TOPIC: BIODIVERSITY

Key Knowledge:

- The biological importance of genetic diversity within a species or population
- Structural, physiological and behavioural adaptations that enhance an organism's survival and enable life to exist in a wide range of environments
- Survival through interdependencies between species, including impact of changes to keystone species and predators and their ecological roles in structuring and maintaining the distribution, density and size of a population in an ecosystem
- The contribution of Aboriginal and Torres Strait Islander peoples' knowledge and perspectives in understanding adaptations of, and interdependencies between, species in Australian ecosystems

ADAPTATIONS

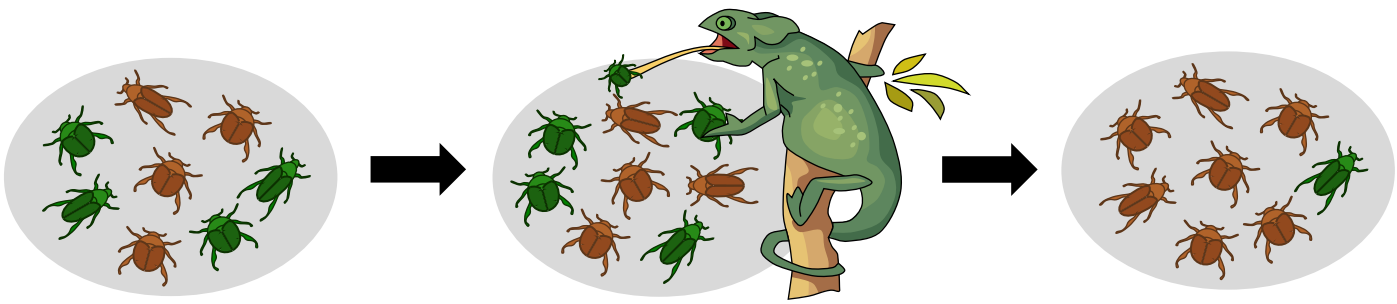
Organisms possess particular characteristics which enhance the prospect of surviving specific environmental conditions. Any feature that supports survival of an organism in a given environment is called an **adaptation**. Adaptations can be described as structural, physiological or behavioural.

- **Structural:** Physical differences in biological structure of an organism *(echidnas have sharp quills for protection and claws for burrowing)*
- **Behavioural:** Observable differences in common patterns of activity *(echidnas may hibernate during winter months in cold regions)*
- **Physiological:** Variations in detection and response by vital organs *(echidnas stiffen their tongue to penetrate the soil and catch ants)*

ECHIDNA ADAPTATIONS

NATURAL SELECTION

Organisms will evolve over many generations to more commonly possess adaptations that are suited to the conditions in which the organism lives. Individuals with beneficial adaptations will be more likely to survive and reproduce ('survival of the fittest'), hence increasing the frequency of these inheritable characteristics in future generations. Adaptations that are detrimental to survival will be less common in a population as individuals are less likely to reproduce and pass on these traits to offspring. Environmental conditions (selection pressures) will determine whether a particular adaptation is beneficial or detrimental to survival. This evolutionary change in response to environmental pressures is called **natural selection**.



BIODIVERSITY

Biodiversity describes the variety and variability of life on Earth. Natural selection reduces the biodiversity within a species, as the frequency of individuals with beneficial adaptations is increased in the population.

ECOLOGICAL RELATIONSHIPS

In nature, no species exists in total isolation – all organisms interact with other organisms. If two species directly interact within a shared environment, they share a positive association (they co-exist). Examples of positive associations include predator-prey or symbiotic relationships. However, if the interactions within an environment are mutually detrimental to both species, they share a negative association and they do not co-exist. Competitive exclusion and resource partitioning are consequences of negative associations.

