Geography Year 1

SECTION

12

POLLUTION IN GHANA

HUMAN AND ENVIRONMENT

Environmental Degradation

Introduction

This section explains air and water pollution, the threat to health and environmental damage.

Air Pollution: Contaminates the air. Caused by industrial emissions, vehicle exhaust, and burning biomass. Prolonged exposure harms human health.

Water Pollution: Contaminates rivers, lakes, and oceans, especially from illegal mining, industrial waste, and agricultural runoff. It affects both ecosystems and human health.

The section highlights the importance of understanding these issues, their impacts, and adopting sustainable practices to protect our environment. It connects to your JHS Social Studies and Integrated Science subjects.

At the end of this section, you will be able to:

- Examine causes and measures for preventing or mitigating air pollution in Ghana
- Examine causes and measures for preventing or mitigating water pollution in Ghana

Key Ideas

- Air pollution is a term used to describe the presence of pollutants in the atmosphere that cause harm to people, the environment and the health of other living things.
- The main **sources** of air pollution are vehicle and industrial emissions, burning fossil fuels like coal, oil and gas, and solvents released from products like paints, aerosols, adhesives and household cleaners.
- Common air pollutants include very small solid particles, nitrogen oxides sulphur dioxide, and carbon monoxide.
- Water pollution is the contamination of water bodies such as lakes, rivers, oceans, groundwater and drinking water sources.
  - » The main sources of water pollution in Ghana are human waste, industrial and agricultural chemicals, oil spills.
  - » Common water pollutants are raw sewage, pesticides and fertilisers, mercury, lead, and plastics.
  - » Strategies that can be devised to control air and water pollution include law enforcement, public education and sustainable industrial and agricultural practices

AIR POLLUTION

Air pollution is a term used to describe the presence of pollutants in the atmosphere that cause harm to people, the environment and the health of other living things.

Fig. 12.1: Air pollution caused by burning of trash / refuse.

Some Common Air Pollutants and their Sources or Causes and Effects on Humans

1. **Particulate Matter (PM)** are very small particles in the air, including dust, powder, and smoke. They come from vehicle exhaust emissions, industrial processes, construction sites, and natural sources like wildfires. They can cause respiratory issues, heart disease, and worsen conditions like asthma.

   Click on the link Particulate Matter & Indoor Air Quality by Indoor Doctor (youtube.com) to watch a video on Particulate Matter (PM).

   If you cannot access the video, check your school or local library or search the internet for the same topic.

2. **Nitrogen Dioxide (NO_2)** is a reddish-brown gas with a strong smell. It is produced as a by-product of vehicle and industrial combustion processes, it can cause respiratory issues. It is very common pollutant in cities like Accra, Tema, Kumasi and Tamale.

Fig. 12.2: Emission of particulate matter and NO2 comes from locomotives and industries

3. **Sulphur Dioxide (SO_2)** is a gas that has a sharp, unpleasant smell. It is a by-product of burning of fossil fuels containing sulphur compounds, such as coal and petroleum. It can cause respiratory problems and contribute to acid rain, which harms ecosystems.

4. **Carbon Monoxide (CO)** is a colourless, odourless gas that is harmful when inhaled. It is produced from the incomplete combustion of carbon-containing fuels. It comes from the incomplete combustion of fossil fuels in car engines, bush burning, and even the burning of refuse in our communities. It reduces the blood's ability to carry oxygen, which can be especially dangerous to life in enclosed spaces.

Fig. 12.3: Emission of CO from gas stove

5. **Ozone (O_3)** is a gas formed at ground level when sunlight reacts with pollutants like volatile organic compounds (VOCs) and nitrogen oxides in the lower atmosphere. It has little to do with the ozone in the upper atmosphere which protects us from ultra-violet radiation. The sources are vehicle emissions and industrial activity in cities. It can cause respiratory problems, especially for people with asthma.
6. **Volatile Organic Compounds (VOCs)** are emitted from solvents, paints, adhesives, pesticides, cleaning and personal care products and vehicle exhausts. They can react with other pollutants to form ground-level ozone and contribute to smog formation. Organic chemicals are usually in the form of vapours or gases. High concentrations can cause eye, nose, and throat irritation, and long-term exposure may lead to serious health issues like cancer.

