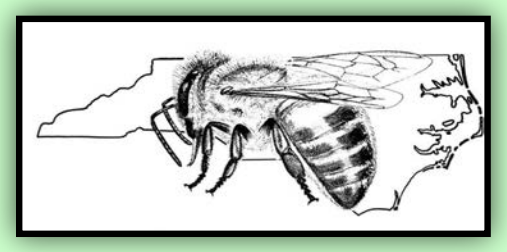
Alamance County Beekeepers Week 2

Camellia sasanqua

Red Maple ♀

Red Maple ♂



North Carolina State Beekeepers Association (NCSBA)

Dr. Geoff Leister
Alamance County Beekeepers
February 3, 2022

Extension Master Gardener
NC COOPERATIVE EXTENSION

NC COOPERATIVE EXTENSION
N.C. A&T STATE UNIVERSITY
NC STATE UNIVERSITY

ALAMANCE COUNTY BEEKEEPERS

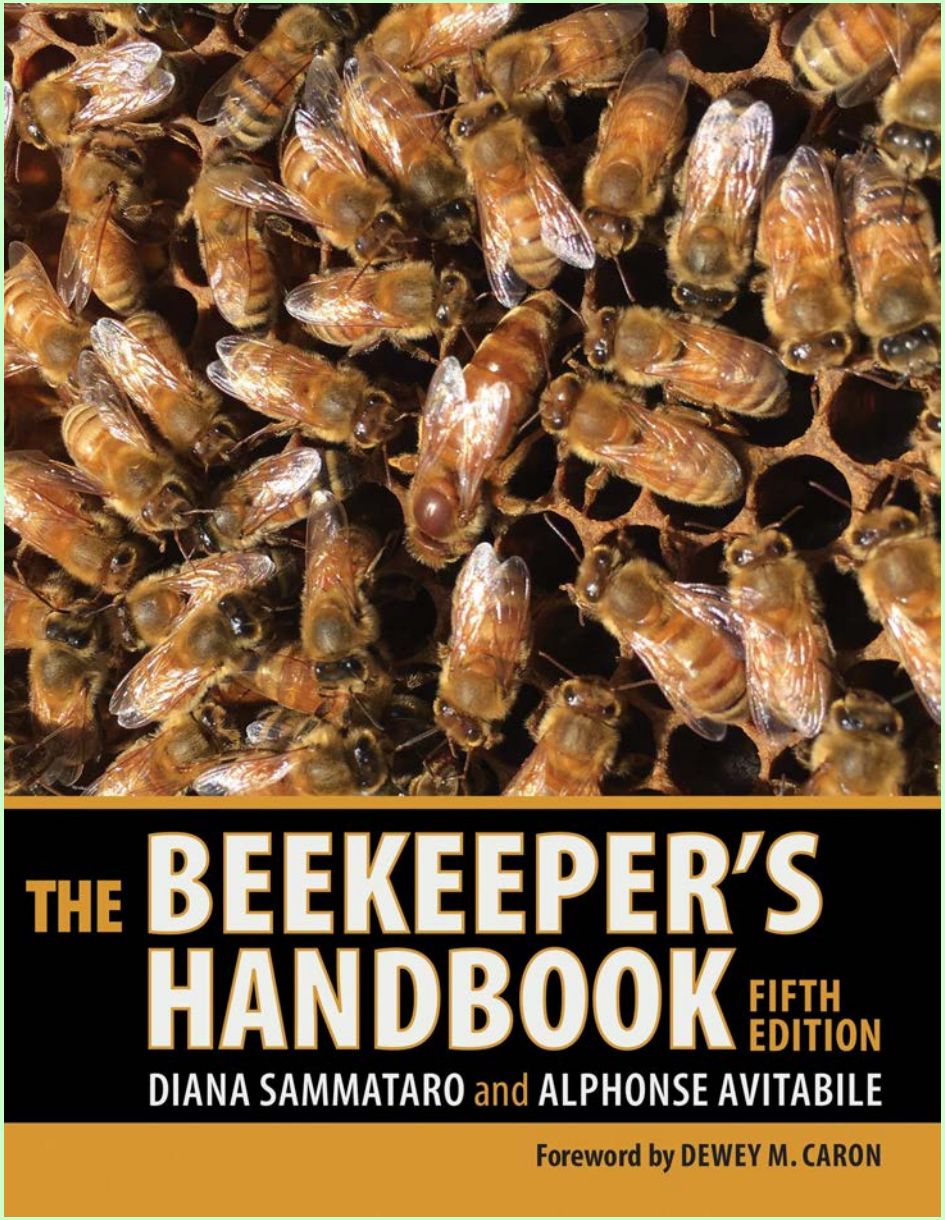
- ✓ Honey Bee Anatomy (Week 2)
  - ✓ Honey bee races
  - ✓ External Anatomy
  - ✓ Internal Anatomy
- ✓ Bees as Social Insects (Week 3)
  - ✓ What are social insects?
  - ✓ Biology of the individuals (workers, drones, & queen)
    - ✓ Development & complete metamorphosis
    - ✓ Hive behaviors among workers, queen & drones
  - ✓ Biology of the **bee colony superorganism** (seasonal cycles, foraging, communications)
  - ✓ Bee Orientation, cleansing and mating flights
  - ✓ Laying workers
  - ✓ Colony supersedure, swarming, absconding, robbing,
  - ✓ Drifting and hive heating & cooling

Who are the usual hive residents?

