

Explorations in Biomimicry

Chameleon

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M.Des Interaction Design

Approval Sheet

DES Project titled “Explorations in Biomimicry: Chameleon” by Zuha Asif P, (Roll Number 216330014) is approved for partial fulfillment of the requirement for the degree of ‘Masters in Design’ in Interaction Design at IDC School of Design, Indian Institute of Technology, Bombay.

Digital Signature
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26-Jul-23 01:36:57 PM

Guide:

Nishant Sharma

CHAMELEON

COMMON NAME: Chameleons

SCIENTIFIC NAME: Chameleonidae

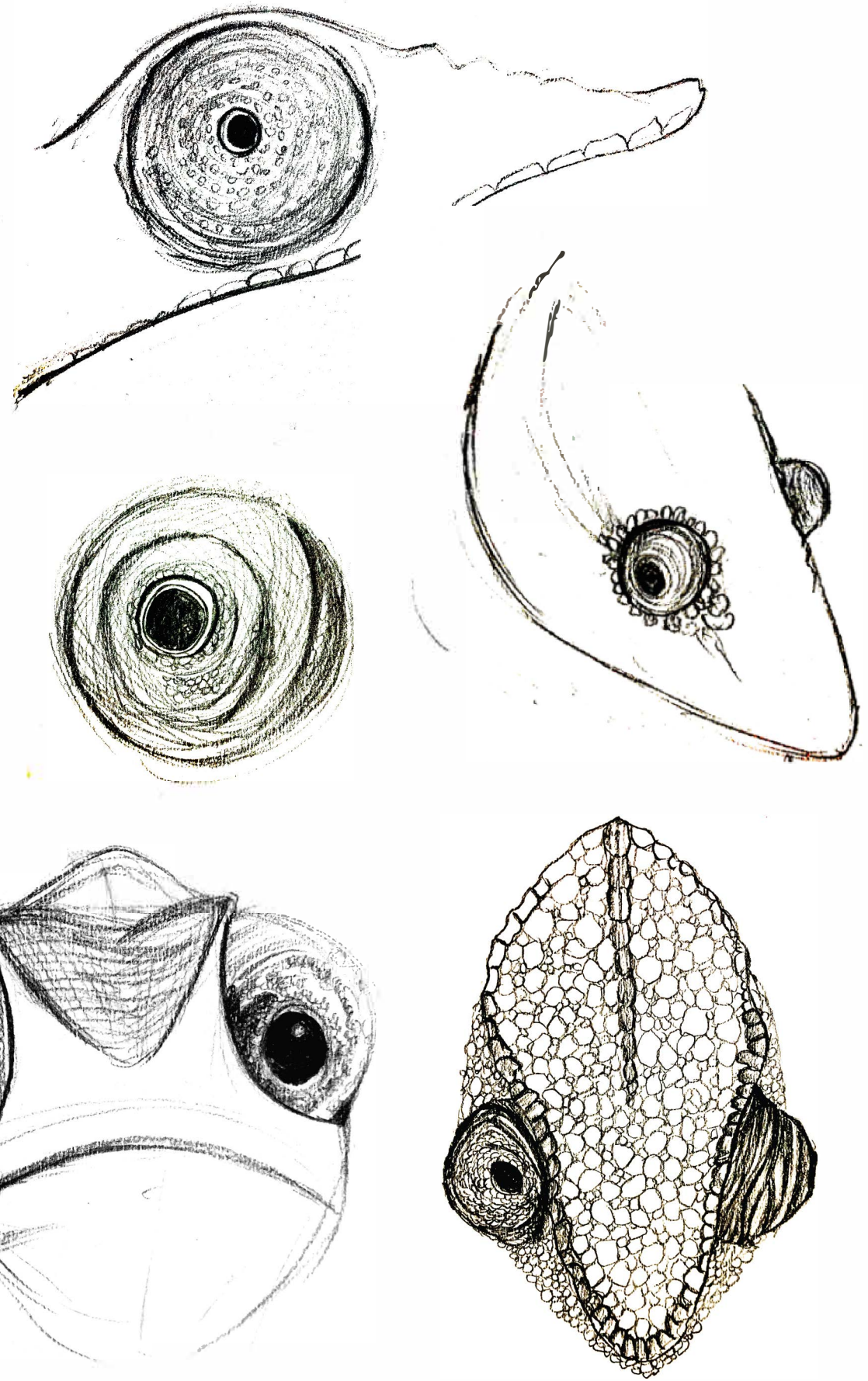
TYPE: Reptiles

DIET: Omnivore

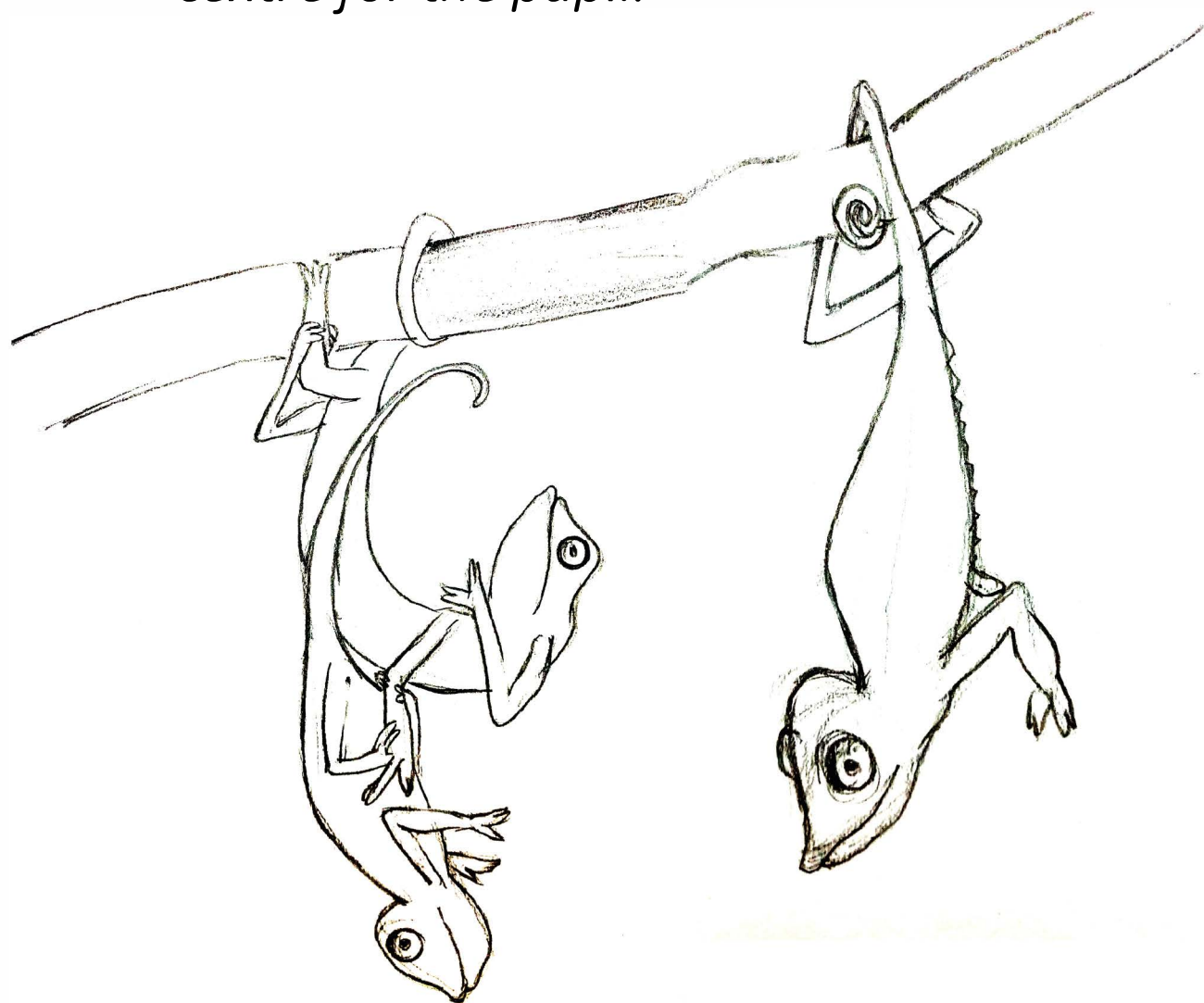
AVERAGE LIFE SPAN: 4 months to 9 years, depending on the species

Telescopic eyes

Chameleon's bulging, swiveling eyes give them incredible panoremic vision - about 180 degrees horizontally and 90 degrees vertically - that helps them watch for potential threats.

