

GILLS

Aquatic

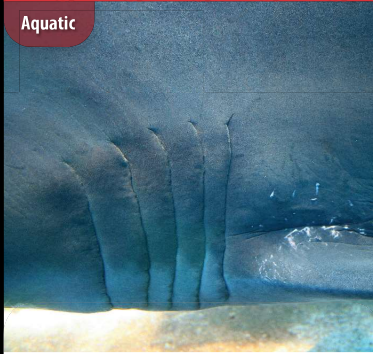


Using countercurrent flow a concentration gradient is maintained across the entire length of the membrane. This is key as oxygen concentration is around 50 times lower in water than in air.

E2

GILLS

Aquatic



Each gill arch consists of filaments and lamellae which provide a large surface area to increase oxygen intake. Bony fish have 4 gill arches on each side of their head.

E2

OSMOCONFORMER

Aquatic



Osmoconformers maintain their internal environment so that it has the same osmotic pressure as that of the external environment.

E2

OSMOCONFORMER

Aquatic



Sharks use urea to increase or decrease their osmolality without altering their ionic concentration.

E2

CHLORIDE CELLS

Aquatic

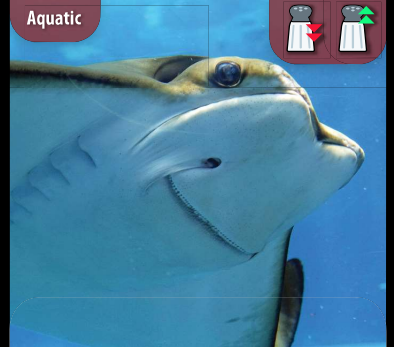


In hypertonic solutions, chloride cells (found in gills) pump sodium and chloride ions out of the body. In low osmolality conditions they pump sodium and chloride ions into the body.

E2

CHLORIDE CELLS

Aquatic

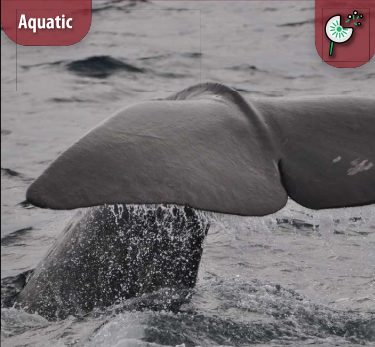


These cells help regulate the sodium and chloride ion potentials in the body. Therefore they help maintain osmotic balance even in hyper/hypotonic solutions.

E2

FINS

Aquatic



Many fins use countercurrent heat exchange to reduce heat loss. The blood leaving the core body loses heat to the cold blood returning from the fin so that when it re-enters the core it does not lower the body temperature.

E2

FINS

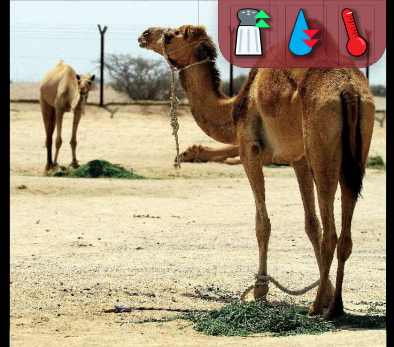
Aquatic



Fish tail fins move side to side to propel them forward whereas aquatic mammal tail fins move up and down. The dorsal and pectoral fins are used to stabilise and direct the movement allowing these animals to control their motion.

E2

CONCENTRATED URINE

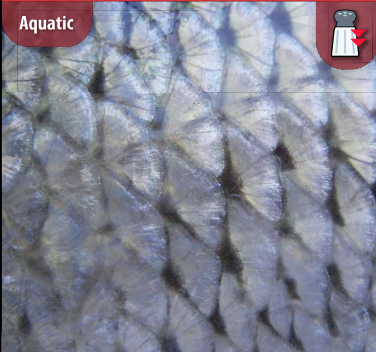


Camels lose little water in their concentrated urine. This means they need to drink less water as most of the water they require can be found in their food and its catabolism.