Worker ♀

Queen ♀

Drone ♂



5th Edition Published April 2021
There are no color plates, but there many clear diagrams. Cost: $22

Table of Contents

Downloadable PDF Handouts

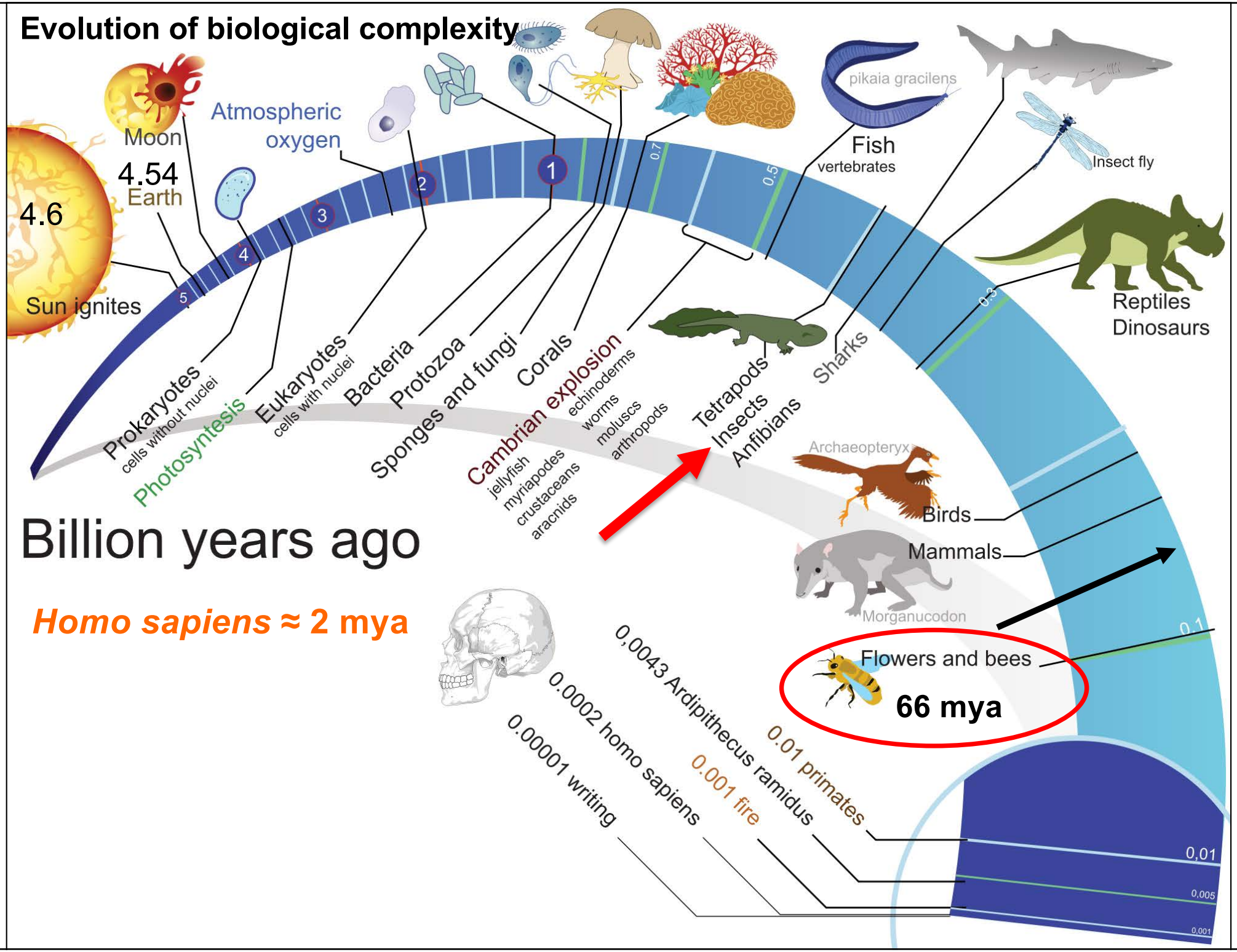
- ✓ Overview Honey Bee Races: Their Traits
  - ✓ Pure Races
  - ✓ Hybrids
- ✓ Overview Honey Bee Races: Pros & Cons
- ✓ The Internal Anatomy of the Honey Bee
- ✓ The External Anatomy of the Honey Bee
- ✓ Handout Honey Bee Races Charts
- ✓ Anatomy Presentation Slides

