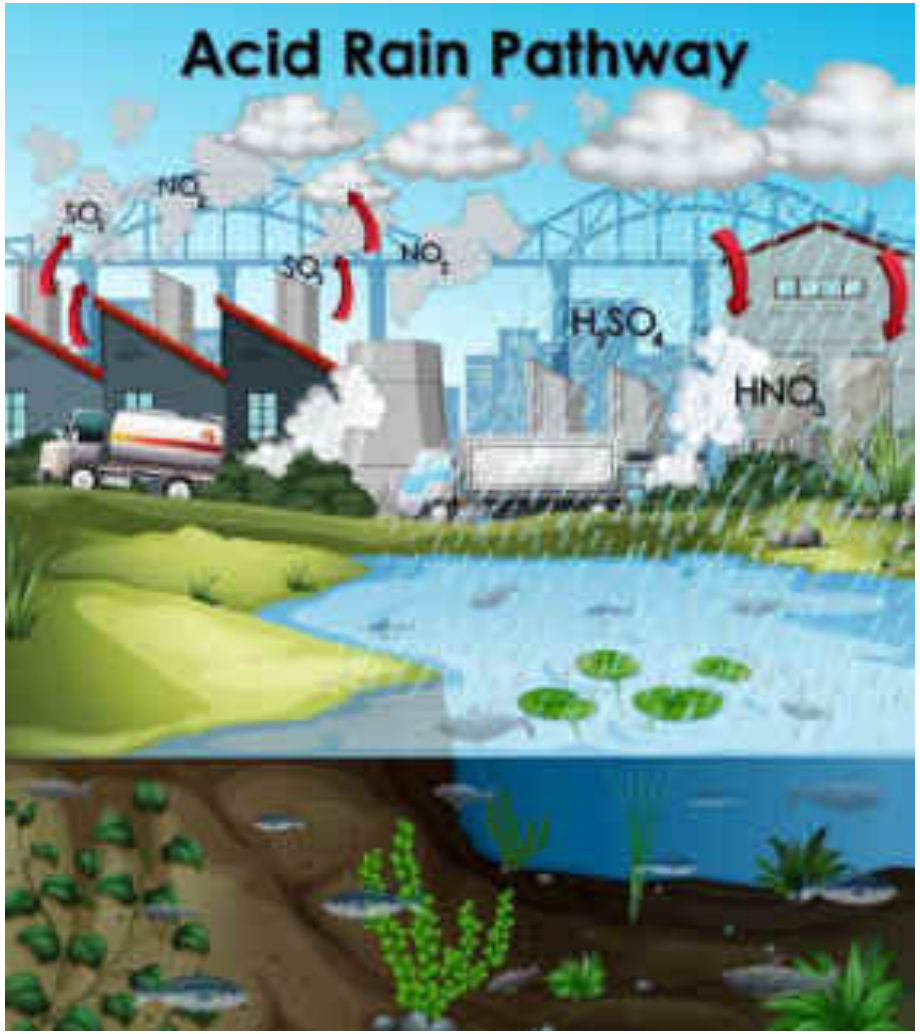
Effects of acid rain

Sulfur dioxide and nitrogen oxides are not primary greenhouse gases that contribute to global warming, one of the main effects of climate change; in fact, sulfur dioxide has a cooling effect on the atmosphere.

But nitrogen oxides contribute to the formation of ground-level ozone, a major pollutant that can be harmful to people.

Both gases cause environmental and health concerns because they can spread easily via air pollution and acid rain.



https://www.freepik.com/free-vector/acid-rain-diagram-with-buildings-water_5768054.htm#fromView=search&page=1&position=5&uuid=2a61f708-0056-4ea3-8e7e-23b9e9868150

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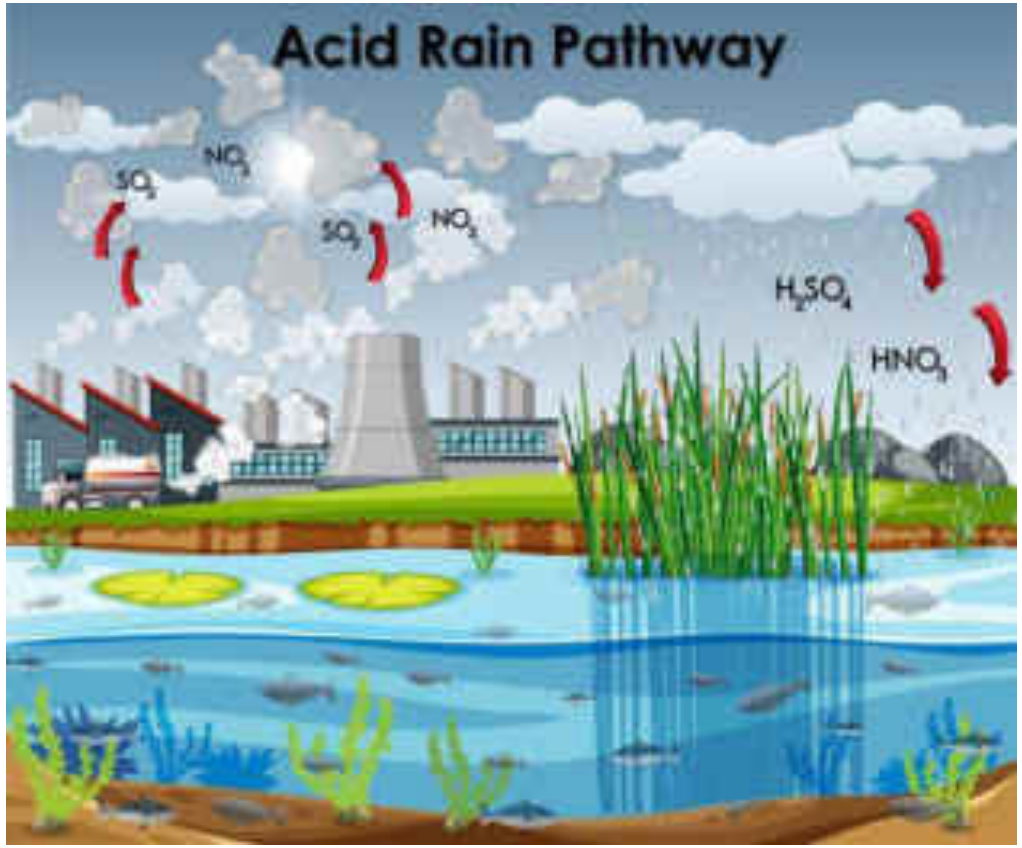
Effects of acid rain



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Acid rain has many ecological effects, especially on lakes, streams, wetlands, and other aquatic environments.

Acid rain makes such waters more acidic, which results in more aluminum absorption from soil, which is carried into lakes and streams. That combination makes waters toxic to crayfish, clams, fish, and other aquatic animals.

Effects of acid rain

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Oceans can lose biodiversity and productivity. The lowering of the pH of marine waters harms phytoplankton, a food source for different organisms and animals, which can modify the food chain and lead to the extinction of different marine species.

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Effects of acid rain

Photo by Stockcake

Inland waters are also acidifying at a very rapid rate, which is particularly worrying as although only 1% of the planet's water is fresh, 40% of fish live in it.

This acidification increases the concentration of metal ions — mainly aluminium ions — which could lead to the death of many fish, amphibians and aquatic plants in acidified lakes. In addition, heavy metals are transported to underground waters, which become unsuitable for consumption.

