Unit 29 · Environmental Pollution

STUDY NOTES

WHAT NEB'S GRADE 11 EXAM ASKS

- **CDC's grid (2077):** Biota and Environment (Units 27–29 together): 6 of 75 marks, 1 short; in one group with Units 1–3, 11–12, 17, 30–31 (21 marks)
- **The paper:** 11 MCQs × 1 · 8 short × 5 · 3 long × 8; 3 hours; 1 mark per expected point
- **CDC's model paper:** short (3 + 2): **overuse of pesticides**, three consequences and two points to raise awareness
- **MCQ (1 mark)**
  - acid rain (SO_2, NO_x); Minamata disease (Japan); photochemical smog; eutrophication
  - why DDT is harmful; World Environment Day (5 June); *E. coli* from sewage; typhoid
  - not a greenhouse gas; BOD in full; methane from paddy fields; lichens and SO_2
  - biomagnification; lead from exhausts
- **Short and long (in parts)**
  - pollution and types of pollutants
  - air pollution: sources, effects on health; control of gases; vehicle exhaust
  - water pollution: sources, effects, prevention
  - soil pollution: industries and agrochemicals; soil degradation

Key terms

Pollution: any undesirable change in the physical, chemical or biological characteristics of air, water or soil that harms, or may harm, living things.

Pollutant: a substance that makes the environment dirty and harmful.

Primary · secondary pollutant: released as it is · formed in the environment.

Biodegradable · non-biodegradable: broken down by microbes · not, or very slowly.

BOD: oxygen microbes need to break down the organic matter in a liter of water (5 days, 20 °C, mg/L).

Eutrophication: nutrients → algal bloom → decay uses up oxygen → fish die.

Biomagnification: a pollutant concentrating up a food chain.

Effluent: factory waste water.

Pesticide treadmill: ever more spraying as pests resist.

IPM: integrated pest management.

Pollution

- **anthropogenic**: industries, agrochemicals, fossil fuels, dumping, deforestation, towns
- **natural**: volcanoes, forest fires, dust storms, decay, pollen
- Nepal's air, 2023: PM2.5 **38 µg/m^3**, ~8 × WHO's guideline of 5

Type	Meaning	Examples
primary	same form as released	DDT, fly ash, SO_2, CO
secondary	formed by reactions (often sunlight)	ground ozone, **PAN**, photochemical smog, sulphuric acid
biodegradable	broken down by microbes	sewage, food waste
non-biodegradable	stay, build up	DDT, BHC, plastics, cans, mercury, lead

Air pollution

- clean dry air: N_2 78.08%, O_2 20.95%, Ar 0.93%, CO_2 0.04%; water vapor 0–4%

Sources

- **natural**: dust, volcanic gases, pollen, methane
- **factories**: CO_2, SO_2, NO, H_2S, CO; **brick kilns** (coal)
- **transport**: CO_2, CO, NO_x, hydrocarbons, soot, SO_2
- **metal processing**: dust, fluorides, lead, nickel, mercury, arsenic
- **burning** firewood, dung, plastic, stubble, rubbish; forest fires
- **nuclear plants**: radiation

Effects on the environment

- **greenhouse effect**: water vapor, **CO_2**, **methane** (paddies), **N_2O**, **CFCs**, ozone → **global warming**; SO_2, NO_2 are not greenhouse gases
- **acid rain**: **SO_2** and **NO_x** → sulphuric, nitric acids; wet and dry deposition

- **ozone depletion**: CFCs, methyl chloroform, CCl_4, methyl bromide → more UV
- less visibility; less sunlight; **soot** on Himalayan snow speeds melting

Effects on plants and animals

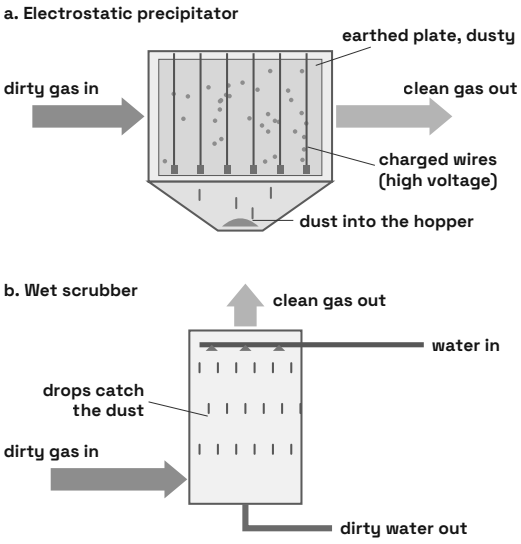
- dust clogs **stomata**; SO_2, ozone: **chlorosis**, dead patches, lower yield
- acid rain: nutrients washed out, aluminium harms roots; acid lakes
- **lichens**: indicators of SO_2 (many kinds = clean air)
- animals: bronchitis, pneumonia, heart disease; hormones upset

Effects on humans

- smoke, ash, dust: allergies, **asthma**, **chronic bronchitis**
- **CO**: binds Hb 200+ × more firmly → **carboxyhemoglobin**; headache, **asphyxia**; heaters in closed rooms
- **H_2S**: eyes, throat, nausea
- **nickel, cadmium**: lung disorders; **lead**: **anemia**, nerve damage (children)
- **NO_x**: eyes, airways; **pulmonary edema**
- long term: heart disease, **strokes**, COPD, **lung cancer**

Prevention

- **arresters**, **filters** (bag filters, cyclones), **electrostatic precipitators**, **scrubbers** (wet; dry with lime)
- scrubber water made alkaline with lime removes SO_2
- vehicles: tuning, low-sulphur fuel, **catalytic converters** (CO, hydrocarbons, NO_x → CO_2, H_2O, N_2), public transport, **electric vehicles**
- renewable energy: solar, hydro, wind, biogas
- industries away from homes; awareness; laws; **zigzag** brick kilns
- leaded petrol: banned everywhere (2021)



Electrostatic precipitator and wet scrubber.