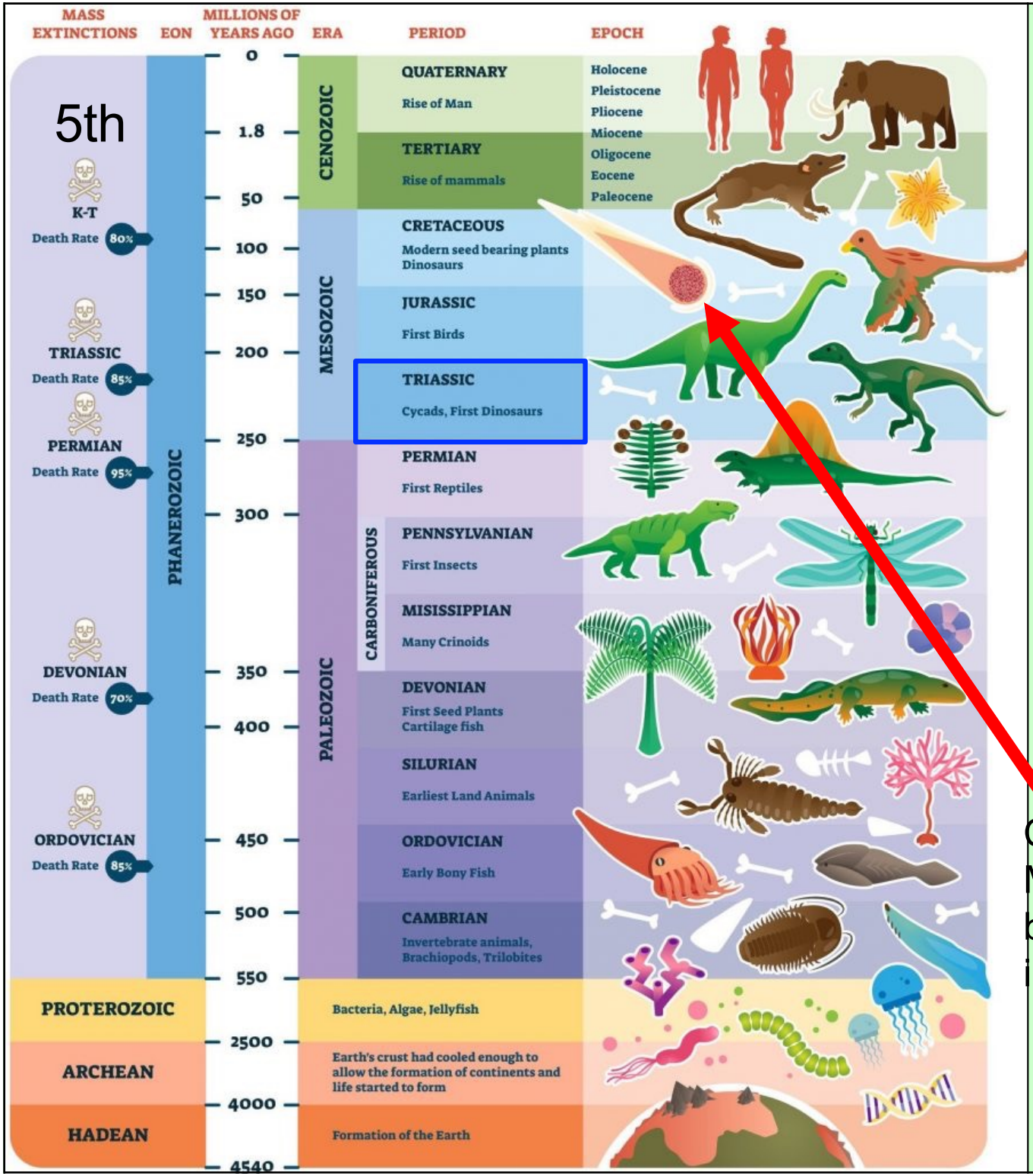
What are some of the Keys to Successful Beekeeping?

- The most important key: Bee School
  - 'Do what you should do, when you should do it.' Jim Powers (1927-2009)
  - 'Acting, not because you happened to think of it – but because you have a plan.' Bob Koehnen (1934-2014)
  - 'What are you doing today to get ready for 180 days from today?' Ryan Elison
    - That would be August 2, 2022 (There is something new happening in the bee hive each day!)

Tonight's Agenda

- ✓ Honey Bee Races
- ✓ External Anatomy
  - ✓ General
    - ✓ Head
    - ✓ Thorax
    - ✓ Abdomen
- ✓ Internal Anatomy
  - ✓ Circulatory System
  - ✓ Alimentary System
  - ✓ Glandular System
  - ✓ Respiratory System
  - ✓ Reproductive System


Evolution of biological complexity
4.6
Sun ignites
Moon
4.54
Earth
Atmospheric oxygen
Prokaryotes
cells without nuclei
Photosyntesis
Eukaryotes
cells with nuclei
Bacteria
Protozoa
Sponges and fungi
Corals
Cambrian explosion
jellyfish
myriapodes
crustaceans
aracnids
echinoderms
worms
molluscs
arthropods
Tetrapods
Insects
Anfibians
Sharks
Fish
vertebrates
pikaia gracilens
Insect fly
Reptiles
Dinosaurs
Archaeopteryx
Birds
Mammals
Morganucodon
Flowers and bees
66 mya
Billion years ago
Homo sapiens ≈ 2 mya
0,0043 Ardipithecus ramidus
0.0002 homo sapiens
0.00001 writing
0.01 primates
0.001 fire
1
2
3
4
5
0.7
0.5
0.3
0.1
0,01
0,005
0,001



Geological Timescale

(Fossil Evidence)

End of the Cretaceous Flowering plants and bees diversified with “pollen baskets.” Found in temperate regions were:

- Magnolias
- Sassafras
- Roses
- Redwoods
- Willows

Cretaceous-Palocene Mass Extinction Event 66 mya by asteroid or comet impact & increased volcanic activity!

