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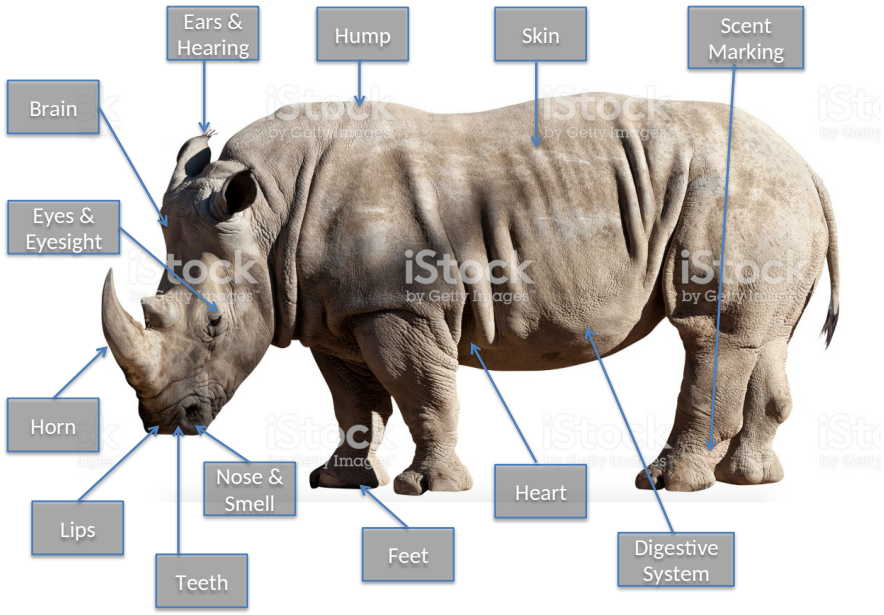
SECTION 3 – MEET THE RHINOS

Section 3.4 *Meet the Rhinos "Anatomy"* *Doc 4 of 6*

Section 3.4.1



RHINO ANATOMY

Without doubt, the rhino's most renowned anatomical feature is its horn – mostly for all the wrong reasons. In many respects rhino physiology and anatomy function like any other mammal, but they do exhibit a number of adaptations, other than their horns, that are particularly beneficial to their way of life. Roll your cursor over the labels in this infographic to find out how rhinos "work".

Rhino skeleton

https://www.storenvy.com/products/16928010-rhino-skeleton-art-print-limited-edition-animal-original-art-illustration

Note: It is envisaged that as the reader tolls over these labels with their cursor the relevant text will pop up

Brain

The rhino's brain is on the small side for a creature of its size. It typically weighs 14 – 21 ounces (400 – 600 grams) but basically it is like that of any other mammal in its general structure and organization. That said the rhino brain has not been well studied in any detail, but recently, scientists at South Africa's University of the Witwatersrand have observed some interesting differences in the brains of Black and White Rhinos. Find out more

Nose & Smell

The rhino's sense of smell is very important to its safety and finding its way around its teritory, as it helps the rhino be aware of things it may not be able to see or hear. The large nostrills are positioned at the tip of the snout, each one richly supplied with millions of extremely sensitive sensory cells that are able to register subtle odours in the air and relay them to the olfactory centre of the brain for interpretation.

Ears & Hearing

The rhino has an excellent sense of hearing. Its cup or tube-shaped ears are sensitive to the slightest sound and can be rotated to pick up audio signals from any direction with equal intensity.

Lips

The White Rhino has a distinctive wide, or square-lipped mouth profile which is perfectly suited to cropping the grasses that make up its diet. By contrast, the Black Rhino and the Asian species that are all browsers or mixed feeders, all have a pointed, prehensile upper lip that enabled the animals to grasp and strip leaves, twigs and small branches.

Heart

The rhino is a big animal and it needs a big pump to circulate blood to and from all parts of its body. The White Rhino – the largest of all the rhinos – has a heart weighing about 22 lb (10 kg) which is about double that of the comparatively small Sumatran Rhino. By comparison an elephants heart can weigh between 26 and 46 lb (12 – 21 kg), while our human heart weighs in at a puny 11 oz (312 g). The creature with the biggest heart of all is the blue whale – a mighty 400 lb (180 kg).

Feet

It would be hard to describe any aspect of a rhino as dainty, but they do have rather small feet for their overall size. Scientists at the Royal Veterinary College in the UK are trying work out how one of the heaviest land creatures on earth manages on such relatively tiny feet. Rhinos are three-toed and belong to a small, ancient group of browsing and grazing mammals known as perrisodactyls (meaning odd-toed) that includes horses and tapirs. The center toe bears most of the weight. Notwitstanding their small feet and short stumpy legs, rhinos are remarkably agile and fast. The Black Rhino is a real speedster and can reach 35 mph (55 kph) over short distances.

Skin

Rhino skin is tough and thick. In White Rhinos for example, it can be nearly two inches thick (50 mm) in places - that is thicker than hippo skin and substantially more so than an elephant's hide which is little more than half an inch thick (about 17mm).

