ECOLOGICAL NICHES

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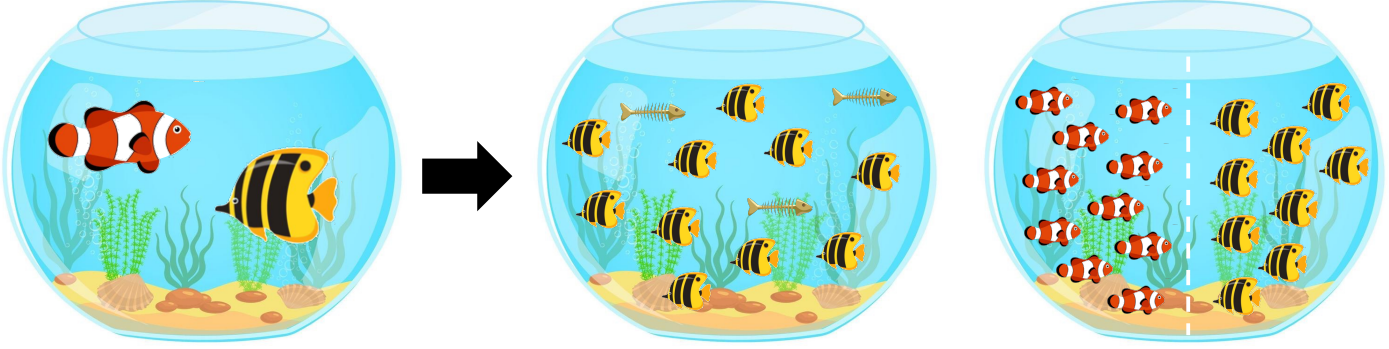
NICHE

An ecological niche describes the **functional position and role** of an organism within its environment. It will consist of all biotic and abiotic interactions that influence growth, survival and reproduction, including how a species obtains food. Components of an ecological niche include the habitat in which an organism lives as well as the resources within the environment (light, temperature, etc.). It also includes the activity patterns of the organism (respiration and nutrition method) and its interactions with other species (predation, etc.).

COMPETITION

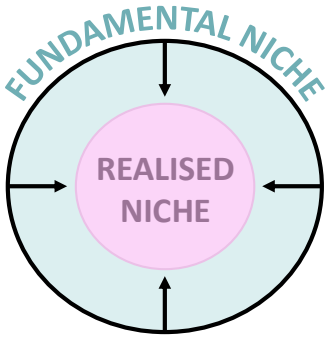
If two distinct species shared an identical niche, there would be competition for space and resources. This competition would result in lowered fitness and a struggle for survival, prompting one of two responses:

- **Competitive exclusion:** One species uses the resources more efficiently, driving the other to extinction
- **Resource partitioning:** Both species alter their use of the habitat to divide the resources between them



Identical Niche | Competitive Exclusion | Resource Partitioning

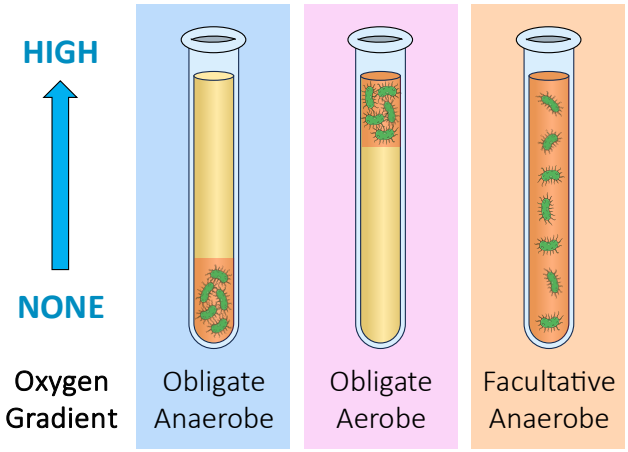
TYPES OF NICHES



Species may not occupy their entire niche as a result competition from other organisms. The **fundamental niche** is the entire set of conditions under which an organism can survive and reproduce (where it *could* live). It is a theoretical habitat and may not be fully occupied due to the presence of other species. A **realised niche** is the set of conditions used by an organism after including all interactions with other species (where it *does* live). It is the actual habitat that is completely occupied by the organism in the presence of other species.