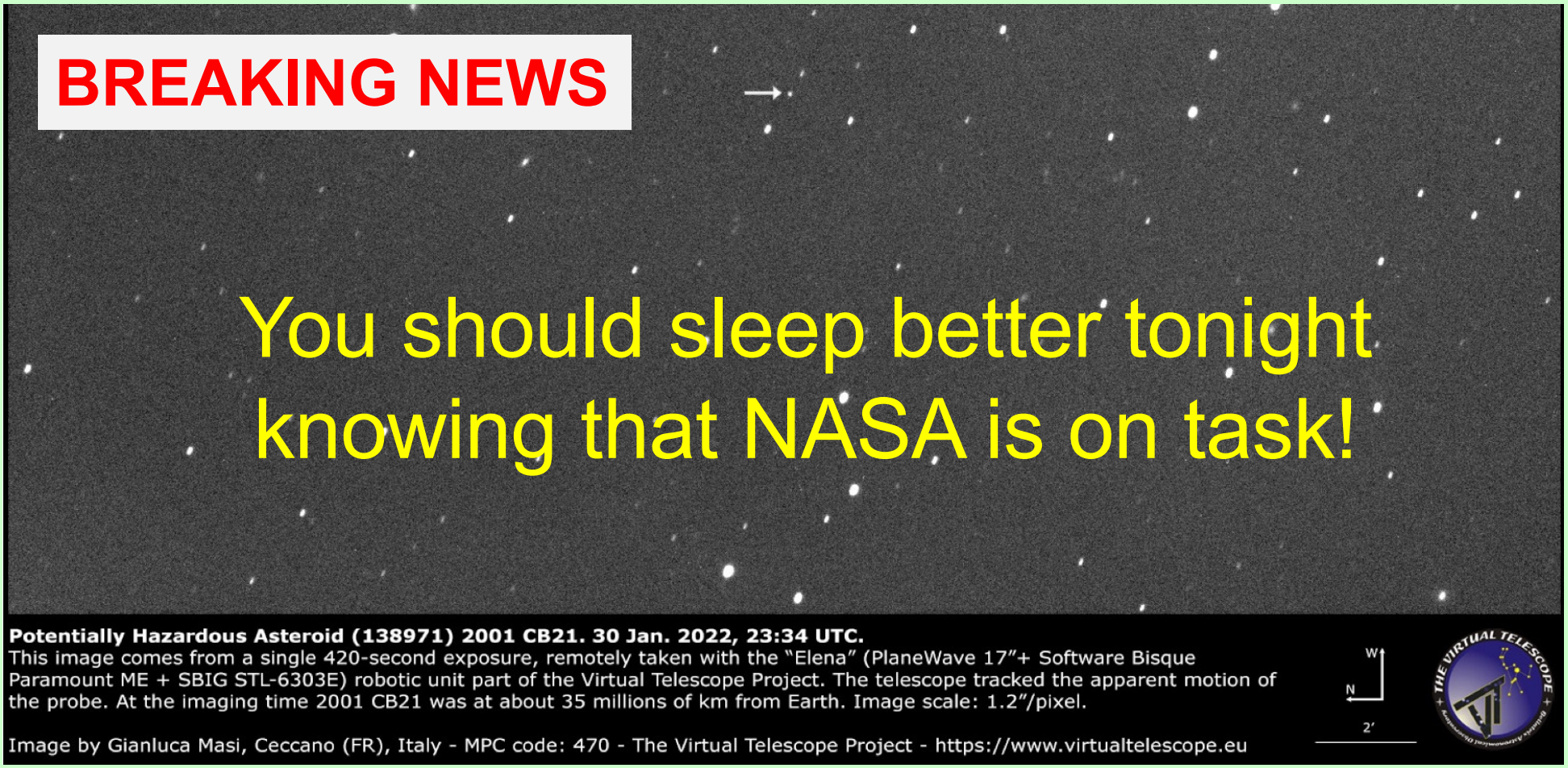
An Asteroid or an Icy comet caused the Chicxulub impact crater buried underneath the Yucatán Peninsula in Mexico some 66 mya.

Don't Look UP

NETFLIX | NOW STREAMING

POWERED BY COUNT US IN

The satirical film **Don't Look Up**, in which a comet stands in for the threat of climate change, has heaps of climate and social scientists who collaborated with Netflix on a climate action platform to accompany the movie. <https://dontlookup.count-us-in.com/steps>



The asteroid, "2001 CB21" (white arrow)
It will pass by earth on March 4 at about 3:00 a.m. ET travelling at over 26,800 miles per hour.
It is 4,265 feet in diameter and equates to four times as wide as the Eiffel Tower is tall.

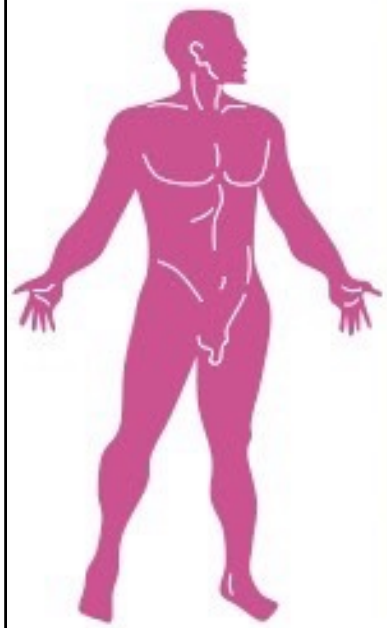
NASA's Asteroid Terrestrial-impact Last Alert System (ATLAS) searches the entire sky every 24 hours and to date has tracked more than 66 comets and 700 near-Earth asteroids (two of which actually hit Earth's atmosphere). One on June 22, 2019, over the Caribbean.

Notes on the Extinction of Dinosaurs!

- ✓ Dinosaurs are a group of reptiles that have lived on Earth for about 245 million years.
- ✓ There are roughly 700 known species of **extinct** dinosaurs.
- ✓ Dinosaur fossils have been **found on all seven continents**.
- ✓ **66 million years ago**, dinosaurs rapidly disappeared completely (except for birds).
- ✓ A sudden catastrophic event sealed their fate!
- ✓ Evidence suggests an asteroid or comet impact was the main culprit.
- ✓ **This 5th extinction event that caused the demise of dinosaurs triggered the evolution and diversification of flowering plants, bees and others.**
- ✓ **NOT** Cholesterol as reported in Baby Blues this morning!

What is in a Name?

Remember from high school, the "Hierarchy of classification"



Animal Example	Taxonomic Rank	Plant Example
Animalia	**Kingdom**	Plantae
Chordata	**Phylum**	Angiospermophyta
Mammalia	**Class**	Eudicotidae
Primate	**Order**	Ranunculales
Hominidae	**Family**	Ranunculacae
Homo	**Genus**	*Ranunculus*
sapiens	**Species**	*acris*
Human	Common Name	Buttercup

Categories of Biological Classification

Scientists Assign Organisms Two-Word Names

- ✓ 2,000 years ago Aristotle grouped plants and animals according to their structural similarities.
- ✓ The science of naming and classifying organisms is called taxonomy.
- ✓ Carl Linnaeus (1850's) wanted to catalog all the known kinds of organisms.
- ✓ He had a 2-word system for naming organisms called **binomial nomenclature**.

