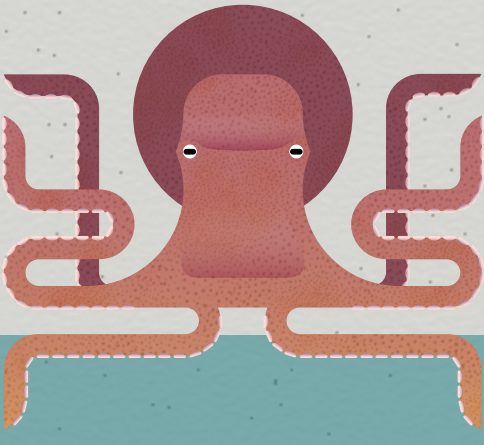
OCEAN

Eight arms allow for fine motor movement, but what about quick escapes?

What two tricks allow octopi to become nearly invisible to predators and prey?

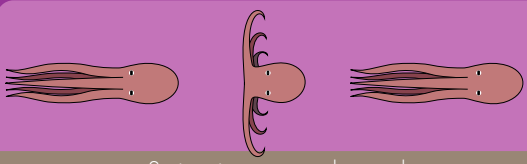
How can a 600 pound octopus crawl through a hole the size of a quarter?

OCTOPUS

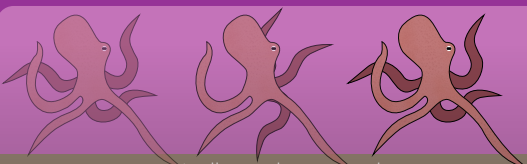


Mobility

Siphon Propulsion - high speed



Swimming - normal speed



Walking - low speed

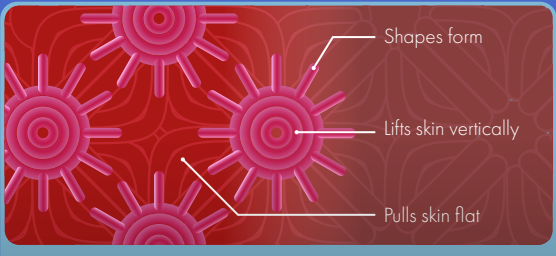
Defense

Chromatophore
Controls browns yellows and blacks

Iridophore
Controls iridescent colors

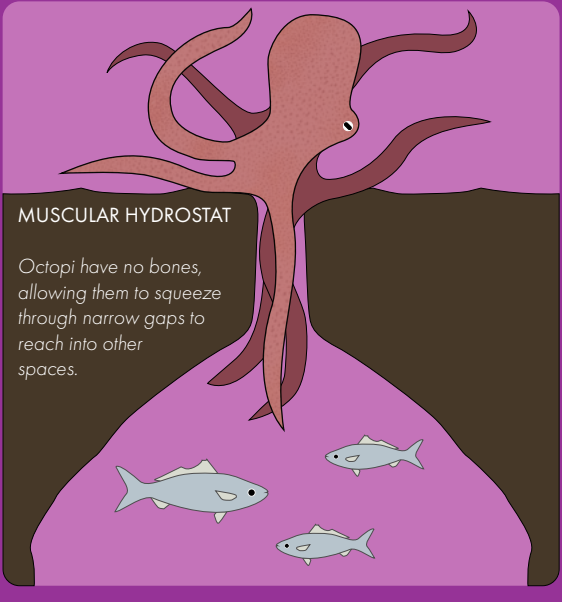
Leucophore
Controls the amount of reflected light (brightness)

Their 3D camouflaging skin allows them to change both ***COLOR***



and ***TEXTURE*** to become nearly invisible

Mobility



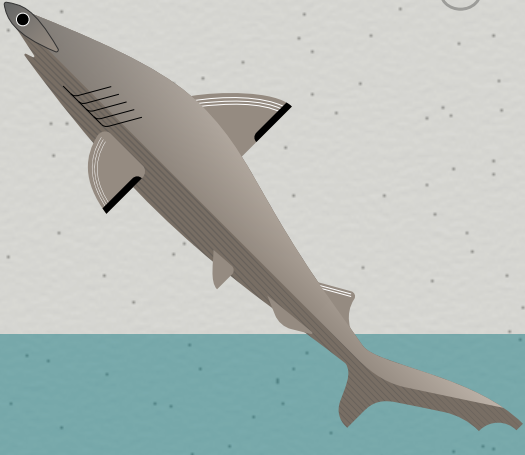
OCEAN

How do female sharks master the art of reproduction?

How do sharks track down prey, even when they can't see them?

How can a 1,000 pound shark keep up with agile fish and squid?

HAMMERHEAD SHARK



Efficiency

MALE + FEMALE =

offspring can be male or female

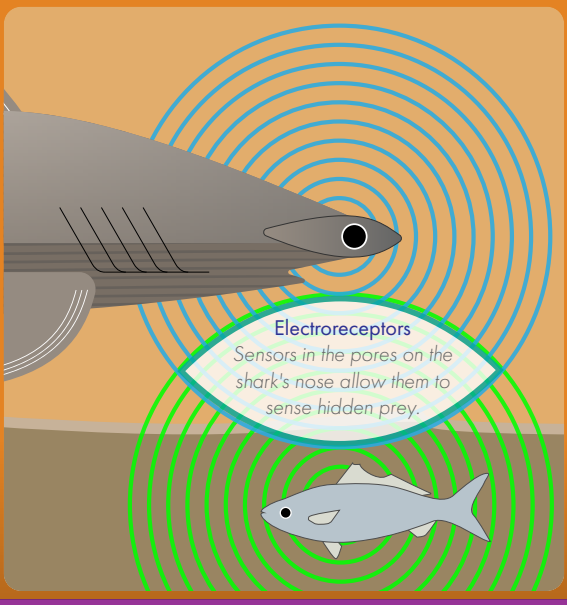
SEXUAL REPRODUCTION
(Sperm & Egg)

NO MALE + FEMALE =

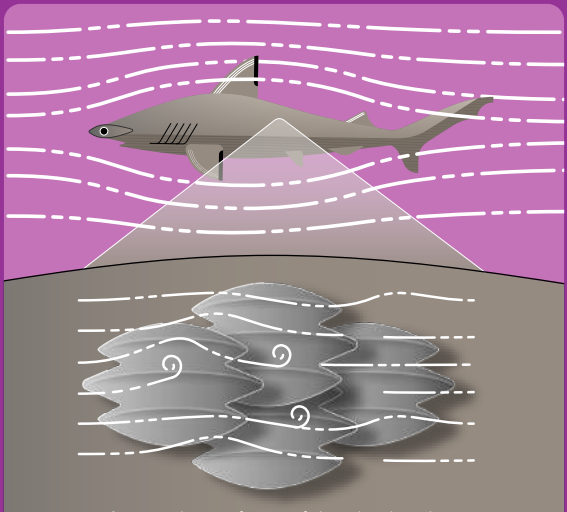
offspring can only be female

PARTHENOGENESIS
(Virgin Birth of Clone)

Sensing



Mobility



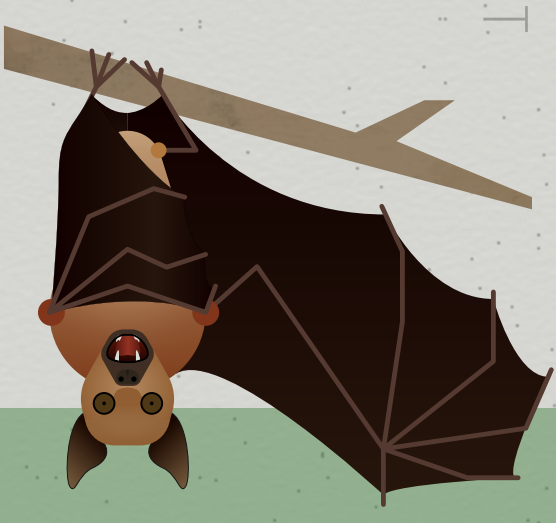
Denticles on the surface of the shark's skin create tiny vortices which reduce drag with the water

With no insects for fuel in the winter, how do bats survive?