Fig. 12.4: Release of VOCs from insecticide spray

Click on the link below to watch a video on Volatile Organic Compounds (VOCs)
Volatile Organic Compounds (VOCs) & Things Building Occupants Should Know (youtube.com).
If you cannot access the video, check your school or local library or search on the internet for the same topic.

7. **Lead:** is a toxic metal found in the air as a pollutant. Lead emission is mainly from industrial sources and leaded fuel for petrol engines. It can affect brain development in children and cause heart problems in adults.

Effects of Air Pollution

The following all apply to Ghana:

1. Ozone Layer Depletion

The **ozone layer** is like a protective shield high up in the atmosphere. It blocks harmful **ultraviolet (UV) rays** from the sun. When air pollution damages this layer, more UV rays reach Earth, which can cause skin burns and increase the risk of skin cancer.

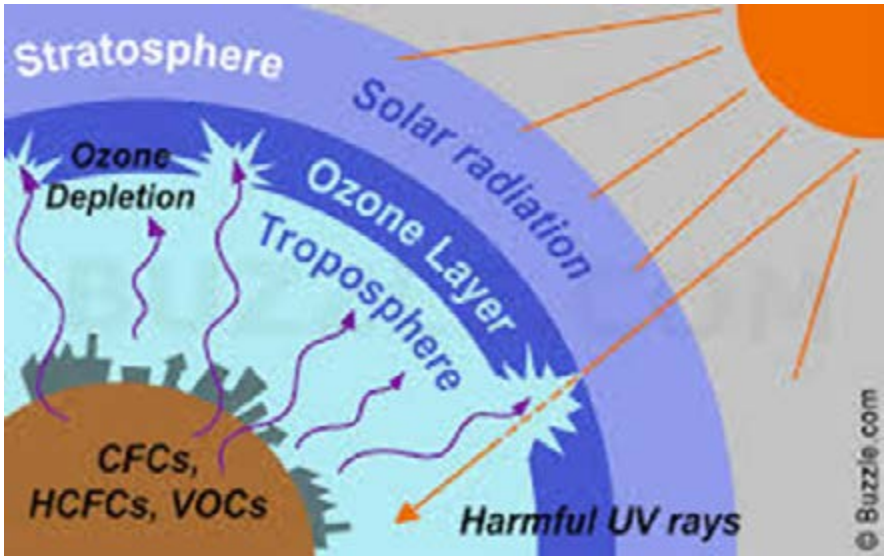


Fig. 12.5: Structure of the atmosphere showing location of ozone layer

2. Climate Change

Air pollution contributes to **climate change**. When humans burn things like coal, oil, and gas for energy, this results in the production of **greenhouse gases**. Carbon Dioxide is a greenhouse gas which is made when Oxygen combines with Carbon Monoxide. These gases allow heat from the sun into the atmosphere but do not allow it to leave, just like in a greenhouse. The trapped heat makes the Earth warmer. This trapped heat leads to climate change with areas experiencing temperature changes, extreme weather causing floods, drought and rising sea levels. To learn more about the Greenhouse Effect click on this link:

Greenhouse effect and greenhouse gases | High school biology | Khan Academy (youtube.com)

Fig. 12.6: Climate Change

3. Damage to Buildings and Objects

Pollution can cause **rusting** of steel causing damage to buildings and vehicles. The chemicals in polluted air can also peel off metal coatings and paint, making things deteriorate faster. This can reduce the lifespan of objects, materials and structures.

4. Increased Skin Cancer and Plant Damage by Ultra-Violet (UV) radiation

More pollution in the air causes the upper ozone layer to be damaged allowing more Ultra-Violet radiation to enter the atmosphere. These increased risks of **skin cancer** as UV exposure harms skin cells. UV radiation also destroys **chlorophyll**, the green pigment that helps them make food. This can affect the growth of plants and trees.

5. Acid Rain

Air pollution can cause **acid rain**, which happens when harmful chemicals mix with rainwater turning it to weak acid. This rain can damage forests, lakes, and buildings, harming the environment and wildlife.

6. Impact on Food and Biodiversity

Air pollution can destroy **crops** and **forests**. For example, pollution from dust can reduce the growth of crops (stunted growth). which means less food for us and other animals. This loss can also reduce the variety of living things (biodiversity) in an area, disrupting ecosystems.

7. Heart Disease and Stroke

Pollution can also harm our hearts. It can damage the **arteries** (the blood vessels that carry blood) and increase the chances of **heart disease** and **strokes**, which can be very serious health issues.

