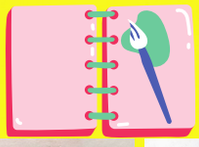
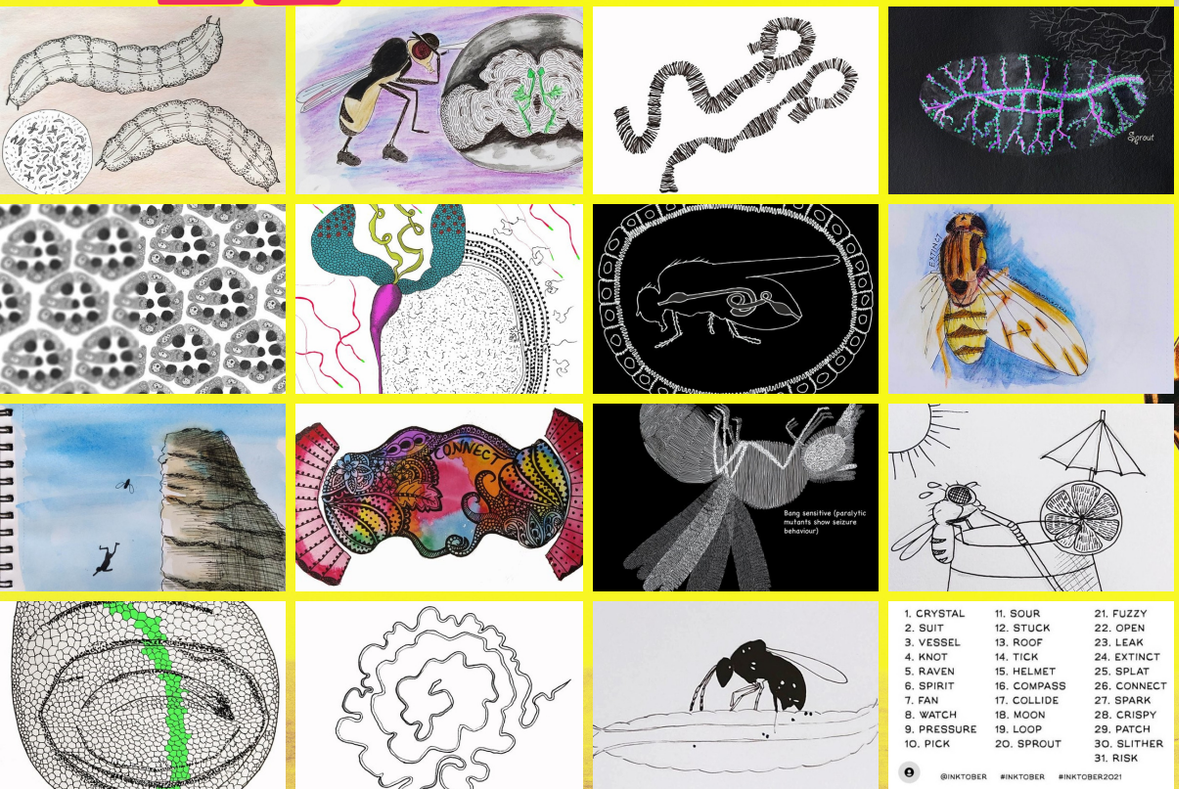
Know the fruit fly from your garden



Art by Dr. Deepti Trivedi



Compiled by Biopatrika

Inktober 2021

OFFICIAL 2021 PROMPT LIST

1. CRYSTAL
2. SUIT
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4. KNOT
5. RAVEN
6. SPIRIT
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@INKTOBER #INKTOBER #INKTOBER2021

Lets take a dip in the world of Drosophila (fruit fly)

Crystal

Crystal cells are a type of blood cells in flies that contain prophenoloxidase crystals and are involved in wound healing by local melanization.
Since flies do not have acquired immunity, innate immunity is very important for their survival.
Crystal cells are filled with regularly packed non-membranous crystalline structure, very few mitochondria, and rough ER and are highly susceptible to rupture when there is a change in physiological condition of hemolymph.

CRYSTAL Oct 1, 2021 depth

Suit

Drosophila is the Queen of Genetics.
It is the most amenable model organism for genetics where one can fine tune gene expression spatially & temporally & ask fundamental questions relevant to us.
Here's a suit of Drosophila themed playing cards.

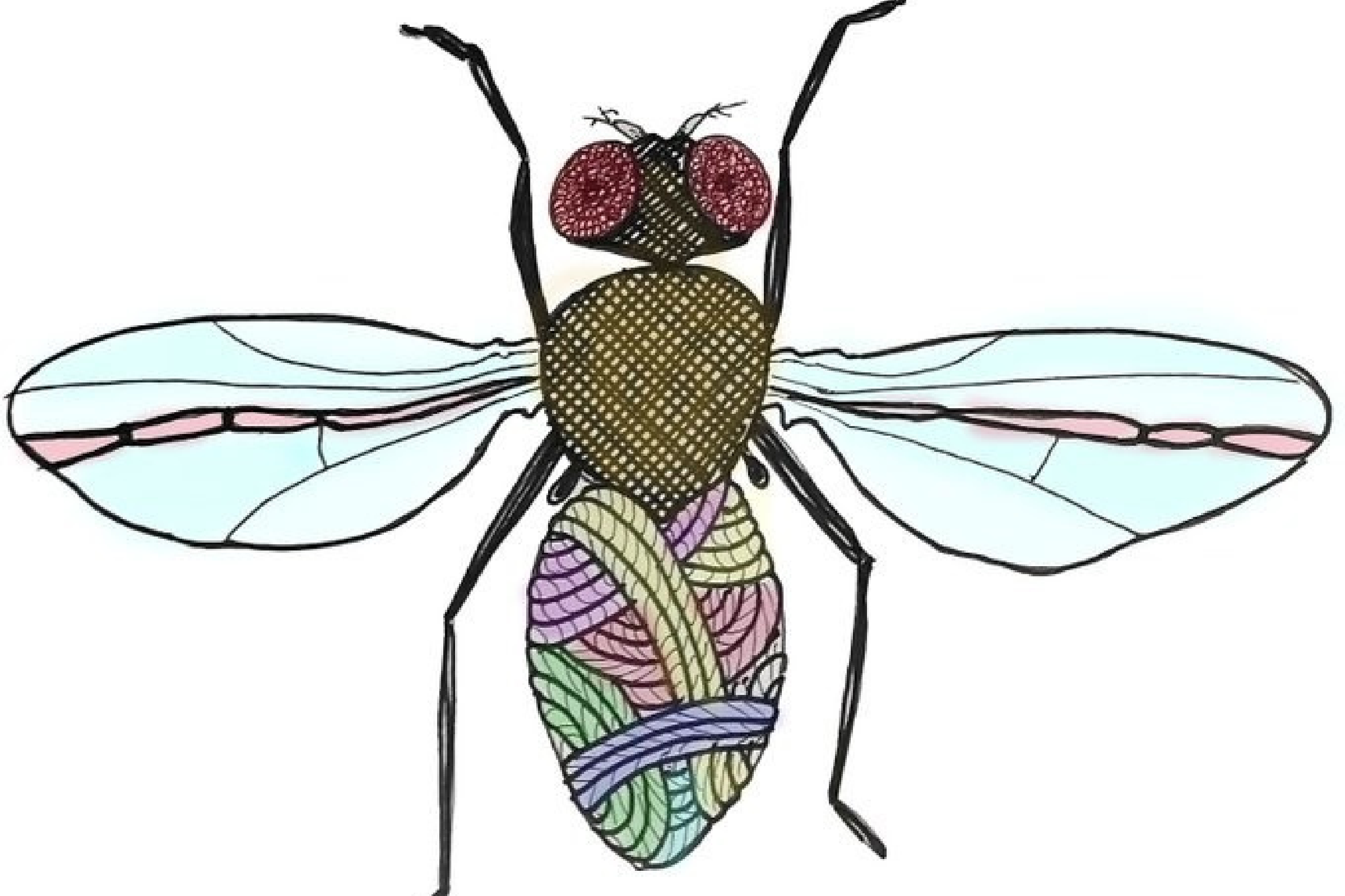
Vessel

The heart of Drosophila is called dorsal vessel as it located underneath the dorsal epidermis.
Its built early during embryogenesis by rows of cardiomyocytes.

Knot

knot gene in flies is so called because of its phenotype in wing patterning defect where wing veins look as if knotted.

Knot is a transcription factor involved in many functions including development & immunity.



Raven

In Norse mythology Hugin and Munin are 2 ravens that fly all over the world and bring information to the God Odin.

Drosophila gene product Hugin is a neuropeptide precursor with similar message conveying function as the raven Hugin.

Spirit

The awesome spirit of Drosophila biologists in sharing of tools, reagents & resources has sped up great discoveries in biology and will continue to advance our understanding.