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Effects of acid rain

Some species can tolerate acidic waters better than others.

However, in an interconnected ecosystem, what affects some species eventually affects many more throughout the food chain, including non-aquatic species such as birds.

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Effects of acid rain

Acid rain and fog also damage forests, especially those at higher elevations.

The acid deposits rob the soil of essential nutrients such as calcium and cause aluminum to be released in the soil, which makes it hard for trees to take up water.

Trees' leaves and needles are also harmed by acids.

In forests, the low pH level of the soil and the concentration of metals such as aluminium prevent vegetation from properly absorbing the water and nutrients it needs. This damages roots, slows growth and makes plants weaker and more vulnerable to diseases and pests.

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Effects of acid rain

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The effects of acid rain, combined with other environmental stressors, leave trees and plants less healthy, more vulnerable to cold temperatures, insects, and disease. The pollutants may also inhibit trees' ability to reproduce.

Some soils are better able to neutralize acids than others. But in areas where the soil's "buffering capacity" is low, the harmful effects of acid rain are much greater.

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Effects of acid rain

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Acid rain also affects artistic, historical and cultural heritage. In addition to corroding metallic elements of buildings and infrastructures, it deteriorates the external appearance of monuments.

The greatest damage occurs to calcareous constructions, such as marble, which gradually dissolve due to the effect of acids and water.

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Effects of acid rain

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Statue of Liberty which is made of copper has also been damaged by the cumulative action of acid rain and oxidation for over 30 years and is, therefore, becoming green.

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Effects of acid rain

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Acid deposits damage physical structures such as limestone buildings and cars.

And when it takes the form of inhalable fog, acid precipitation can cause health problems including eye irritation and asthma.

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What can be done?

The only way to fight acid rain is by curbing the release of the pollutants that cause it. This means burning fewer fossil fuels and setting air-quality standards.

Since we are its main cause, the solution to the problem of the acidification of the environment is in the hands of humans: to mitigate acid rain, it is essential to reduce pollutant emissions. For this, there needs to be a commitment at government and corporate level to drive a series of measures:

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What can be done?

- Filter and detoxify the water used by the factories before returning it to the rivers.
- Reduce the emission of pollutant gases by industry.
- Encourage the production and use of renewable energy instead of fossil fuels.
- Reduce the energy consumption of factories and companies.
- Promote innovation and new technologies aimed at optimising energy consumption and developing renewable energy.
- Plant trees to absorb polluted air.
- Make the population aware of the importance of reducing household energy consumption.
- Encourage the use of the electric vehicles and other non-polluting vehicles, such as bicycles.

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Learning Unit:
"Fertilizer, Acid rain and algae growth"
by Greece

IEK Kavalas, Kavala, Greece
Kalliopi Ntolou

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Content

1. What are Algae?
2. Nutrient pollution
3. Eutrophication: Scope, Causes and Consequences
4. Anthropogenic Eutrophication
5. Harmful Algal Blooms
6. Acid rain and algae growth
7. How can we reduce nutrient pollution?

What are Algae?

Algae exist in environments ranging from oceans, rivers, and lakes to ponds, brackish waters and even snow.

Algae are usually green, but they can be found in a variety of different colours.

For instance, algae living in snow contain carotenoid pigments in addition to chlorophyll, hence giving the surrounding snow a distinctive red hue.

Photo by Stockcake

What are Algae?

So, algae are a diverse group of single celled, plant-like organisms that appear in a wide range of environmental habitats. They're photoautotrophic cells that contain chlorophyll, have simple reproductive structures, and their tissue isn't differentiated by roots, stems, or leaves.

The term algae covers a variety of organisms that produce oxygen through photosynthesis. It's estimated that about 70-80% of the oxygen we breathe is produced by these organisms. Besides, algae provide food for fish and other aquatic animals.

Photo by Stockcake

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Size range and diversity of structure

The size range of the algae spans seven orders of magnitude.

Many algae consist of only one cell, while the largest have millions of cells. In large, macroscopic algae, groups of cells are specialized for specific functions, such as anchorage, transport, photosynthesis, and reproduction; such specialization indicates a measure of complexity and evolutionary advancement.

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Size range and diversity of structure

The algae can be divided into several types based on the morphology of their vegetative, or growing, state. Filamentous forms have cells arranged in chains like strings of beads. Some filaments (e.g., *Spirogyra*) are unbranched, whereas others (e.g., *Stigeoclonium*) are branched and bush like. In many red algae (e.g., *Palmaria*), numerous adjacent filaments joined laterally create the gross morphological form of the alga. Parenchymatous (tissue like) forms, such as the giant kelp (*Macrocystis*), can measure many metres in length. Coenocytic forms of algae, such the green seaweed *Codium*, grow to fairly large sizes without forming distinct cells. Coenocytic algae are essentially unicellular, multinucleated algae in which the protoplasm (cytoplasmic and nuclear content of a cell) is not subdivided by cell walls. Some algae have flagella and swim through the water.

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Distribution and abundance

Algae are almost ubiquitous throughout the world and can be categorized ecologically by their habitats.

- Planktonic algae are microscopic and grow suspended in the water, whereas neustonic algae grow on the water surface and can be micro- or macroscopic.
- Cryophilic algae occur in snow and ice (see red snow);
- thermophilic algae live in hot springs;
- edaphic algae live on or in soil; epizoic algae grow on animals, such as turtles and sloths;

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Distribution and abundance

- epiphytic algae grow on fungi, land plants, or other algae;
- corticolous algae grow on the bark of trees;
- epilithic algae live on rocks;
- endolithic algae live in porous rocks or coral;
- and chasmolithic algae grow in rock fissures.

Some algae live inside other organisms, and in a general sense these are called endosymbionts. Specifically, endozoic endosymbionts live in protozoa or animals such as shelled gastropods, whereas endophytic endosymbionts live in fungi, plants, or other algae.

Photo by Stockcake

Distribution and abundance

Algal abundance and diversity vary from one environment to the next, just as land plant abundance and diversity vary from tropical forests to deserts. Terrestrial vegetation (plants and algae) is influenced most by precipitation and temperature, whereas aquatic vegetation (primarily algae) is influenced most by light and nutrients.

When nutrients are abundant, as in some polluted waters, algal cell numbers can become great enough to produce obvious patches of algae called “blooms” or “red tides,” which can deplete the oxygen content in the water and poison aquatic animals and waterfowl.

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Nutrient pollution

Nutrient pollution is the process where too many nutrients, mainly nitrogen and phosphorus, are added to bodies of water and can act like fertilizer, causing excessive growth of algae.

Nutrients can run off of land in urban areas where lawn and garden fertilizers are used.

Nutrient pollution is one of most widespread, costly and challenging environmental problems.

Nutrients are chemical elements that all living organisms—plants and animals—need to grow. When too much nitrogen and phosphorus enter the environment—usually from a wide range of human activities—the air and water can become polluted.

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Sources of Nutrient Pollution

The primary sources of nutrient pollution are fertilizer, animal manure, sewage treatment plant discharge, detergents, storm water runoff, cars and power plants, failing septic tanks and pet waste.

In some places nutrients from row crops, large farms and concentrated animal feeding operations contribute the most nutrient pollution.

Photo by Stockcake

Sources of Nutrient Pollution

For as long as humans have lived near waterways, they have also used them to wash away and dilute societies wastes and pollutants.