The rhino's hump

Rhinos have powerful, well-developed shoulder and neck regions, a feature most pronounced in White Rhinos which have noticeable "humps". There are three components to these humps: a thick, outer covering of skin tissue, an underlying layer of fat, and a mass of muscle which, together with a well developed ligament joining the base of the skull to the last vertebrae in the neck, forms the bulk of the hump in thickness and volume. This ligament is absent or poorly developed in many mammals, but for those adapted for running, a well developed ligament helps to support the head and prevents excessive stress on the muscles of the region. It is logical, therefore, given their overall bulk, need for mobility and comparatively massive heads, that this ligament in rhinos is particularly strong, especially in White Rhinos which are specialist grazers and for much of the time carry their heads close to the ground.

Teeth

Rhinos have powerful molars and premolars in the upper and lower jaws which are used for grinding the coarse plant material that makes up their diet. The two African rhino species lack incisors, but the Asian species are armed with long, sharp, tusk-like incisors in the lower jaw. These are present in males and females but are longer in males – they can reach a length of more than five inches (13 cm) in dominant male Indian Rhinos and are used not for feeding but as potentially lethal weapons when competing for access to breeding females. African rhinos spar with their horns in dominance battles.

Horn

In most horned mammals the horn has a living, bony core covered by a thin sheath of keratin Rhino horn differs in that it is almost entirely made up of keratin. But there is a lot more to it than that. Find out more

Hair

All mammals have hair but in rhinos this feature is hardly discernable and for the most part they appear hairless but for a straggly tuft at the tip of the tail and a fringe around the ears. The Sumatran Rhino is the exception, however, and is sometimes referred to as the “hairy rhino”. According to DNA samples, it is the closest still-living relative of the extinct Woolly Rhino which was common in Europe and northern Asia during the Pleistocene Epoch (Ice Age) and which survived the last interglacial period (11,800 to 11,700 years ago).

Sight

Rhinos have small eyes for their body size and their positioning on the side of the head means that they lack binocular vision. But are rhinos as poor sighted as they are made out to be? Find out more

Pedal Glands
The Indian and Javan Rhinos have pedal glands that exude a thick secretion almost continuously. In this way they scent mark along their trails – important signals to other rhinos moving through the same area. The Sumatran Rhino and the two African species lack these glands.

Digestive System

Rhinos are vegetarians and either grazers or browsers or a combination of both. Because plant matter has a high cellulose component – cellulose is the tough fibrous material that gives plants their strength – the rhino’s gut needs to break it down before nutrients can be absorbed into the body. Find out more

Sleep

Although rhinos are on the move, eating as they go at anytime during the day or night, they are most active in the early morning and late afternoon. When not feeding, rhinos spend most of their time resting up, especially in the heat of the day, to conserving their energy. They do sleep, at times deeply, either standing up or lying down with their legs curled up to the side or underneath their bodies. The Black Rhino will also sleep on its side, but it is the only species to do this.

Section 3.4.1

Rhino Brains – Different strengths for different lifestyle

Recently, scientists at South Africa’s University of the Witwatersrand have begun to fill this gap in our knowledge about rhino brains - they examined the brain of a male Black Rhino and that of a female White Rhino and made some interesting observations.

Not surprisingly, given that the two species are each other's closest relatives, their brains are very similar in appearance except that that of the Black Rhino is more rounded compared with more elongated shape of the White Rhino's brain. The brain shape is in keeping with the general head shape of the two species: the Black Rhino has a shorter, broader skull while the White Rhino's is narrower and longer.

The significance of the brain and skull shape could be related to their different feeding habits: Black Rhinos are browsers while White Rhinos are grazers. A long, low-slung head might be an evolutionary advantage to the "mowing" feeding action of the White Rhino.

Dietary specialization could well also explain a few other differences noted by the researchers. For example, the area of the brain that remembers the details of a mammal's surroundings is bigger in Black Rhinos than in White Rhinos. This would be important for black rhinos as they browse on a greater number of seasonal plant species in a bushier, more wooded environment compared to the fewer and less seasonably variable grasses grazed by the White Rhino in their more open habitat. Black Rhino's also tend to have larger territories and so a better "mind map" of their surroundings coupled with a memory for what food is avaible where and when, would be a distict advantage.

The area of the brain to do with smell is also larger in Black Rhinos and this could also be explained by diet: a better sense of smell would be more important to a browser reliant on a greater number of plants and their seasonality, than for a grazing animal with a far more limited and less seasonal diet.

The last difference noted by the researchers focussed on the ventricular system of the brain which holds the cerebrospinal fluid that fills these brain cavities and surrounds the brain within the skull. This fluid plays an important role in all mammals, supporting the brain and cushioning it from sudden blows, but it also plays a vital role in clearing the brain of metabolic waste products and toxins. The researchers found that ventricular system of the White Rhino is much larger than that of the black Rhino and again this difference may be related to the species' differing diets. Some of the grasses eaten by White Rhinos are potentially toxic and the larger ventricles would help to flush harmful substances from the central nervous system.