Fan

Drosophila brain is complex.
A prominent part of the central complex is occupied by a region called Fan Shaped body.
These are involved in complex behaviours of learning, flight, sleep, innate and conditioned pain response

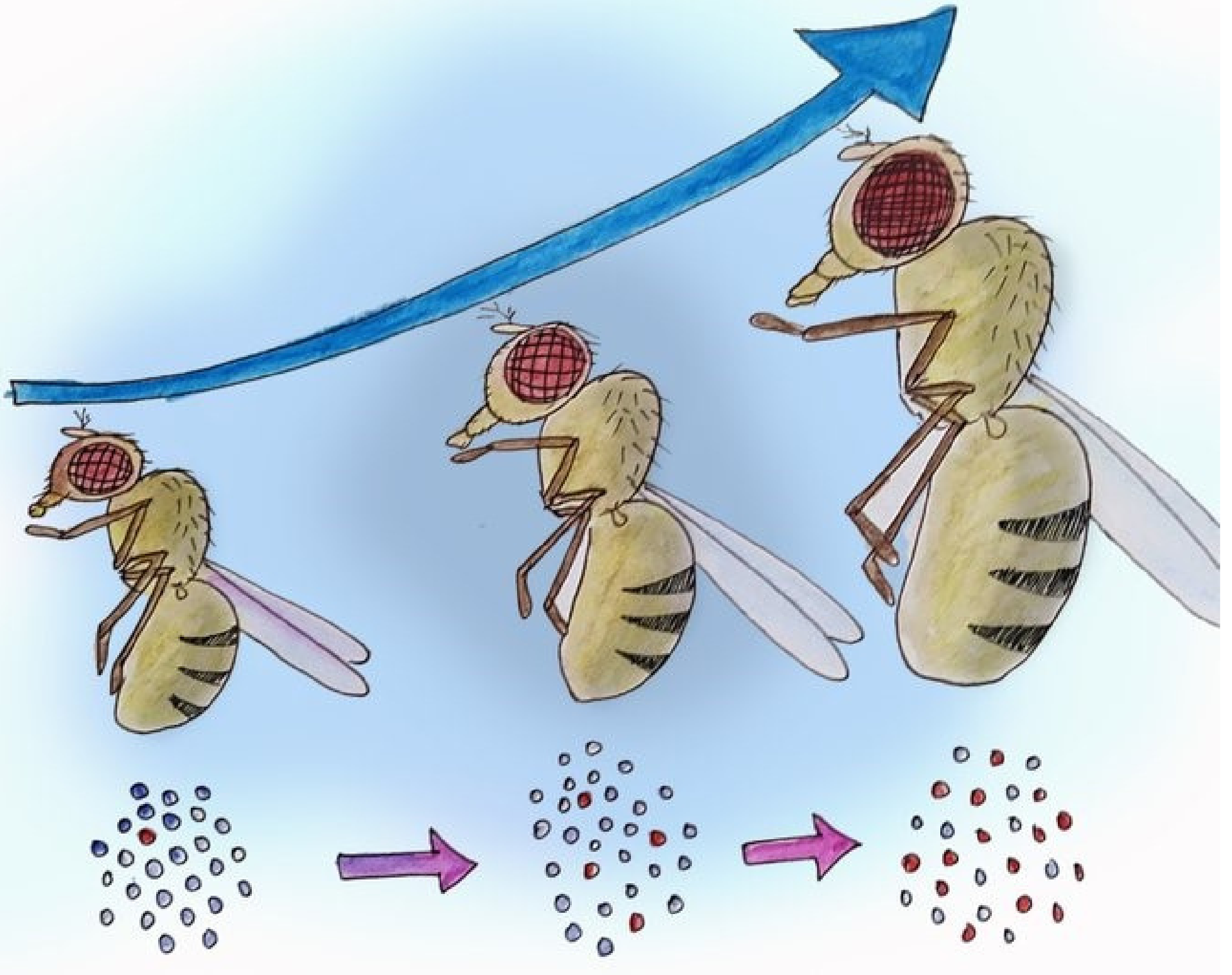
Watch

Drosophila is a pioneer organism in which clock genes were first discovered.
Shown here are the neurons that express clock genes, drawn based on a book chapter by Charlotte Helfrich-Förster.


Ocelli
DN1a
DN1p
DN3
LPN
LNd
LN
sLNv

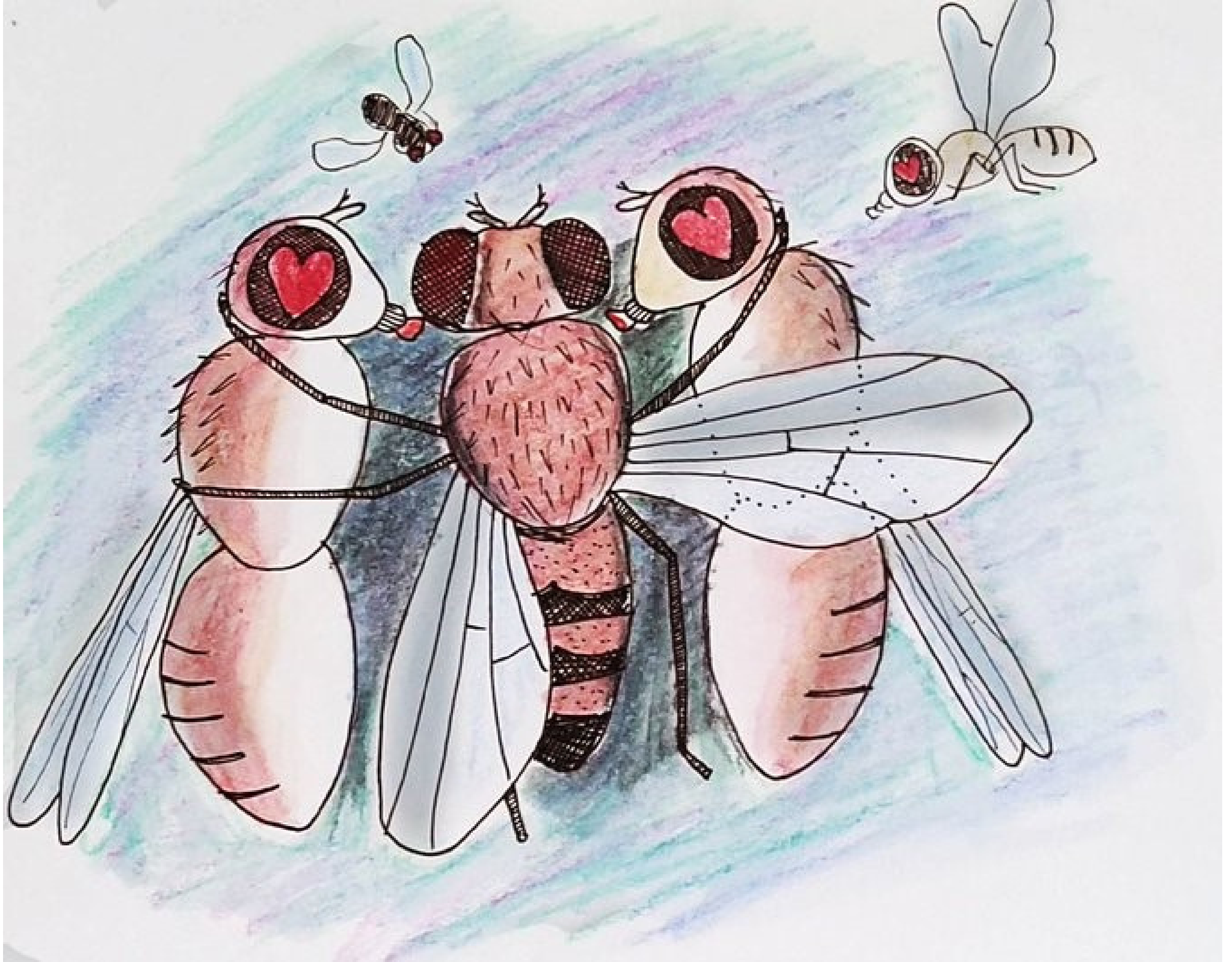
Pressure

Lab defined selection pressure can be used to study evolution in Drosophila.
As a hypothetical example shown here, fly populations are allowed to evolve by selecting only largest flies over generations.