But with growing populations and increased production and consumption, this long tradition of flushing wastes down-stream has begun to overwhelm the cleansing capacities of the Earth's waters.

Pollutant inputs have increased in recent decades, and the result has been degradation of water quality in many rivers, lakes and coastal oceans.

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Sources of Nutrient Pollution

The most common impairment of surface waters

is eutrophication caused by excessive inputs

of phosphorus (P) and nitrogen (N). Impaired waters are

defined as those that are not suitable for designated uses such as drinking, irrigation, industry, recreation, or fishing.

Eutrophication accounts for about half of the impaired lake area and 60% of the impaired river and is also the most widespread pollution problem.

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Eutrophication: Scope and Causes

Eutrophication means the fertilization of sur-

face waters by nutrients that were previously scarce.

Today human activities are greatly accelerating the process.

Freshwater eutrophication has been a growing problem for decades.

Both P and N supplies contribute to it, although for many lakes excessive P inputs are the primary cause.

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Eutrophication: Scope and Causes

Within the past 50 years, eutrophication — the over-enrichment of water by nutrients such as nitrogen phosphorus — has emerged as one of the leading causes of water quality impairment.

The two most acute symptoms of eutrophication are hypoxia (or oxygen depletion) and harmful algal blooms, which among other things can destroy aquatic life in affected areas.

Photo by Stockcake

Consequences

Eutrophication has many negative effects on aquatic ecosystems. Perhaps the most visible consequence is the proliferation of algae, which can turn water a turbid green and coat shallower surfaces with pond scum. This increased growth of algae and also aquatic weeds can degrade water quality and interfere with use of the water for fisheries, recreation, industry, agriculture, and drinking.

Photo by Stockcake

Consequences

As overabundant nuisance plants die,
bacterial decomposers proliferate;
as they work to break down this plant matter,
the bacteria consume more dissolved oxygen from the water.
The result can be oxygen shortages that cause fish
kills. Eutrophication can lead to loss of habitats such
as aquatic plant beds in fresh and marine waters and
coral reefs along tropical coasts.
Thus, eutrophication
plays a role in the loss of aquatic biodiversity.

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Anthropogenic Eutrophication

Anthropogenic eutrophication is caused by human activity – Agricultural farms, golf courses, lawns, etc. are supplied with nutrients by humans in the form of fertilizers. These fertilizers are washed away by rains and eventually find their way into water bodies such as lakes and rivers.

When introduced to an aqueous ecosystem, the fertilizers supply plentiful nutrients to algae and plankton, resulting in the eutrophication of the water body.

Photo by Stockcake

Anthropogenic Eutrophication

Overpopulation places a huge demand on industrial and agricultural expansion, which in turn leads to deforestation. When this occurs, the soil erodes more easily, resulting in increased soil deposits in water bodies. If the soil is rich in phosphorus, it can lead to eutrophication and severely damage the ecosystem in and around the water body.

When sewage pipes and industrial wastes are directed to water bodies, the nutrients present in the sewage and other wastes increase the rate at which eutrophication occurs.

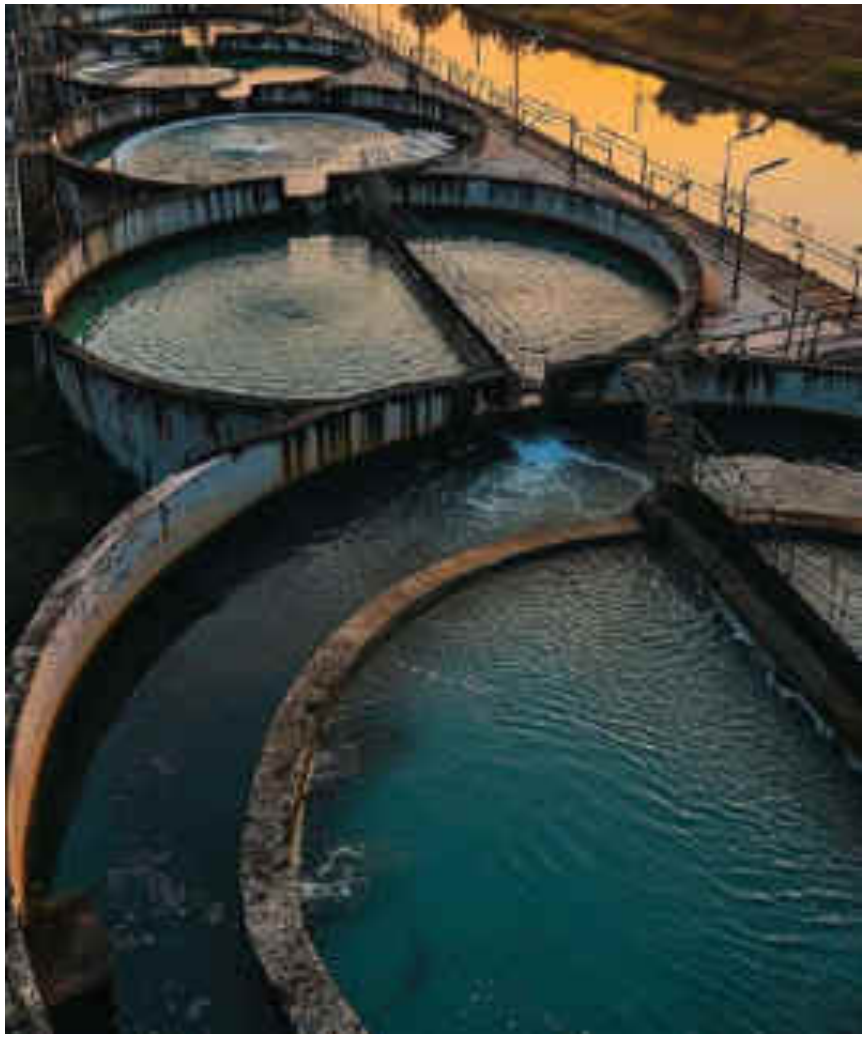

Photo by Stockcake

Harmful Algal Blooms

Harmful algal blooms can cause fish kills, human illness through shellfish poisoning, and death of marine mammals and shore birds. Harmful algal blooms are often referred to as “red tides” or “brown tides” because of the appearance of the water when these blooms occur.

One red tide event, which occurred near Hong Kong in 1998, wiped out 90 percent of the entire stock of Hong Kong’s fish farms and resulted in an estimated economic loss of $40 million USD.

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Hypoxia

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Hypoxia, considered to be the most severe symptom of eutrophication, occurs when algae and other organisms die, sink to the bottom, and are decomposed by bacteria, using the available dissolved oxygen.

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Hypoxia

Salinity and temperature differences between surface and subsurface waters lead to stratification, limiting oxygen replenishment from surface waters and creating conditions that can lead to the formation of a hypoxic or “dead” zone.

The formation of dead zones can lead to fish kills and benthic mortality. Because benthic organisms are bottom dwelling and cannot easily flee low-oxygen zones, they are often the most severely impacted.

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Where do nutrients come from?

Nutrient pollution released to freshwater and coastal areas comes from many diverse sources including agriculture, aquaculture, septic tanks, urban wastewater, urban storm water runoff, industry, and fossil fuel combustion.

Nutrients enter aquatic ecosystems via the air, surface water, or groundwater.

Photo by Stockcake

Agricultural Sources

Agricultural nutrient sources include fertilizer leaching and runoff from agricultural fields; manure and aquaculture operations.