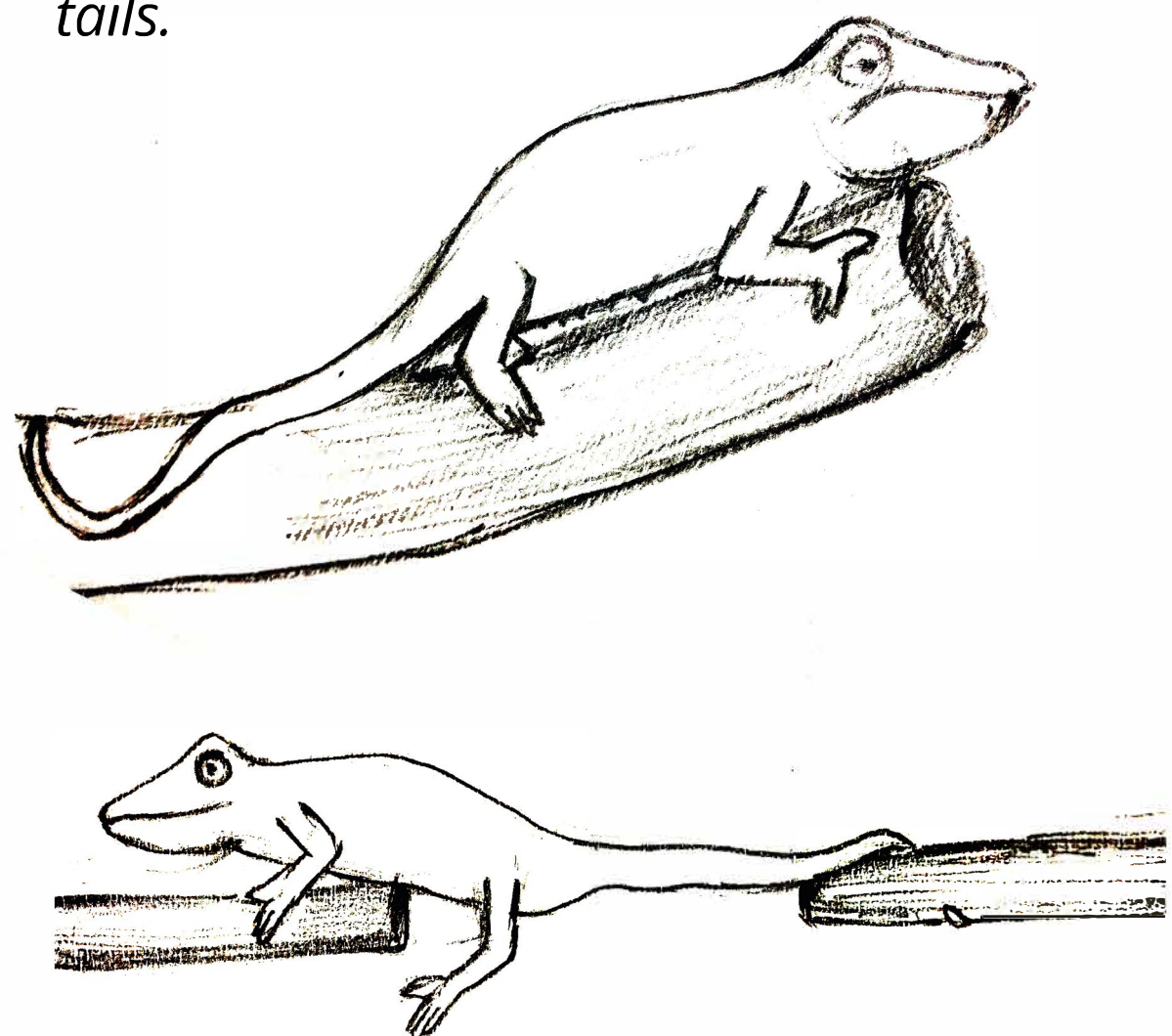


Each eye has a cone-shaped eyelid that's fused to the eyeball with a tiny hole in the centre for the pupil.



Grasping tail

Chameleons primarily use their tails to grab onto objects. Other than that, they also use tails to balance themselves while they climb around trees. They can also hang on their tails.



Chameleons use their tails as support while moving from one branch to another

CHAMELEON

Ballistic Tongue

The tongue of a chameleon is 1-2 times the size of the owner covered with a sticky saliva. There are mainly 3 parts of the tongue: Retractor, Accelerator and Tongue pad.