Pick

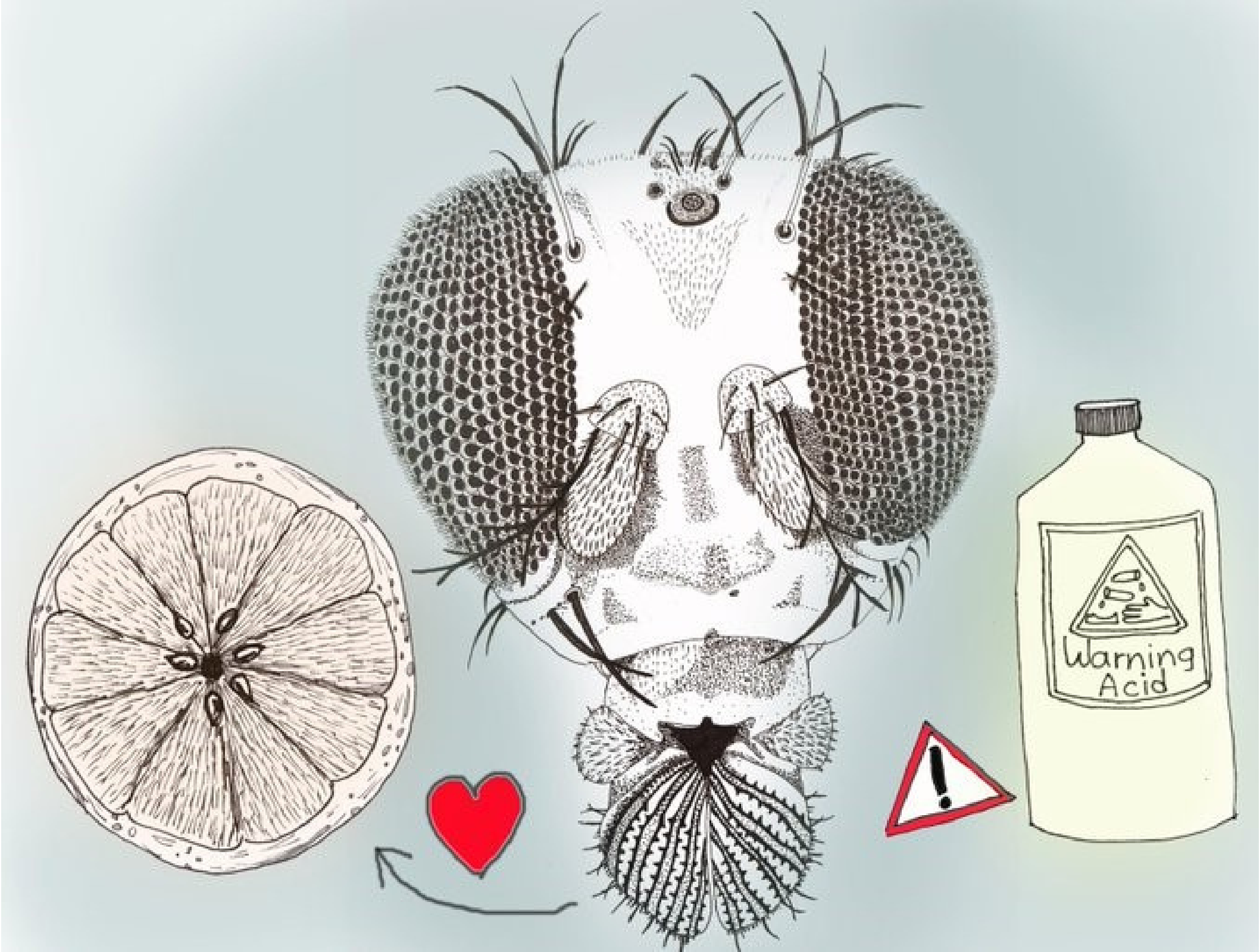
How did you pick your partner?
Mate-choice copying, or non-independent mate choice, occurs when a female of a species copies another fellow female's mate choice irrespective of their own preference.
This behavior is speculated to be one of the driving forces of sexual selection and the evolution of male traits.



Sour

Recently, Zhang lab at Monell Center discovered Otopetrin-like a as a bonafide sour taste receptor in flies.

Loss of OtopLa causes loss of attraction to low-acid food while keeping the aversion of high-acid food intact suggests 2 separate pathways.


Warning
Acid

Stuck

Drosophila cultures get infested with mites at times, mostly by food mites.
However, the most difficult to get rid of are the ectoparasitic mites that get stuck to the bellies of flies in nature and hitch rides from one place to the other.

Roof

Roof of the world Himalayas pose adaptive challenges due to low oxygen and pressure conditions.

Drosophila & humans share the genetic signals for this adaptation and similar SNPs associated with hypoxia tolerance & metabolism.

In addition to hypoxia adaptation, flies adapted to high altitude have reduced body weight & size, cell number, & cell size.

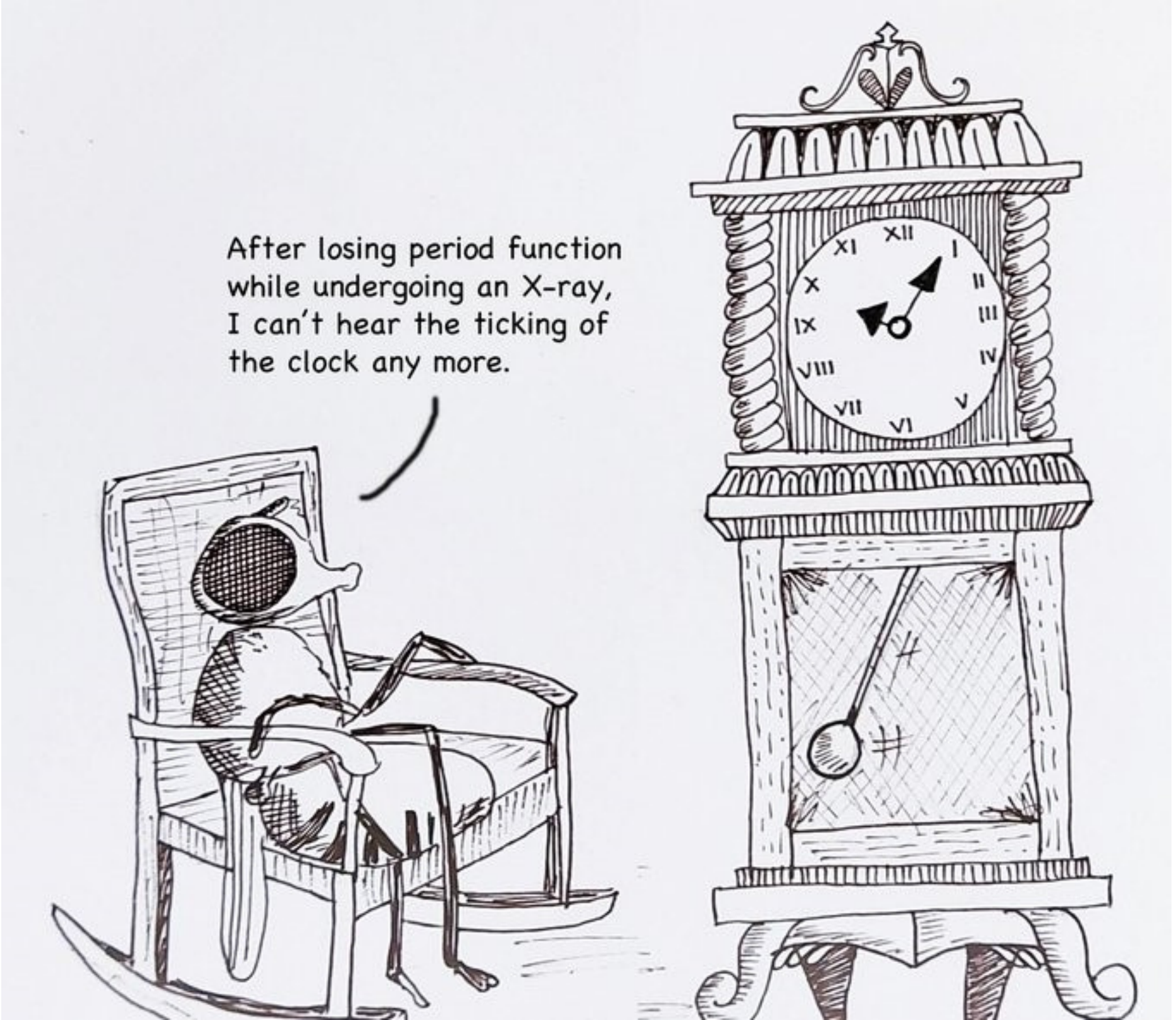
Tick

A handful of circadian clock genes keep our body clocks ticking.

Period is one of the circadian rhythm genes in flies and us.

Mutation in this gene can shorten, lengthen or abolish circadian rhythms.

Here is a mutant fly that has lost the tick.


After losing period function while undergoing an X-ray, I can't hear the ticking of the clock any more.
XII
I
II
III
IV
V
VI
VII
VIII
IX
X
XI

Helmet

Drosophila eyes are compound eyes.
They are composed of 7-800 ommatidia and occupy a large part of their head.
A transparent helmet would perhaps help this bicycling enthusiast.

Compass

Wind direction influences the compass in fly brain and how?

Specialized ring neurons extract info on wind direction by the movement of antennae in wind and convey it to the compass.