Photo by Stockcake

Chemical fertilizers

Between 1960 and 1990, global use of synthetic nitrogen fertilizer increased more than sevenfold, while phosphorus use more than tripled. Studies have shown that fertilizers are often applied in excess of crop needs. The excess nutrients are lost through volatilization (when nitrogen vaporizes in the atmosphere in the form of ammonia), surface runoff and leaching to groundwater.

On average, about 20 percent of nitrogen fertilizer is lost through surface runoff or leaching into groundwater. Synthetic nitrogen fertilizer and nitrogen in manure that is spread on fields is also subject to volatilization. Under some conditions, up to 60 percent of the nitrogen applied to crops can be lost to the atmosphere by volatilization, more commonly, volatilization losses are 40 percent or less.

A portion of the volatilized ammonia is redeposited in waterways through atmospheric deposition. Phosphorus, which binds to the soil, is generally lost through soil erosion from agricultural lands.

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Aquaculture

Aquaculture (fish farming) is another growing source of nutrient pollution. Annual aquaculture production worldwide increased by 600 percent in twenty years. Today nearly 43 percent of all aquaculture production is within marine or brackish environments, with the remainder in freshwater lakes, streams, and man-made ponds. These farms generate concentrated amounts of nitrogen and phosphorus from excrement, uneaten food, and other organic waste.

If improperly managed, aquaculture operations can have severe impacts on aquatic ecosystems as nutrient wastes are discharged directly into the surrounding waters.

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Urban and Industrial Sources

Municipal wastewater treatment plants and industrial wastewater discharges, nitrogen leaching from below-ground septic tanks, and stormwater runoff are some of the urban and industrial sources of nutrient pollution.

Municipal and industrial sources are considered “point sources” of nutrient pollution because they discharge nutrients directly to surface waters or groundwater via a pipe or other discrete conveyance.

They are typically the most controllable sources of nutrients and are often regulated in developed countries.

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Urban and Industrial Sources

Photo by Stockcake

The most prevalent urban source of nutrient pollution is human sewage, though its importance varies by region and country.

Stormwater runoff is another significant source of nutrients from urban areas. Rainfall events flush nutrients from residential lawns and impervious surfaces into nearby rivers and streams.

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Urban and Industrial Sources

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For industrial sources of nutrient pollution, certain industries are larger sources than others. Pulp and paper mills, food and meat processing, agro-industries, and direct discharge of sewage from maritime vessels are some of the larger sources of industrial nutrient pollution.

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Urban and Industrial Sources

As it is already explained, algae grows naturally in ponds, lakes, seas etc. and is a normal part of the ecosystem of them.

Photo by Stockcake

Urban and Industrial Sources

Photo by Stockcake

However, certain pollutants can affect the growth of algae. Phosphorus is one of the most important nutrients for plant growth, but if too much phosphorus makes its way into a pond, river, or lake, it can cause the algae and other aquatic plants to explode in growth. They use up all the oxygen in the water and suffocate out other life forms like frogs and fish.

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Urban and Industrial Sources

Acid rain is another problematic pollutant. If the pH level is outside of the normal range in water, then it kills off the algae and other living things.

Acid rain increases the acidity of lake water. This causes changes in the assemblages of plant and animals that occur naturally in the lake.

An acid-stressed lake is typically very clear, with filamentous algae along the bottom and reduced fish population.

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Urban and Industrial Sources

Acid Rain will decrease the available carbon within an aquatic ecosystem and make the body of water more acidic. This shifts the species composition of algae to only acidophilic forms (acid tolerant).

An increase in the acidity of water initially causes a general increase in algae.

However, high levels of water acidity due to pollution by acid-forming chemicals or acid rains result in a decrease in planktonic algae in the water body.

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Urban and Industrial Sources

Photo by Stockcake

Farmers put fertilizers on their fields to help their crops grow. But if the fields have too much water runoff then that fertilizer becomes a pollutant in nearby streams and rivers.

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How can we reduce nutrient pollution?

A major solution to the problem of eutrophication lies in the adoption of more sustainable farming practices.

Applying fertilizers in the proper amount, at the right time of year and with the right method can significantly reduce how much fertilizer reaches water bodies.

Keeping animals and their waste out of streams keeps nitrogen and phosphorus out of the water and protects stream banks.

Photo by Stockcake

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Learn STEM

Innovative Model of learning STEM in secondary schools

School Education
ERASMUS+

KA220-SCH -
Cooperation partnerships in school education

Reference Number:
2022-1-TR01-KA220-SCH-000087583

Duration:
31.12.2022 to 30.12.2024 (24 months)

LearnSTEM
Innovative Model of learning STEM in secondary schools

Learning resources

Topic II: “Pollution”

Learning Unit: “Sulfur Dioxide Destroys Plants and Buildings” by Greece

IEK Kavalas, Kavala, Greece
Kalliopi Ntolou

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Content

1. What is sulphur dioxide
2. Where does sulfur dioxide come from?
3. Where are the world's highest SO2 concentrations?
4. What is the environmental impact of sulphur dioxide?
5. What is the health impact of sulphur dioxide?
6. How might people be exposed to sulfur dioxide?
7. Effects of SO2 on vegetation
8. Impacts of Acid Rain on Buildings
9. How can sulphur dioxide emissions be lessened?

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What is sulphur dioxide?

Sulphur dioxide (SO2) is a heavy, colourless, and poisonous gas with a pungent and irritating odour. Its smell is often described similar to that of a burnt matchstick. The gas forms secondary particulate matter when it oxidizes to sulphuric acid (H2SO4) by combining with water vapour. It also reacts with ammonia (NH3) to create another dangerous compound called ammonium sulphate ((NH4)2SO4).

SO2 also contributes to sulphurous smog, which results from a high concentration of sulfur oxides (SOx) in the atmosphere and is exacerbated by dampness and particulate matter.

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Where does sulfur dioxide come from?

Sulfur dioxide can be dangerous and poisonous, and research has shown that it can be harmful to people, and the environment. However, it is found naturally in the environment and we use it in a wide variety of ways — from preserving yummy fresh fruit to cleaning our toilets with bleach!

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What about the natural environment?

Sulfur dioxide can occur naturally in the environment through geothermal activity, which is energy from the heat of the earth, such as hot springs and volcanoes. Sulfur dioxide is also produced when vegetation on land, in wetlands and in oceans decays or breaks down.

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What about industry?

Industries that carry out activities such as wood pulping, paper manufacturing, petroleum and metal refining and metal smelting, especially of ores containing sulfides, such as lead, silver and zinc, all emit sulfur dioxide into the air. Fossil fuel combustion, such as in coal-burning power plants, also emits sulfur dioxide.

Photo by Stockcake

What about transport?

Sulfur dioxide may be present in exhaust fumes emitted into the atmosphere by cars, buses and trucks.

Wouldn't it be great if everyone walked or rode bicycles to get around?

Just imagine how much less sulfur dioxide there would be in our atmosphere!

Photo by Stockcake

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What about in the products we buy?

Common products containing sulfur dioxide include foods, such as dried fruit, preserved fruit, food preservatives, as well as wine, bleach, disinfectant and fumigants which are used to control pests.

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What are some of the other sources?

Textile bleaching, wineries, and fumigation, where fruit growers and farmers spray their crops to keep insects away, are also sources of sulfur dioxide.

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What are some of the other sources?