Initial extension of the tongue



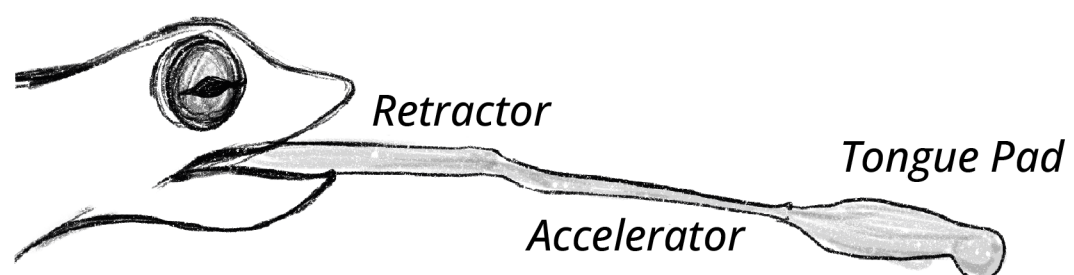
Telescopic extension



Full extension



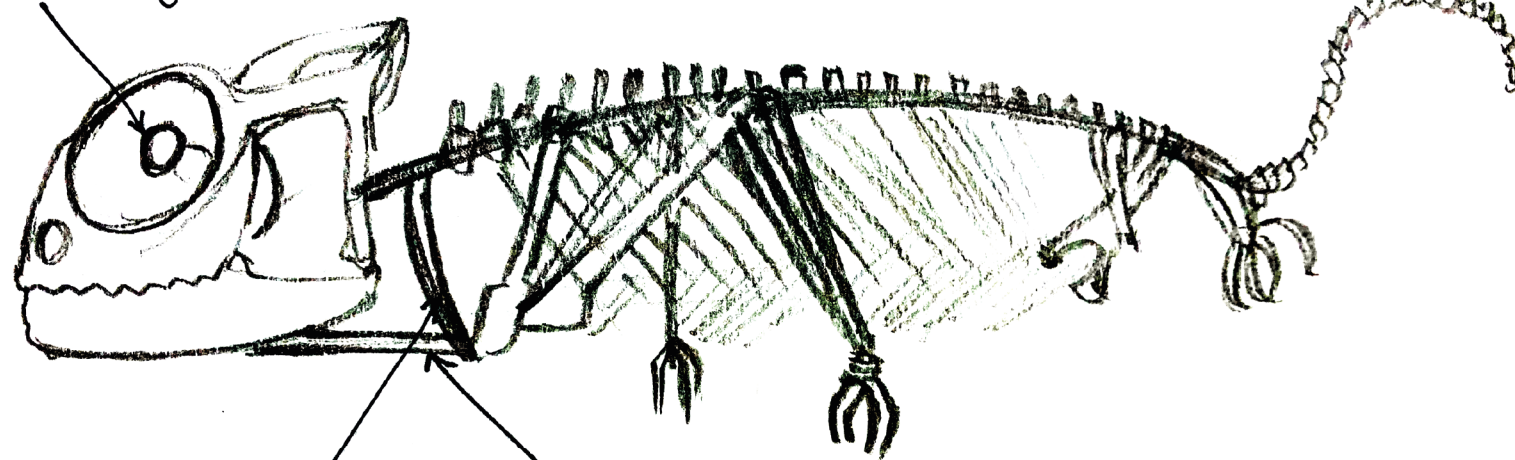
Coiled (before catching prey)



Full Extension

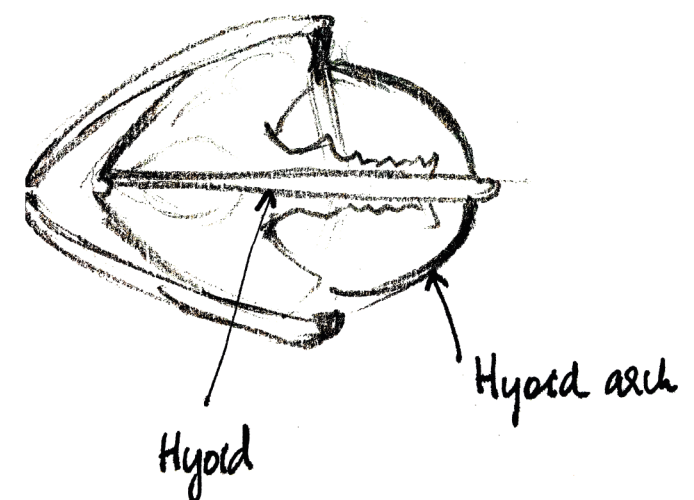
Skeleton

Sclerotic Ring

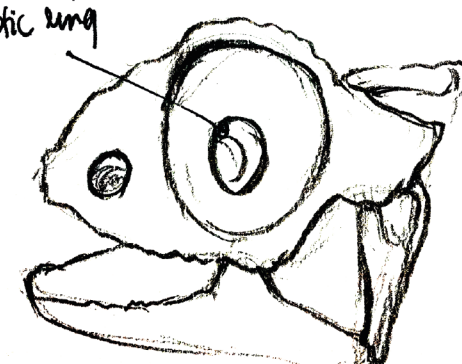


Hyoid arch

Hyoid



Sclerotic ring

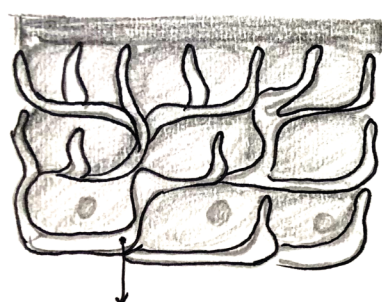


Hyoid Bone: accelerator muscles squeeze against the hyoid bone

Hyoid Arch: acts as a support for the bone in recoil mechanism

Skin Layers

SUBMISSIVE: Darker colour to show that it is not a threat. Disperse melanin to upper layers



Melanophore: The melanin in this moves up when the chameleon is submissive

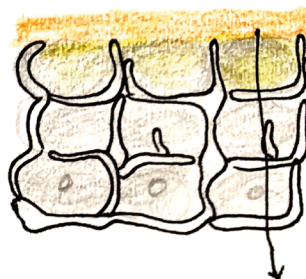
NEUTRAL: Alert it is typically Red for green or brown. Blue and green wavelengths crystals reflect off tightly packed crystals



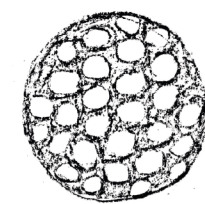
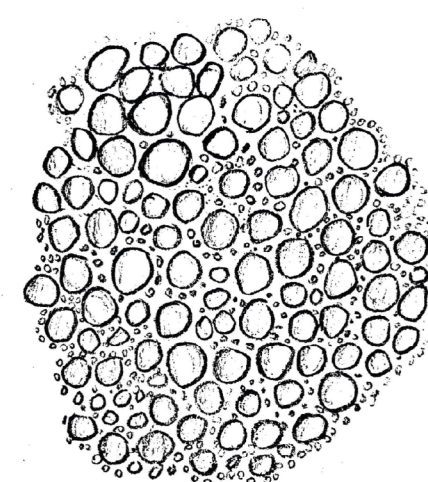
Xanthophore: contains yellow pigment.
Leucophore: contains monocrystals

EXCITED:

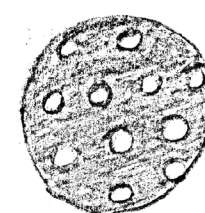
Vibrant colours - signal aggression or a desire to mate. Crystals move wider apart reflecting yellow, orange and red



Erythrophore: Cells with red pigment are usually in the areas of skin that form stripes



In resting, chameleon crystals form a tight lattice.