E2

PLACOID SCALES

Aquatic



Freshwater fish inhabit hypotonic solutions so they must have impermeable skin to prevent excess water gain.

E2

BLUBBER

Aquatic



Blubber is a form of subcutaneous fat that insulates against heat loss and is a common thermoregulatory adaptation in marine animals.

E2

SHIVERING THERMOGENESIS



Invest 1.

Small regular muscular contractions which increase the temperature of the organism.

E2

TAXES



Directional movement in response to a graded stimulus. *Aquaspirillum* displays a magnetotaxis which allows it to burrow downwards where it meets more anoxic conditions which suits the organism's anaerobic lifestyle.

E2

EURYHALINE

Aquatic

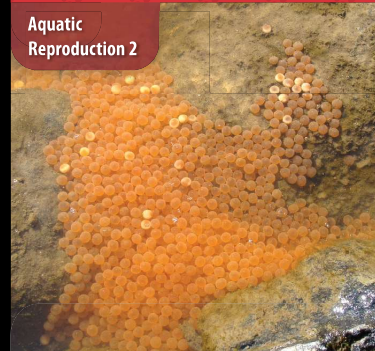


Can tolerate wide variations in osmotic pressure. Salmonids, like mackerel, hunt in the oceans but must travel up river to spawn. As a result they are exposed to both hypotonic and hypertonic solutions.

E2

EXTERNAL FERTILISATION

Aquatic
Reproduction 2

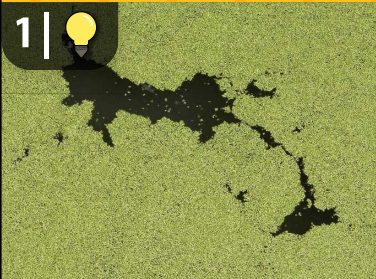


Many fish species use monthly cycles to coordinate the release of large quantities of gametes in a single place. This protects against the chance of all the eggs being eaten by predators.

E2

EUTROPHICATION

1 |



Affects Plants and Aquatic Species Only.

For each Vulnerable Plant Species lose 2 Trait cards and for each Aquatic Species lose 1 Trait card.

Draw 1 card for each Resilient Species.

Surface run-off from fertilised farmland into surrounding rivers and lakes causes surface algal blooms. As a result, aquatic populations have no access to sunlight and oxygen availability decreases.

E2

FOREST FIRE

1 |



Affects Plants and non-Aquatic Animal Species only.

All your Vulnerable Species go Extinct. Look through the deck and take 1 Plant Trait card for each Plant Species lost, and 1 Animal Trait card for each Animal Species lost, taking the first ones you find. Place these separately in your Community as new Species. Afterwards, shuffle the deck. If there are not enough Traits in the deck, search the discard pile.

An already established ecosystem is reduced to a smaller or non-existent population. Secondary succession then occurs on soils in which seeds and roots of plants may have survived.

E2

FRESH WATER

1 |



Affects Aquatic Species only.

If you have any Resilient Species, take a look at the hand of an opponent of your choice. In addition, draw 1 card for each Resilient Species.

Lakes, rivers and ponds make up the majority of the freshwater biome. These can vary largely in climate, nutrient input and oxygen availability.

E2

⚡ NUCLEAR WINTER

1 | 



Your 2 Vulnerable Species which have the fewest Trait cards go Extinct.



For each Resilient Species, search the discard pile for the first Trait card you find. Add it to your hand or play it immediately.

Following a nuclear war, there will be a period of cold and darkness. This is caused by a layer of smoke and dust in the atmosphere, which blocks the sun's rays.

E2

⚡ RISING SEA LEVELS



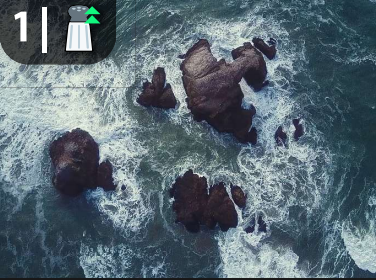
Affects all players. Affects non-Aquatic Animal Species only.