Summarizing, sulphur dioxide is released into the atmosphere through:

- Burning fossil fuels (coal, oil) for domestic heating, transport (locomostives, ships), power plants, and other industrial facilities
- Smelting mineral ores that contain sulphur (iron pyrite, copper pyrite)
- Natural volcanic activity

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Where are the world's highest SO2 concentrations?

The world's sulfur dioxide hotspots are:

- India as the largest emitter of SO2 in the world, contributing more than 21% of global emissions mainly coming from coal-based electricity generation.
- Russia as the second largest emitter of SO2, causing approximately 12% of global emissions. Most of the SO2 emissions stem from smelters (75%), followed by oil and gas (15%), and coal (10%).
- China emitted approximately 8% of global SO2 emissions – mainly stemming from its coal-fired power generation, which has the largest capacity in the world.

There is a relationship between nations' wealth and their emission trends: Less wealthy countries tend to have faster sulfur dioxide emission growth rates while high-income countries tend to have slower growth rates.

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What is the environmental impact of sulphur dioxide?

As mentioned earlier, sulphur dioxide is capable of turning into sulphuric acid (H2SO4), which is a major component of acid rain. Acid rain has many harmful effects, such as:

- Acidifying aquatic ecosystems (lakes, streams, wetlands), which lowers biodiversity by killing plants and animals
- Deforestation through the damaging of vegetation
- Depriving the soil of essential nutrients (calcium, aluminum, magnesium)
- Corroding buildings and materials

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What is the environmental impact of sulphur dioxide?

Classed as a pollutant by the Environmental Protection Agency, SO2 is a toxic gas that poses a threat to both environmental and human health.

Sulfur dioxide can have serious effects on environment. It is absorbed by soils and plants, affecting land and water ecosystems, and it can even be captured within and below clouds, which increases the chance of acid rain.

Even small amounts of sulfur dioxide can harm plants and trees and slow down their growth, so farmers have fewer crops to harvest.

Photo by Stockcake

Air quality and visibility

SO2 is just one of several sulphur oxides that can react with other atmospheric compounds to form fine particulate matter. This can create a low-lying haze that can reduce visibility, block out sunlight and compromise plant growth. It's not just cities that suffer from SO2 related haze, with many wilderness areas and national parks in the United States also plagued by air pollution.

The long-term effects of atmospheric SO2 are visible to the naked eye, with experts warning that the Taj Mahal in India is acquiring a yellow tinge due to excessive air pollution.

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What is the health impact of sulphur dioxide?

As an irritant, sulfur dioxide can affect lung function and cause and worsen respiratory diseases in humans and animals. Some of SO2's direct health effects include:

- Eye irritation
- Wheezing, shortness of breath, chest tightness
- Aggravation of asthma and chronic bronchitis
- Inflammation of the respiratory tract (coughing, mucus secretion)

In the long term, SO2 exposure leads to an overall increase in hospitalization rates for cardiac diseases, and overall higher mortality rates.

What is the health impact of sulphur dioxide?

In more details, Sulphuric acid in concentrated form is very corrosive to any tissues with which it comes into contact. Single, strong doses of sulphuric acid inhaled, ingested, or absorbed via the skin can be lethal. Inhaling powerful inorganic acid mists, which may contain sulphuric acid, causes laryngeal cancer; research shows that exposure is also linked to lung cancer in people. Inhalation can induce respiratory tract and eye discomfort, lacrimation, rhinorrhoea, cough and chest tightness. After a single short-term exposure, severe lung damage such as chemical pneumonia, congestion, fibrosis, bronchiectasis and inflammation can ensue.

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What is the health impact of sulphur dioxide?

Ingestion can result in oedema, airway blockage and trouble clearing bronchial secretions, as well as acute burns to the mouth, throat, larynx, oesophagus and stomach. Salivation, dysphagia, vomiting, bleeding, haematemesis, diarrhoea and abdominal discomfort are all possible symptoms. Circulatory collapse, metabolic acidosis, hypoxia, respiratory failure, acute renal failure, haemolysis and disseminated intravascular coagulation, as well as death, are all possible outcomes. Pain, blepharospasm, lacrimation, conjunctivitis, photophobia, palpebral oedema, glaucoma, cataracts and corneal damage are all possible side effects of ocular exposure. Chemical burns can occur as a result of exposure to concentrated sulphuric acid.

Photo by Stockcake

What is the health impact of sulphur dioxide?

Sulphuric acid exposure to the skin can produce irritation, erythema and burns; severe chemical burns from sulphuric acid contact can be lethal.

Sulphuric acid poisoning is mostly caused by effects at the point of initial contact, while systemic symptoms such as circulatory collapse, metabolic acidosis, hypoxia, respiratory failure, acute renal failure, haemolysis and disseminated intravascular coagulation have been reported.

Sulphuric acid isn't thought to constitute a developmental hazard.

In humans, skin contact with sulphuric acid is not considered an allergy.

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How might people be exposed to sulfur dioxide?

People living in cities are exposed to low levels of sulfur dioxide every day. You can be exposed to sulfur dioxide in the following ways:

- Breathing polluted air.
- Living in, or near, industrial areas.
- Living in cities, near freeways and busy roads.
- Eating preserved foods and drinking wine.
- Working in workplaces where sulfur dioxide is used or produced, such as wineries, smelters and coal-burning power plants.

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How Air Pollution Harms Vegetation

Whilst acid rain is a major cause of damage to vegetation, air pollutants which can also be harmful directly. These include Sulphur dioxide and ozone.

Sulphur dioxide, one of the main components of acid rain, has direct effects on vegetation. Changes in the physical appearance of vegetation are an indication that the plants' metabolism is impaired by the concentration of Sulphur dioxide. Harm caused by Sulphur dioxide is first noticeable on the leaves of the plants. For some plants injury can occur within hours or days of being exposed to high levels of Sulphur dioxide. It is the leaves in mid-growth that are the most vulnerable, while the older and younger leaves are more resistant. You can see the damage to coniferous needles by observing the extreme color difference between the green base and the bright orange-red tips.

How Air Pollution Harms Vegetation

The effects of sulphur dioxide are influenced by other biological and environmental factors such as plant type, age, sunlight levels, temperature, humidity and the presence of other pollutants (ozone and nitrogen oxides).

Thus, even though sulphur dioxide levels may be extremely high, the levels may not affect vegetation because of the surrounding environmental conditions.

It is also possible that the plants and soils may temporarily store pollutants. By storing the pollutants they are preventing the pollutants from reacting with other substances in the plants or soil.

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Effects of SO_2 on vegetation

High sulfur dioxide concentrations can produce acute injury in plants in the form of foliar necrosis, even after a relatively short-duration exposure. However, these effects are of lesser significance than chronic injuries, which result from long-term exposure to lower concentrations of gases and are cumulative in nature and result in reduced growth and yield and increased senescence, often with no clear visible symptoms or else with some degree of chlorosis.