8. Health Risks: Lung Cancer and Shorter Lifespan

Breathing in polluted air can lead to serious health problems, including **lung cancer**. Research evidence has shown that air pollution can cause death. Carbon Monoxide can cause mental issues, headaches and heart failure. The inhalation of thick smoke, ash and dust can be harmful to our lungs, throat and heart and lead to loss of life.

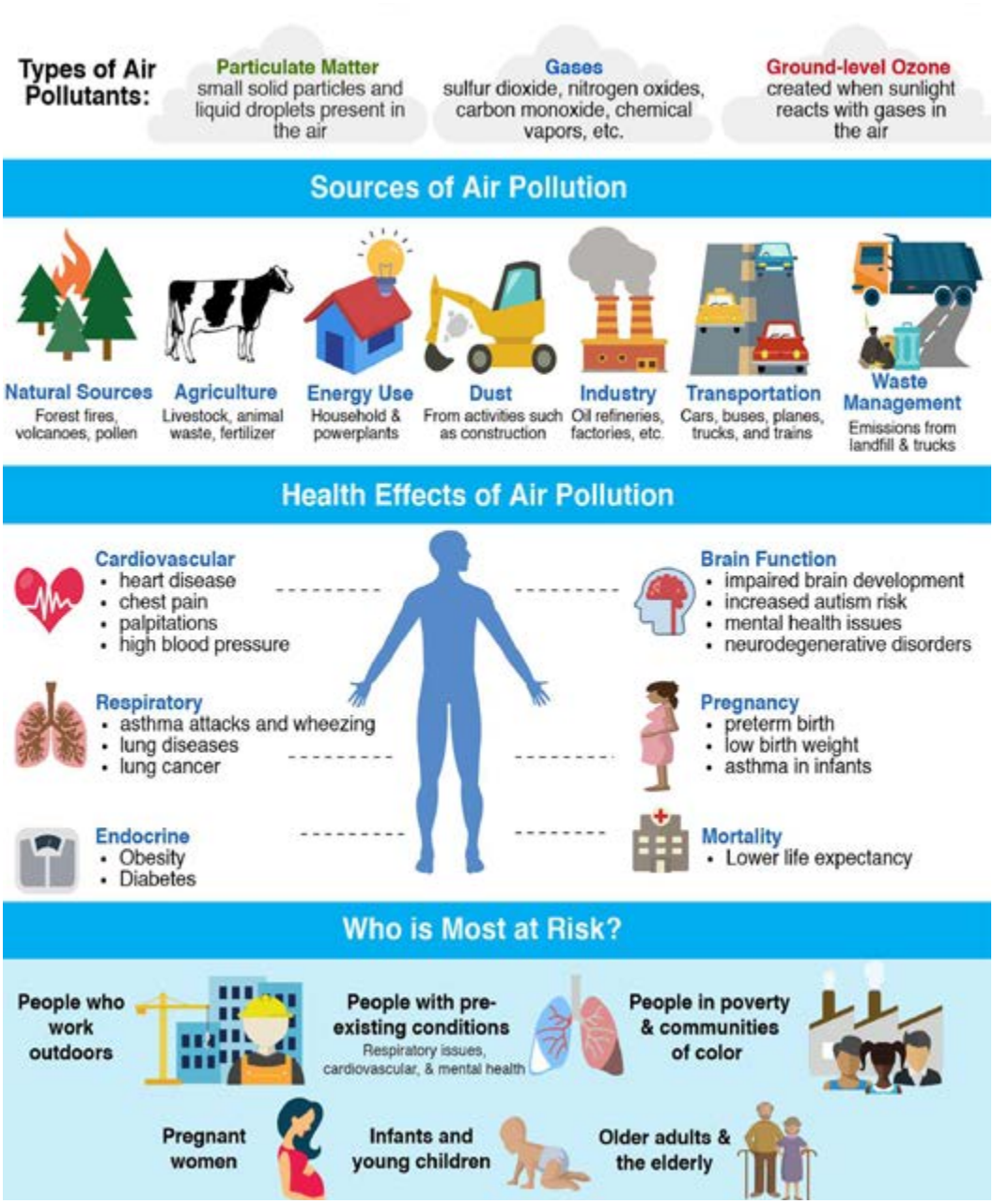


Fig. 12.7: Health risks of air pollution

9. Ocean Acidification

When carbon dioxide from polluted air dissolves in the ocean, it makes the water more acidic, a process called **ocean acidification**. This can harm fish and other marine life, disrupting entire ocean ecosystems.