All non-Aquatic Animal Species go Extinct

Sea level rise is caused by thermal expansion of water in the oceans and melting of ice sheets and glaciers on land. This can have direct impact on coastal habitats, cause destructive erosion and cause wetland flooding.

E2

⚡ SALT WATER



Affects Aquatic Species only.

All your opponents draw a card for each Vulnerable Species.

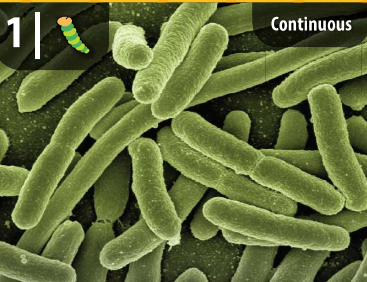


Draw 1 card for each Resilient Species.

There is a high concentration of sodium chloride in the water, making it a hypertonic solution to the majority of species that live there.

E2

⚡ TROPIC LV. 2 PARASITE INVASION



Continuous

Affects Trophic Level 2 Species only.

The opponent to your left chooses 1 of your Vulnerable Species. This Species loses 1 Trait card at the end of this turn and your next 2 turns. If this Species becomes Resilient to Parasitism this Event is removed to the Event History.



If all your Species are Resilient draw 2 cards.

A parasite invasion or pathogenic infection often results in the parasite or pathogen benefiting at the expense of the host species. This resulting population dynamics can be similar to those seen in predator-prey cycles.

E2

↗ INTERACTION INHIBITOR

Negate the activation and/or effect of an Interaction card and place it in the discard pile.

E2

↗ SHOALS

Continuous

All Aquatic Species in your Community are Resilient to Predation. Place this next to your Community. When all of your Aquatic Species go Extinct, place this card in the discard pile.

A shoal describes any grouping together of fish for a social advantage. When a shoal begins to move as a coordinated group and in the same direction it is referred to as a school. These behaviours are prevented by keeping fish in an aquarium.

E2

↗ SHOALS

Continuous

All Aquatic Species in your Community are Resilient to Predation. Place this next to your Community. When all of your Aquatic Species go Extinct, place this card in the discard pile.

Some of the benefits of shoaling are that individuals are better protected against predation (as each individual is less exposed), there is improved foraging and an increased chance of finding a mate.

E2

↗ SHOALS

Continuous

All Aquatic Species in your Community are Resilient to Predation. Place this next to your Community. When all of your Aquatic Species go Extinct, place this card in the discard pile.

Surgeonfish do not move in a coordinated group, like schools of herring, but stay close together promoting social cohesion. Individual fish have a higher respiratory rate than those in a school.

E2

↗ EAST AUSTRALIAN CURRENT

Move an Aquatic Species to another Community. If the chosen Species originated in your Community, it returns to your Community at the start of your next turn.

The EAC is an ocean current off the coast of Australia which can reach up to 90 cm/s. This current carries animals and plant from the tropical regions above Australia into the sub-tropical regions.

E2

EAST AUSTRALIAN CURRENT

Move an Aquatic Species to another Community. If the chosen Species originated in your Community, it returns to your Community at the start of your next turn.

A number of aquatic species use ocean currents to direct their circannual rhythms of migration. These fish, such as capelins around Iceland, often follow krill populations when they migrate.

E2

EAST AUSTRALIAN CURRENT

Move an Aquatic Species to another Community. If the chosen Species originated in your Community, it returns to your Community at the start of your next turn.

While tides are formed from the moon's rotation around the Earth, the currents are caused by changes in ocean temperatures and the wind.

E2

FORAGING

When one of your Trophic Level 2 Species has lost one of their food sources, replace it with 2 Traits from an opponent's Plant Species.

Group foraging in lion and dog populations increases the efficiency and success of the exercise up to a certain population size. After this optimal group size is reached, any additional animals lower the group's foraging success.

E2

MARINE PROTECTED AREA

One of your Aquatic Species becomes Protected.