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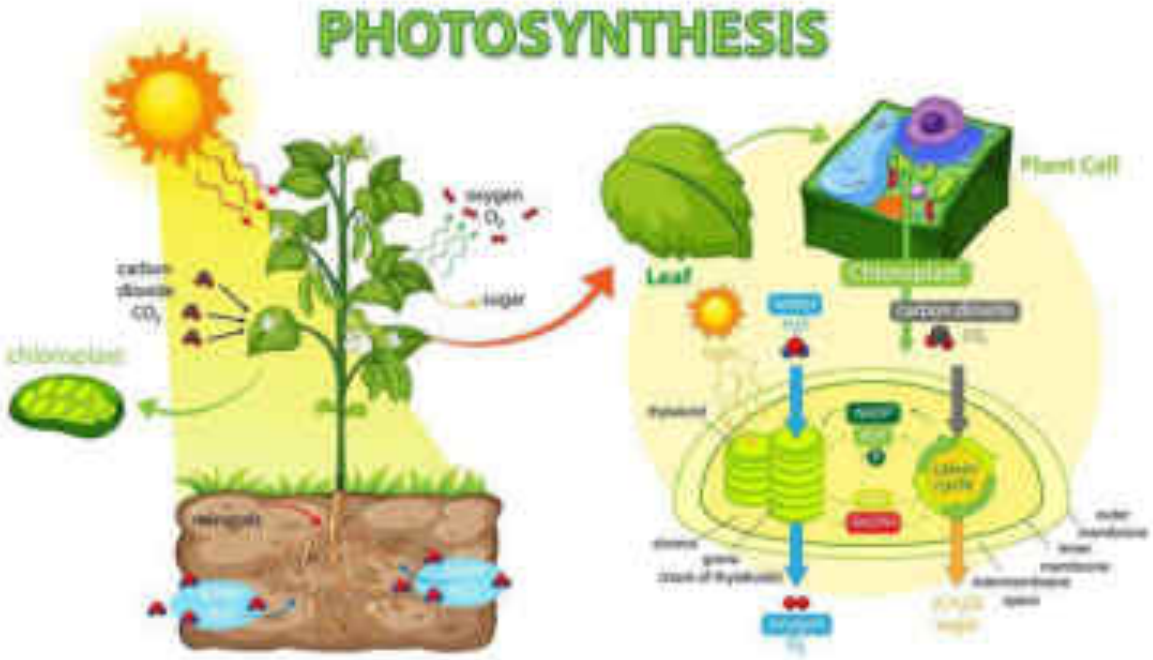
Effects of SO_2 on vegetation

Plants are sensitive to sulfur dioxide and they are affected by it both directly and indirectly.

The direct effects may be acute or chronic, depending on the duration and intensity of the exposure.

Sulfur dioxide inhibits photosynthesis by disrupting the photosynthetic mechanism.

The opening of the stomata is promoted by sulfur dioxide, resulting in an excessive loss of water.



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Effects of SO_2 on vegetation

Another indirect effect results from the acid rain which leaches out nutrients from plant canopy and soil. The acidic run-off changes the pH of the receiving waters and adds large quantities of nutrients which disturb the equilibrium of aquatic communities.

Plants vary widely in their tolerance to sulfur dioxide. Lichens and bryophytes are among the most sensitive and have been successfully used as indicators of sulfur dioxide pollution.

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Foliage damage

At high concentrations, atmospheric sulphur dioxide can cause acute damage to foliage.

The toxic gas can bleach or dark pigmentation on the leaves of broad-leaved plants, as well as cause conifer needles to brown and wilt.

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Foliage damage

The cumulative effect of sulferous pollution is to reduce the quantity and quality of plant yield. Generally, its impact is more severe when in combination with other pollutants such as oxides of nitrogen, fluorides, and ozone.

At the ecosystem level, sulfur dioxide affects species composition by eliminating more sensitive species. This reduces primary productivity and alters trophic relationships which have far-reaching implications for the animal and microbial populations in the community.

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Impacts of Acid Rain on Buildings

Since the beginning of the Industrial Revolution soiling and degradation of buildings in urban areas has been noticeable. The cause of this has often been attributed to the effects of air pollution.

Despite the reduction in emissions lately, there is no clear evidence that cleaner air has brought about a reduction in building degradation. In fact, buildings that have withstood thousands of years of weathering have in the last 25 years or so begun to deteriorate rapidly. This can be attributed to the permanent alteration of stone surfaces by sulphation, a process whereby the exposed surface of limestone dissolves away as rainfall washes away the sulphated layers.

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Materials Affected

The list of materials affected by acid deposition is very long as most materials are liable to some degree of damage.

Those most vulnerable are: limestone; marble; carbon-steel; zinc; nickel; paint and some plastics.

Stone decay can take several forms, including the removal of detail from carved stone, and the build-up of black gypsum crusts in sheltered areas.

Metal corrosion is caused primarily by oxygen and moisture, although SO2 does accelerate the process.

Most structures and buildings are affected by acid deposition to some degree because few materials are safe from these effects. In addition to atmospheric attack structures that are submerged in acidified waters such as foundations and pipes can also be corroded.

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How does sulfur dioxide affect buildings?

Pollutants can accelerate the corrosion of ferrous and non-ferrous metals, reduce the durability of paints, decrease the fiber strength of certain textiles, cause some dyes to fade, stimulate the early deterioration of leather and paper goods and attack limestone, marble, and other building materials. It also contributes to the decay of building materials and paints, including monuments and statues.

The materials most sensitive to pollutants are calcareous building stones and ferrous metals.

Manifestations of damage include losses of mass, changes in porosity, discoloration and embrittlement.

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Examples of Damage

The effects of acid deposition on modern buildings are considerably less damaging than the effects on ancient monuments. Limestone and calcareous stones which are used in most heritage buildings are the most vulnerable to corrosion and need continued renovation.

Evidence of the damaging effect of acid deposition can be seen throughout the world. For example, world famous structures as Taj Mahal, Cologne Cathedral, Notre Dame, Colosseum and Westminster Abbey have all been affected.

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How can sulphur dioxide emissions be lessened?

Only the implementation of targeted measures can reduce sulphur dioxide emissions. Some of them are:

- Shifting from high-sulphur solid (coal) and liquid (heavy fuel oil) fuels to low-sulphur content fuels (natural gas)
- Installing flue gas desulphurization abatement technology in industrial facilities
- Limiting the sulphur content of transport (e.g. car) fuels
- Closing down older, less-efficient power plants

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Learn STEM

Innovative Model of learning STEM in secondary schools

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Reference Number:
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Duration:
31.12.2022 to 30.12.2024 (24 months)

LearnSTEM
Innovative Model of learning STEM in secondary schools

Learning resources

Topic II: “Pollution”

Learning Unit: “The Tanker spills oil” by Greece

IEK Kavalas, Kavala, Greece
Kalliopi Ntolou

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6. Effects of oil on plants and animals
7. Sensitivity of Aquatic Habitats
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What is the meaning of tanker oil spill?

Photo by Stockcake

An oil spill is the release of a liquid petroleum hydrocarbon into the environment, especially the marine ecosystem, due to human activity, and is a form of pollution. The term is usually given to marine oil spills, where oil is released into the ocean or coastal waters, but spills may also occur on land.

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What is oil?

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Crude oil, the liquid remains of ancient plants and animals, is a fossil fuel that is used to make a wide range of fuels and products. Oil is found below ground or below the ocean floor in reservoirs, where oil droplets reside in “pores” or holes in the rock. After drilling down and pumping out the crude oil, oil companies transport it by pipes, ships, trucks, or trains to processing plants called refineries. There it is refined so it can be made into different petroleum products, including gasoline and other fuels as well as products like asphalt, plastics, soaps, and paints.

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PHYSICAL PROPERTIES OF OIL

The term oil describes a broad range of hydrocarbon- based substances. Hydrocarbons are chemical compounds composed of the elements hydrogen and carbon. This includes substances that are commonly thought of as oils, such as crude oil and refined petroleum products, but it also includes animal fats, vegetable oils, and other non- petroleum oils. Each type of oil has distinct physical and chemical properties. These properties affect the way oil will spread and break down, the hazard it may pose to aquatic and human life, and the likelihood that it will pose a threat to natural and man-made resources.