Measures for preventing or easing Air Pollution in Ghana

1. Promoting renewable energy sources such as solar energy, wind power, and hydropower can lead to a decrease in fossil fuel dependency and a reduction in emissions from energy production.
2. Implementing measures to reduce vehicle emissions. These measures may include encouraging the use of public transport, setting fuel efficiency requirements, and promoting the use of electric vehicles.
3. Establishing and enforcing strict emission standards for industries can significantly reduce pollution. Regular monitoring and penalties for non-compliance can encourage industries to adopt cleaner technologies.
4. Proper waste management practices, including waste segregation, recycling, and waste-to-energy processes, can help prevent the release of harmful pollutants from waste burning and landfill sites. For example, Zoom Lion has waste recycling and treatment in Accra and Kumasi. Ghanaians are therefore advised to practice the "3R" which is Reduce, Reuse and Recycle waste.
5. Creating and preserving green spaces within urban areas can help absorb pollutants and improve air quality. Ghanaians need to plant trees and preserve vegetation in our various communities. Trees and vegetation act as natural air filters.
6. Discouraging open burning of waste, agricultural residues, and other materials can reduce the release of harmful particulate matter and toxic substances into the air. It is also advisable to minimize the use of plastic containers and polythene bags and indiscriminate dumping of refuse.
7. Raising awareness about the causes and consequences of air pollution can encourage public participation in pollution prevention efforts and support policy changes. This can be done on radio Television, community information centres and other public gatherings.
8. Promoting sustainable agricultural practices by providing farmers with training and resources, and by regulating the use of pesticides and fertilisers. For example, farmers can practice the traditional way of controlling weeds, insects and diseases in their farms such as the use of neem trees to control insects and diseases.

Activity 12.1

1. Click on the link below to watch a video on Air Pollution and answer the following questions

   https://youtu.be/e6rglsLy1Ys.

   If you cannot access the video, check your school or local library or search on the internet for the same topic.

i. Share with a friend the environmental effects of air pollution
ii. Describe to your colleague or friend in class how your community can reduce or minimise air pollution
iii. Present to your class the health implications of air pollution.

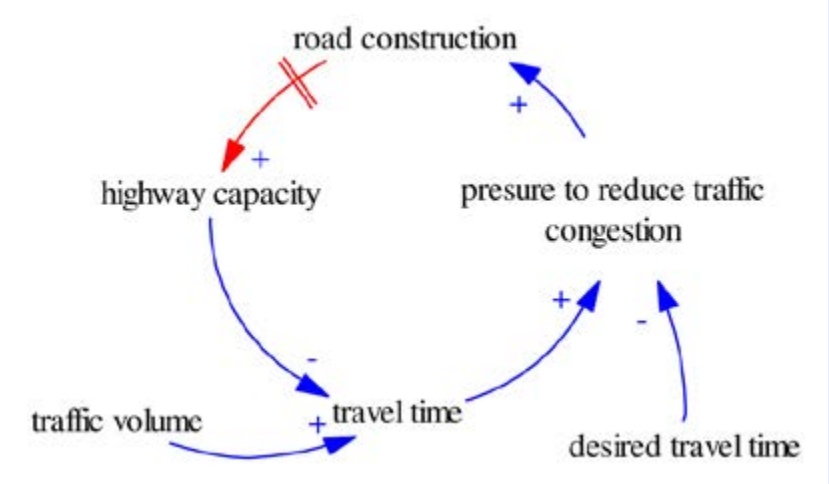
4. With support from your teacher, approach a local factory within or near your community and ask if you can observe how they perform their activities
   i. How do their operations contribute to air pollution
   ii. Discuss with a friend or colleague in class the air pollutants released from the factory.
   iii. Find out from the factory operators how they reduce or control pollution from their activities
   iv. What advice will you give them regarding pollution
5. Take a walk to the roadside in your community and observe how the fumes (smoke) from cars pollute the air.
   i. Explain to a friend in class the health implications of smoke from vehicle
   ii. Recommendations on how the fumes or smoke from cars increase disease outbreaks.

