Electric Eel

Electrophorus electricus

Gen. Habitat	Water
Habitat	Rivers
Temperature	0-35 C
Humidity	Undefined
Pressure	High
Salinity	1000-3000 ppm
pH	6.0-8.0

Summary:
The electric eel is a species of fish found in the basins of the Amazon and Orinoco Rivers of South America. It can produce an electric discharge on the order of 600-650 volts, which it uses for both hunting and self-defense. It is an apex predator in its South American range. Despite its name it is not an eel at all but rather a knifefish.

They have a vascularized respiratory organ **(**which **captures and distributes oxygen)** in their oral cavity. These fish are obligate air-breathers; rising to the surface every 10 minutes or so, the animal will gulp air before returning to the bottom. Nearly 80% of the oxygen used by the fish is taken in this way.

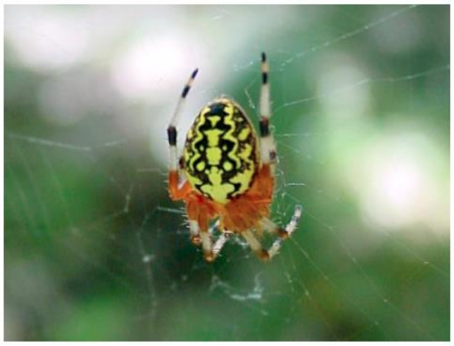
Scientists have been able to determine through experimental information that E. electricus has a **well-developed sense of hearing**. They have a Weberian apparatus that connects the ear to the swim bladder, which greatly enhances their hearing capability.

The electric eel generates its characteristic electrical pulse in a manner similar to a battery, in which stacked plates produce an electrical charge. When the eel is resting, no electricity is generated from its organs; **when it moves it charges its "electricity cells,"** called electrocytes. These cells are designed such that only one side of the cell carries the electric potential, and all of the cells are aligned similarly and in a series. 5,000 to 6,000 stacked cells are capable of producing a shock at up to 500 volts and 1 ampere of current (500 watts).

Orb weaver spider

Generus: araneus

Gen. Habitat	Land
Habitat	tropical and sub-tropical dry broadleaf forest
Temperature	0-35 C
Humidity	31-70%
Salinity	Undefined
Pressure	Undefined
pH	6.0-8.0



Orb-weaving spiders are three-clawed builders of **flat webs with sticky spiral capture silk**. The building of a web is an engineering feat, begun when the spider floats a line on the wind to another surface. The spider secures the line and then drops another line from the center, making a "Y". The rest of the scaffolding follows with many radii of non-sticky silk being constructed before a final spiral of sticky capture silk. The third claw is used to walk on the non-sticky part of the web.

Many species of diurnal orb-web spiders use **metallic coloring to reflect solar radiation**. These organisms spend a great deal of time exposed to radiation while monitoring their webs, so are particularly susceptible to overheating. Metallic or other reflective coloration is an adaptive response to this challenge.

The orb weaver spider employs four different adhesive strategies in building and using its prey capture webs: **cement, hooks, glue, and friction**. Generally speaking, orb weaver spiders use cement to build the web, hooks to temporarily attach themselves to the web, and either glue or friction to ensnare prey.

Cement is a **liquid adhesive that hardens when exposed to air**. Spider silk is a type of cement. At the time of its release from the silk-producing glands, spider silk is in liquid form and can attach to surfaces or existing web threads.

Capture silk can be either dry (cribellate) or sticky (ecribellate). Dry thread ensnares prey through friction, or the resistance between two surfaces and is composed of many fine, **looped fibrils that increase its surface area** and therefore its adhesion to prey. Sticky thread ensnares prey with the help of a **viscous, glue-like substance** deposited along its surface and contains nitrate, phosphate, and pyrrolidone.