The rate at which an oil spill spreads will determine its effect on the environment. Most oils tend to spread horizontally into a smooth and slippery surface, called a slick, on top of the water. Factors which affect the ability of an oil spill to spread include surface tension, specific gravity, and viscosity.

Photo by Stockcake

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Oil spills

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As we have mentioned, oil is an ancient fossil fuel that we use to heat our homes, generate electricity, and power large sectors of our economy. But when oil accidentally spills into the ocean, it can cause big problems. Oil spills can harm sea creatures, ruin a day at the beach, and make seafood unsafe to eat. It takes sound science to clean up the oil, measure the impacts of pollution, and help the ocean recover.

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How do oil spills happen?

Oil spills are more common than you might think, and they happen in many different ways. Thousands of oil spills occur in waters each year. Most of these spills are small, for example when oil spills while refueling a ship. But these spills can still cause damage, especially if they happen in sensitive environments, like beaches, mangroves, and wetlands.

Large oil spills are major, dangerous disasters. These tend to happen when pipelines break, big oil tanker ships sink, or drilling operations go wrong. Consequences to ecosystems and economies can be felt for decades following a large oil spill.

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How do oil spills happen?

Photo by Stockcake

Note that not all oil spills come from tankers. They can also come from other sites, such as offshore oil rigs and damaged pipelines. The world's largest (and most well-known) event was *Deepwater Horizon* in the Gulf of Mexico in 2010. This disaster was caused by an explosion in a drilling rig.

The US Government estimates that 4.9 million barrels of oil were released (equivalent to around 700,000 tonnes).

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Where do oil spills happen?

Photo by Stockcake

Oil spills can happen anywhere oil is drilled, transported, or used. When oil spills happen in the ocean, in the Lakes, on the shore, or in rivers that flow into these coastal waters, experts have to get involved.

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How do oil spills harm or kill ocean life?

Generally, oil spills harm ocean life in two ways:

Photo by Stockcake

Fouling or oiling: Fouling or oiling occurs when oil physically harms a plant or animal. Oil can coat a bird's wings and leave it unable to fly or strip away the insulating properties of a sea otter's fur, putting it at risk of hypothermia. The degree of oiling often impacts the animal's chances of survival.

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How do oil spills harm or kill ocean life?

Photo by Stockcake

Oil toxicity: Oil consists of many different toxic compounds. These toxic compounds can cause severe health problems like heart damage, stunted growth, immune system effects, and even death.

Our understanding of oil toxicity has expanded by studying the effects of the 2010 Deepwater Horizon oil spill.

Wildlife recovery, cleaning, and rehabilitation is often an important part of oil spill response. However wildlife is difficult to find and catch, oil spills can happen over wide areas, and some animals (like whales) are too big to recover. Unfortunately, it's unrealistic to rescue all wildlife impacted during oil spills.

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EFFECTS OF OIL ON PLANTS AND ANIMALS

SOME TOXIC SUBSTANCES in an oil spill may evaporate quickly. Therefore, plant, animal, and human exposure to the most toxic substances are reduced with time, and are usually limited to the initial spill area. Although some organisms may be seriously injured or killed very soon after contact with the oil in a spill, non-lethal toxic effects can be more subtle and often longer lasting. For example, aquatic life on reefs and shorelines is at risk of being smothered by oil that washes ashore. It can also be poisoned slowly by long-term exposure to oil trapped in shallow water or on beaches.

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Sensitivity of Aquatic Habitats

Aquatic environments are made up of complex interrelations between plant and animal species and their physical environment.

Harm to the physical environment will often lead to harm for one or more species in a food chain, which may lead to damage for other species further in the chain. Where an organism spends most of its time—in open water, near coastal areas, or on the shoreline—will determine the effects an oil spill is likely to have on that organism.

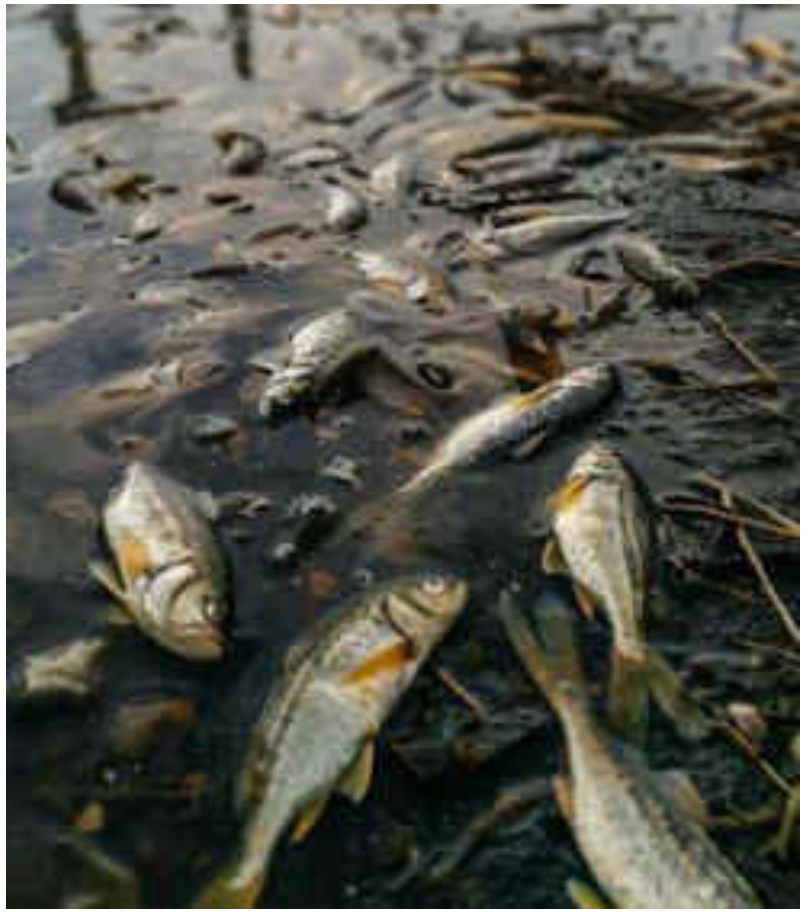

Photo by Stockcake

Sensitivity of Aquatic Habitats

In open water, fish and whales have the ability to swim away from a spill by going deeper in the water or further out to sea, reducing the likelihood that they will be harmed by even a major spill.

Aquatic animals that generally live closer to shore, such as turtles, seals, and dolphins, risk contamination by oil that washes onto beaches or by consuming oil-contaminated prey. In shallow waters, oil may harm sea grasses and kelp beds, which are used for food, shelter, and nesting sites by many different species.

Photo by Stockcake

Who cleans up an oil spill — and how?

Usually Coast Guard is primarily responsible for cleaning up oil spills, while experts provide scientific support to make smart decisions that protect people and the environment. There are different equipment and tactics that trained experts can use to contain or remove oil from the environment when a spill occurs. Booms are floating physical barriers to oil, which help keep it contained and away from sensitive areas, like beaches, mangroves, and wetlands. Skimmers are used off of boats and can “skim” oil from the sea surface. In situ burning, or setting fire to an oil slick, can burn the oil away at sea, and chemical dispersants can break up oil slicks from the surface.