3. Imagine you could design or redesign an urban area. Examine practical measures you would implement to reduce air pollution in a densely populated community or locality. Share your information with your classmates.
4. Use the pictures below to perform the following activities


   i. Write down how this heavy traffic can lead to an increase in air pollution.
   ii. What are the main sources of air pollution in the pictures above
   iii. Relate the pictures above to any urban centre in Ghana and explain how these activities contribute to air pollution. Share with your friend.
   iv. In your community, share and discuss the strategies the community can adopt to reduce air pollution, and what the benefits might be.
   v. Illustrate with a diagram how emissions like carbon monoxide and nitrogen oxides from cars and trucks contribute to poor-quality air and respiratory problems.

6.

a. The diagram below illustrates cycle of traffic congestion. It shows how road construction and highway capacity contribute to increased traffic volume. Draw a similar cycle of traffic congestion and interpret it to your friend.



b. Highlights the need for solutions to address traffic congestion and pollution caused by transportation activities. Share your information with a friend.

WATER POLLUTION

Water pollution is the contamination of water bodies such as lakes, rivers, oceans, groundwater and drinking water sources.

Fig. 12.8: Water Pollution

Causes and Sources of Water Pollution in Ghana

Water pollution in Ghana is caused by the following:

1. **Sewage and Wastewater:** Untreated or inadequately treated sewage and wastewater from residential, industrial, and commercial sources can introduce a wide range of pollutants into water bodies. In Ghana, wastewater mostly comes from homes, hospitals, markets and industrial activities. The water sometimes ends up in surface water bodies such as rivers, streams and even the sea. Some may seep into the groundwater. For example, the pollution of Subin River in Kumasi as well as Odaw River and Korle Lagoon in Accra can be attributed to contamination from domestic and industrial waste. **Figure 12.9** is a typical example of wastewater spillage into surface water bodies.

Fig. 12.9: Impure sewage water pouring into running water

2. **Industrial Discharges:** These are pollutants released into water bodies by industrial facilities. They include heavy metals (mercury, lead, cadmium), toxic chemicals (chlorinated solvents, pesticides), and organic compounds (petroleum hydrocarbons, PCBs). This kind of pollution is very common in our towns and cities such as Kumasi, Accra, Tema, Tamale and Sekondi-Takoradi.

3. **Agricultural Runoff:** Fertilisers, herbicides, and pesticides used on farms contaminate both surface and ground water. These chemicals can be carried by rainwater and soil erosion to nearby rivers and lakes.

4. **Oil and Petroleum Products:** Oil spills from accidents during transportation, offshore drilling, or leakage from storage facilities can contaminate water bodies. For example, such pollution has ever occurred in the Saltpond and Axim oilfields in Ghana.

5. **Heavy Metals:** Heavy metals, such as mercury, lead, arsenic, and cadmium, can come from various sources, including industrial discharges, mining activities, and atmospheric deposition. For example, the activities of both small- and large-scale mining in Ghana may have contributed to the pollution of some groundwater as well as surface water like River Daboase, Pra, Birim, and Ankobra.

Fig. 12.10: A farmer applying weedicide. This can end up in rivers and streams through surface run-off if the farm is closer to waterbodies.

6. **Plastic Waste:** Plastics are a significant source of pollution in water bodies, particularly in the oceans. In recent times, one of the major environmental challenges to Ghana and Ghanaians is plastic pollution. This is mainly caused by Ghanaians themselves through indiscriminate disposal of sachet water plastics, bottled water plastics, polythene bags and plastics from soft drinks. These are all over markets, streets, and gutters which eventually may end up in rivers, streams and the sea.