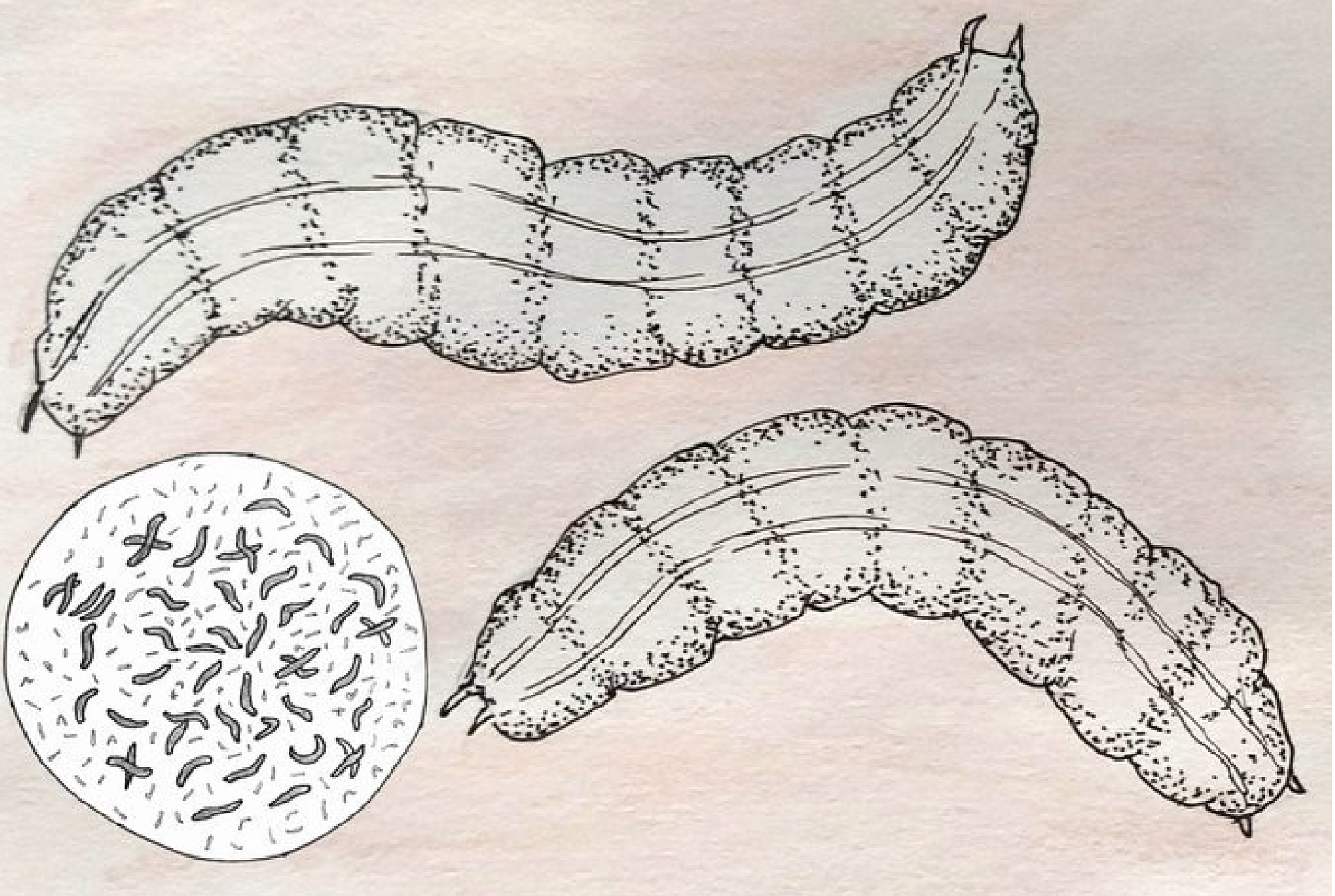
Wind and visual cues finally help flies to map their way.


Banana

Collide

Ever wondered how Drosophila Larvae navigate?

Drosophila larvae are able recognize other larvae in a narrow perceptive field using sensory cues to avoid imminent collision and able to differentiate between alive, dead and plastic larvae.

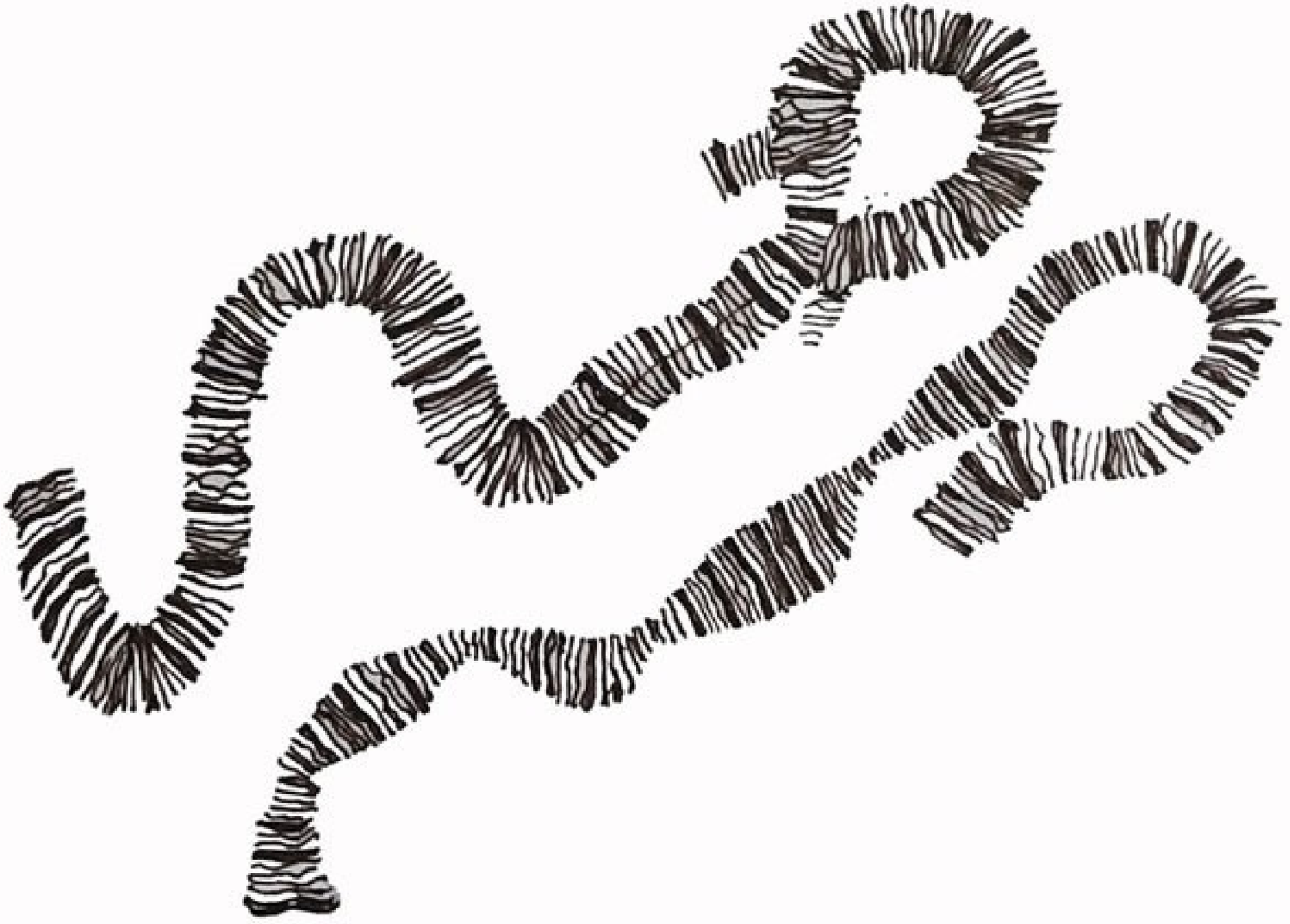


Moon

Moonwalker Descending Neurons (MDNs) are cluster of neurons the activity of which is necessary & sufficient to trigger backward walking in flies.

Loop

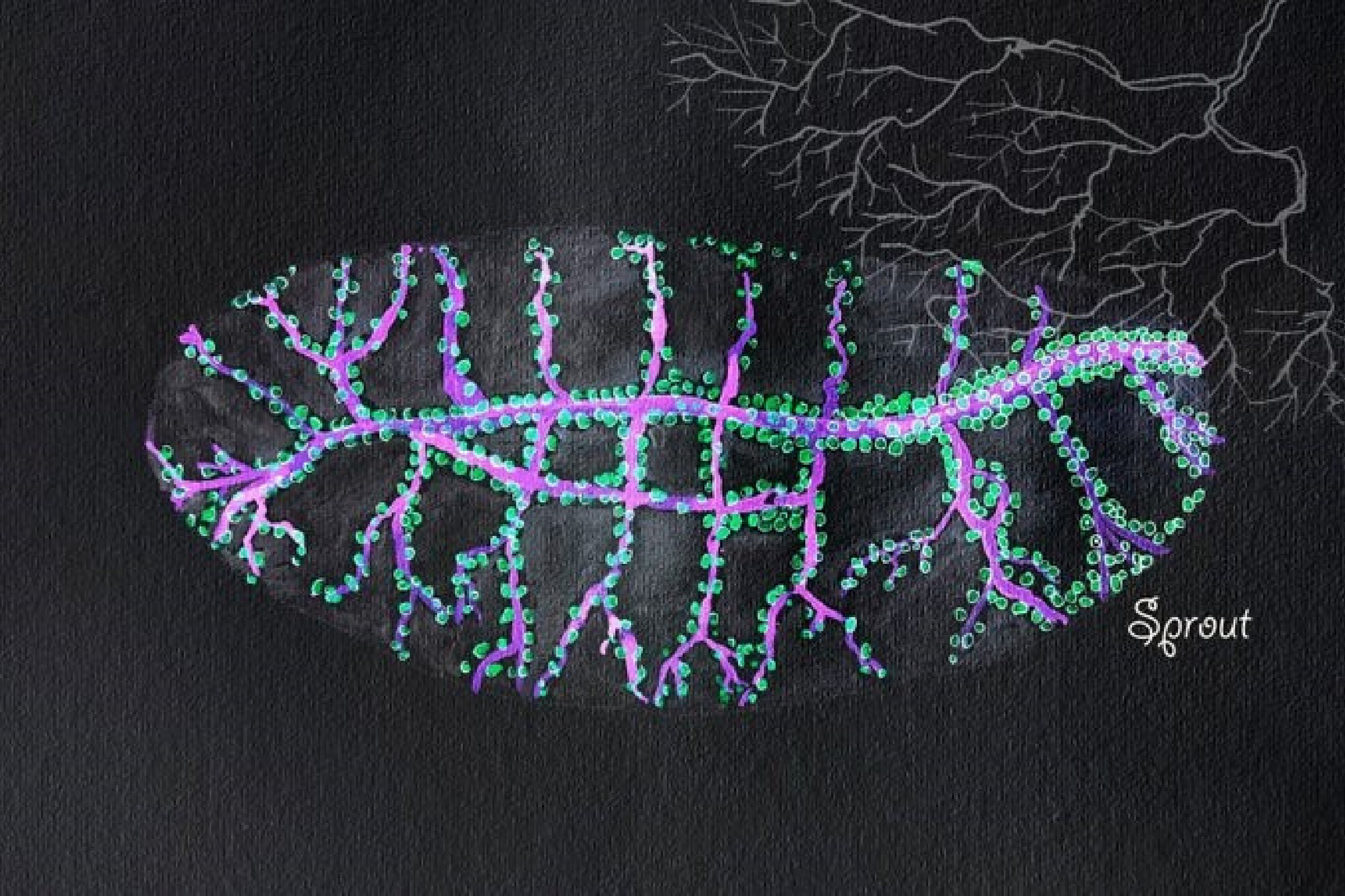
Drosophila polytene chromosome have 1000s of DNA strands forming light and dark bands as sister chromatid precisely synapse.
Chromosome inversions and heterozygosis leads to formation of loops first seen by Sturtevant in 1916.