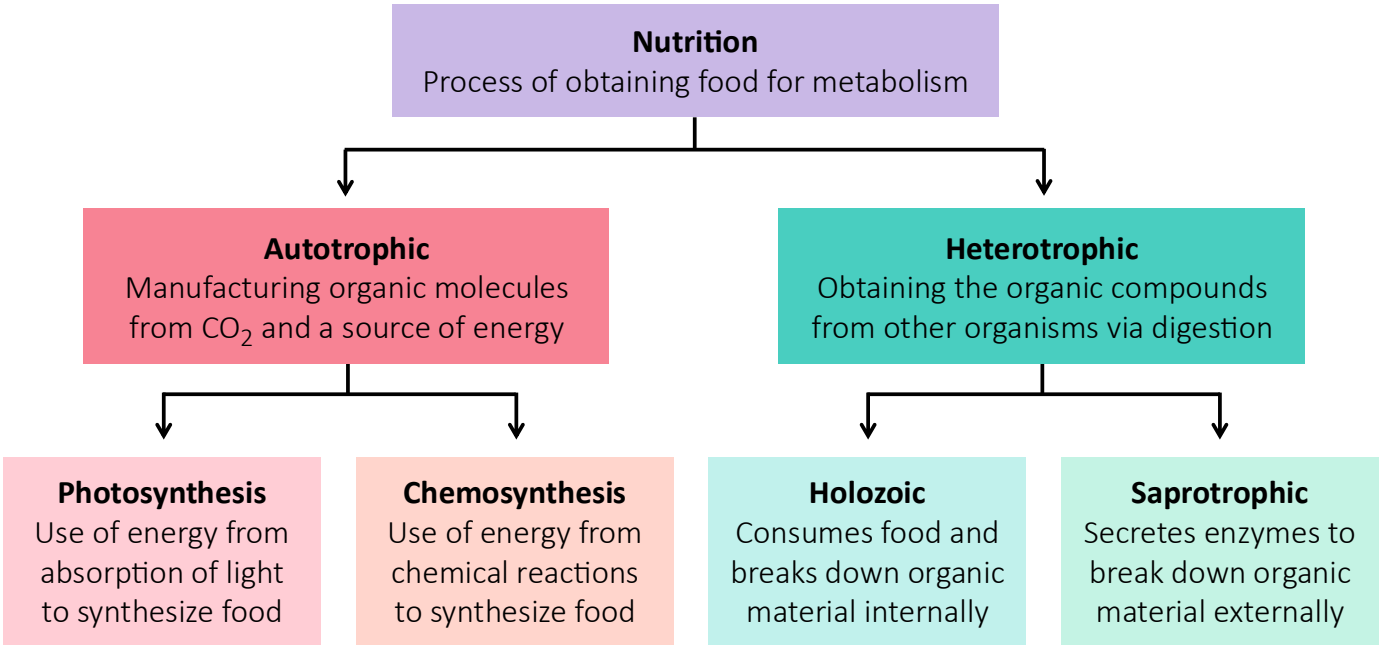
MODES OF RESPIRATION

A niche can be characterised according to the method by which a given organism undertakes cell respiration. An **obligate anaerobe** cannot tolerate the presence of oxygen (it undertakes anaerobic respiration only). An **obligate aerobe** cannot survive in the absence of any oxygen (requires aerobic respiration for survival). But a **facultative anaerobe** is able to respire anaerobically or aerobically – it can tolerate oxygen but experiences no negative long-term effects from its absence either.



MODES OF NUTRITION

Niches can also be differentiated according to an organism's feeding patterns (mode of nutrition). All living organisms need to synthesise cellular energy (ATP) in order to undertake metabolic activities. Organisms may undertake a variety of feeding methods to acquire the nutrients needed to complete these functions. **Autotrophic nutrition** involves synthesising organic compounds from simple inorganic molecules (e.g. CO_2). The energy required for these anabolic reactions can be either derived from sunlight (via *photosynthesis*) or the oxidation of inorganic substances – such as iron oxide, ammonia or hydrogen gas (via *chemosynthesis*). **Heterotrophic nutrition** involves obtaining organic compounds from other organisms via feeding. Holozoic nutrition involves the ingestion and *internal* digestion of carbon compounds, while saprotrophic nutrition involves releasing enzymes to chemically digest organic material *externally*, before absorbing the products.



NUTRITIONAL DIVERSITY

Certain groups of organisms utilise a range of different modes of nutrition to meet energy requirements. For example, **archaea** are one of the three domains of life and are metabolically very diverse. Archaea can use either light *(phototrophs)*, inorganic molecules *(lithotrophs)* or organic compounds *(organotrophs)* to synthesise ATP. Some archaea also possess unique nutritional processes (e.g. *methanogenesis* by gut flora).

Specific organisms may also on occasion use both autotrophic and heterotrophic nutrition, depending on resource availability. These organisms are **mixotrophs** and can be either obligate (must use both forms) or facultative (can survive using only one form). Examples of mixotrophs include *Euglena* and dinoflagellates.

NICHE ADAPTATIONS

Organisms may possess specific adaptations depending on their method of feeding to better suit a niche. Plants possess adaptations to maximise light absorption and resist herbivory. Herbivores possess adaptions to better feed on plants and resist predation, while predators have adaptations for catching and killing prey.

Plant adaptations for harvesting light and maximising photosynthesis may include:

- **Lianas** – Woody vines rooted in the soil that extend along trunks to the canopy
- **Overstory** – Emergent trees grow above the canopy to gain the most sunlight
- **Understory** – Low-growing herbs and shrubs have larger leaves (↑ surface area)
- **Shade tolerant plants** – Have different pigments to absorb more wavelengths
- **Epiphytes** – Plants growing on the branches of other plants (no contact to soil)

Plant defences for protecting against herbivory may include physical structures (such as spines, thorns and thick bark) or chemical compounds (such as bitter-tasting chemicals or toxic compounds in seeds or leaves).

Herbivore adaptations for feeding on plants may include specialised mouthparts (stylets and mandibles), specialised digestive systems with specific bacteria (such as multiple stomach compartments containing gut flora for digesting cellulose) or unique metabolic processes (some animals can neutralise the plant toxins).

Prey adaptations that herbivores and other animals may use to resist predation include tough outer shells, the capacity to camouflage or mimic predator structures, chemical toxins or scents to deter predators, as well as defensively oriented behavioural patterns (such as feigning death, puffing up or grouping together).

Predator adaptations for finding, catching and killing prey include heightened sensory organs and physical features such as sharp teeth and claws, chemical compounds (such as neurotoxins and venoms to subdue prey), camouflaged appearances and predatory behaviours such as laying in ambush or hunting in packs.

DENTITION AND DIET

Omnivores are animals that feed on both vegetation and meat and have specialised teeth shapes (**dentition**) for this function. Hominidae are a family of greater apes (including humans) and exhibit different dental profiles according to the diet. Hominids that eat more meat have narrower jaws and smaller teeth (for chewing softer tissue), with incisors and canines for cutting and tearing. Hominids that feed primarily on plant matter have jaws that are broader with larger premolars for tougher vegetation.