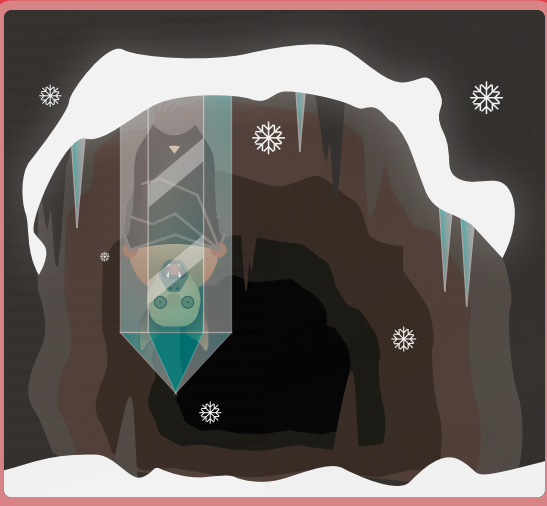
How do bat ears tune in to sounds so well that they can virtually see in the dark?

How might vampire bats support others in need, in their own special way?

VAMPIRE BAT

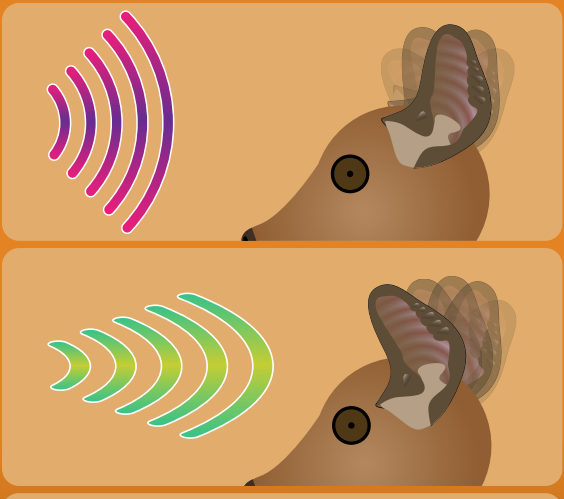


Efficiency



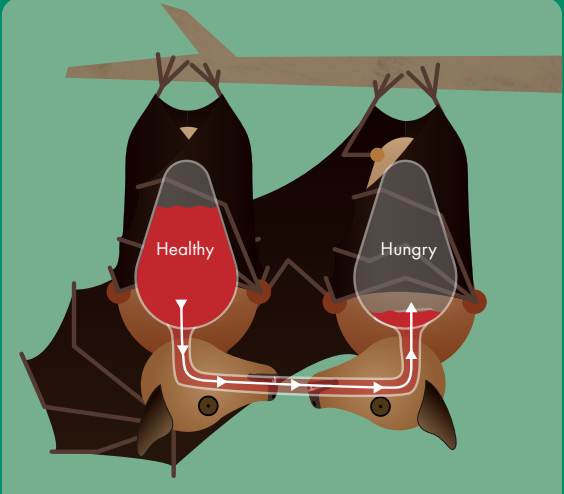
Bats deactivate non-essential body functions to survive the cold winter months when there aren't many insects out

Sensing



Bats change the shape of their ears to tune specific sounds in and out.

Cooperation



Vampire bats who are healthy and full will give blood to sick or hungry bats in the colony

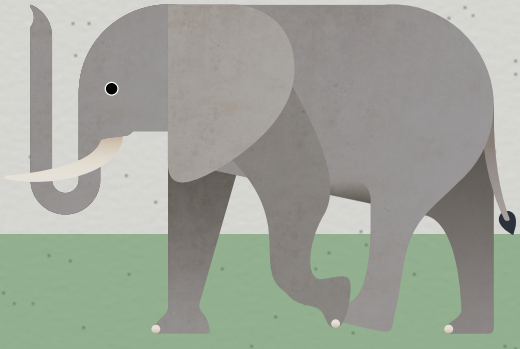
JUNGLE

Elephants have massive ears, but did you know they can hear even further with another body part?

What enables an Elephant's nose to be truly all-purpose?

In nature, selfishness has its merits, but how do elephants benefit from selflessness?

ELEPHANT



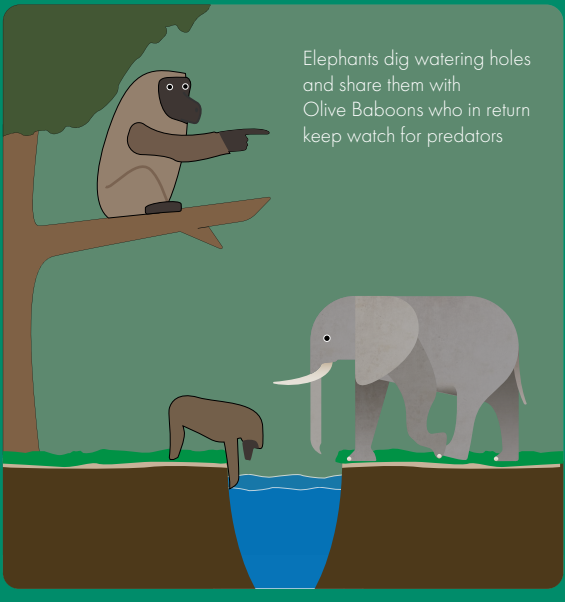
Sensing

Mobility

The elephant's trunk is made up of 40,000 muscles, compared to the human's 650!

Elephant trunks have no bones, allowing for incredible flexibility and versatility.

Cooperation



URBAN

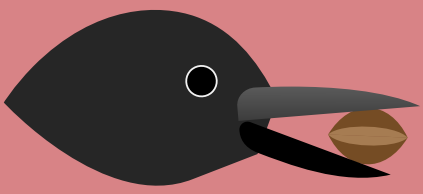
How much problem solving is a bird brain capable of?

What feature makes bird bones flight-ready?

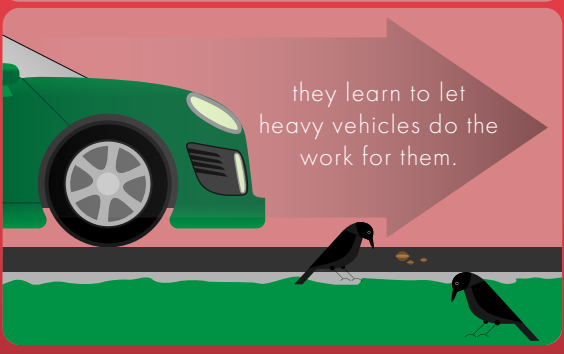
How might a 3 pound crow eat a 200 pound deer?