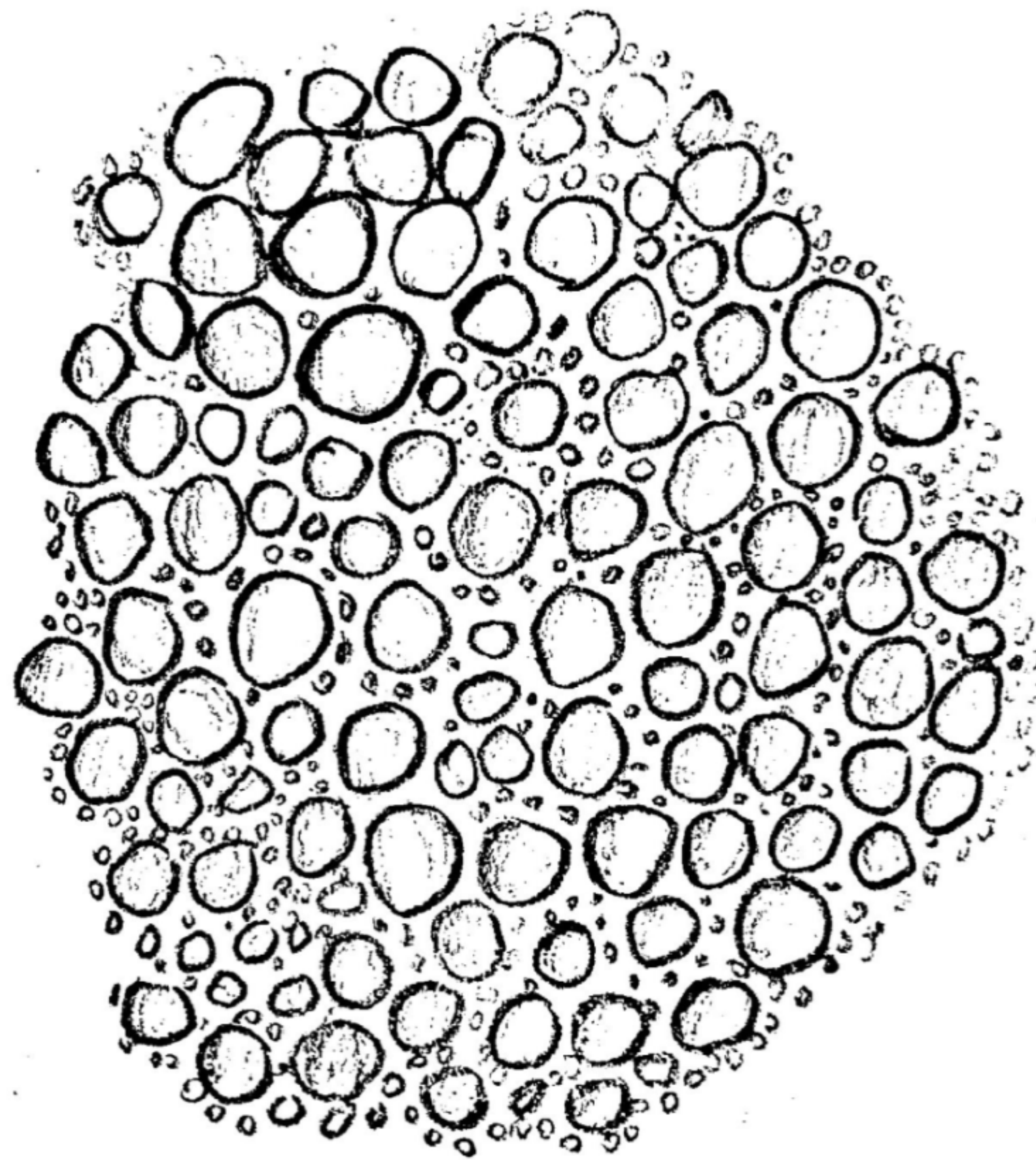
The crystals are spread when the chameleon is excited

They can quickly change their appearance in response to temperature, environment and mood.

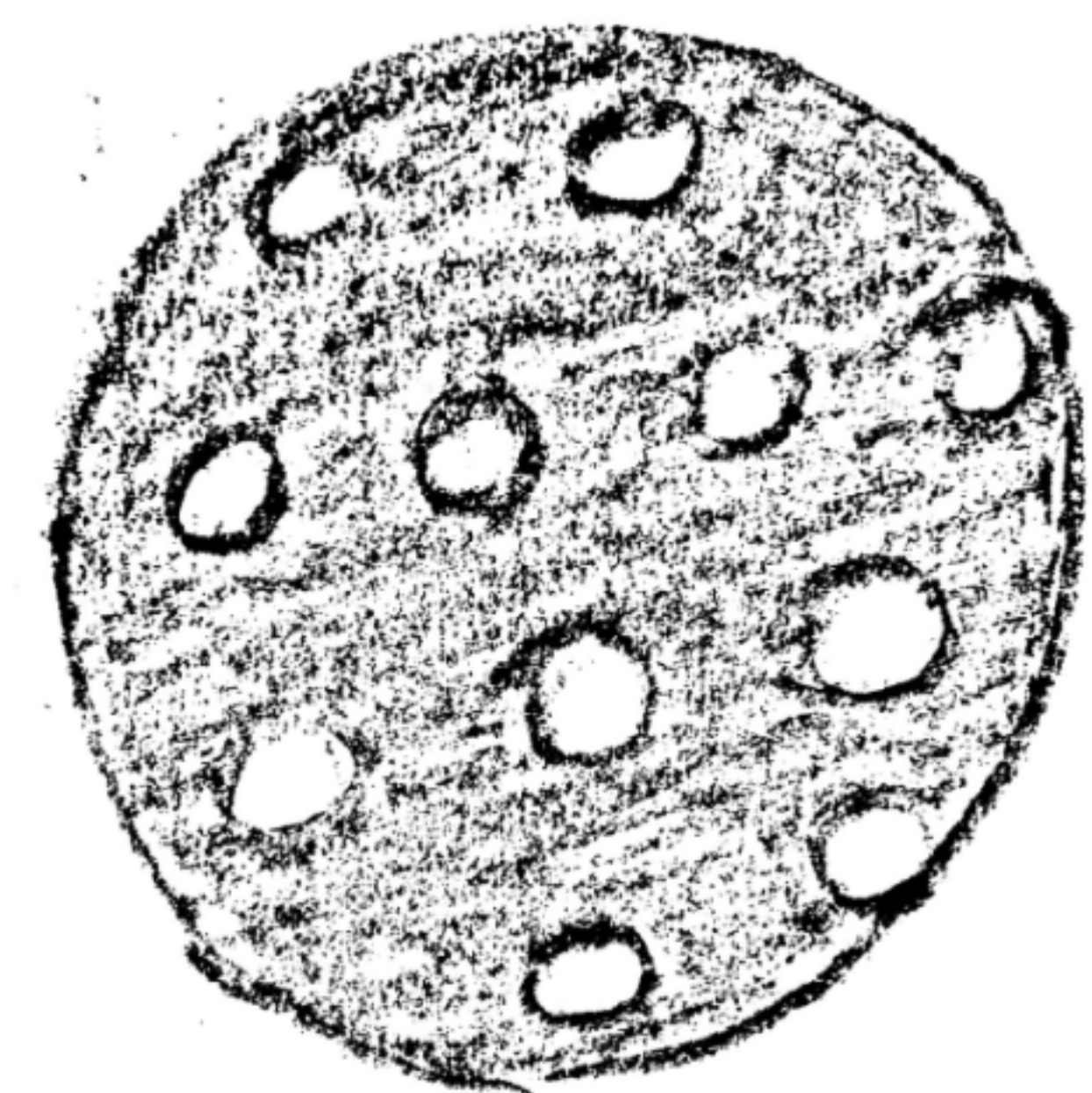
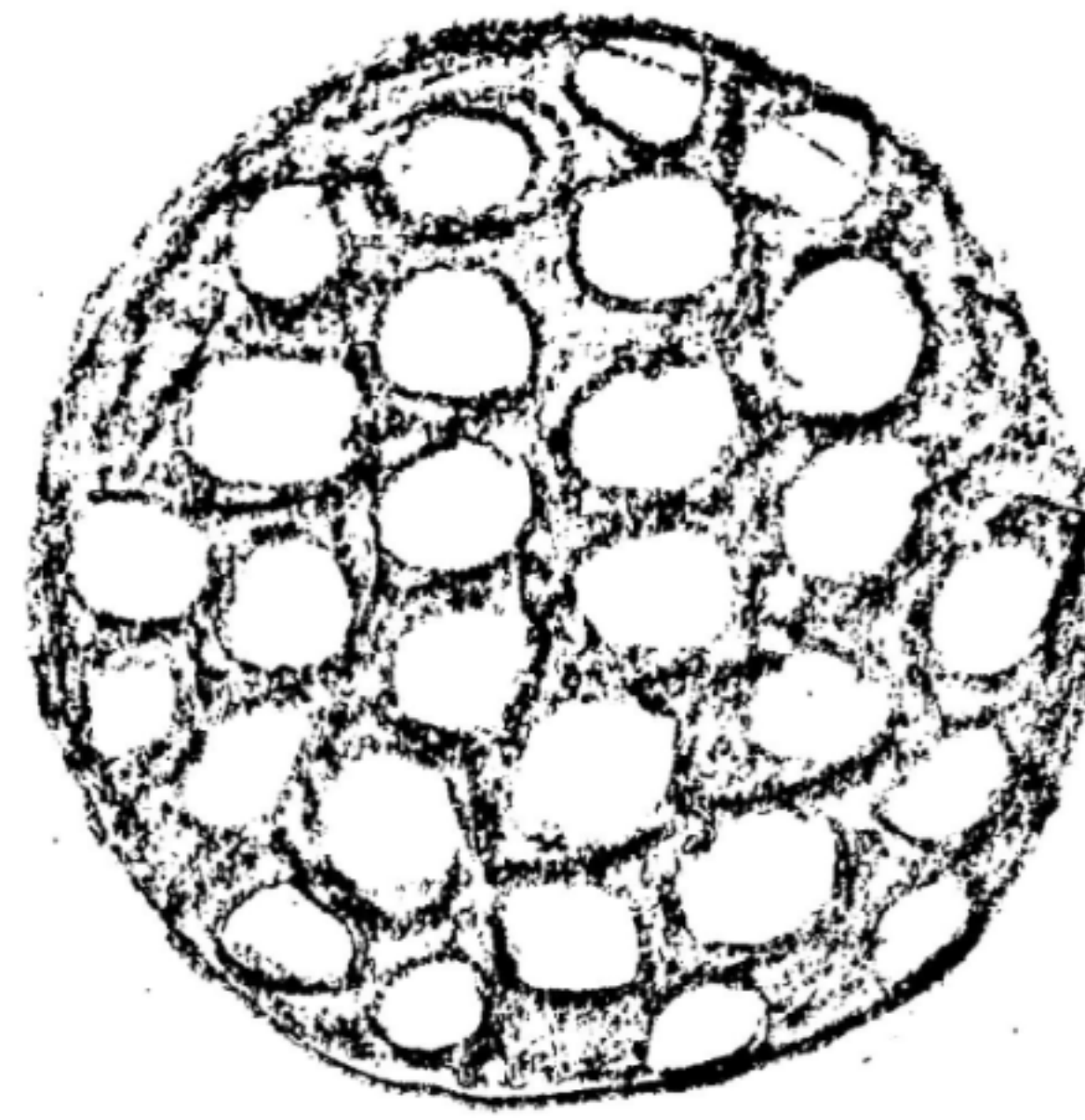
CHAMELEON SKIN