Fig. 12.11: Plastic waste in and near the sea

Effects of Water Pollution

Water pollution causes the following problems

1. Water pollution can kill biological organisms such as plants, animals and humans. It may retard their growth and eventually cause plants and animals to die and wither away.
2. When chemicals are introduced into water bodies, sometimes these chemicals become concentrated as excess nutrients leading to eutrophication. It is when there is too much nitrogen and phosphorus in the water from farming and untreated sewage.
3. Industrial waste spills and bad waste disposal can release toxic chemicals like heavy metals and pesticides, as well as industrial chemicals, into the water supply. These chemicals can have adverse health effects on humans, aquatic plants and fishes. Sometimes it kills all the life in the water body, such as in the state of Korle Lagoon in Accra and Chemu Lagoon in Tema.
4. Water pollution can contaminate drinking water sources and cause serious health problems for people, leading to death.
5. Water pollution can degrade and destroy aquatic habitats, including wetlands, marshes, and coral reefs. Some wetlands in Ghana such as Chemu, Densu, and Sakumo wetlands are all under threat from water pollution. It reduces their aesthetic or beautiful nature.
6. Pollution, especially from oil spills, can have devastating effects on coastal ecosystems, including mangroves, and estuaries. It can threaten marine life.
7. Water pollution can have significant economic impacts. It can affect fisheries, aquaculture, tourism, and industries that rely on clean water for their processes. It can lead to water shortage and high cost of treating water. In recent times, the Ghana Water Company has been complaining of high-water treatment costs due to high water pollution in some parts of the country.

Fig. 12.12: A polluted water body with dead fishes

Measures for preventing or mitigating Water Pollution in Ghana

1. Implementing and enforcing stringent regulations for industrial and municipal wastewater treatment is essential.
2. Investing in modern and efficient sewage treatment plants for urban areas can help prevent untreated sewage from contaminating water sources.
3. Encouraging and supporting farmers to adopt sustainable agricultural practices, such as reduced pesticide and fertiliser use, contour ploughing, and agroforestry, can minimise agricultural runoff and nutrient pollution in water bodies. That is ensuring green agriculture.
4. Establishing and maintaining buffer or riparian zones along rivers and lakes can help filter pollutants and prevent sediment run-off from adjacent lands.
5. Raising public awareness about the importance of water conservation and pollution prevention is crucial. Educating communities about the impacts of water pollution and promoting responsible waste disposal can foster a culture of environmental stewardship. Protection of wetlands.
6. Recycling programs and waste collection initiatives should be promoted to reduce the amount of waste entering water systems.
7. Reducing plastic waste through the reuse of plastics and other materials that would have ended up in water bodies.
8. Encouraging industries to use eco-friendly technologies and cleaner ways to make products that can help lower pollution and reduce the harmful substances that end up in our rivers and lakes.