AMERICAN CROW

Efficiency



A lot. When nuts are too hard for crows,



Mobility

Small cavities reduce mass making it easy to lift off and fly for long durations

Cooperation

When a crow's beak cannot break through

the crow alerts a predator with sharp teeth

URBAN

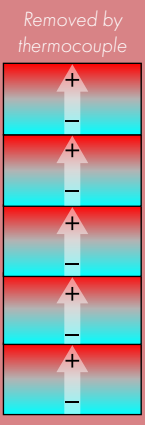
How can these small insects work so hard even in the blistering heat?

Yellow jackets fly as far as 6 km from their nests. How do they find their way back?

What makes many wasps want to take up residence together?

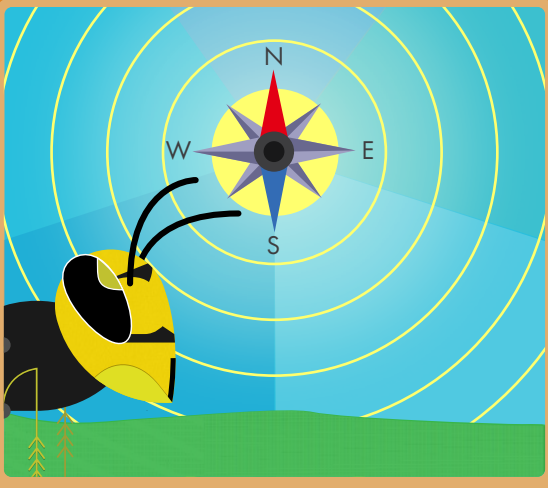
YELLOW JACKET

Efficiency



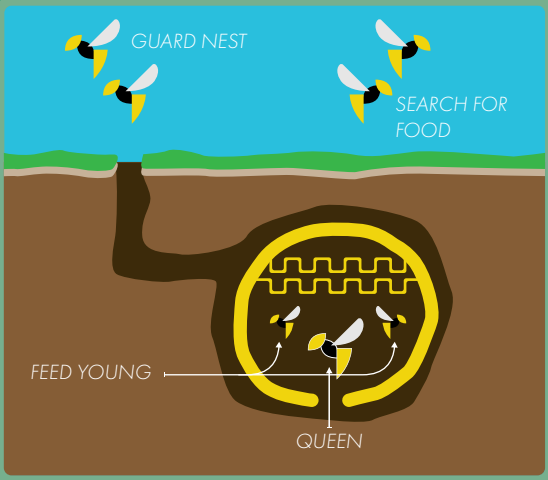
The Yellow Jacket dissipates heat through miniaturized thermocouples in its cuticle (skin)

Sensing



Wasps can see polarized light, allowing them to navigate home from long distances.

Cooperation



Yellow jackets specialize and divide work in order to improve their communal success.

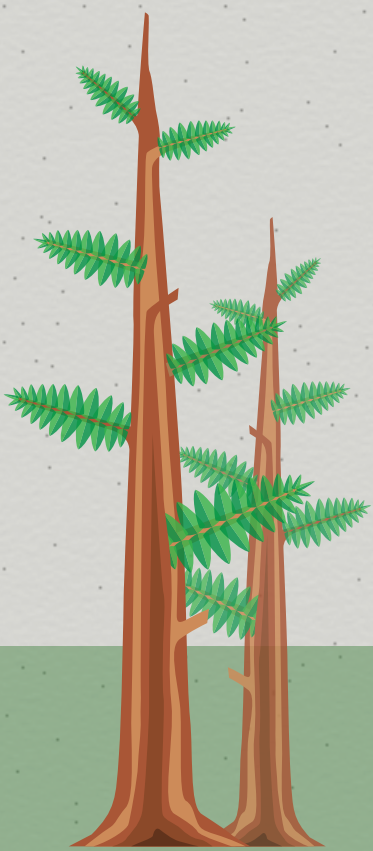
FOREST

Most plants can only absorb water through their roots, how can Redwoods absorb water from the fog in the air?

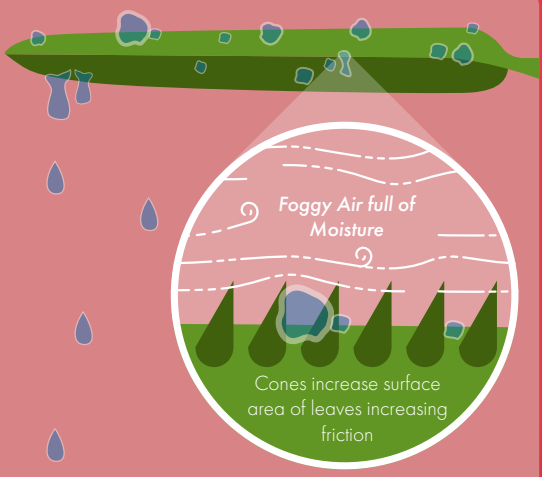
How can a Redwood lift water over 300 feet into the air with no water pump?

How can a root system only 5 feet deep support a 350 foot tall tree?

REDWOOD



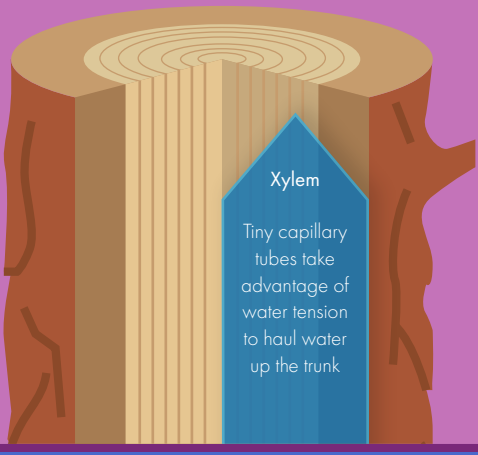
Efficiency



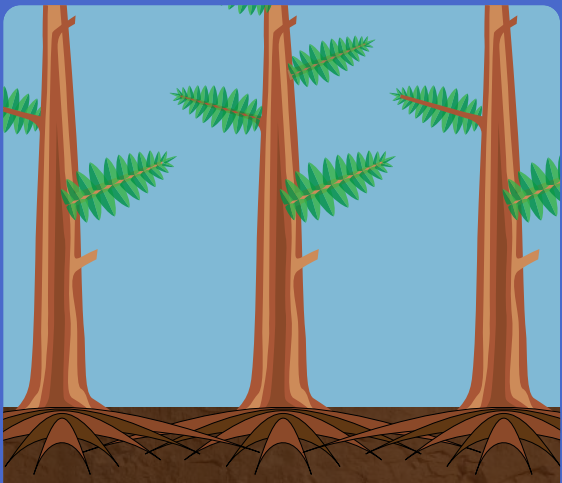
The abrasive texture of Redwood leaves draw water out of the air. The leaves absorb this water or drop it below for the roots.