Sprout

Drosophila tracheal terminal branches are plastic and have the capacity to sprout out projections toward oxygen-starved areas, in a process analogous to mammalian angiogenesis.

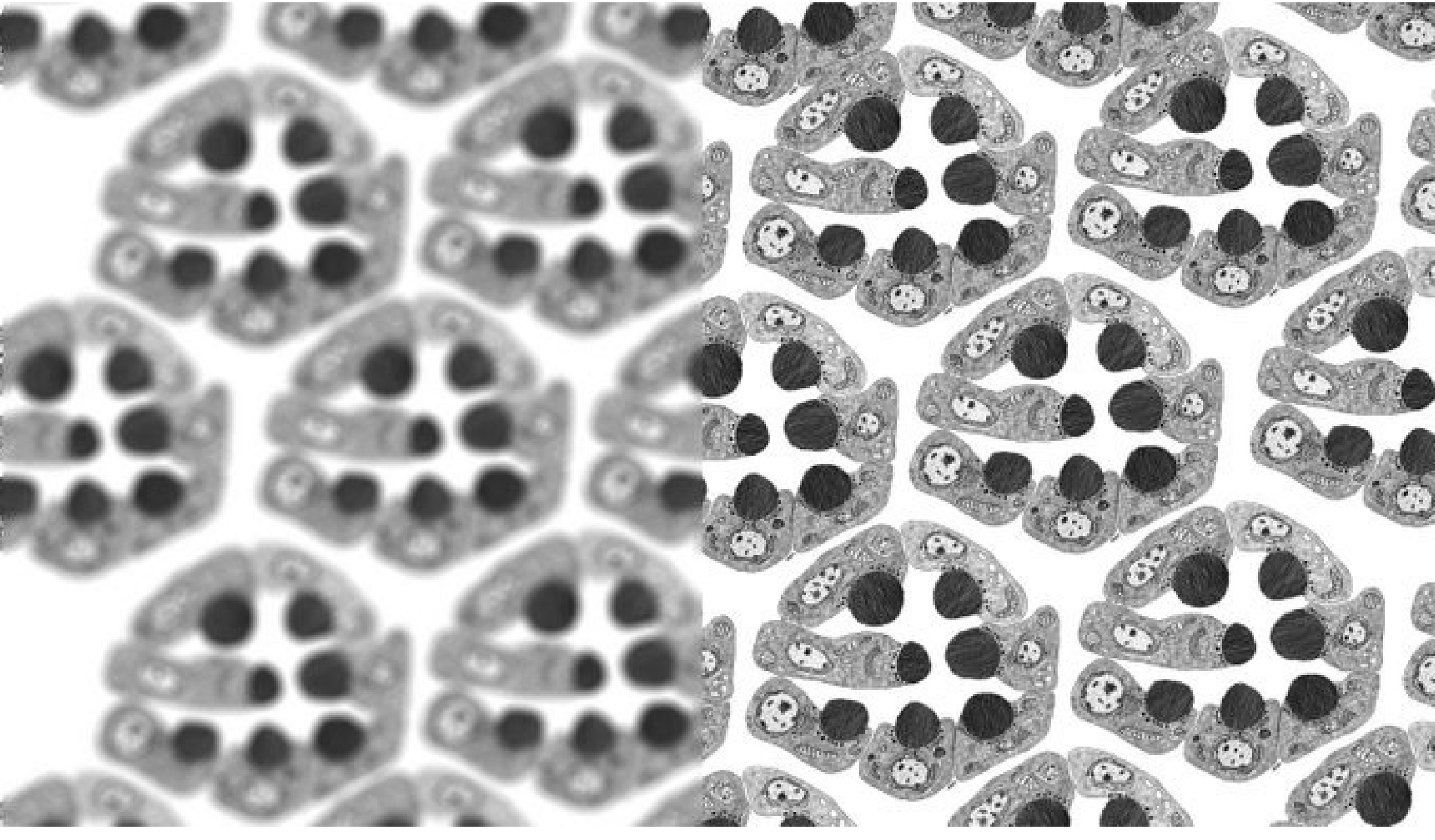
Here I show the tracheal arborization in an embryo.


Sprout

Fuzzy

Flies should see fuzzy considering their compound eyes have relatively few ommatidia (drawn here), right?

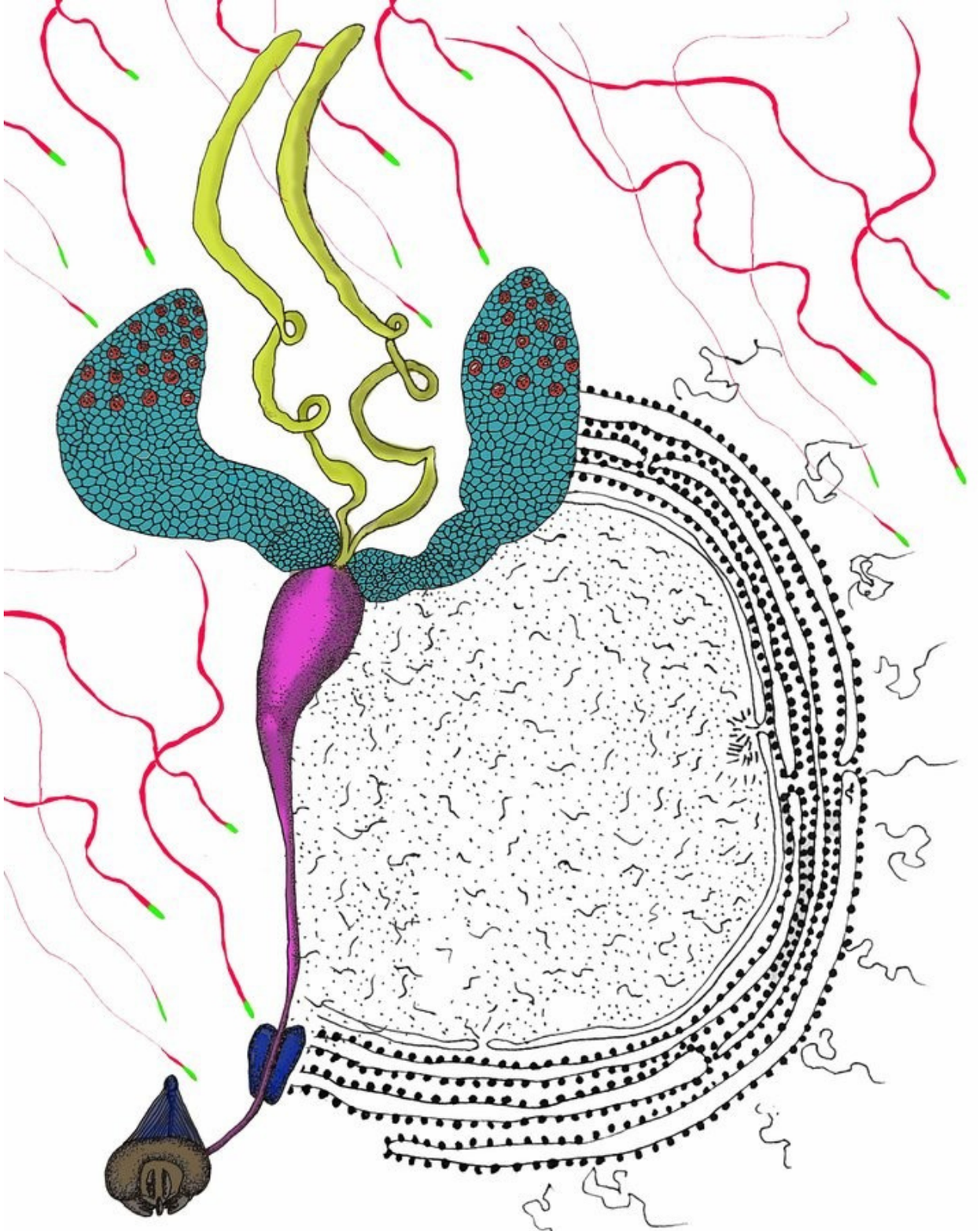
WRONG. In fact, although fly visual behavior is saccadical, their visual sampling exceeds the compound eyes' optical limits. Refractory phototransduction and rapid photomechanical photoreceptor contractions jointly sharpen retinal images of moving objects in space-time, enabling hyperacute vision.