MPAs are conservation efforts which may be based on national, regional or local laws. They often aim to reduce the amount of pollution that enters the system, reduce exploitation and protect the spawning grounds of fish species.

E2

MARINE PROTECTED AREA

One of your Aquatic Species becomes Protected.

Some of the most extreme MPAs are found around Kenya and Belize where all but the smallest levels of activity, used to sustain local communities, are prohibited. This aims to protect the local environments and species.

E2

MARINE PROTECTED AREA

One of your Aquatic Species becomes Protected.

One high profile MPA is enshrined in the group of treaties centred on the Antarctic. This area is often contested and attempts to prevent exploitation of krill are key to protecting the local ecosystem.

E2

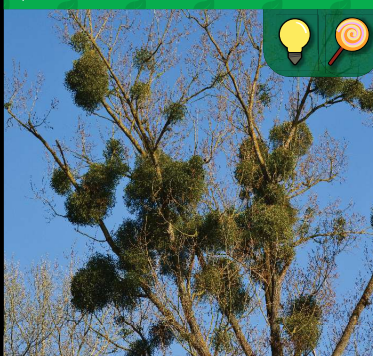
RITUALISATION

Can only be played on your turn. Go through the discard pile and add any 2 Interaction cards of your choice to your hand, apart from 'Ritualisation' or 'Commensalism'.

When a pre-existing behaviour is used for communication it is made more conspicuous, less variable and eventually will take on a different meaning to its original function.

E2

PARASITIC PLANT

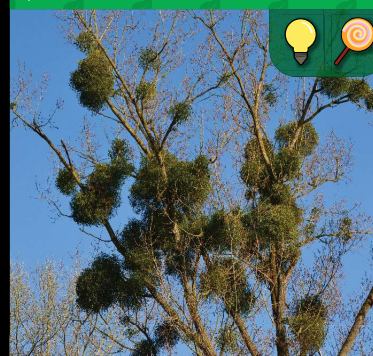


When you play this card, choose a Trait on an opponent's Plant Species that is Vulnerable to Parasitism. Place it in the Discard Pile.

Striga is an obligate parasite and grows its root towards the host root system. Striga is the biggest cause of biotic crop loss in sub-Saharan Africa.

E2

PARASITIC PLANT



When you play this card, choose a Trait on an opponent's Plant Species that is Vulnerable to Parasitism. Place it in the Discard Pile.

This helps plants overcome low nitrogen environments, by allowing them to obtain nitrogen from other plants.

E2

PHYLLOTAXIS



Leaves are positioned in spiral patterns to minimise their overlapping. This increases the surface area that can capture unfiltered light.

E2

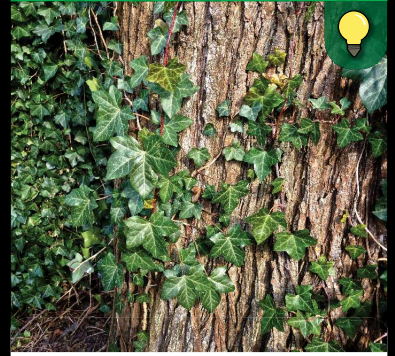
PHYLLOTAXIS



The angle at which the next leaf in the pattern is placed normally consists of a fraction of the total rotation in which numerator and denominator are both Fibonacci numbers (e.g. $3/8$ for sunflowers).

E2

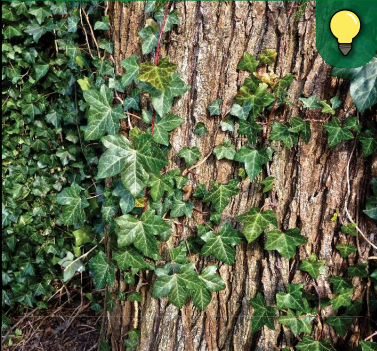
CLIMBING PLANT



Some plants minimise their investment in structural tissue but still gain access to direct sunlight by using tendrils to attach themselves to the stems of other plants.

E2

CLIMBING PLANT



Climbing plants are often called vines and their scandent stems wrap around the stems of other plants or attach the plant to rock surfaces.

E2