Mobility

Water evaporating from the leaves creates a vacuum pressure at the top



Defense



Redwood roots can spread as far as 100 ft from the trunk. Neighbor trees can intertwine & fuse together to improve support against the forces of nature

DESERT

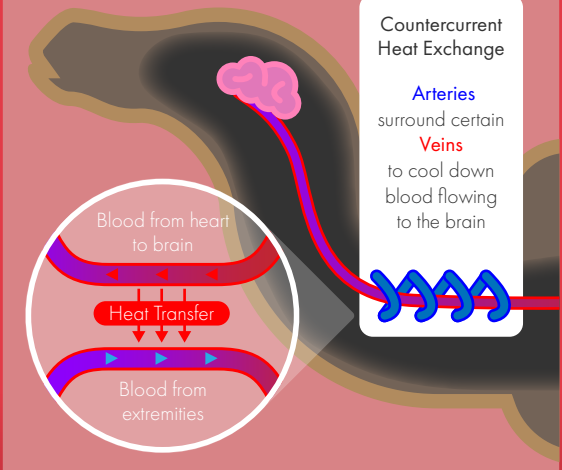
How does a Camel's blood help it survive over a week without water in 120°F heat

Why do camels have a hump?

How can camels overcome the unique challenges of desert life, beyond heat?

CAMEL

Efficiency



Cooler blood returning from extremities runs close to warmer blood on its way to the brain to absorb some of the heat

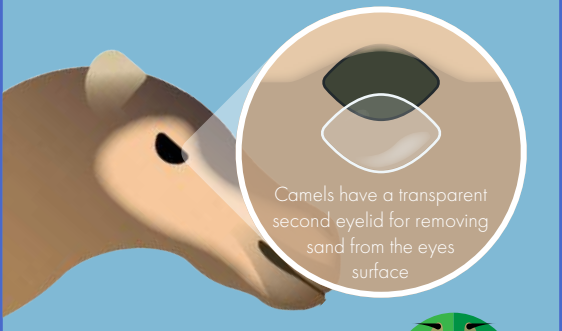
Efficiency

Fat is very useful for storing energy for long treks, however it insulates and traps in heat

A large surface area helps camels get rid of body heat

Defense

The ears and the eyes are protected by long hairs and the nostrils close to help keep sand out



Camel's lips are lined with a thick protective skin to withstand thorny plants

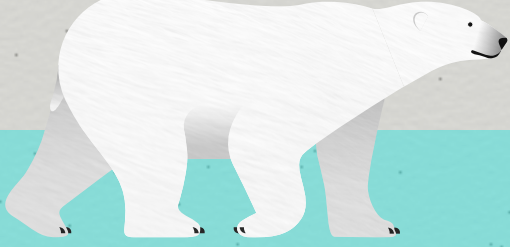
TUNDRA

Multiple layers of fur help to keep Polar Bears warm both above and below water

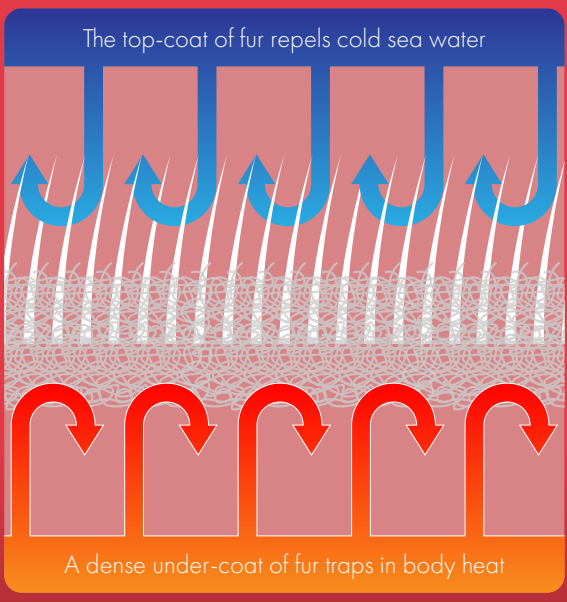
White fur helps blend in with the landscape, but what color is their skin and why?

When living life on layer of ice how can you avoid slipping and sliding?

POLAR BEAR

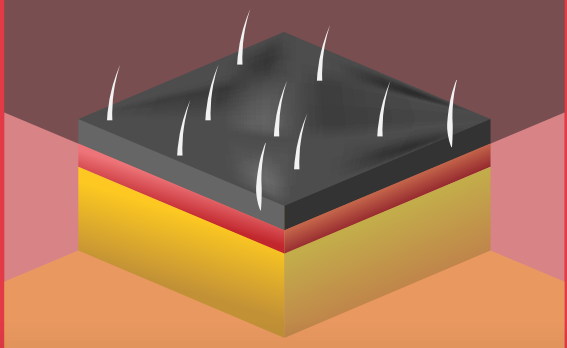


Efficiency



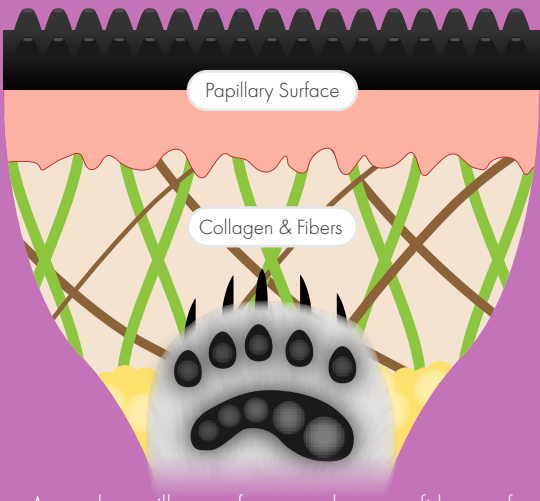
Efficiency

Underneath the white fur, Polar Bear skin is black to absorb the maximum amount of energy from the sun



A thick layer of blubber underneath the skin acts as insulation from cold air & water, and traps in body

Mobility



A rough papillary surface overlays a soft layer of dermis filled with elastic fibers and collagen.

TUNDRA

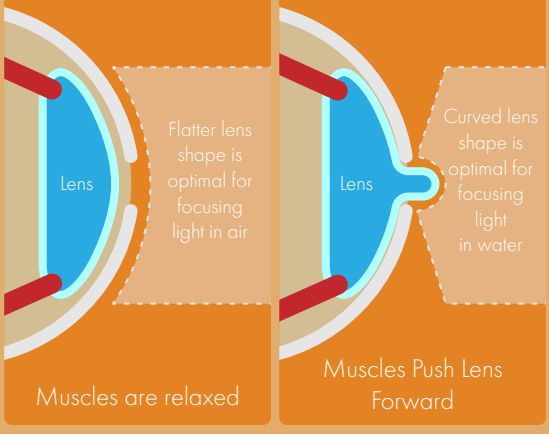
Fish can't see out of water. Humans can't see underwater. How can penguins do both?

What feature makes bird bones flight-ready?

What makes the famous Penguin Huddle so effective against arctic temperatures?