Panamanian liana

Gen. Habitat	Land
Habitat	tropical and sub-tropical broadleaf forest
Temperature	0-35 C
Humidity	31-70%
Pressure	Undefined
Salinity	Undefined
pH	6.0-8.0

Summary:
A vine of Panama's lowland forests that sheds water from upper leaflet surfaces through thigmonastic and nyctinastic leaf movements, or movement in response to touch and light, respectively.

These climbers often **form bridges** between the forest canopy, connect the entire forest and provide arboreal animals with paths across the forest. Some lianas are strong enough to support the weight of a human.

The leaflets of the Panamanian liana employ several mechanisms to shed water: acuminate tips, thigmonasty, and nyctinasty. Acuminate tips, or drip-tips, are a morphological adaptation that promotes **rapid water drain** from the leaf surface. Rapid draining of water is a useful and necessary adaptation since standing water on leaves encourages colonization by epiphytes (plants growing on other plants) and microorganisms, and reduces photosynthetic activities by encouraging the formation of light-blocking surface films.

Thigmonasty is movement in response to tactile stimuli. Within seconds of the first gentle raindrop hitting a leaflet, the leaves fold or roll up, thereby **preventing the collection of water** on leaf surfaces.

And finally, nyctinasty is a diurnal movement pattern. During the day leaflets are generally horizontal to take the **greatest advantage of solar radiation,** while at night they droop to approximately 50 degrees below the horizontal. The steep nighttime angle ensures that night rains will drain rapidly from the leaf surfaces.

Pilot Whale

Genera: Globicephala

Gen. Habitat	Water
Habitat	Temperate shelf and seas
Temperature	0-35 C
Humidity	Undefined
Pressure	High
Salinity	3000-10000 ppm
pH	6.0-8.0

Pilot whales have been observed hunting in groups to help concentrate their prey in the center of a pod by using their **(underwater) vocal communications**.

Pilot whales must keep their skin free of microorganisms. Biofilms and biofouling microbes not only present health risks for their host, but also create drag. To combat colonization by undesirable microorganisms, different strategies are used: **anti-mcrobial nanoridges with biogels** and **anti-microbial enzymes**.

Nanoridges provide a physical barrier to microbial adhesion, while biogels provide a chemical barrier. The skin surface of the pilot whale consists of a gel-like coating, zymogel, made of alternating hydrophilic and hydrophobic layers, embedded within a matrix of nanoridges. Nanoridges are formed by the outermost layer of hardened skin cells, and each depression, or pore, between ridges is approximately 0.1-1.2 um^2 across.

Additionally, the tough outer layer of pilot whale skin contains numerous enzymes. These enzymes have two anti-microbial functions in the external skin cells:

1) hydrolyzing biofilm precursors (the whale excretes an **enzyme which prevent biofilms**)
2) **slowing the degradation of surface cells** so that they retain their hydrolytic capabilities

What makes the pilot whale so interesting is that it employs both a structural and chemical strategy to prevent biofouling.

RETICULATED GIRAFFE

GIRAFFA CAMELOPARDALIS RETICULATA

Gen. Habitat	Land
Habitat	temperate grasslands and savannas
Temperature	0–35 C
Humidity	0–30%
Pressure	Undefined
Salinity	Undefined
pH	6.0–8.0

Giraffes have long necks, which they use to browse the leaves of trees. They possess seven vertebrae in the neck (the usual number for a mammal) that are elongated. The vertebrae are separated by **highly flexible joints**. The base of the neck has spines which project upward and form a hump over the shoulders. They have anchor muscles that hold the neck upright, and serve as the basis for their **extraordinary, and very stable, vertical reach**.

Giraffes are difficult and dangerous prey; when attacked they defend themselves by **kicking with great force**. A single well-placed kick from an adult giraffe can shatter a lion's skull or break its spine.

The giraffe's structure, particularly to the circulatory system, is impressive. A giraffe's heart **generates high pressure**, ~double the normal blood pressure for a large mammal to maintain blood flow to the brain against gravity. In the upper neck, a **complex pressure regulation system** called the rete mirabile prevents excess blood flow to the brain when the giraffe lowers its head to drink.