Scientific Names are Universal

- ✓This unique 2-word name for plant or animal is its **scientific name**. The first word is the **genus** to which the organism belongs. A genus is a taxonomic category containing similar species. Grouped based on a major characteristics. (Ex. All maple trees are in the genus *Acer.)*
- ✓The second word identifies one particular kind of organism within the genus, called a **species**.

Scientists Use a System to Classify Organisms

- ✓ The different groups into which organisms are classified have expanded since Linnaeus's time and now consist of 7 levels.
  - ✓ **species**
  - ✓ **genus**
- ✓ Similar genera are grouped into a **family**
- ✓ Similar families are grouped into an **order**
- ✓ Common orders are grouped into a **class**
- ✓ Common classes are grouped into a **phylum**
- ✓ Common phyla are collected into a **kingdom**

Classification of a Honey Bee

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta

Order: Hymenoptera

Family: Apidae

Subfamily: Apinae

Genus: *Apis*

Species: *Apis mellifera*

Pollination of Blueberry

Apis is the Latin word for “bee”; “*mellifera*” comes from the Greek “melli” honey, and “ferre”, to bear.

Phylum	*Arthropoda*	Jointed Leg
Class	*Insecta*	head thorax abdomen
Order	*Hymenoptera*	membrane winged
Superfamily	*Apoidea*	the bees
Family	*Apidae*	honey and bumble bees, orchid bees, some stingless bees
Subfamily	*Apinae*	perennial social colonies
Genus	*Apis*	hive bee
Species	*mellifera*	"honey bearing", western world

Binomial nomenclature uses both the genus and species names. That is *Apis mellifera* is the honey bee. (Note the use of italic font)

We refer to ***Apis mellifera*** as the **species** name for the honey bee! (OR is it honeybee?)

You will find it both ways when you search on Google.

Is it Honey Bee or Honeybee? House Fly or Housefly?

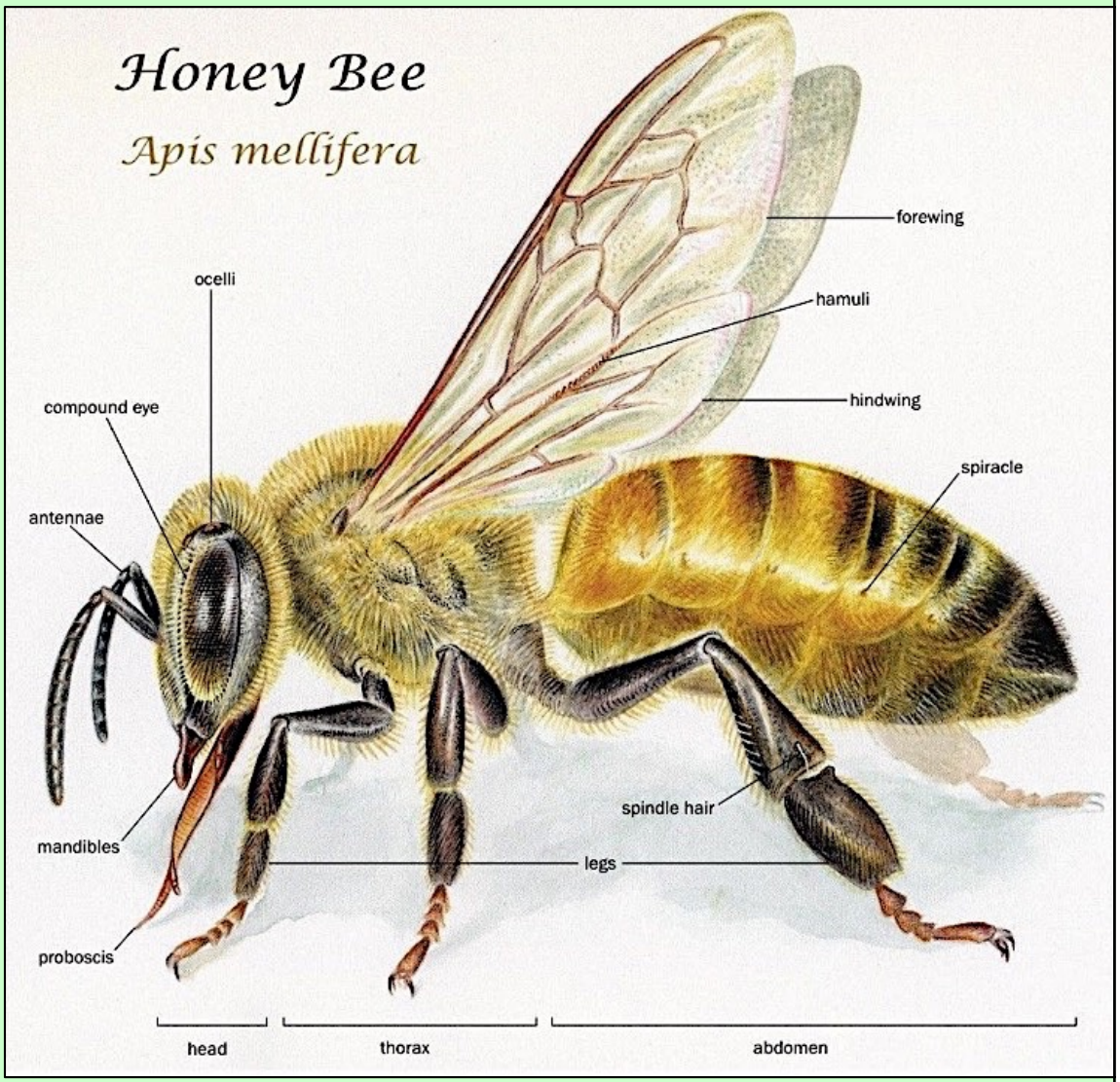
According to Entomological Society of America (ESA) in their Common Names of Insects Database: Honey bee is **two words**