HERBIVORY

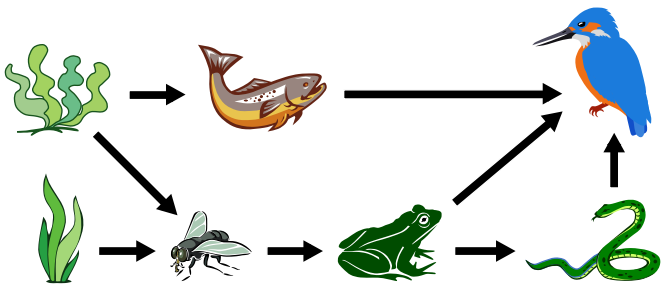
Herbivory is the act of eating only plant matter. All feeding sequences begin with an autotrophic organism and so plants are a vital component of most ecosystems. Herbivory can be harmful or beneficial to plants:

- Certain herbivores may feed voraciously on the foliage of crop plants (folivores), causing crop failure
- Fruit-eating animals (frugivores) spread seeds from a fruit in their faeces, promoting seed dispersal

PREDATION

Predation is a biological interaction whereby one organism (predator) hunts and feeds on another (prey). Because the predator relies on the prey as a food source, their population levels are intertwined. Feeding relationships between networks of organisms can be represented as interrelated **food webs**. The position an organism occupies within a feeding sequence is known as a **trophic level**. Producers always occupy the first trophic level in a feeding sequence, while organisms can occupy multiple trophic levels in a food web.

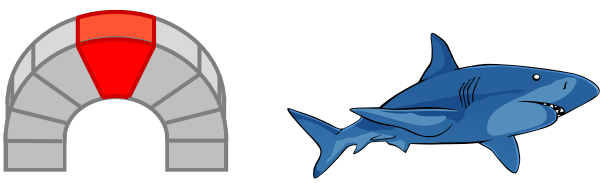
TROPHIC LEVEL	EXAMPLES
1 – Producer	Waterweed, Algae
2 – Primary Consumer	Fly, Trout
3 – Secondary Consumer	Frog, Kingfisher
4 – Tertiary Consumer	Snake, Kingfisher
5 – Quaternary Consumer	Kingfisher



KEYSTONE SPECIES

A keystone species is a species that has a disproportionately large impact on the environment relative to its abundance. It is analogous to a keystone in an arch – it fundamentally supports the whole structure and prevents it from collapsing. Keystone species may influence communities in a number of different ways:

- **Predators:** May exert pressure on lower trophic levels to prevent them monopolising certain resources
- **Mutualists:** Can support the life cycle of various species in a community (e.g. honey bees = pollinators)
- **Engineers:** Will refashion the environment in a manner that benefits other species (e.g. beaver dams)



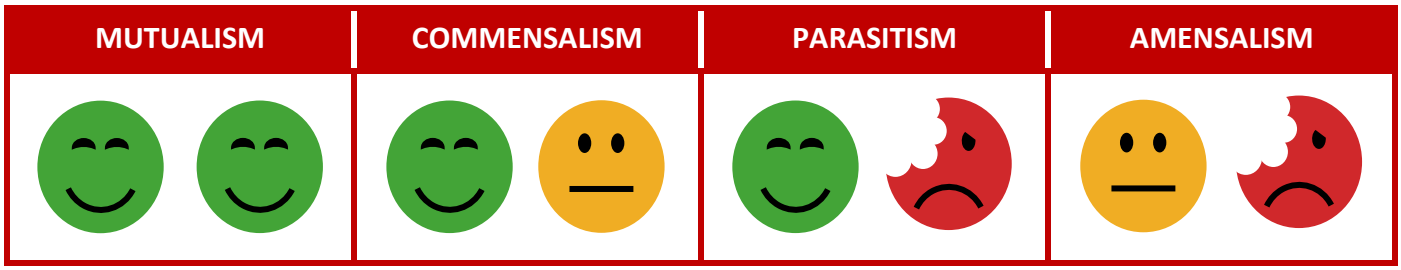
KEYSTONE (SHARK)
Sharks are apex predators and keep prey populations stable

NO KEYSTONE
Rays overpopulate, causing the lower trophic levels to collapse

SYMBIOSIS

Symbiosis describes the close and persistent (long-term) interaction between two species. The relationship can be either obligate (required for survival) or facultative (advantageous without being strictly necessary). Common examples of symbiotic relationships include: mutualism, commensalism, parasitism, amensalism.

