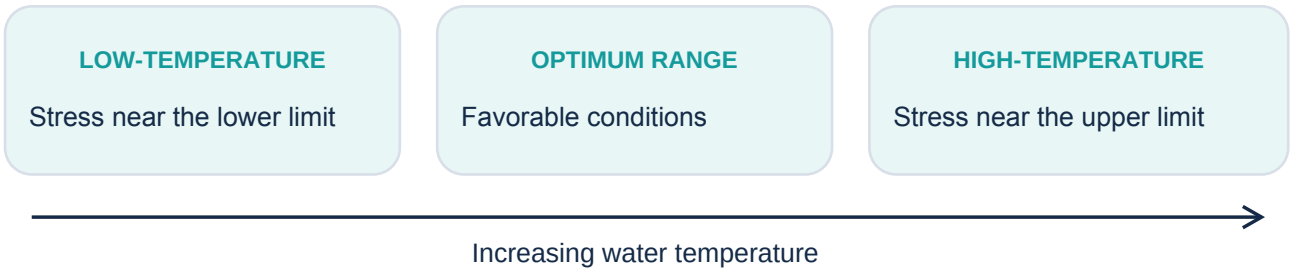
When conditions exceed tolerance

Human activities can change temperature, water clarity, oxygen availability and exposure to toxic substances. The impact depends on the organism, the intensity of the change and how long it lasts.

1. A TOLERANCE RANGE IS NOT UNLIMITED

Within an optimum range, organisms maintain internal conditions and function well. Approaching a tolerance limit causes stress and can reduce growth or reproduction. Beyond the limits, survival becomes unlikely.



Schematic for one species, not a universal scale. Species have different limits. Toxic pollution is not beneficial merely because temperature has an optimum range.

2. CORALS: DIFFERENT STRESSORS, DIFFERENT DAMAGE

Warming: heat stress can cause loss of symbiotic algae and bleaching, reducing the coral's energy supply. Bleaching is not necessarily immediate death.
Destructive fishing: explosives or contact with fishing gear can break reef structure; chemicals used to capture fish can poison reef organisms.

3. SEDIMENT CHANGES LIGHT AND HABITAT

Erosion and runoff can deliver suspended particles that make water cloudy. Less light reaches aquatic primary producers, limiting photosynthesis; visual predators may find prey less easily. Settling sediment can bury bottom habitat and smother corals or other organisms. Sediment can cause physical harm without being chemically toxic.

Tolerance and sediment mechanisms: College Board, STB-3.B.1 and STB-3.B.9.
Reef stressors: NOAA, Human Threats to Corals.

Scope: College Board AP Environmental Science CED, Topic 8.2, pp. 158-159.