Open

Small Open Reading Frames, smORFs are sequences that code for short peptides only a few AAs long. Although numerous, functns of such small peptides are only recently being elucidated. 1 such example is 9aa peptide importnt for sperm competition.

This "micropeptide" (MSAmiP) is expressed exclusively in the secondary cells of the male accessory gland, where it seems to accumulate in nuclei. Loss of function of this peptide causes defects in sperm competition.

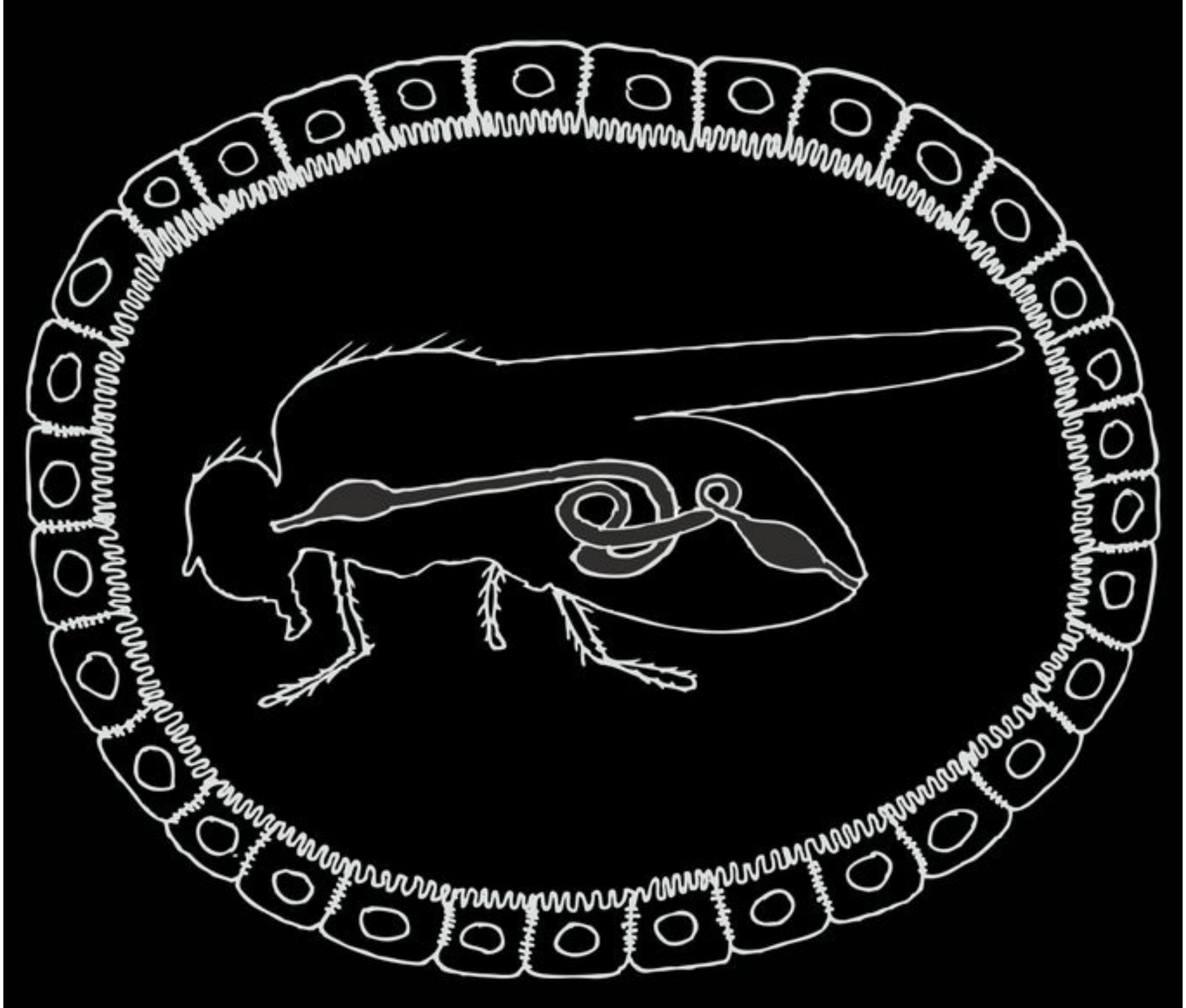


Leak

Chill susceptible insects die at low temperature due to cold induced loss of ion and water homeostasis. This kind of osmolyte leak leads to hemolymph hyperkalemia, cell depolarization and cell death.

At low temperatures flies have increased rates of paracellular leaks through gut epithelia, which is reduced significantly in cold acclimated flies. This way cold acclimated flies can maintain homeostasis and avoid injury better than warm-acclimated flies.

Improved barrier function is associated with changes in the abundance of septate junction proteins & changes in ultrastructure of subapical intercellular regions of contact between adjacent midgut epithelial cells.



Extinct

So I drew an extinct Drosophila species.

According to Wikipedia D. lanaiensis was a species of fly in family Drosophilidae that was endemic to Hawaii.

It was last seen in 1893 & is now considered extinct by the Hawaii Biological Survey & IUCN.


EXTINCT
Drosophila lanaiensis

Splat

A human and a fly,
From 100 ft they jump,
The human goes splat,
The fly goes unscathed, without a bump.

Gravity is so kind to fruit flies because smaller animals have large surface to weight ratio & show resistance to fall thru air.

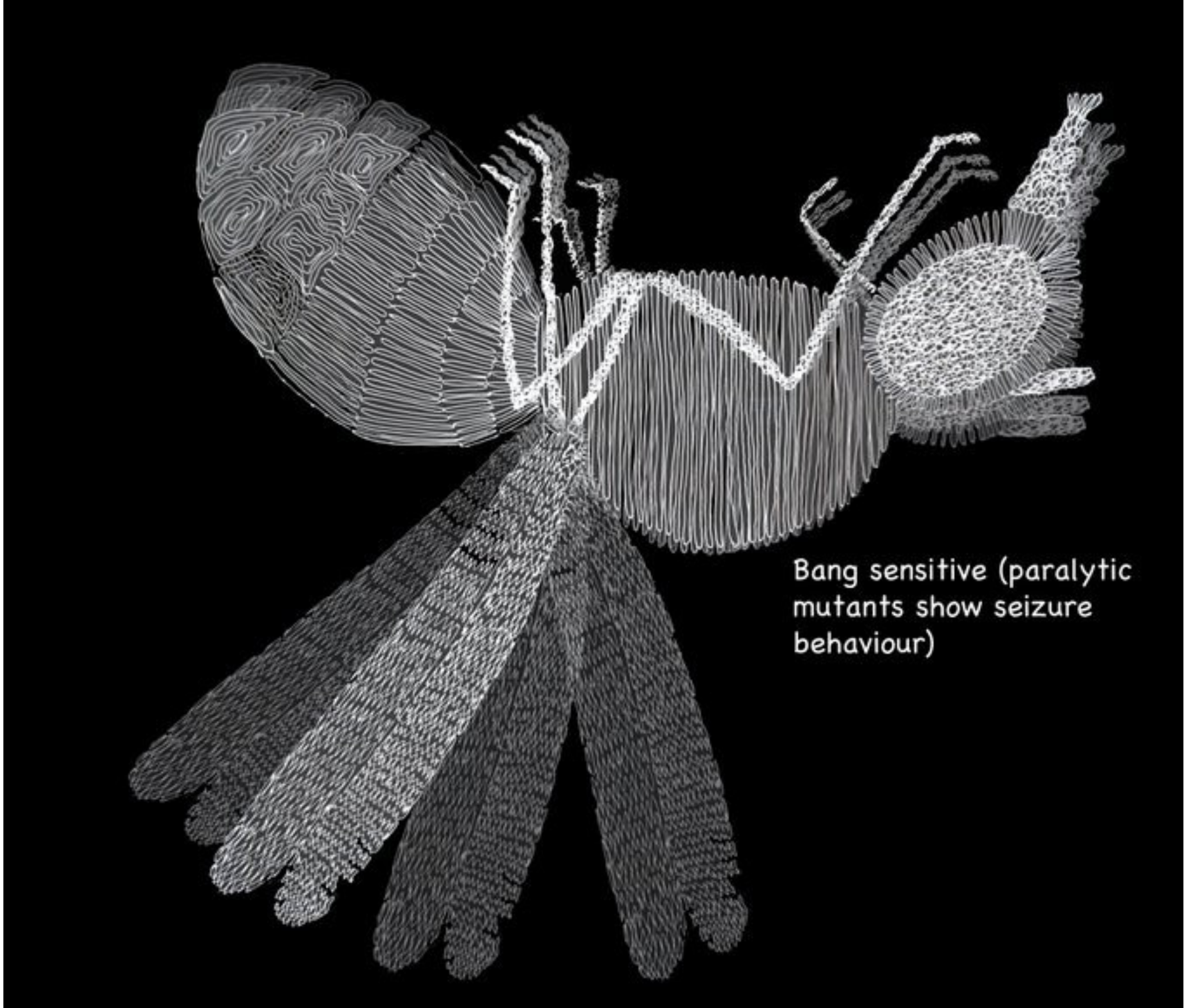
Connect

Drosophila brain contain >100,000 neurons forming meaningful connections (synapses) responsible for its body function and behavior.