- Honey bee is a true bee in the order Hemiptera (four wings)
- House fly, taxonomically, is a true fly in the order Diptera (two wings)
- Butterflies are NOT true flies, because they are not in the order Hemiptera, but are in the order Lepidoptera (scale wings).
- If the insect is what the name implies, write the two words separately; otherwise run them together.

Honey Bees

Class: Insecta

- ✓ 3 body segments: (Head, thorax, and abdomen)
- ✓ Skeleton on outside of body (Exoskeleton)
- ✓ Pair of antennae
- ✓ 2 pairs of wings (4 wings total)
- ✓ 3 pairs of appendages (6 legs total)
- ✓ Undergo complete metamorphosis (*juvenile and adult stages look completely different*)



What is a species?

- ✓ In a simple sense, a species is simply a group of individuals that are capable of interbreeding in nature

- ✓ As we will see shortly, there is tremendous variation in a species
- ✓ We use subspecies to discuss different races/stocks of bees:
  - That is ***Apis mellifera ligustica*** (The Italian bee) is a subspecies of ***Apis mellifera***
- ✓ Although we have different subspecies, they are all capable of mating and producing offspring

Two Different Subspecies of Honey Bees

Africanized honey bee *(Apis mellifera scutellata) on the left* and Italian honey bee (*Apis mellifera ligustica) on the right*

Photo from Corona apicultures

More on Subspecies

- ✓ These two subspecies have different “traits” that are desirable (as we will discuss in more detail in a bit)
- ✓ We can either choose to raise a specific subspecies for it’s traits, or we can select “hybrids” between various subspecies
- ✓ If you look inside a beehive, you will probably see a lot of variation in color, due to the exchange of genes in nature

Africanized honey bee *(Apis mellifera scutellata)* and Italian honey bee (*Apis mellifera ligustica)*

Honey Bee Variation

- ✓ There are at least 20 recognized subspecies, races, or locally derived biotypes of *Apis mellifera* from Europe, the Middle East, and Africa
- ✓ The photos to the right are both *Apis mellifera* honey bees
- ✓ The mixing of different genes, subspecies, races and biotypes can create a lot of color variation within and between colonies

Photos from bugguide.net

Subspecies of *Apis mellifera*

Central Mediterranean and SW Europe:

- *ligustica*
- *carnica*
- *macedonia*
- *sicula*
- *cecropia*

Western Mediterranean and NW Europe:

- *mellifera*
- *iberica*
- *sahariensis*
- *intermissa*

Middle East:

- *meda*
- *adami*
- *cypria*
- *caucasica*
- *armeniaca*
- *anatolica*

African:

- *intermissa*
- *major*
- *sahariensis*
- *adansonii*
- *unicolor*
- *capensis*
- *monticola*
- *scutellata*
- *lamarkii*
- *yementica*
- *litorea*

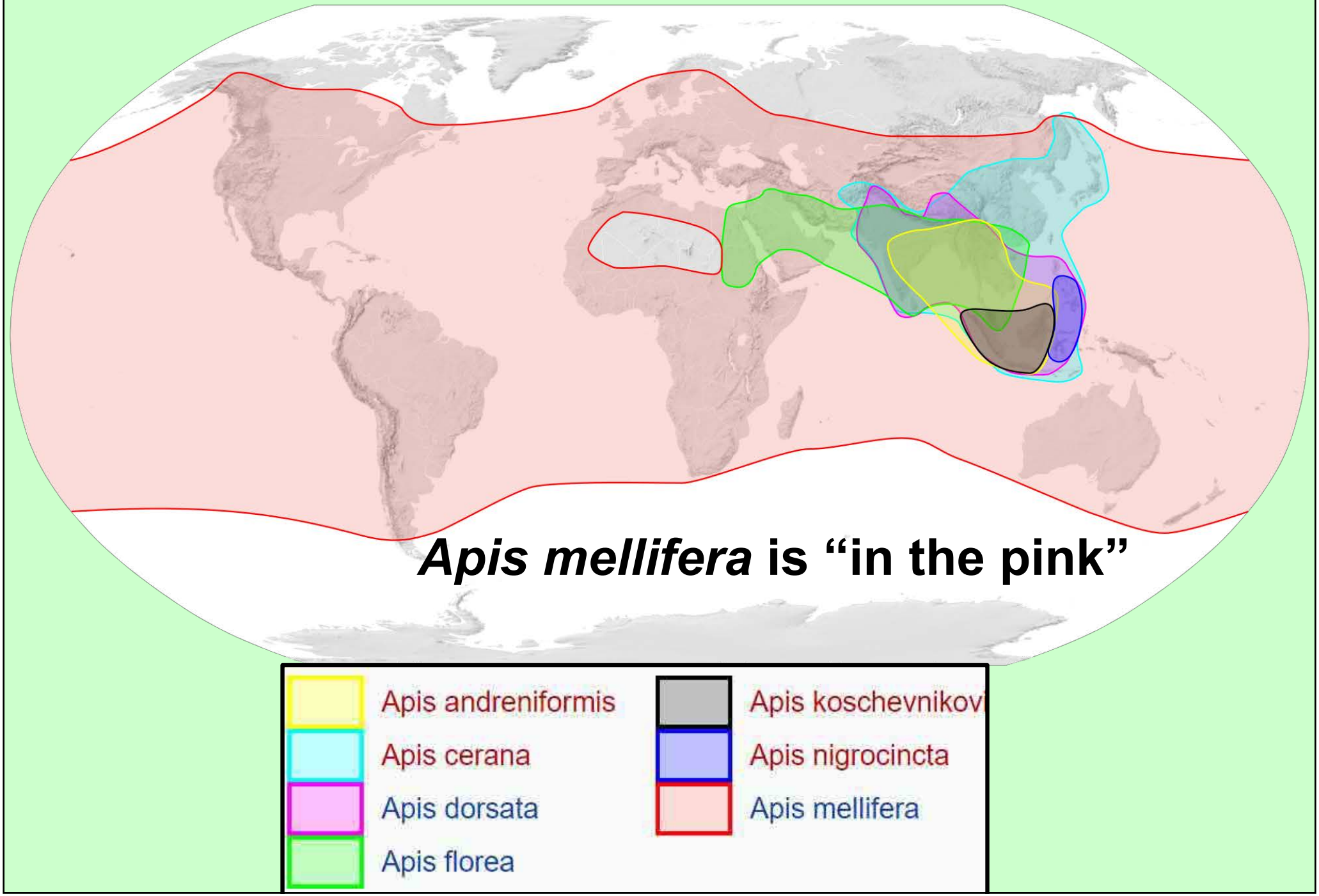
Asian species of *Apis*:

- *Apis koschevnikovi*
- *Apis nuluensis*
- *Apis nigrocincta*
- *Apis dorsata*
- *Apis laboriosa*
- *Apis florea*
- *Apis andreniformis*
- *Apis cerana*

Apis cerana, subspecies:

- *cerana*
- *indica*
- *japonica*
- *himalaya*

World distribution map of honey bee species (*Apis*).



Distribution of the various subspecies of the European honey bee (Apis mellifera)

Apis mellifera iberica (Spain and Portugal) and Apis mellifera mellifera (western and northern Europe)

Honey Bees North American

- ✓ *Apis mellifera* is not native to North America
- ✓ Many honey bees were introduced during European colonization of North America
- ✓ Many of the honey bees we are familiar with come from Europe, the Middle East, and Asia

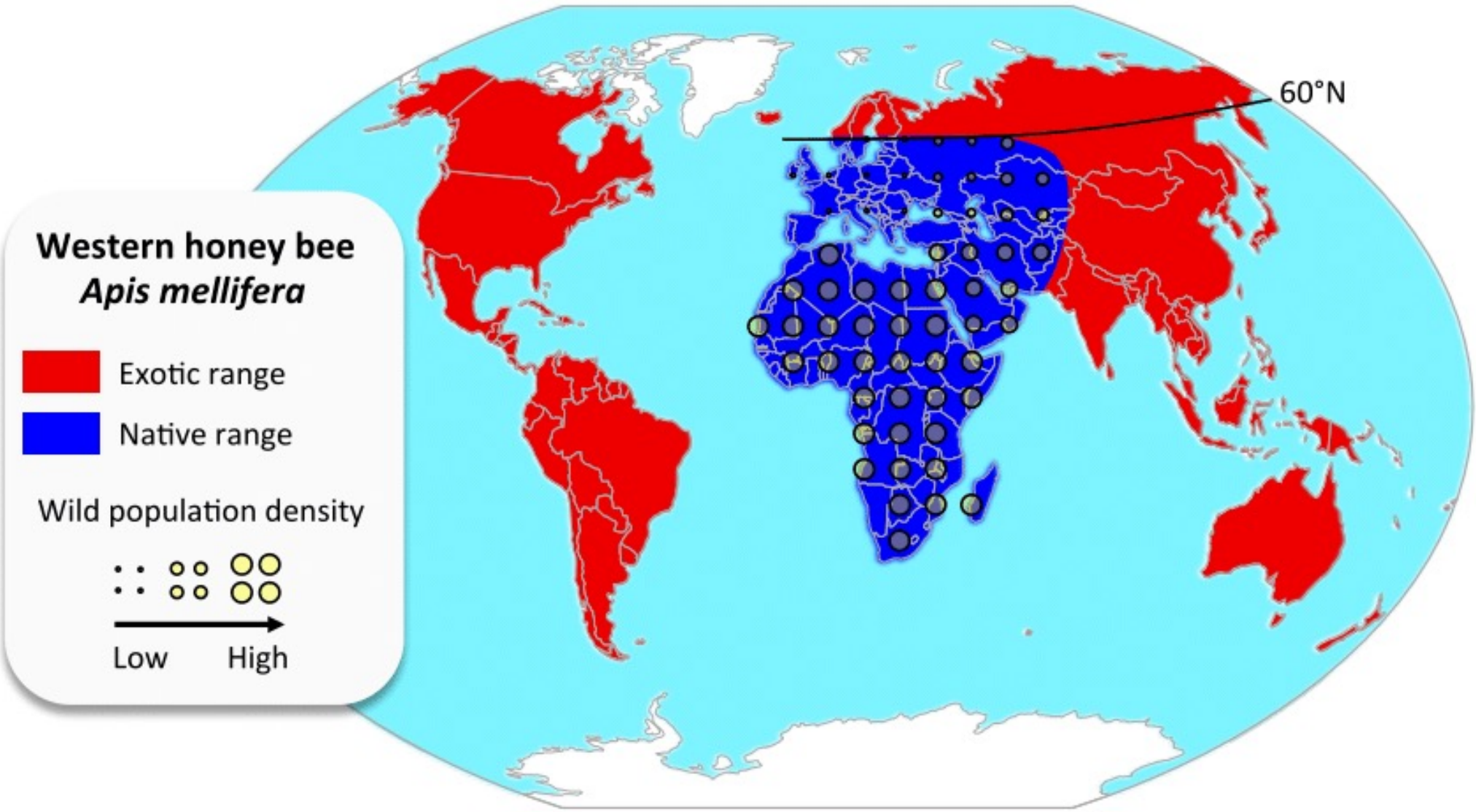
Middle Ages woodcut

Western Honey Bee

(*Apis mellifera*)

Not native to Americas!