Water pollution

Sources

- **domestic sewage**: food, detergents, feces; **nitrates**, **phosphates**; pathogens
- **industrial effluents**: **lead, mercury, chromium**; oils, dyes, solvents (tanneries, paper mills)
- **farm runoff**: pesticides, fertilizers
- **oil spills**: film stops oxygen dissolving; coats birds
- **radioactive** wastes
- **natural**: **arsenic** in Terai tube wells

Effects

- **waterborne diseases**: diarrhea, cholera, **typhoid** (*Salmonella* Typhi), dysentery, hepatitis A, E; *E. coli* shows **feces** in water
- **high BOD**: decomposers use up oxygen; clean river a few mg/L, sewage 100–400 mg/L
- **thermal pollution**: warm water holds less oxygen (14.6 mg/L at 0 °C, 9.1 at 20 °C, 7.6 at 30 °C); fish need more
- **biomagnification**
- **eutrophication**: nitrates, phosphates → **algal bloom** → decay, no oxygen → fish die (Phewa Lake)
- **heavy metals**: kidneys, nerves, cancer
- **Minamata disease** (Japan, **1956**): factory **mercury** → **methylmercury** in fish → shaking, blindness, brain-damaged babies

Prevention

- compost or biogas from organic waste
- **treat** sewage, effluents (Guheshwori plant)
- recycle; treat before dumping
- minimum **agrochemicals**; IPM
- awareness; trees along rivers; laws

Soil pollution

- any undesirable change in the soil; changes texture, fertility, water holding

Sources

- **domestic** wastes: plastic, cans, glass; breed germs
- **municipal** wastes: sort biodegradable and non-; heavy metals (Sisdol landfill)
- **industrial** wastes: sulphides, bleach, drugs, mine waste, heavy metals
- **biocides** (DDT, aldrin, lindane, parathion, toxaphene) and **chemical fertilizers**
- **physical**: bad irrigation (salty soil), building, deforestation
- **acid rain**; **radioactive** waste
- **overgrazing**, **deforestation**: **topsoil** washed away; soil packed hard

Effects

- kills soil life; food scarce and contaminated
- pollutes air and water too
- heavy metals: cancer, skin, nerve, urinary, digestive disorders, birth defects
- plastics block roots → crop failure
- microbes and other life lost; landscape spoiled

Control

- **3R**: reduce, reuse, recycle
- dung to **biogas**, slurry as manure
- ban or minimize biocides
- **biofertilizers** (*Rhizobium*, blue-green algae), manure
- stop cutting trees; **afforestation**

Pesticides

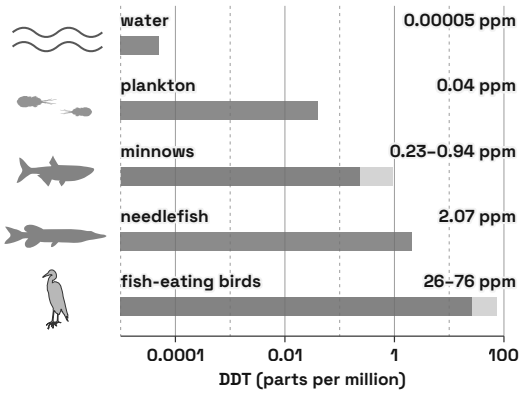
- **pest**: unwanted organism harming crops, livestock, forests, people
- **biocides**: insecticides, rodenticides, fungicides, herbicides

Type	Examples	Note
organochlorines	**DDT**, aldrin, dieldrin, lindane	**hard**: persist; banned (Stockholm, 2001) except DDT for malaria
organophosphates	parathion, malathion	nerve poisons; break down faster; more toxic to people
carbamates	carbaryl, aldicarb	nerve poisons, less lasting
plant-derived	pyrethrum, rotenone, nicotine, azadirachtin (neem)	from plants
pyrethroids	permethrin, cypermethrin	mosquito coils, bed nets
oils	mineral oils	block breathing pores
growth regulators	Dimilin	stop molting

- organophosphates and carbamates block **acetylcholinesterase**: nerves keep firing

Effects (consequences of overuse)

1. pollute air, water, soil
2. **non-biodegradable**, fat-soluble → **biomagnification**: thin eggshells of fish-eating birds (ospreys, pelicans, falcons)
3. kill **non-target** animals: **honeybees**, **earthworms**, birds, fish
4. **residues** on food; poisoning (sweating, vomiting, cramps); long-term liver, kidney damage
5. harm biodiversity
6. pests become **resistant**
7. **pesticide treadmill**: more spraying; natural enemies killed; pests rebound



DDT up a food chain: water to fish-eating birds, about a million times.

Alternatives and awareness

- **crop rotation**
- **biological control**: ladybirds eat aphids; *Trichogramma*; *Bacillus thuringiensis* (Bt)
- **biopesticides**: ash, cow urine, neem
- **mechanical**: hand-picking, traps, sticky yellow cards
- resistant varieties
- **IPM**: all together; spray only when pests do real harm; farmer field schools (late 1990s)
- spray with protection; wash vegetables; follow the dose

COMMON MISTAKES

✗ SO_2 is a greenhouse gas
✓ it isn't; it causes **acid rain**.

✗ All pollutants come from people
✓ natural ones too (volcanoes, pollen).

✗ Clear water is clean
✓ it can still carry germs or poisons.

✗ Organophosphates are hard pesticides
✓ organochlorines are; organophosphates break down faster.

✗ "Deminin"
✓ **Dimilin** (diflubenzuron).