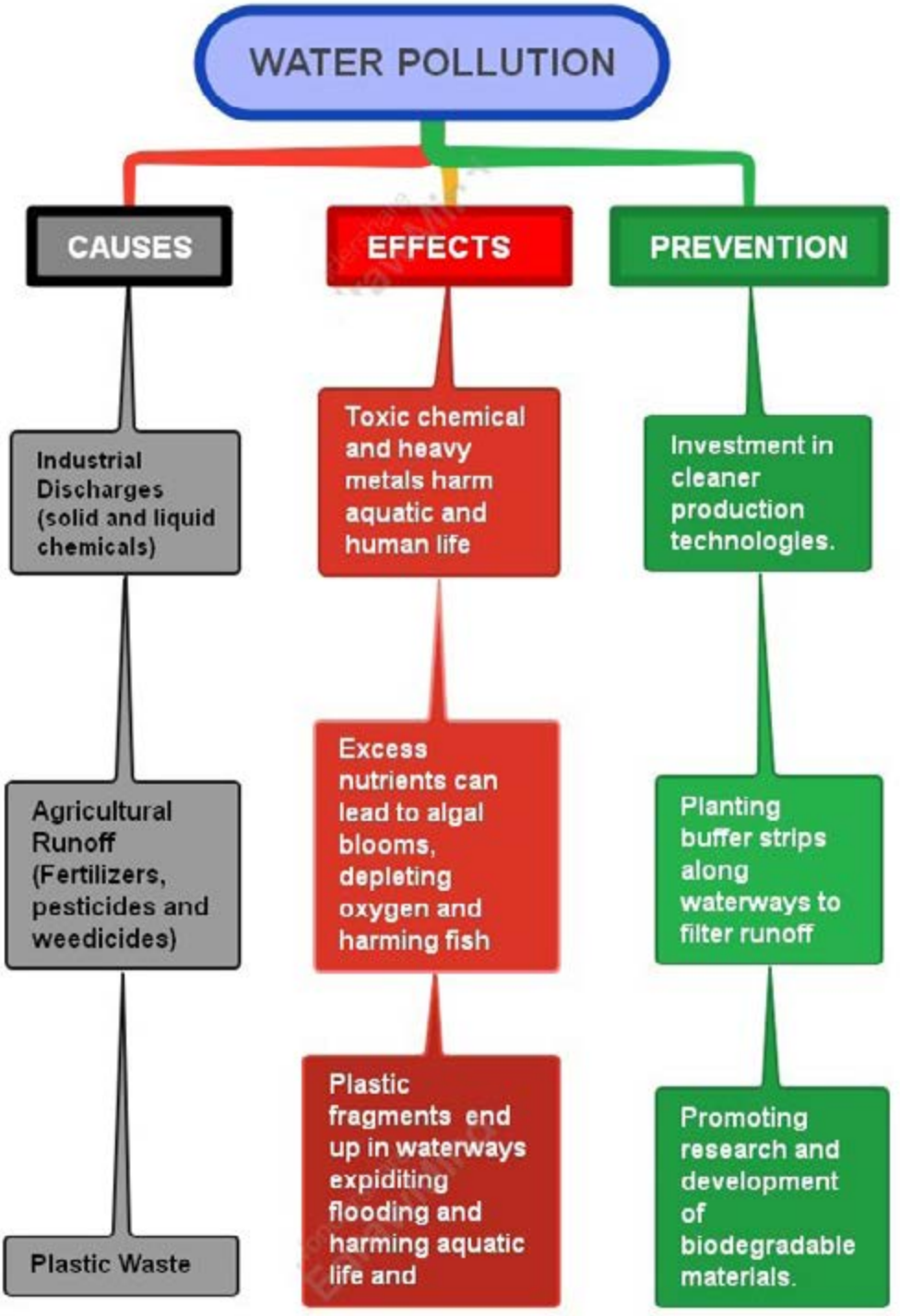


Fig. 12.13: Sample mind map of water pollution showing causes, effects and prevention

Activity 12.2

1. Observe the pictures below and undertake the activities that follow.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

i. Discuss with a friend what you see in these pictures above showing different water bodies.

ii. Give some reasons for what you can see in each picture. Share your observations with your friends in class.

iii. Relate what you see in the pictures above to the water bodies in your community. Discuss with your friend the strategies that your community members can adopt to protect their water bodies.

2. After discussion with your teacher, organise a field trip with your friends to a nearby water body. Take the proper precautions near water and take a responsible adult with you if possible.
   i. Observe the state of the water, in terms of colour and pollutants found in it.
   ii. Discuss with your friend what the community should do to protect the water bodies in the area.
3. Hold a debate with your friends in class on any one of the following issues.

   "Should plastic bottles be banned?"

   'Is our drinking water safe to drink'

   'How can we solve the problem of water pollution'
4. Create a poster for use in your community to inform community members on the causes of water pollution and what action they can take to reduce it.
5. Develop a plan to reduce plastic waste in your school or community.

Review Questions

REVIEW QUESTIONS 12.1: AIR POLLUTION

1. Describe how industrial emissions contribute to air pollution and provide examples of industries that release harmful pollutants.
2. Explain the impact of air pollution on the ozone layer and its consequences for human health and the environment.

REVIEW QUESTIONS PART 12.2: WATER POLLUTION

1. How will you explain water pollution to a friend?
2. What are the main sources of water pollution?
3. Describe the effects of water pollution on human health.
4. How does water pollution affect aquatic life?
5. What can individuals do to reduce water pollution?
6. What is the role of your community in preventing water pollution?
7. What are some common water pollutants?
8. What are the economic impacts of water pollution?
9. How can farmers prevent water pollution in agricultural practices?

Answers to Review Questions

ANSWERS TO REVIEW QUESTIONS 12.1: AIR POLLUTION

1. Industrial Emissions and Air Pollution
Air pollution is a big problem that affects our health and the environment. One major source of air pollution comes from industries, which produce goods like cars, clothes, and food. Let's break down how industrial emissions contribute to air pollution and look at some examples of industries that release harmful pollutants.

   Industrial emissions are gases and particles that are released into the air when factories and power plants operate. These emissions can come from burning fossil fuels, manufacturing processes, and even waste disposal. When these substances enter the atmosphere, they can lead to serious air quality issues.