- **Mutualism:** Both species benefit from the interaction – an example is **honey bees** and **flowering plants**
  Honey bees gather nectar from flowers and distribute pollen between plants (promoting reproduction)
- **Commensalism:** One species benefits while the other is unaffected – an example is a **remora** and **shark**
  Remora attach to the underside of larger predatory fish (e.g. sharks) and feed off uneaten food scraps
- **Parasitism:** One species benefits to the detriment of another species – an example is a **tick** and a **host**
  Ticks infest the skin and fur of a host animal, feeding off the host blood and potentially causing disease
- **Amensalism:** One species is harmed and the other is unaffected – an example is **cattle** trampling **grass**
  Grass suffers by being crushed by livestock (e.g. cows and sheep), but has no effect on the cattle hooves



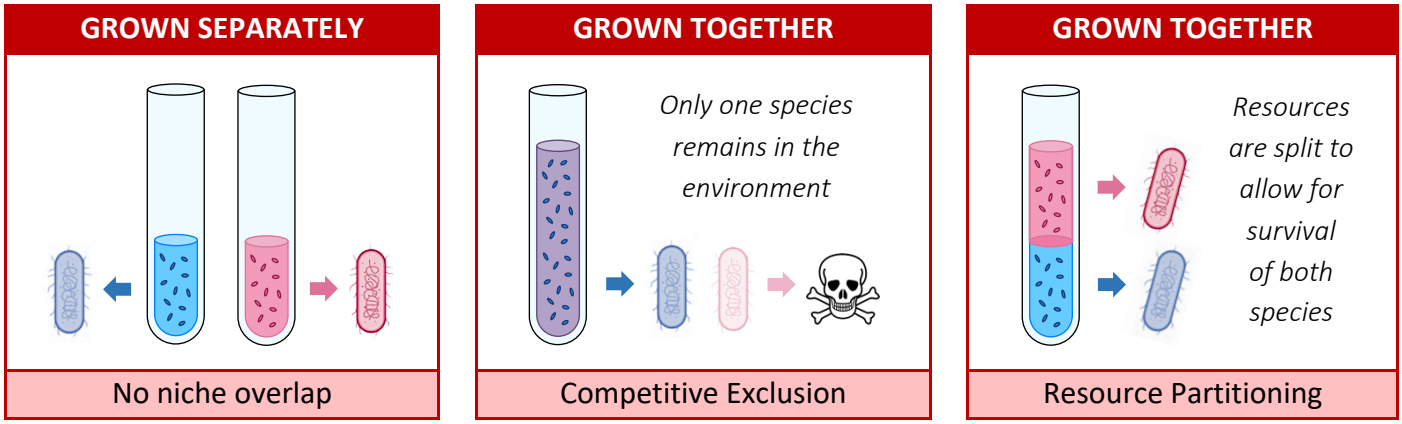
COMPETITION

Competition describes any interactions whereby the fitness of an organism is lowered by the presence of another. It is a negative association in that both species are harmed by the interaction. Competition that occurs between different species is called **inter**specific competition, whereas competition occurring within a particular species is called **intra**specific competition. Competition plays a critical role in natural selection.

An **ecological niche** describes the functional position and role of an organism within a given environment. Competition may prevent a species from occupying their entire niche. The *fundamental* niche describes the set of conditions under which an organism can survive (where it ***can*** live), whereas a *realised* niche is the set of conditions actually used by an organism in response to competitive forces (where it ***does*** live).