A chameleon can quickly change their appearance in response to temperature, environment and mood.

How does it change colour?



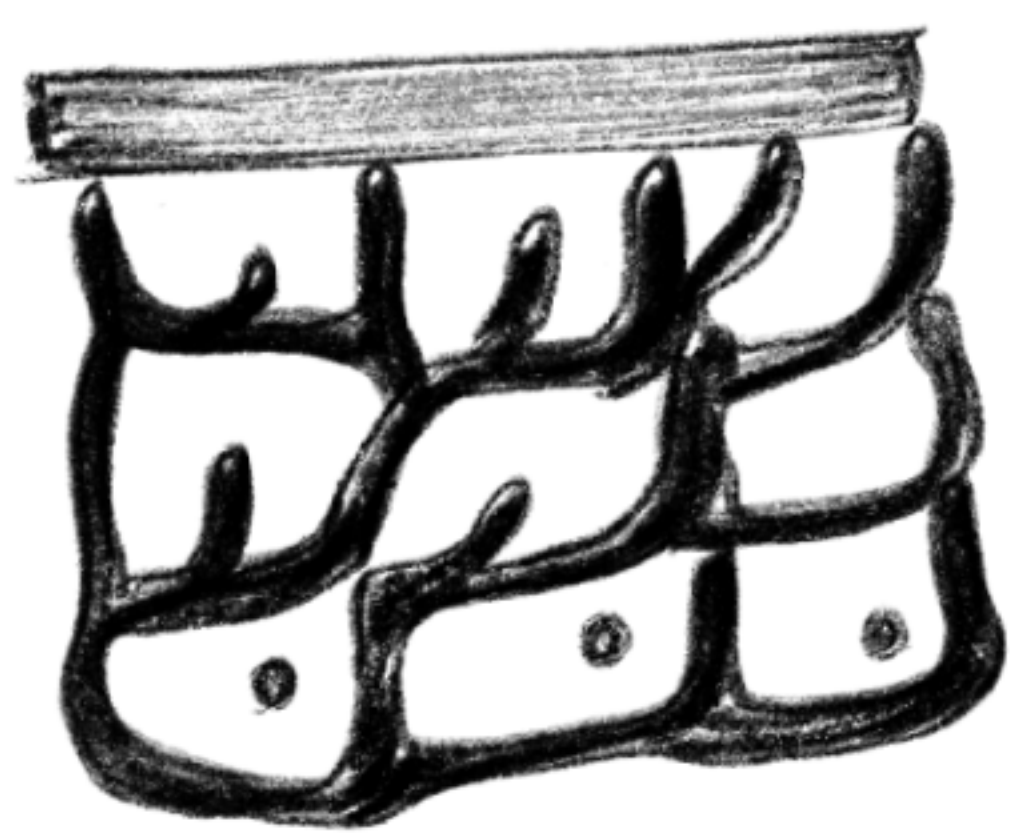
In resting, chameleon crystals form a tight lattice.



The crystals are spread when the chameleon is excited

SUBMISSIVE

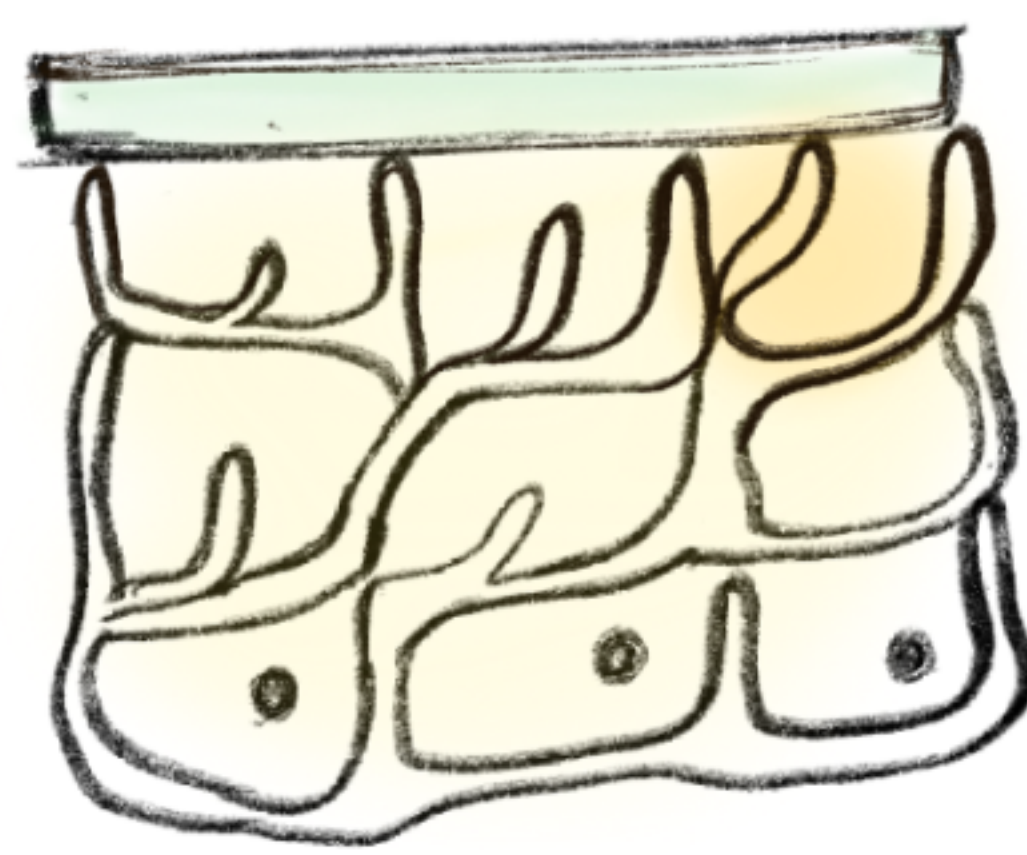
Darker colour to show that it is not a threat. It disperses melanin to upper layers