CONNECT

Spark

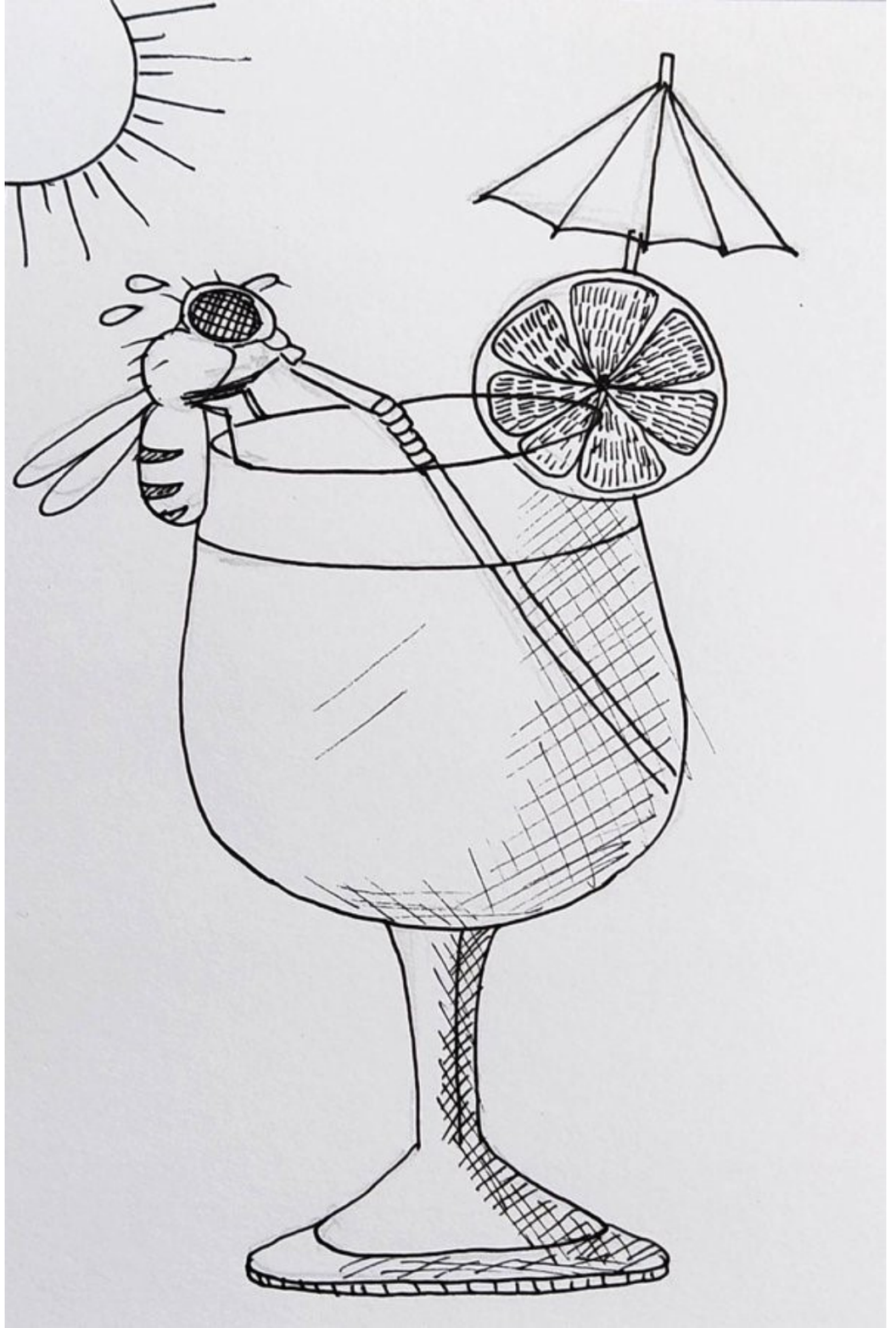
Neurons in the brain spark & convey info to each other.
What happens when it goes awry?
Paralytic gene encodes a subunit of Voltage gated Sodium channel required for action potential & mutations lead to paralysis, bang sensitivity, seizures.


Bang sensitive (paralytic mutants show seizure behaviour)

Crispy

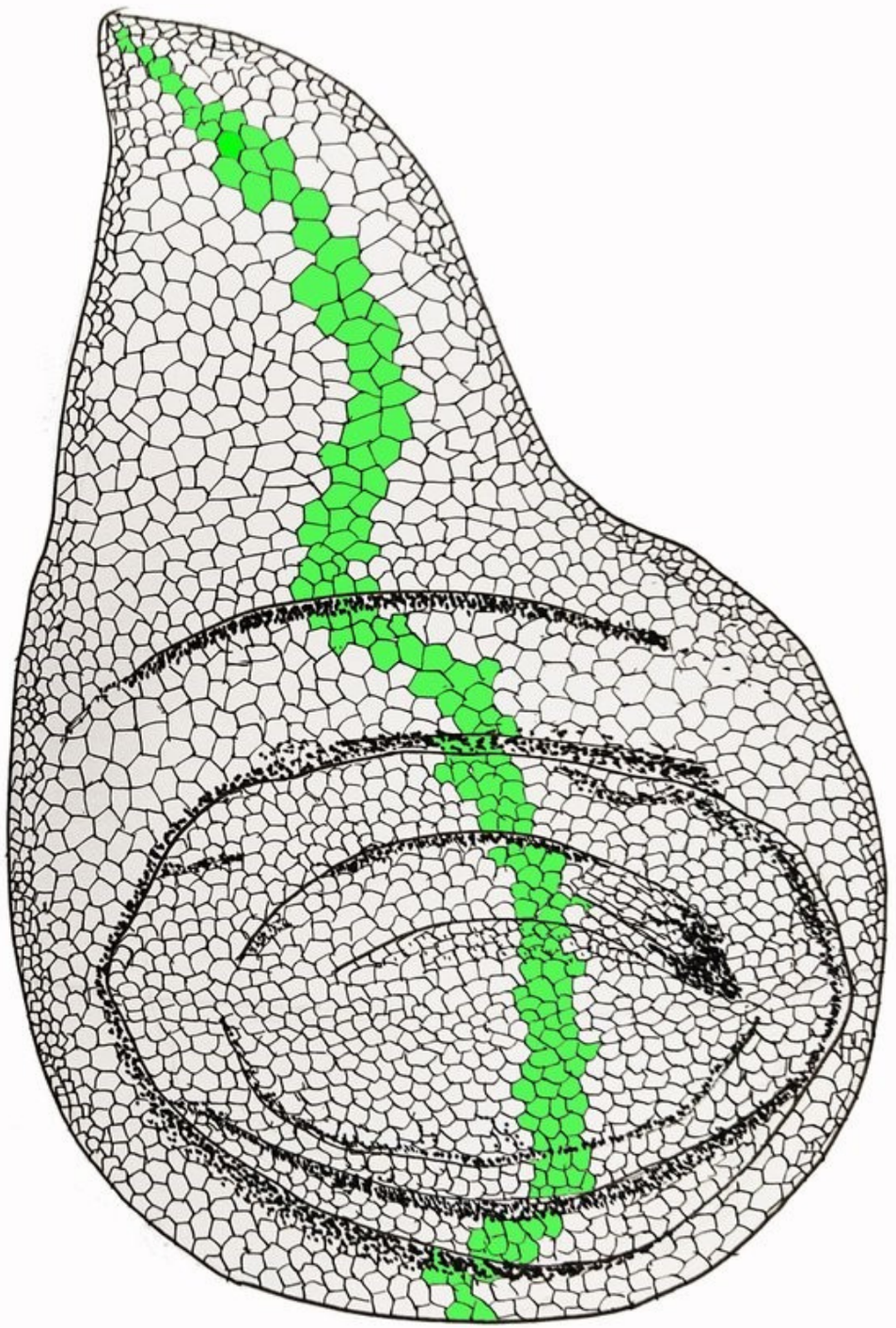
How crispy can a fly get before it dies? Experiments show that flies resistant to dehydration do so by reducing the rates of water loss.