PENGUIN

Sensing

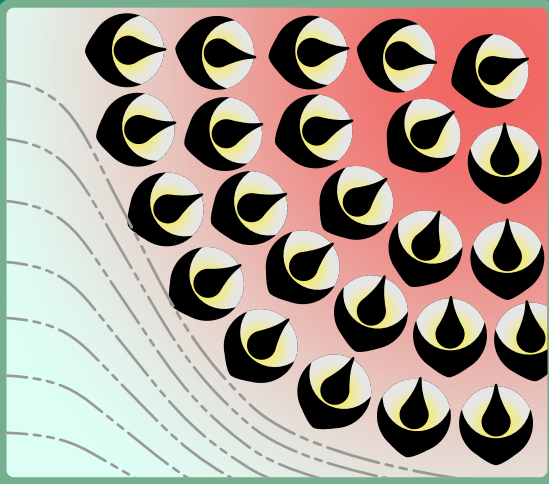


The lens of the Penguin eye is soft. When the Penguin enters the water, muscles press the lens against the pupil, changing the shape of the lens to be more effective in the new environment.

Mobility

Penguins have a streamlined body that reduces drag along with webbed feet for thrusting to speeds of up to 15 mph

Cooperation



Penguins huddle close together to protect from arctic wind and retain body heat. Huddles reduce heat loss by 50%

FOREST

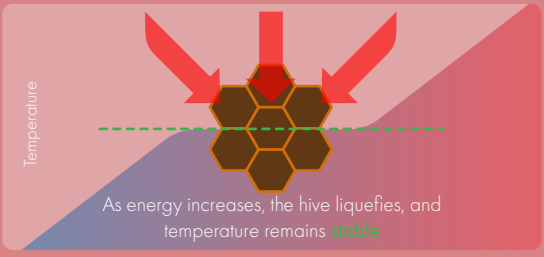
Living comfortably and making honey requires a stable temperature, how do bee hives maintain this?

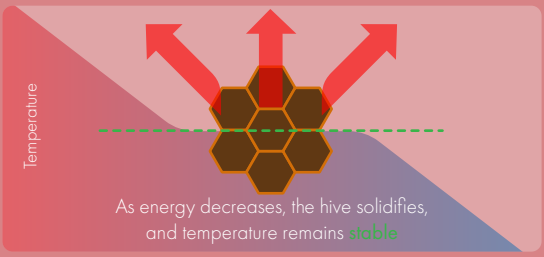
How can a bee tell other foragers where to find pollen and other useful resources?

How can a colony of Bees work together to regulate the temperature of their hive?

HONEY BEE

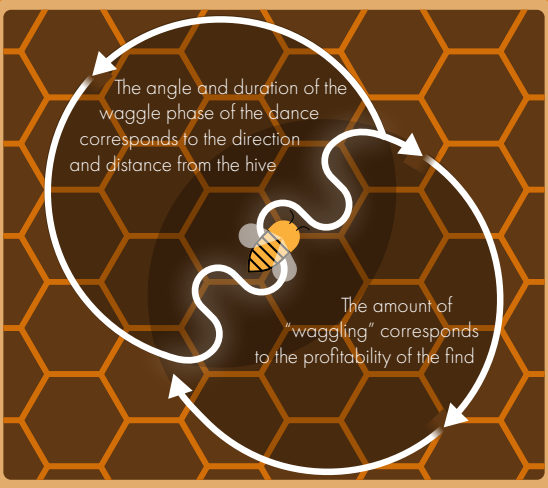
Efficiency





As a result, the hive temperature varies only slightly despite considerable energy gain & loss

Sensing



By performing the ***Waggle Dance***, foragers can share the location of resources to the colony.

Cooperation

When the hive becomes too warm, the colony will create a breeze with their wings to cool it down again

When the hive becomes too cold the colony will gather on its surface and vibrate their bodies to heat it up

DESERT

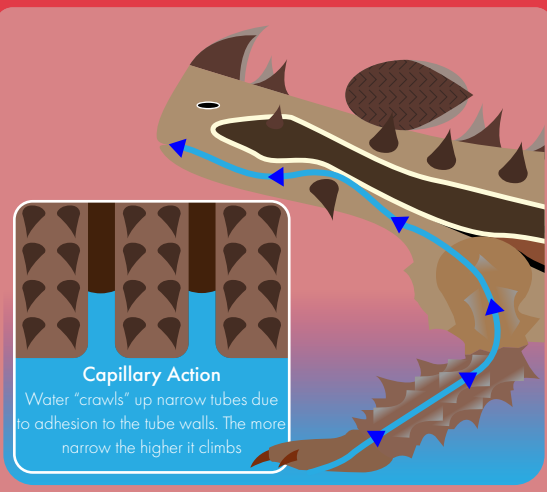
How can Thorny Devils drink where there is no water?

The desert seasons can change the scenery drastically, how can camo keep up?

Are two heads really better than one?

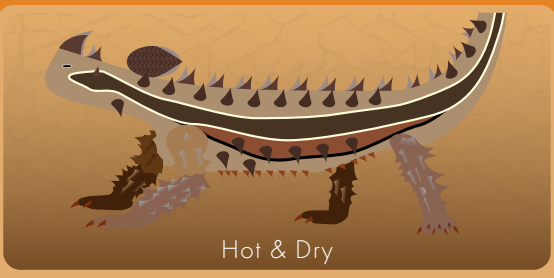
THORNY DEVIL

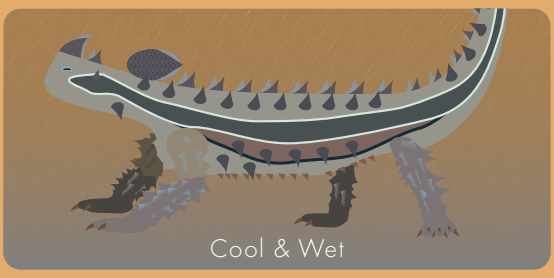
Efficiency



Tiny paths between their spikes draw water from damp sand, puddles, and dewy plants to the mouth

Sensing





Thorny Devil's color changes to match its environment

Defense

Spikes cover the body, making Thorny Devils unpleasant to eat.

When threatened, Thorny Devils tuck their head between their legs presenting a false head in order to preserve the real one.

SAVANNA

Termites live and breath underground, how do replinish air with no machines?

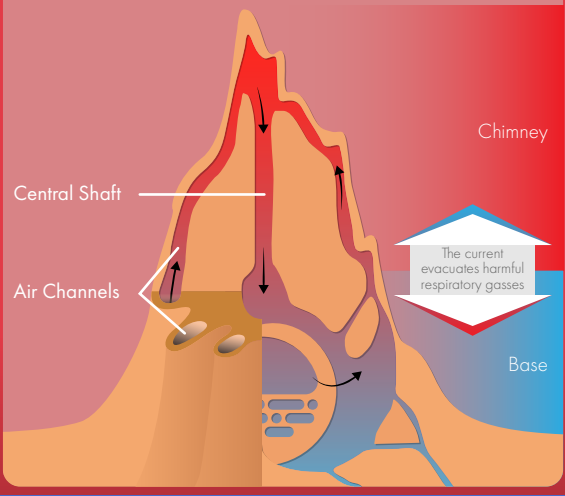
Humans often carry pepper spray as self defense, what do termites carry?

How can termites produce offspring that are very different from one another for specific tasks?