Melanophore:
The melanin in this moves up when the chameleon is submissive

NEUTRAL

At rest, it is typically green/ brown these are reflected from the tightly packed crystals

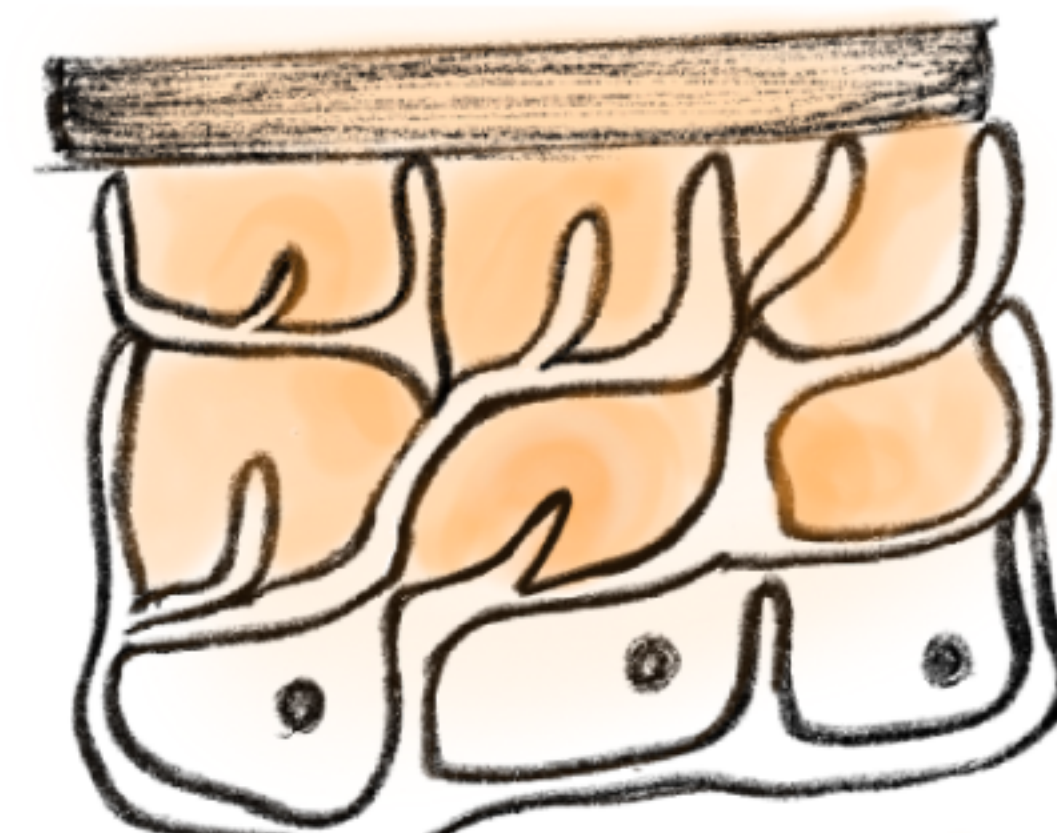


Iridophore:
Contains monocrystals

Xanthophore:
Contains yellow pigment

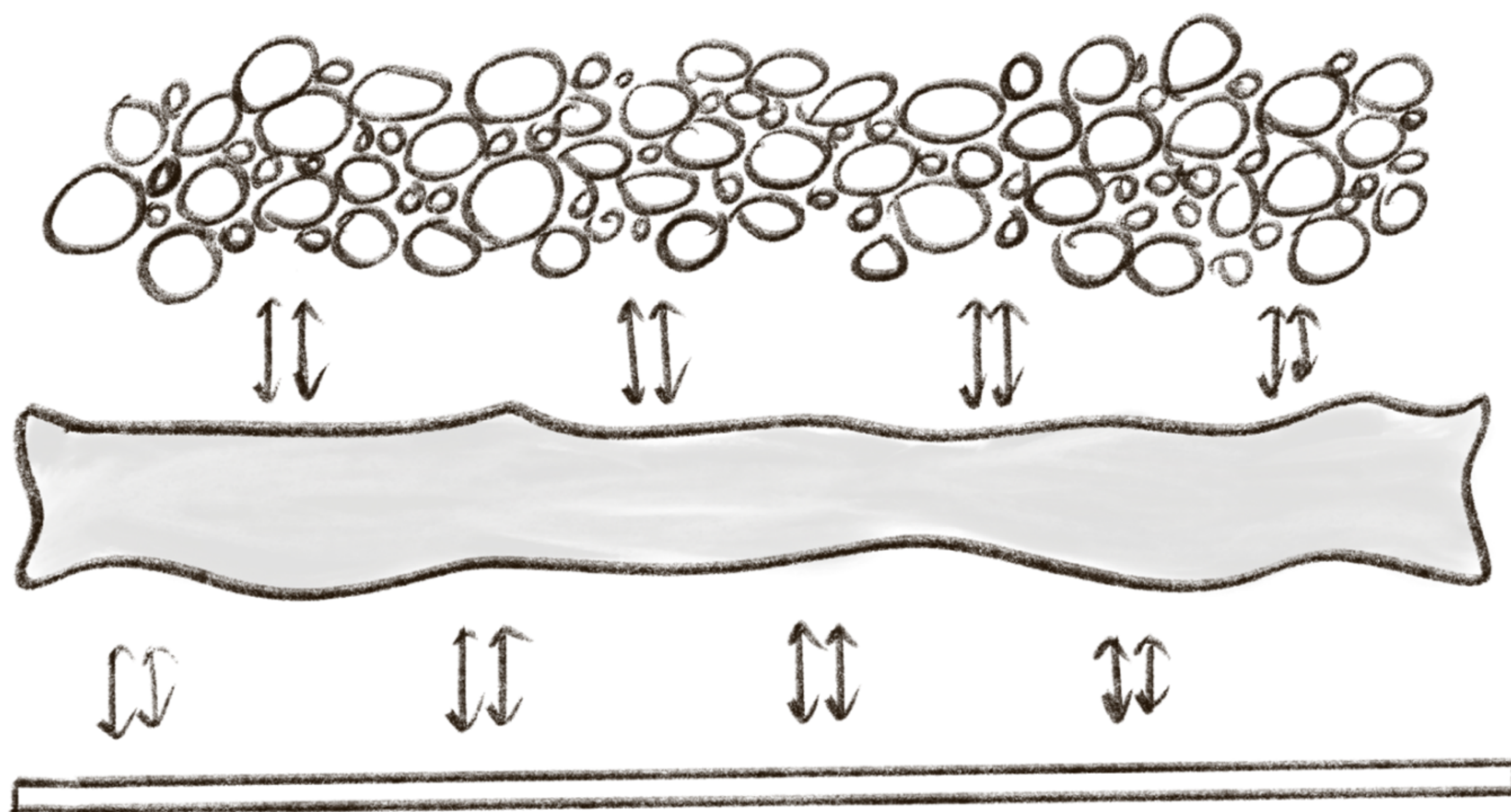
EXCITED

Vibrant Colours - Signal aggression or a desire to mate. Crystals move wider apart reflecting yellow, orange and red.