Minimum water content at the time of death remains same irrespective of adaptation or lab selection.



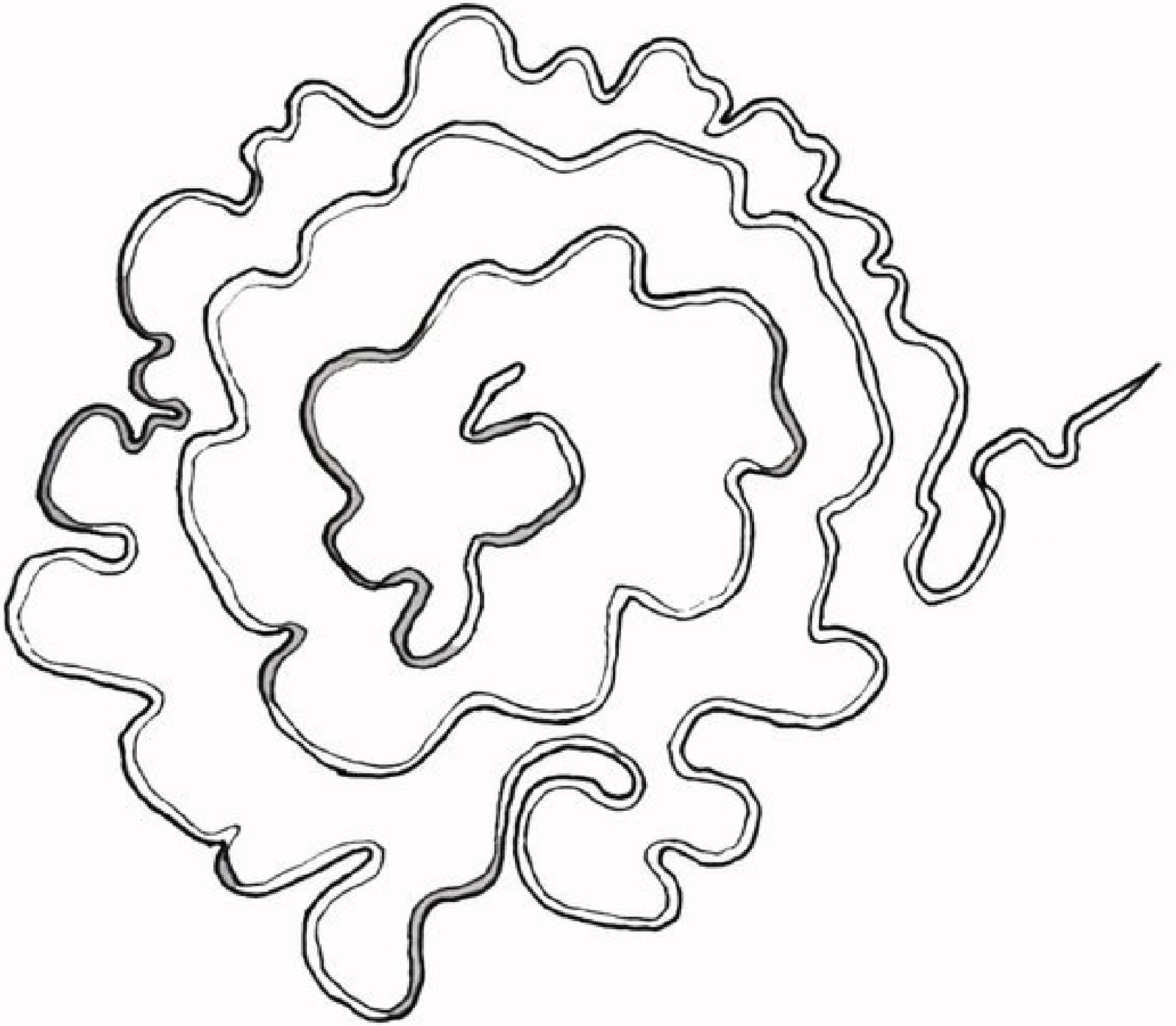
Patch

Patched gene in Drosophila is important for cell fate determination in embryos and along anterior posterior axis in adult wings.
Shown here is the expression pattern of patched in wing imaginal discs.



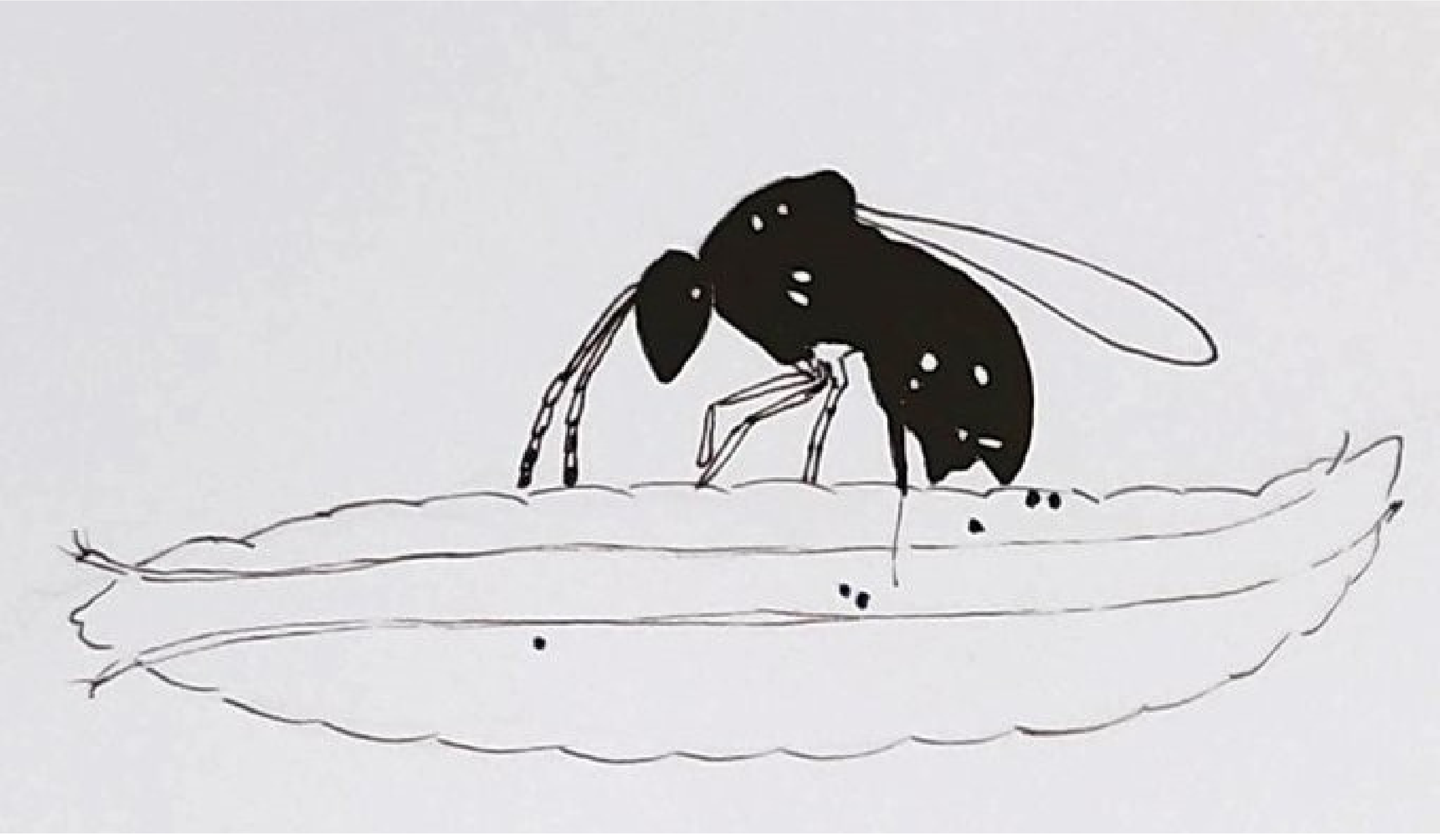
Slither

Drosophila makes giant sperms.
Their movement from end to end is nothing short of amazing.
Their flagellar movements include arc-like and helical waveforms, hairpin bend propagation, & slithering as they avoid entangling with other sperms.



Risk

In nature fruit flies are at high risk of wasp infections.
To avoid this risk, in the presence of wasps, Drosophila adult females retain their eggs and subsequently lay them in a wasp non-infested area.



About Deepti

Dr. Deepti Trivedi is head of the fly facility at Bangalore LifeScience Cluster. She has a Ph.D. from the University of Cambridge and postdoctoral experience from the University of California, Los Angeles. Deepti is a biologist with interests in Drosophila genome engineering and technology development. She is also an avid science artist.

Twitter: @deeptrivedivyas

https://www.ncbs.res.in/research-facilities/drosophila-Incharge

About Biopatrika

Biopatrika is a volunteer-run science community focussed on connecting various aspects of Indian Science. In today's tech era, relay of scientific jargon to a layperson is necessary to keep the scientific spirit alive. We fill this need by bringing together young researchers, science illustrators and content writers who translate simplified versions of recent discoveries and career stories to scientific enthusiasts at all learning stages.

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