Section 3.4.2

Short-sighted – not really

According to legend and other largely anecdotal "evidence" one could be forgiven for believing that rhinos have really bad eyesight. But, it transpires, this assumption is wrong. While it is true that rhino eyes have only about a tenth of the resolution capability of a human eye, a study of the black rhino's retina suggests that rhino vision is on a par with that of a rabbit and better than many other mammals including seals, dolphins, microbats, and rats. And so, the rhino's reputation as a myopic, weakly visual animal is somewhat unfounded. The scientists who conducted the study reckon that a black rhinoceros could readily distinguish a human of average size at a distance of around 200 metres given the appropriate visual background. The visual acuity of other rhino species is likely to be similar to that of the black rhino.

Read the science : https://www.cambridge.org/core/journals/visual-neuroscience/article/retinal-ganglion-cell-density-of-the-black-rhinoceros-diceros-bicornis-calculating-visual-resolution/BDA8AE4B3A01755EF34342ED0681678F

Section 3.4.3

Coping with a rhino diet

Rhinos are vegetarians and therfore have to cope with a diet high in fibrous cellulose – a difficult substance to break down so that butrients can be absorbed into the body.
Some plant-eating mammals – such as cattle, giraffes and antelopes, for example - manage this by having a stomach divided into four chambers which process and reprocess food mechanically and with the help of specialised bacteria.
Rhinos cope with their food a bit differently. Their digestive sytem is more like that of a horse in that food passes through a simple stomach into the caecum and large intestine where the real work of digestion is carried out.
The caecum is the equivalent of the apppendix in humans, but there the comparison ends for the caecum, unlike the vestigial appendix which has no really understood purpose, the caecum is a vital organ for rhinos. It is a very large sac that is home to millions of bacteria – the gut flora - which break down the food into simpler, digestible compounds. Rhino digestion isn't as efficient as that in cattle – a quick look at their droppings illustrates this – cow pats are smooth and paste-like whereas in rhino droppings the plant matter is more or less intact.

Rhino skin is also very strong, so much so that it is often referred to as "dermal armor", a feature most pronounced in Indian Rhinos where the skin is deeply folded into plates giving the animal the appearance of a medieval battle machine (see "War Rhinos?") below. The Javan and Sumatran Rhinos also have deeply folded skin, but not to the same extent as their Indian cousins. Other mammals, such as armadillos and pangolins, also have protective amour, but theirs derives from bone-like skin adaptations whereas in rhinos, the skin strength comes from dense, tightly organized bundles of collagen, the fibrous protein found abundantly in all mammals. Other structures, some rich in keratin – one of the hardest proteins produced by animals - add to the toughness of rhino skin, providing the animal with protection from serious injury during combat with other rhinos, and from the bumps and scrapes inevitable in their wild environments.

Section 4.3.4

Thick skinned, but sensitive

A rhino's skin maybe thick and rather like armor plating but it is also prolifically served with nerve tissue suggesting that, despite its thickness, it is highly sensitive to touch and vibration. The blood vessel network is also dense and in addition to supplying the skin with blood it is thought that these vessels might play a role in cooling – rhinos do have sweat glands but they lack any high concentration and are not uniformly present.

Most rhinos will from time to time suffer from skin lesions and these are generally likely to be opportunistic infections as a result of injury. In Black Rhino, however, lesions are far more widespread, especially behind the shoulders and under the chin and stomach. They clearly cause discomfort given that rhinos will rub and scrape themselves against trees and rocks until the patches of irritation become persistent weeping wounds. The cause of the problem is a fly-borne nematode worm, and appears to be worst in seasons of high rainfall and temperature.

Section 4.3.5

What is rhino horn?

About what rhino horn is there is no doubt – it is basically made up of keratin - the hard protein-based material that comprises hair, nails, scales, feathers, beaks and claws in mammals, birds, reptiles and other vertebrates. The baleen plates of filter-feeding whales are also composed of keratin. In toughness and strength the only other biological structure with similar properties is chitin, a cellulose-like glucose-

insects and other arthropods and the cell wall structure of fungi.

But rhino horn is not simply a uniform mass of tightly compacted hair-like fibres as once thought. In 2006, a study published by Ohio State University in the USA referred to scans revealing dark patches running through the horn centre. These were found to be dense deposits of calcium and melanin and it is believed that they serve an important purpose: calcium adds hardness and strength to the core of the horn, while the melanin protects the core from the sun's harmful UV rays that are able to penetrate the outer layers. This comparatively softer outer portion of the horn weakens with exposure to the sun, rubbing on woody plants and hard ground, as well as in clashes with other rhinos. As a result the horn gradually weathers into its characteristic curved shape, pointed at the tip – think of a pencil's tough graphite core surrounded by softer wood.

Myths and legends about rhino horn and its putative pharmacologic attributes abound (Click here to find out more).

Pull quote:
"Ultimately, we think our findings will help dispel some of the folk wisdom attached to the horn. The more we can learn about the horn, the better we can understand and manage rhino populations in the wild and in captivity …" Lawrence Witmer, professor of anatomy in Ohio University's College of Osteopathic Medicine.
Find out more: https://people.ohio.edu/witmerl/3D_rhino.htm