Erythrophore:
Cells with red pigment are usually in the areas of skin that form stripes

Adapting this mechanism to artificial materials



A layer of nanocrystals arranged in different layers, which on stretching and compression change colours.

An elastic layer/ material on to which these crystals are embedded.

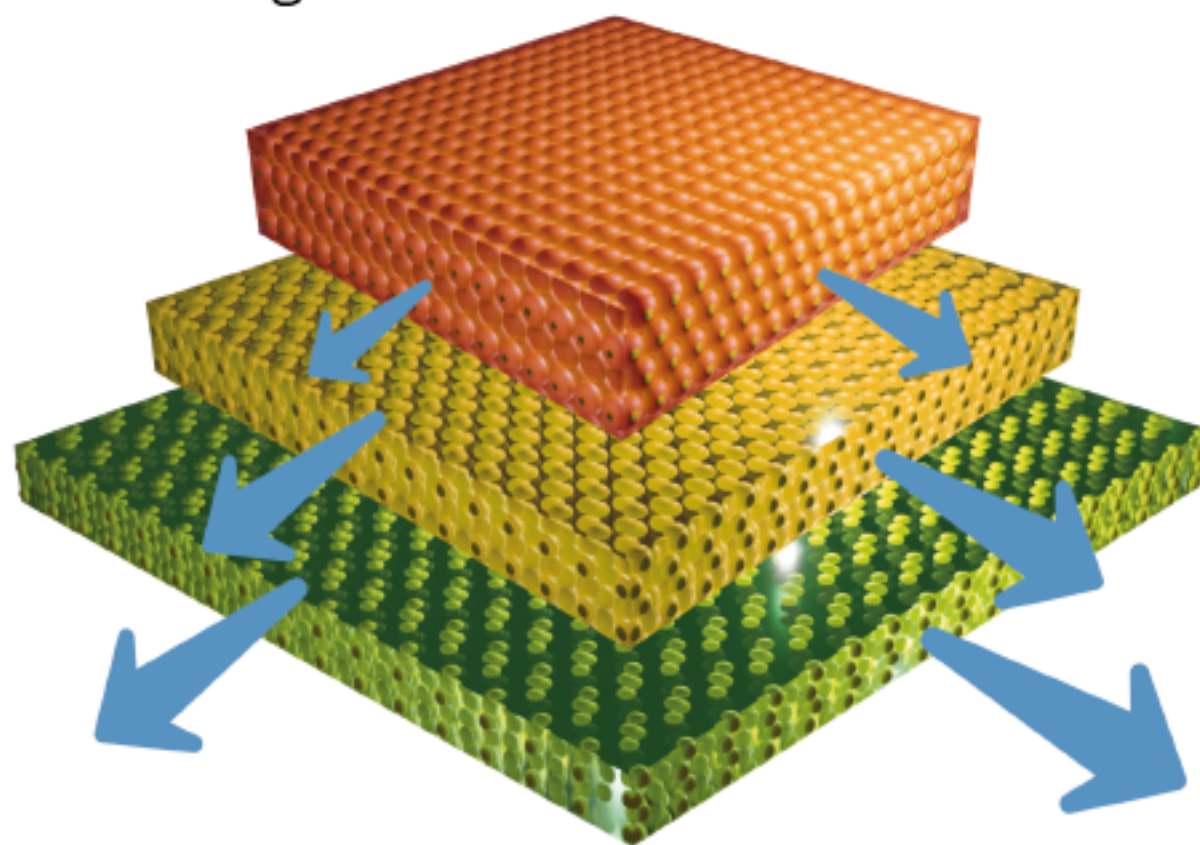
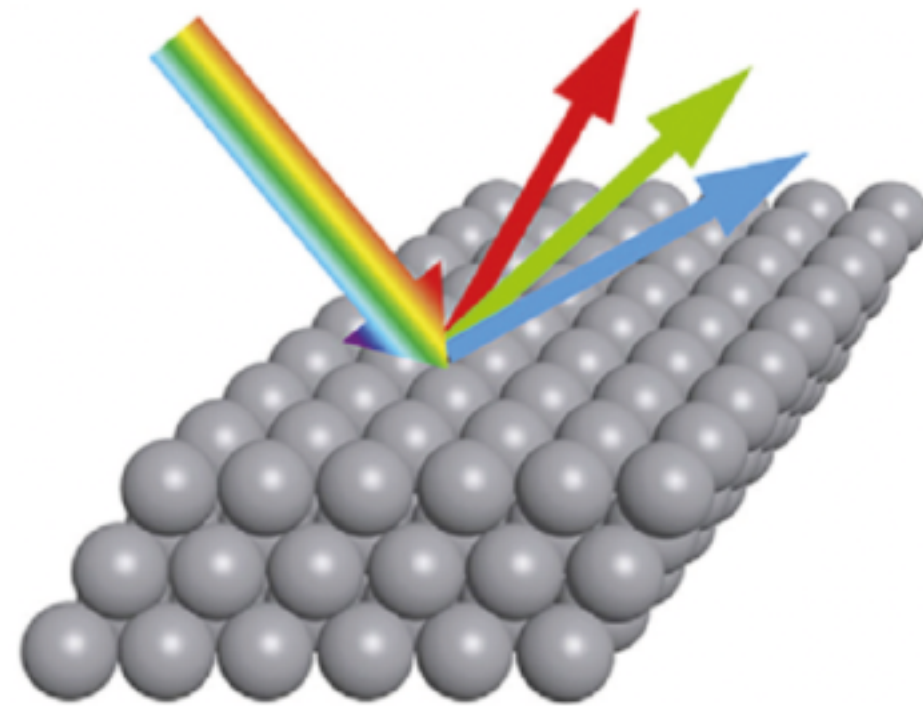
Temperature sensitive material

SKIN - APPLICATIONS

Colour changing Property

A material can change its colour if it is made up of certain nano crystals that are capable of reflecting and absorbing certain wavelengths of light

These crystals are arranged in such a way that any form of pressure: Mechanical, Temperature results in changing the lattice arrangement



Colour changes from orange to green on stretching

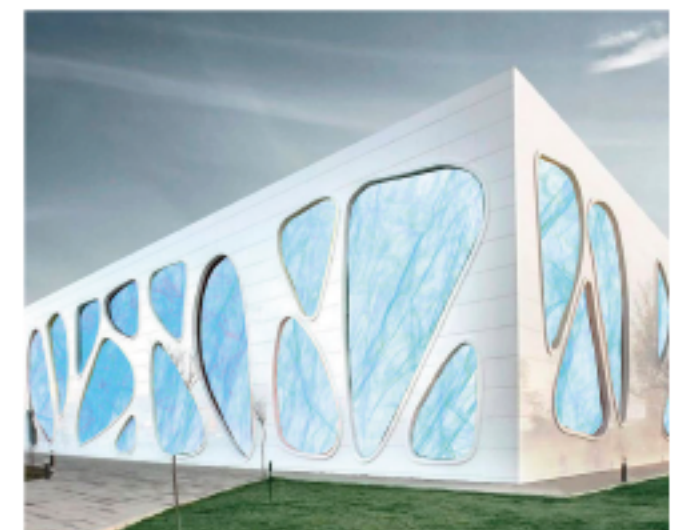
How to impart Stretching?