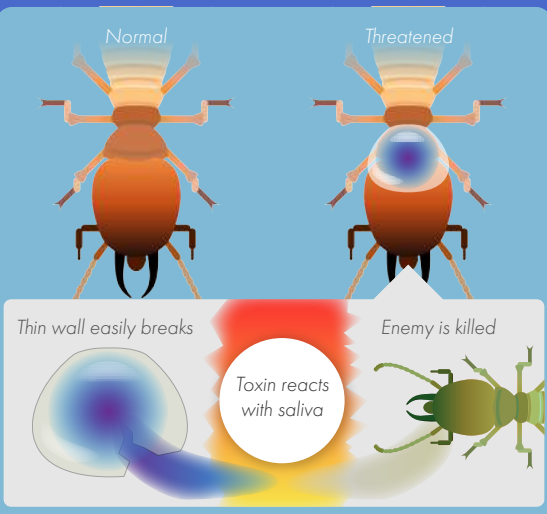
TERMITES

Efficiency

Differences in temperature in the mound's base and chimney cause a convection cycle to regulate temperature and circulate air.



Defense



When threatened, Termites will expand a thin abdominal wall containing toxic chemicals that bursts when bitten.

Cooperation

Worker
Stays inside the mound and feeds young

Soldier
Defends the colony and forages nearby

Winged Reproductive
Begins new colonies or helps make eggs

Queen
Can produce up to 1000 eggs per day

Hormones that are present around the eggs determine what role a termite will play by shutting off specific parts of their DNA

RAINFOREST

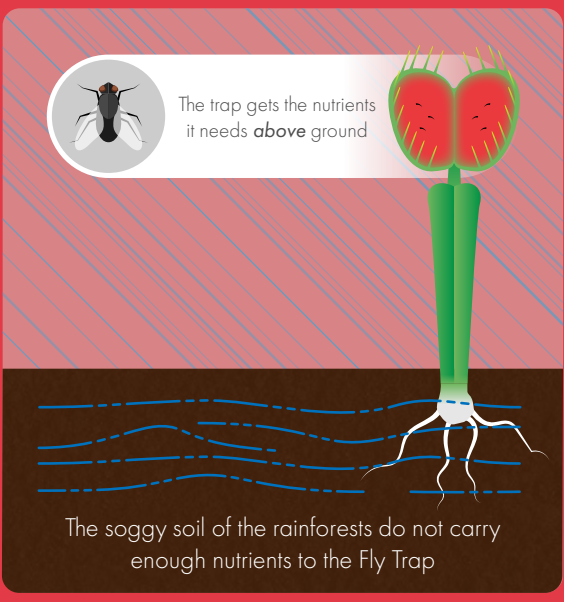
Why did the Venus Fly Trap resort to a carnivorous lifestyle?

How can the Venus Flytrap choose what it eats, and why does it matter?

How can a Venus Fly Trap close without any muscles or tendons?

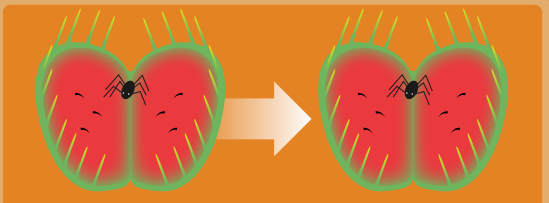
VENUS FLY TRAP

Efficiency

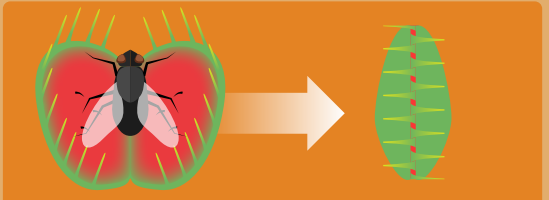


The soggy soil of the rainforests do not carry enough nutrients to the Fly Trap

Sensing



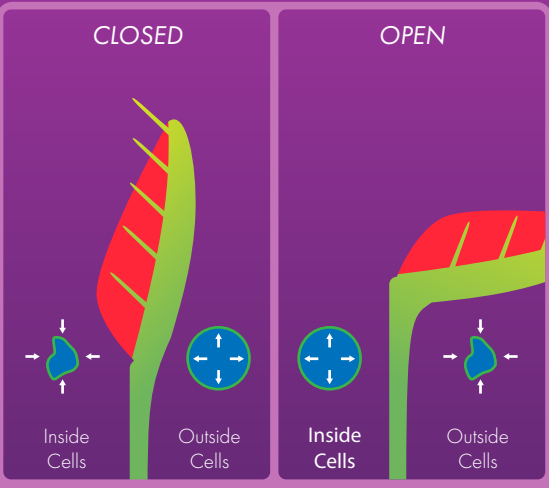
A small insect only contacts only one or two of the ***Trigger Hairs***



A large insect contacts multiple ***Trigger Hairs*** and the trap closes

The plant can only afford to eat large energy-rich prey because closing the trap and digesting insects takes a lot of energy.

Mobility



The Venus Fly Trap changes the water pressure inside of its cells in strategic areas in order to close its trap.

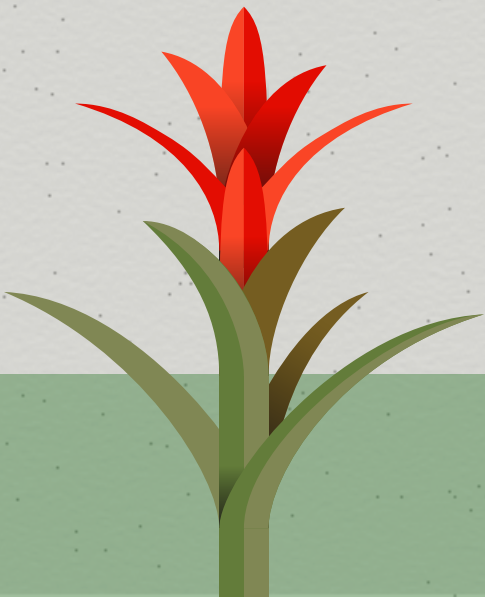
RAINFOREST

How can one kind of plant grow in nearly any environment?

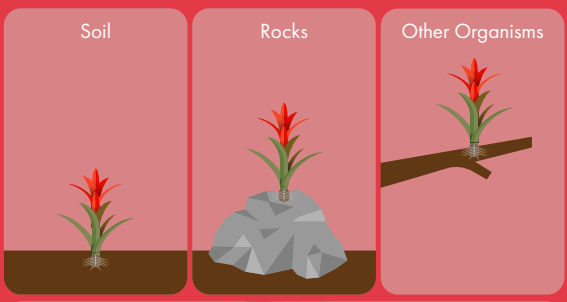
How can a plant direct water exactly where it wants it?

How can providing a public water source benefit the community and the provider?