Competition can influence the distribution of a species within its environment in one of two main ways:

- **Competitive exclusion:** One species uses resources more efficiently, driving another to local extinction
- **Resource partitioning:** Two species alter their use of environment to divide resources between them



ABORIGINAL CONTRIBUTIONS

Aboriginal and Torres Strait Islander people have observed the adaptations of, and interdependencies between, species in Australian ecosystems and exploited these characteristics for a myriad of applications.

Biomimicry

Biomimicry involves imitating natural adaptations to solve human problems. Indigenous examples include:

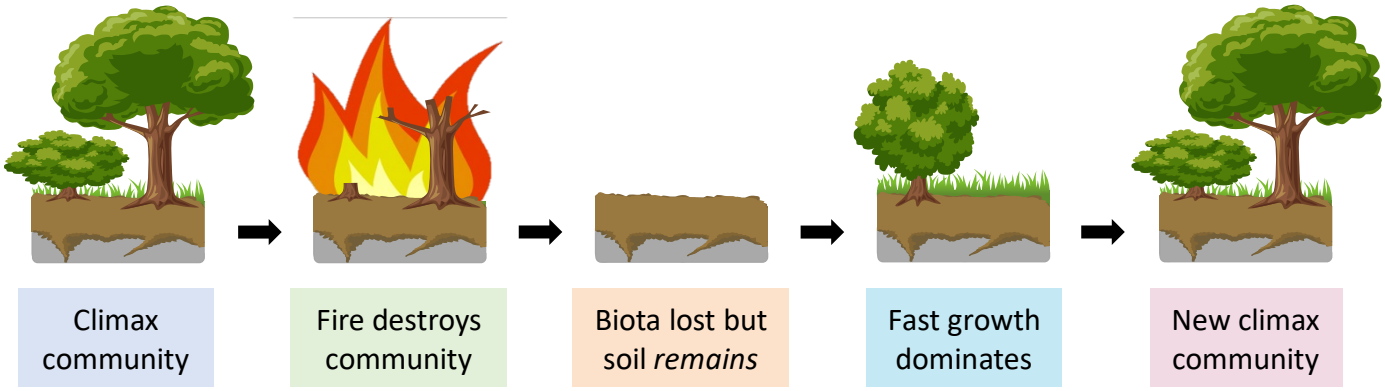
- Designing weapons from animal parts (e.g. spear points from a stingray tail or knives from shark teeth)
- Using hooks from plants to catch prawns and fish or extract witchety grubs from the bores of trees
- Making items of clothing from possum fur and using echidna quills as pins to affix the clothing items

Water Sourcing

Australian water-holding frogs have the ability to store water underneath the skin for absorption into the body when water is scarce. Indigenous Australians have discovered how to locate these frogs (by finding soil markings) and extract the water from the skin of the frog (via gentle squeezing). This has provided the Aboriginal people with a ready source of water in the dry and desert conditions of the Australian outback.

Controlled Burning

Indigenous Australians have traditionally used fire as a means of ecological management. Australian flora is adapted to cope with fire, with the periodic burning of established plant life creating a nutrient-rich soil that allows for new growth. Many eucalypts have **lignotubers** – root swellings that contain buds where new shoots can sprout from. These lignotubers allow for the re-establishment of the eucalypt following a fire (which enriches the soil, kills competing plant species and consequently allows seeds to germinate).



Bush Medicine

Bush medicine involves using components of native Australian flora and fauna in the act of healing. First Nations people have used a wide variety of plant oils as treatments for common infections and fevers. Furthermore, desert mushrooms were traditionally used as natural teething rings, while certain flowers and witchety grubs have been ground into pastes to treat various ailments, including burns treatments.

Biopiracy

Biopiracy is the unauthorised appropriation of knowledge from indigenous communities by institutions seeking to establish profits through patents and monopolies. As Indigenous Australians pioneered the use of certain bush medicines, the commercialisation of their biological properties by corporate entities could be considered an act of intellectual theft (if undertaken without permission from indigenous communities).