Heat/ Mechanical/Time

Applications

Colour changing facades:

Depending on the sun's position, the temperature on the facade is different. This results in uneven stretching which results in different colour formation



Ambient Lighting

Colour changing exercise bands:

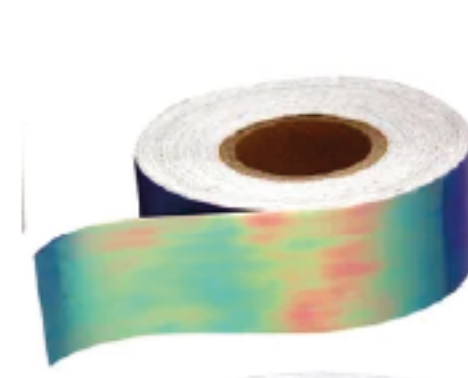
Doctors/ physiotherapists can instruct exact amount of pressure to be applied with the help of colours



Controlled exercise

Colour changing tapes:

These are temperature sensitive tapes which changes colour from blue to red. Can be used as a precautionary measure.



Temperature precaution

EYES - APPLICATIONS

360 Degree Vision for Military/ Defense



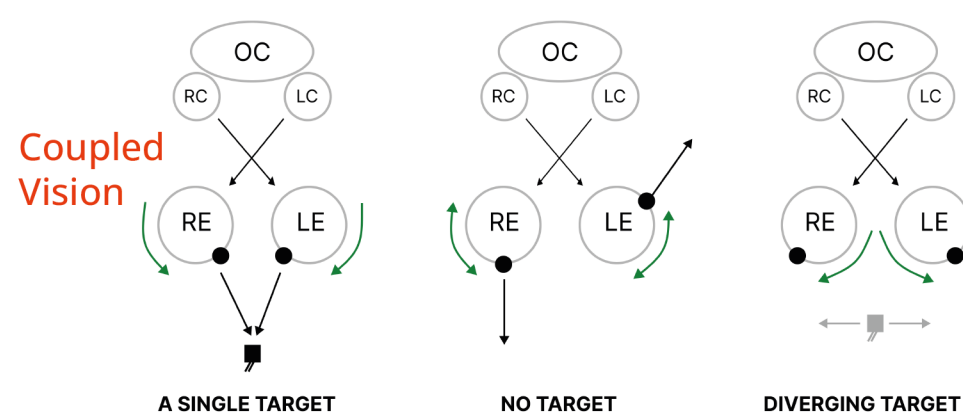
Hemispherical dome shaped track for camera movement for 360 degree vision inspired from chameleon eyes

Camera is mounted at the intersection of the rails

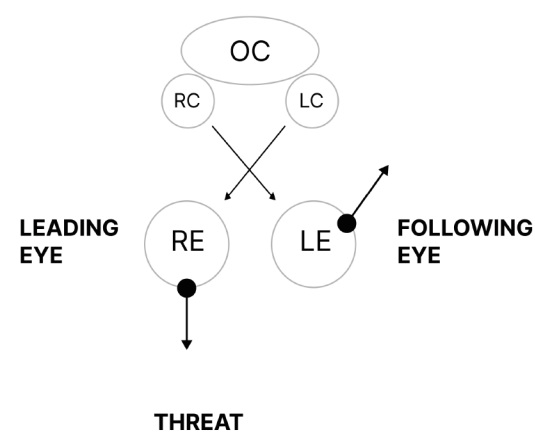


Working

Transition from monocular to binocular vision

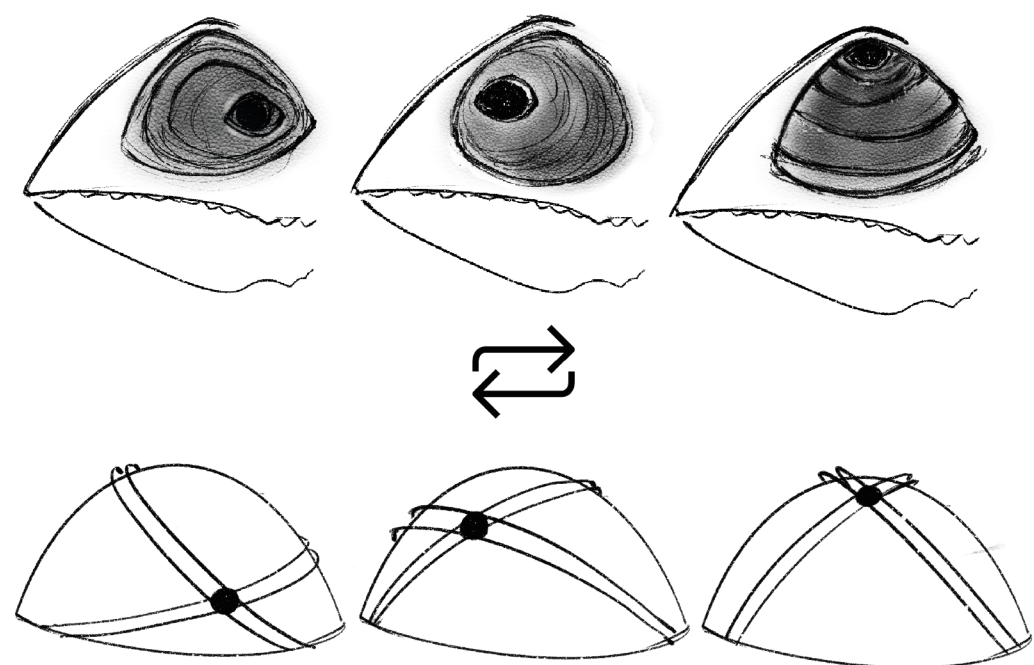


The chameleon can fix one eye on the target and scan the environment for threats



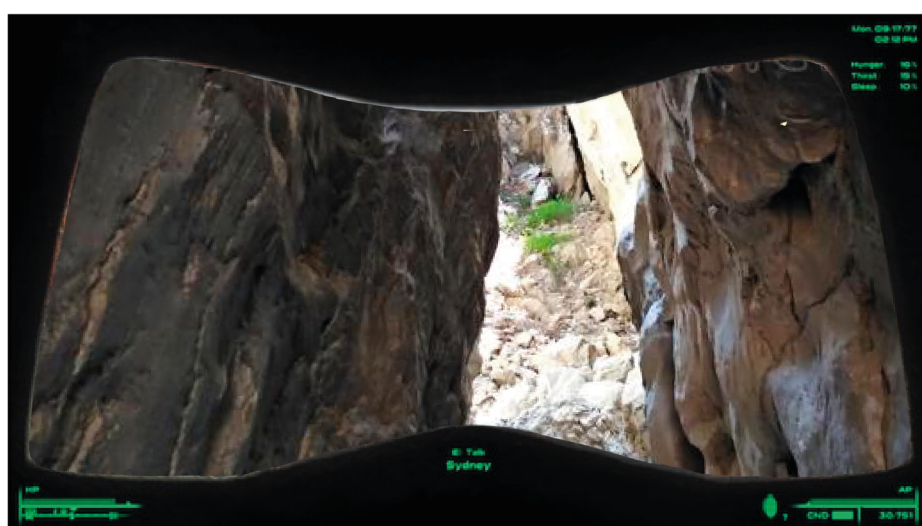
Inspiration

Rotation with high degree of freedom



The movement and shape of the camera is inspired from the positioning and working of chameleon eyes

Scenario



A Soldier is walking through narrow crevices and it is difficult for him to turn around and see what is behind him.

Threat found



Scan the environment fixing the position of threat