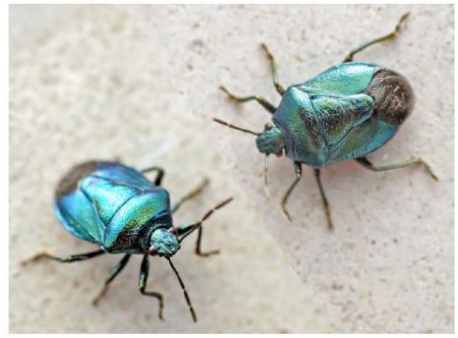
Conversely, the blood vessels in the lower legs are under great pressure (because of the weight of fluid pressing down on them). In other animals such pressure would force the blood out through the capillary walls; giraffes, however, have a very tight sheath of thick skin over their lower limbs which **maintains high extravascular pressure** in exactly the same way as a pilot's g suit.

Recent research has shown evidence that the animal **communicates at an infrasound level** (below the threshold of human hearing).

The skin of the reticulated giraffe produces scented chemicals that **moderate antimicrobial activity and repel insects**. What makes these volatile chemical compounds interesting is that they are made with *local materials using simple ingredients found within the organism, created at room temperature, and produced on an as-needed basis*.

Shield Bug

Gen. Habitat	Land and Underground
Habitat	Various
Temperature	0–35 C
Humidity	Undefined
Pressure	Undefined
Salinity	Undefined
pH	Undefined



They are often called Stink-Bugs because they can **produce a horrible smell**. The scent is known to **repel certain vertebrate predators**, and is known to strongly stain your fingers like iodine and is chemically similar to pheromones.

Shield Bugs have **symbiotic bacteria in their guts** to help them digest food. When laying eggs, the shield bug smears them with the symbiotic bacteria which baby bugs ingest as they eat their eggshell upon hatching. This method ensures the young have enough symbiotic bacteria for future meals.

Shield bugs range in color from drab browns and greens to brilliant blues and other striking hues made possible by **structural color** (ie, their physical microstructures reflect light to produce colors). These colors are used to either **camouflage** themselves or to warn potential predators of their bad smell and taste.

The light-reflecting structures found on the shield bug are **small, transparent, cone-shaped micro tubes**.

Tent Caterpillar

Malacosoma americanum

Gen. Habitat	Land
Habitat	Temperate broadleaf and mixed forest
Temperature	0-35 C
Humidity	31-70%
Pressure	Undefined
Salinity	Undefined
pH	6.0-8.0

The caterpillars are hairy with areas of blue, white, black and orange. The blue and white colors are **structural colors created by the selective filtering of** light by microtubules that arise on the cuticle.

The adult moth lays her eggs in a single batch in late spring or early summer. The egg masses contain on average 200-300 eggs. **Embryogenesis proceeds rapidly** and within three weeks fully formed caterpillars can be found within the eggs (but the small caterpillars lie quiescent until the following spring).

Newly hatched caterpillars initiate the **construction of a silk tent** soon after emerging. The tent has several important features. First, it is 'smart,' **expanding as its residents require more space**. Every day, the caterpillars add more silk to their tent, with each day's annex contracting to form a discrete layer external to the previous day's. The result is a **multi-layered structure regulates the temperature** in the tent.

Second, it is essentially **waterproof**, protecting its residents both from rain and from low power pesticide sprays. The caterpillar stretches each strand beyond its equilibrium length before fastening it. The **silk strands will super-contract when wet** by rain or condensation, causing the tent structure to have an even tighter, waterproof configuration.

Third, it **gathers radiant energy from the sun**, while reducing convective heat loss by blocking the wind.

Lastly, the caterpillars feed three times each day and lay down **pheromone trails to guide their movements** between the tent and feeding sites.