However, cleanup activities can never remove 100% of the oil spilled, and scientists have to be careful that their actions don’t cause additional harm. After the Exxon Valdez oil spill in 1989, scientists learned that high-pressure, hot-water hoses used to clean up beaches caused more damage than the oil alone. Sensitive habitats need extra consideration during oil spill cleanup.

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Spilled oil and cleanup operations can threaten different types of aquatic habitats, with different results.

- **Coral reefs** are important nurseries for shrimp, fish, and other animals as well as recreational attractions for divers.

Coral reefs and the aquatic organisms that live within and around them are at risk from exposure to the toxic substances within oil as well as smothering.

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Spilled oil and cleanup operations can threaten different types of aquatic habitats, with different results.

Exposed sandy, gravel, or cobble beaches are usually cleaned by manual techniques. Although oil can soak into sand and gravel, few organisms live full-time in this habitat, so the risk to animal life or the food chain is less than in other habitats, such as tidal flats.

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Spilled oil and cleanup operations can threaten different types of aquatic habitats, with different results.

- **Sheltered beaches** have very little wave action to encourage natural dispersion. If timely cleanup efforts are not begun, oil may remain stranded on these beaches for years.

- **Tidal flats** are broad, low-tide zones, usually containing rich plant, animal, and bird communities. Deposited oil may seep into the muddy bottoms of these flats, creating potentially harmful effects on the ecology of the area.

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Spilled oil and cleanup operations can threaten different types of aquatic habitats, with different results.

- **Salt marshes** are found in sheltered waters in cold and temperate areas. They host a variety of plant, bird, and mammal life. Marsh vegetation, especially root systems, is easily damaged by fresh light oils.
- **Mangrove forests** are located in tropical regions and are home to a diversity of plant and animal life. Mangrove trees have long roots, called prop roots, that stick out well above the water level and help to hold the mangrove tree in place. A coating of oil on these prop roots can be fatal to the mangrove tree, and because they grow so slowly, replacing a mangrove tree can take decades.

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Spilled oil and cleanup operations can threaten different types of aquatic habitats, with different results.

- **Marshes and swamps with little water movement** are likely to incur more severe impacts than flowing water. In calm water conditions, the affected habitat may take years to restore.

- **Other standing water bodies**, such as inland lakes and ponds, are home to a variety of birds, mammals, and fish. The human food chain can be affected by spills in these environments.

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Spilled oil and cleanup operations can threaten different types of aquatic habitats, with different results.

- **River habitats** may be less severely affected by spills than standing water bodies because of water movement. However, spills in these water bodies can affect plants, grasses, and mosses that grow in the environment. When rivers are used as drinking water sources, oil spills on rivers can pose direct threats to human health.

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Sensitivity of Birds and Mammals

An oil spill can harm birds and mammals in several ways:

direct physical contact, toxic contamination, destruction of food sources and habitats, and reproductive problems.

- **Physical contact –** When fur or feathers come into contact with oil, they get matted down. This matting causes fur and feathers to lose their insulating properties, placing animals at risk of freezing to death.

For birds, the risk of drowning increases,

as the complex structure of their feathers that allows them to float or to fly becomes Damaged.

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Sensitivity of Birds and Mammals

Toxic contamination – Some species are susceptible to the toxic effects of inhaled oil vapors. Oil vapors can cause damage to the animal's central nervous system, liver, and lungs. Animals are also at risk from ingesting oil, which can reduce the animal's ability to eat or digest its food by damaging cells in the intestinal tract.

Photo by Stockcake

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Destruction of food resources and habitats –

Even species which are not directly in contact with oil can be harmed by a spill. Predators that consume contaminated Prey can be exposed to oil through ingestion. Because oil contamination gives fish and other animals unpleasant tastes and smells, predators will sometimes refuse to eat their prey and will begin to starve.

Sometimes a local population of prey organisms is destroyed, leaving no food resources for predators.

Depending on the environmental conditions, the spilled oil may linger in the environment for long periods of time, adding to the detrimental effects. In calm water conditions, oil that interacts with rocks or sediments can remain in the environment indefinitely.

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Reproductive problems

Photo by Stockcake

Oil can be transferred from birds' plumage to the eggs they are hatching.

Oil can smother eggs by sealing pores in the eggs and preventing gas exchange. Scientists have also observed developmental effects in bird embryos that were exposed to oil. Also, the number of breeding animals and the of nesting habitats can be reduced by the spill. Long-term reproductive problems have also been shown in some studies in animals that have been exposed to oil.

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How do experts help after an oil spill?

When a person gets sick, a doctor evaluates their symptoms, diagnoses a problem, and then prescribes a treatment to help them get better. That's also what experts do after an oil spill: they evaluate what happened, assess the impacts, and then design restoration projects to help the ocean recover. Restoration isn't the same as cleanup. It requires projects like building marshland or protecting bird nesting habitat to actively bolster the environment.

Restoration projects are important because they speed up the amount of time it takes for different species and habitats to recover. In addition to restoring habitats, the group responsible for the spill may also be held accountable for restoring access to natural spaces by constructing parks, boat ramps, and fishing piers.

Photo by Stockcake

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Two major steps involved in controlling oil spills are containment and recovery.

Here are some of the techniques and equipment that are used to conduct oil spill control efforts.

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CONTAINMENT

When an oil spill occurs on water, it is critical to contain the spill as quickly as possible in order to minimize danger and potential damage to persons, property, and natural resources. Containment equipment is used to restrict the spread of oil and to allow for its recovery, removal, or dispersal. The most common type of equipment used to control the spread of oil is floating barriers, called booms.

Photo by Stockcake

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RECOVERY OF OIL

Once an oil spill has been contained, efforts to remove the oil from the water can begin. Three different types of equipment—booms, skimmers, and sorbents—are commonly used to recover oil from the surface.

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Booms

When used in recovering oil, booms are often supported by a horizontal arm extending directly off one or both sides of a vessel. Sailing through the heaviest sections of the spill at low speeds, a vessel scoops the oil and traps it between the angle of the boom and the vessel's hull. In another variation, a boom is moored at the end points of a rigid arm extended from the vessel, forming a "U"- or "J"-shaped pocket in which oil can collect. In either case, the trapped oil can then be pumped out to holding tanks and returned to shore for proper disposal or recycling.

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Skimmers

Photo by Stockcake

A skimmer is a device for recovery of spilled oil from the water’s surface.

Skimmers may be self-propelled and may be used from shore or operated from vessels.

The efficiency of skimmers depends on weather conditions.

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Sorbents

Sorbents are materials that soak up liquids. They can be used to recover oil through the mechanisms of absorption, adsorption, or both. Absorbents allow oil to penetrate into pore spaces in the material they are made of, while adsorbents attract oil to their surfaces but do not allow it to penetrate into the material. To be useful in combating oil spills, sorbents need to be both oleophilic and hydrophobic (water-repellant). Although they may be used as the sole cleanup method in small spills, sorbents are most often used to remove final traces of oil, or in areas that cannot be reached by skimmers.

Once sorbents have been used to recover oil, they must be removed from the water and properly disposed of on land or cleaned for re-use. Any oil that is removed from sorbent materials must also be properly disposed of or recycled.

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Finally why is oil spilling bad?

Photo by Stockcake

When oil is spilled into an aquatic environment, it can harm organisms that live on or around the water surface and those that live under water. Spilled oil can also damage parts of the food chain, including human food resources.

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