   How Industrial Emissions Contribute to Air Pollution

   a. **Release of Harmful Gases:** Industries often burn coal, oil, or natural gas to produce energy. This process releases gases like carbon dioxide (CO_2), sulfur dioxide (SO_2), and nitrogen oxides (NOx). These gases can contribute to climate change and create acid rain, which harms plants, animals, and buildings.

   b. **Particulate Matter:** Factories may also release tiny particles known as particulate matter (PM). These particles can be made of soot, dust, and chemicals. When inhaled, they can cause respiratory problems, heart disease, and other health issues.

   c. **Volatile Organic Compounds (VOCs):** Some industries, such as paint and chemical manufacturing, release VOCs. These compounds can react with sunlight to form smog, which can irritate the eyes and lungs, especially for people with asthma.

   Examples of Industries That Release Harmful Pollutants

   a. **Power Plants:** These facilities often burn coal or natural gas to produce electricity. They are major sources of CO_2, SO_2, and NOx, contributing significantly to air pollution.

   b. **Manufacturing:** Factories that produce goods—like automobiles, textiles, and electronics—can emit a variety of pollutants, including VOCs and particulate matter.

   c. **Agriculture:** While not always considered an "industry," agricultural practices can also contribute to air pollution. For example, the use of fertilisers can release ammonia, and livestock can produce methane, a greenhouse gas.

d. **Construction:** Dust and emissions from construction sites can contribute to air pollution. Heavy machinery often runs on diesel fuel, releasing harmful exhaust into the air.

2. The Impact of Air Pollution on the Ozone Layer

Air pollution not only affects the air we breathe but also has a significant impact on the ozone layer, which is crucial for life on Earth. Let's explore what the ozone layer is, how air pollution harms it, and the consequences for our health and the environment.

Ozone Layer

The ozone layer is a region of the Earth's stratosphere that contains a high concentration of ozone (O_3) gas. It is located about 10 to 30 miles above the Earth's surface. The ozone layer acts like a shield, protecting us from the Sun's harmful ultraviolet (UV) radiation.

The following are the **ways Air Pollution Affects the Ozone Layer**

a. **Release of Ozone-Depleting Substances:** Certain pollutants, especially chlorofluorocarbons (CFCs), halons, and other chemicals, can break down ozone molecules in the atmosphere. These substances are often found in old refrigeration systems, aerosol sprays, and some industrial processes.

b. **Nitrogen Oxides (NOx):** Emissions from vehicles and factories release nitrogen oxides, which can also contribute to ozone depletion. These gases can react in the atmosphere and lead to the breakdown of ozone.

c. **Climate Change:** Air pollutants, such as carbon dioxide (CO_2), contribute to climate change. Changes in temperature and weather patterns can affect the stability of the ozone layer, leading to further depletion.

Consequences of Ozone Layer Depletion

d. **Increased UV Radiation:** When the ozone layer is damaged, more UV rays reach the Earth's surface. Increased exposure to UV radiation can lead to serious health problems, including:
   - **Skin Cancer**: Higher UV levels can increase the risk of skin cancer.
   - **Eye Damage**: UV rays can cause cataracts and other eye conditions.
   - **Weakened Immune System**: Increased UV exposure can weaken our immune response, making us more susceptible to diseases.

e. **Harm to the Environment:** The effects of ozone depletion extend beyond human health:
   - **Plant Life:** Increased UV radiation can harm crops and other plants, reducing their growth and yields.
   - **Ecosystems:** Aquatic ecosystems, like coral reefs, are especially vulnerable, as UV rays can damage marine life and disrupt food chains.

f. **Impact on Wildlife:** Many species, including those in oceans and forests, are affected by changes resulting from increased UV radiation. This can lead to declines in populations and biodiversity.

ANSWERS TO REVIEW QUESTIONS 12.2: WATER POLLUTION

1. Water pollution is the contamination of water bodies such as lakes, rivers, oceans, groundwater and drinking water sources
2. Main sources: industrial waste, agricultural runoff, domestic sewage, oil spills, and litter.
3. Effects on human health: waterborne diseases, cancer, reproductive issues, and neurological problems.
4. Effects on aquatic life: habitat destruction, species die, broken ecosystems.
5. Individuals can reduce pollution by using eco-friendly products like paper bags, conserving water, and disposing of waste properly.
6. Community role: enforce regulations, monitor water quality, provide education, and implement community byelaws and policies.
7. Common water pollutants: bacteria, viruses, heavy metals, pesticides, and industrial chemicals.
8. Economic impacts: healthcare costs, lost productivity, and damage to fisheries and tourism.
9. Prevent pollution in agriculture by using best management practices, crop rotation, and organic farming.

Extended Reading

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