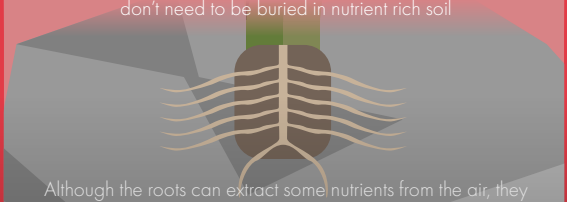
BROMELIAD



Efficiency

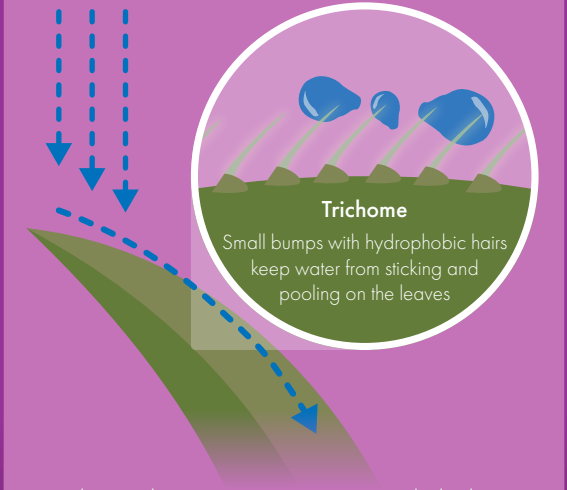


The pool above provides the enough nutrients, so the roots don't need to be buried in nutrient rich soil



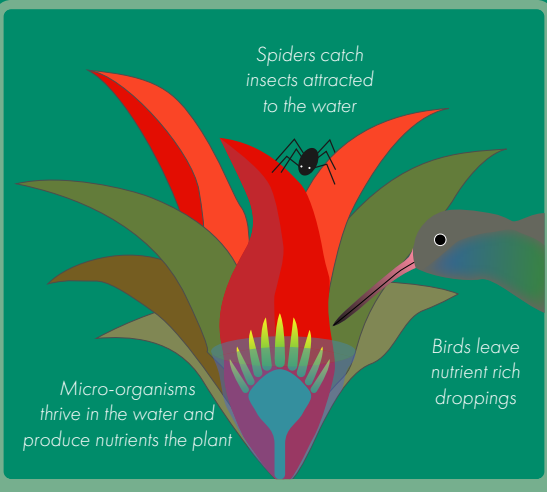
Although the roots can extract some nutrients from the air, they are primarily used for support.

Mobility



Trichomes keep water moving towards the large center pool and ensures none is wasted.

Cooperation



The pool of water at the center draws in a diverse crowd of life which leaves behind beneficial waste.

FOREST

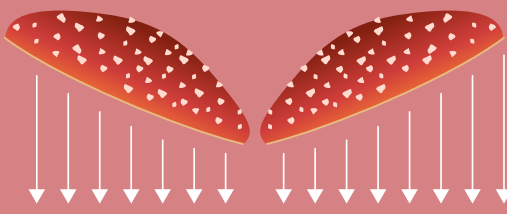
How do Mushrooms manage to produce and release millions of spores at a time?

How does a Mushroom absorb special nutrients that plants cannot?

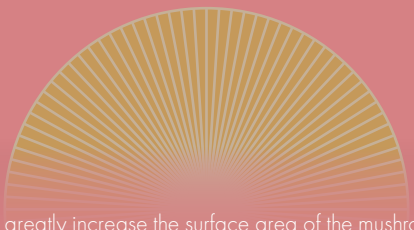
How do Mushrooms avoid competition for nutrients with their offspring when they are unable to move?

MUSHROOM

Efficiency



Gills always orient themselves parallel to gravity.
This ensures all spores can be released successfully.



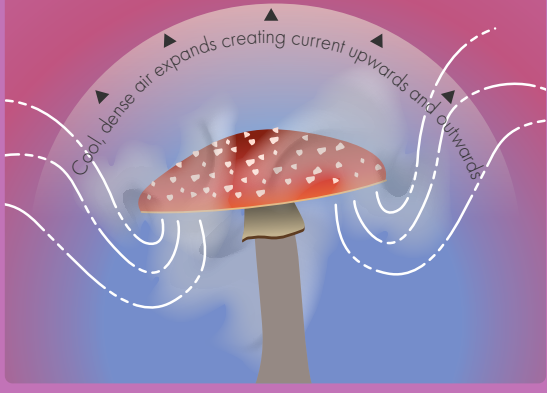
Gills greatly increase the surface area of the mushroom, allowing it to produce millions of spores.

Efficiency

Exoenzymes soak into the soil and breakdown complex macromolecules so the mushroom can easily absorb the nutrients.

Mobility

When it is time to eject the spores the mushroom releases water vapor



The current helps spread the Mushroom's offspring further away so that they don't compete for resources.

FOREST

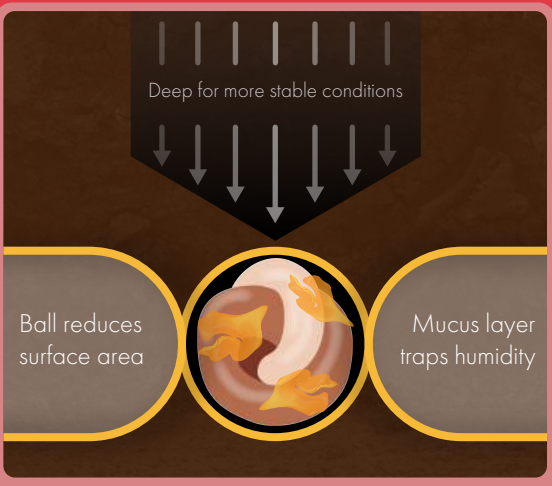
Worms must remain wet at all times in order to breath. How do they survive a drought?

How can worms move around in cramped spaces without arms or legs?

How do worms protect their tunnels from invaders both big and small?

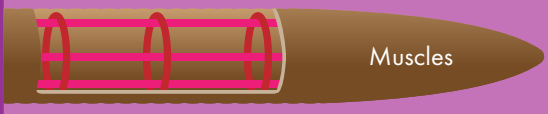
EARTHWORM

Efficiency

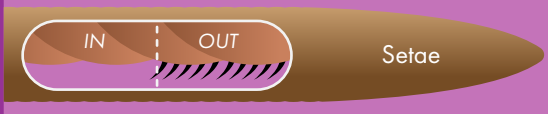


Worms can endure unfavorable conditions for up to 3 weeks by retreating into a state of dormancy known as ***aestivation.***

Mobility



Two Muscle types, ***Circular*** and ***Longitudinal***, which are used to change diameter and length to push itself along.



Tiny hairs all over the body of the worm supply traction when needed and retract allowing the body to slide forward.

Mucus is excreted all across the body of the worm, to help it move smoothly through the soil as it tunnels.

Defense

The mucus used for lubrication solidifies behind the worm as it burrows

The solid mucus strengthens the tunnel and serves as an anti-bacterial barrier

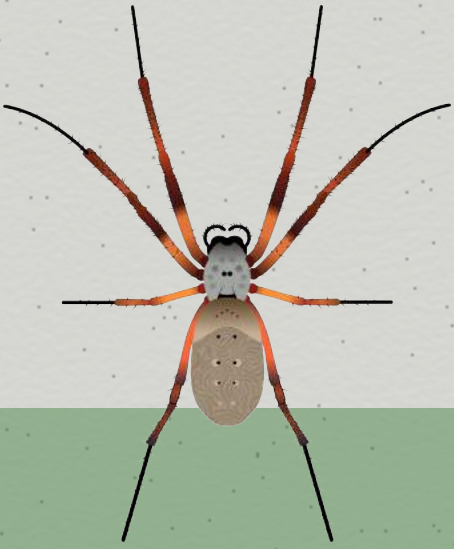
FOREST

Spiders use web to travel, hunt, build & more. How can their silk be so versatile?