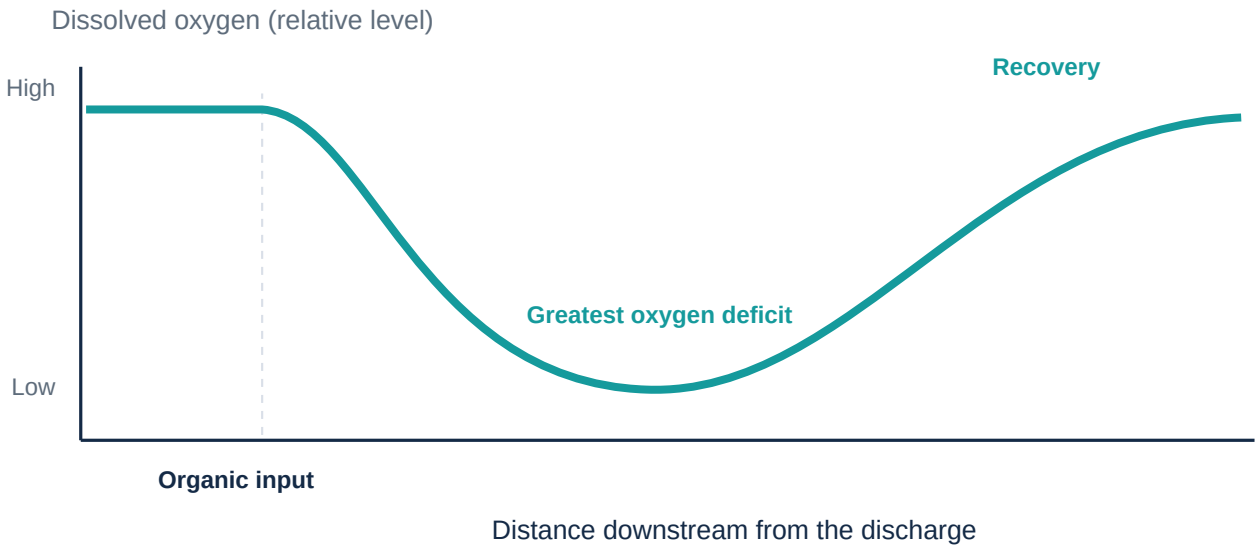
Follow the oxygen, not just the algae

Dissolved oxygen (DO) is oxygen gas available in water. Oxygen-demanding waste and nutrient enrichment can lower DO enough to stress aquatic organisms, force mobile animals to leave or cause deaths.

1. NUTRIENTS CAN TRIGGER AN INDIRECT OXYGEN LOSS

Excess nitrogen or phosphorus can stimulate algal growth. Microbes decompose dead material and waste, consuming oxygen through aerobic respiration. If consumption exceeds replacement, DO falls.
Hypoxia means low oxygen; anoxia means no oxygen. A "dead zone" is a low-oxygen area, not a claim that every organism is absent.

2. READ AN OXYGEN-SAG CURVE



Schematic, not measured data. The lowest DO may occur downstream because oxygen-consuming decomposition takes time. Recovery is possible as the waste is used up and oxygen replacement exceeds demand; continued inputs or poor mixing can prevent it.

3. QUANTIFY THE CHANGE

Illustrative DO decrease: 8 to 2 mg/L.
Percentage decrease = (8 - 2) / 8 × 100 = 75%

Nutrients, decomposition and hypoxia: NOAA, What Is a Dead Zone?
Oxygen-sag interpretation: College Board, STB-3.B.5 and STB-3.B.6.

Scope: College Board AP Environmental Science CED, Topic 8.2, pp. 158-159.

Connect each pollutant to its harm

Pollution can act through toxicity, oxygen depletion or physical damage. Name the pathway and the affected organism or resource instead of treating every pollutant as having the same effect.

1. OIL: TOXICITY AND PHYSICAL COATING

Hydrocarbons and other oil constituents can poison exposed organisms. Surface oil coats feathers and fur, reducing insulation and the ability to maintain body temperature. Most oil initially floats, but some components or oil mixed with particles can reach the bottom and harm benthic organisms. Oil reaching shore can damage coastal habitats and disrupt fishing and tourism. The effects depend on oil type, location and exposure; a clean-looking surface does not prove that all contamination is gone.

2. METALS: TRACK THE SOURCE AND CHEMICAL FORM

Mining, industrial activities and fossil-fuel combustion can release metals. Contaminants may enter surface water or move through soil into groundwater, threatening drinking-water sources.
Mercury illustrates why chemical form matters: microbes can convert some inorganic mercury into methylmercury, a highly toxic organic form. It can enter aquatic food webs. Transformation does not mean the element has disappeared or become harmless.

3. LITTER: MORE THAN AN UNTIDY SHORE

Animals may mistake litter for food, causing choking or intestinal blockage. Nets and line can entangle wildlife, restricting movement or feeding. Some litter can introduce toxic chemicals into food chains.
Swallowing plastic can cause physical injury; exposure to chemicals associated with debris is a separate potential hazard. Effects vary with material, dose and organism.

Connect the pages: sediment can reduce light; nutrients can reduce oxygen indirectly; oil and metals can be toxic; litter can physically injure organisms. Several mechanisms may operate in the same ecosystem at the same time.

Oil exposure and coating: NOAA, How Oil Harms Animals and Plants.
Mercury forms and transformations: US EPA, Basic Information about Mercury.
Oil, metals and litter: College Board, STB-3.B.3, .4, .7, .8 and .10.

Scope: College Board AP Environmental Science CED, Topic 8.2, pp. 158-159.