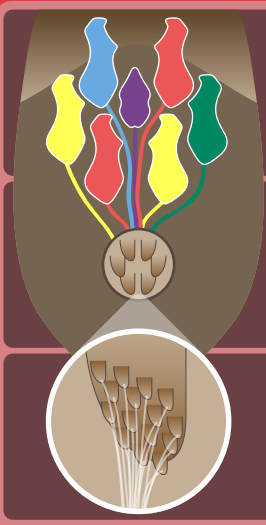
How do Spiders run fast and jump far without big muscles weighing them down?

You've seen spiders capture prey with their webs, but what else can they be used for?

SPIDER



Efficiency



Silk Glands

Each gland produces a silk formula with special attributes (sticky, waterproof, etc...) that can be mixed for different uses.

Spinneret

The Spinneret has 4-6 fingers that the spider uses to weave, cut, and manipulate the web to produce complex constructions.

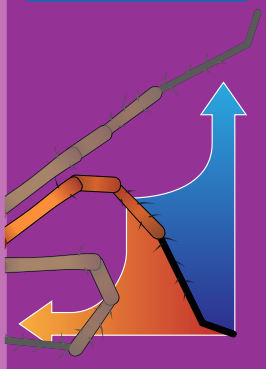
Silk Tubes

The tip of each Spinneret Finger has hundreds of tubes that extrude the diluted silk into a thin solid strand.

By combining multiple strands of specialized silk into a custom blend, Spiders can engineer the perfect material for any task.

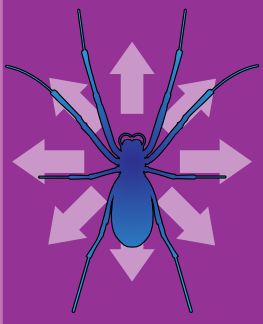
Mobility

Hydraulics Extend Legs



Muscles Contract Legs

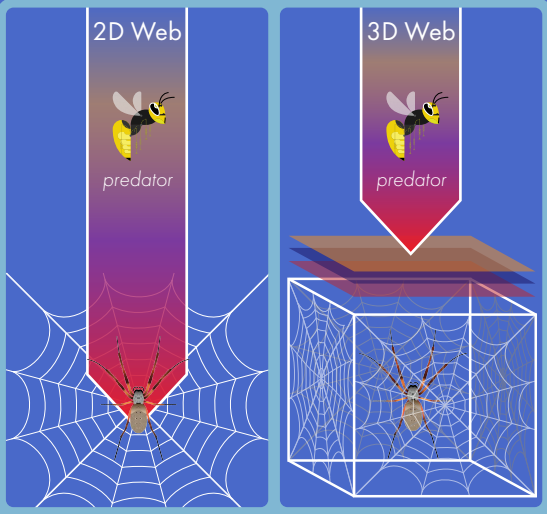
Spider blood, *hemolymph*, fills their entire body. It is not transported by veins.



Spiders use their blood as a hydraulic medium and pump it throughout their body and legs.

The strength of hydraulic power enables spiders to move fast and jump over 50 times their own body length.

Defense



3D webs are useful for catching prey & protecting the spider from deadly predators. Spider Silk is 10 stronger than steel!

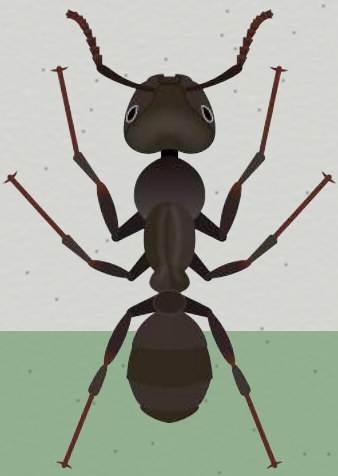
FOREST

Where do ants get the material to build their mounds?

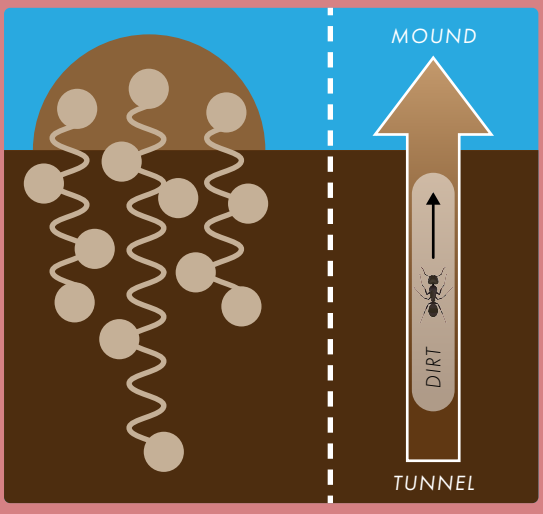
Why do ants help other bugs eat plants?

Ants have the fastest bite in the world but what do they use this unique talent for?

ANT

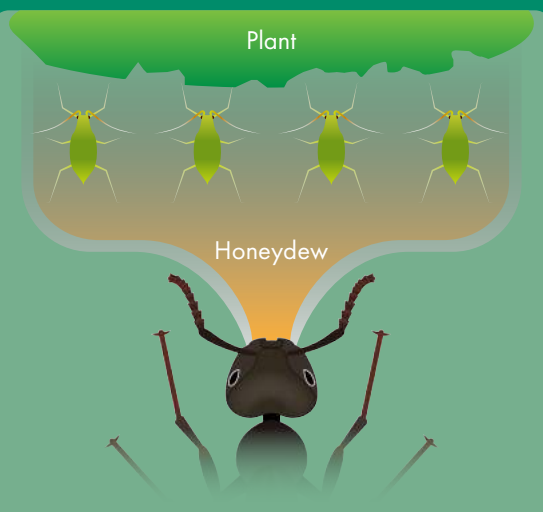


Efficiency



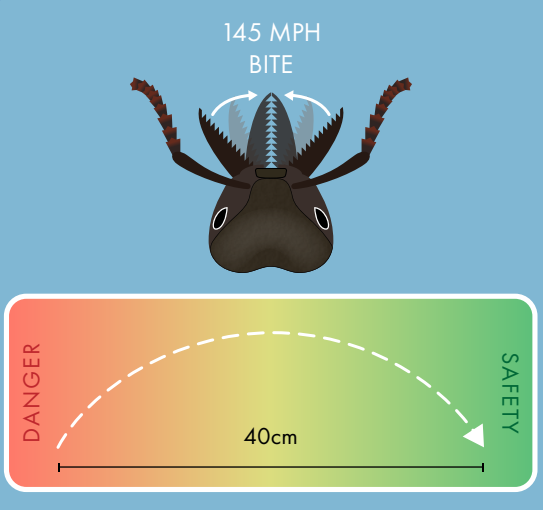
Ants create vast underground tunnel systems. They use the dirt excavated from the tunnels to build a mound at the entrance.

Cooperation



Ants carry aphids from plant to plant, protecting them while they eat. Aphids produce a sugary waste that Ants love.

Defense



Some Ants can bite so powerfully it sends them flying. Ants use this to flee danger, confuse predators, and dodge during fights.