Honey bee colonies known to have been shipped across the Atlantic to Virginia in 1622 & to Massachusetts around 1638.


Western honey bee
Apis mellifera
Exotic range
Native range
Wild population density
Low
High
60°N

Some Common Honey Bees

1. German black bees
2. Italian honey bees
3. Caucasian bees
4. Carniolan bees
5. Russian bees
6. Africanized honey bees

Honey bee Photos from Wikipedia.org

The German Black Bee

Apis mellifera mellifera

- ✓ Also known as the north European bee (Native to England and Germany)
- ✓ Was likely the first honey bee imported into North America (1600s – 1800s)

The German Black Bee (continued)

- ✓ Suitable for northern latitudes (do well in damp/cold environments)
- ✓ Has a tendency to sting a lot and swarm more often
- ✓ Prone to serious diseases
  - ✓ American & European Foulbrood
- ✓ Not very common in the US anymore

The Italian Honey Bee

Apis mellifera ligustica

- ✓ Most common for beginners
- ✓ Usually have bands on their abdomen of brown to yellow color
- ✓ Very hygienic
- ✓ Great foragers

Foraging on *Mahonia* in my yard on Front St.

The Italian Honey Bee (continued)

- ✓ Gentle to manage
- ✓ One of the most productive honey bee races
- ✓ Weaker defense and less prone to disease
- ✓ Weak cluster forming in cold periods
- ✓ Use less propolis and keep a clean hive
- ✓ Have some tendency to rob
- ✓ General susceptibility to pests

Foraging on Basil

The Caucasian Honey Bee

Apis mellifera caucasica

- ✓ Native to region between the black and Caspian seas
- ✓ Imported into North America around the late 1800s
- ✓ Body is grey/black

Photo from Corona apicultures

The Caucasian Honey Bee (continued)

- ✓ One of the most gentle bees
- ✓ Forages earlier and on cooler days
- ✓ Winters well
- ✓ Less productive than Italians
- ✓ Slower spring start up
- ✓ Tendency to use a lot of propolis
- ✓ Less prone to robbing

The Carniolan Honey Bee

Apis mellifera carnica

- ✓ Native to east-central Europe
- ✓ The second most popular bee after Italians
- ✓ One of the darkest of the races
- ✓ Incredibly docile
- ✓ Best for overwintering
- ✓ Excessive swarming tendency

Photo from Ales Tosovsky located on wikimedia

The Carniolan Honey Bee (continued)

- ✓ Thought to express a measure of resistance to mites
- ✓ Conservative use of food resources
- ✓ Average production
- ✓ Are better in northern climates and winters well
- ✓ Little use of propolis
- ✓ Less susceptible to brood diseases
- ✓ Less likely to rob

Photo from skagitvalleybeekeepers.org

The Russian Honey Bee

Apis mellifera caucasia + *ligustica* + *carnica* **(Hybrid)**

- ✓ From the Eastern part of Russia in the Primorsky region
- ✓ This region of Russia is home to Varroa mites and Tracheal mites, and it had been hypothesized that the local bees might be resistant
- ✓ Most important characteristic is that they are resistant to Varroa and tracheal mites
- ✓ Adaption of brood in times of dearth

Photo from sweetmountainfarm.com

The Russian Honey Bee (continued)

- ✓ Adapted very well to cold climates (overwinter well)
- ✓ Tends to swarm
- ✓ Less likely to be robbed (“head butting” vs stinging threats)
- ✓ Susceptible to be infected by Nosema fungus
- ✓ Can be expensive

The Africanized Honey Bee

Apis mellifera scutellata + *ligustica* (**Hybrid**)

- ✓ Were transported to tropical regions of South America from tropical Africa
- ✓ Despite infamous reputation for being defensive, these bees are popular in Brazil (tropical climate)
- ✓ Resistant to Varroa mites

Photo by Sean McCann, Flickr

The Africanized Honey Bee (continued)

- ✓ Under good management, these bees are very productive
- ✓ Overwinters poorly in temperate climates.
- ✓ Difficult to keep near to human habitations and livestock
- ✓ We will discuss the Africanized honey bee later in this presentation

Races of Bees

An overview of all honey bee races and their pros, cons and fun facts

BEE RACE	Italian	German	Caucasian	Carniolan	African	Cordovan SUBSET	Buckfast HYBRID	Russian HYBRID	Africanized HYBRID
PROS	• Good beginner bee • Readily builds comb • Unparalleled comb builders • Only moderate tendency to swarm • Relatively easy and calm to work with • Lower range propolis producer	• Well adapted to cold climates; • Overwinter long and cold winters exceptionally well; • Needs very moderate food supplies: • develop fertile workers more readily	• tolerant to a harsh winter environment; • not overly inclined to swarm; • calm behavior when on comb; • less prone to robbing • good resistance to some diseases;	• incredibly docile • explosive spring buildup • rank among the best for overwintering, • very good builders of wax combs, good honey gatherers. • Low tendency to rob other colonies	• Higher rates of colony growth and reproduction compared to European bees. • resistant to Varroa destructor mite and Nosema virus	• they appreciate warm weather; • More docile than their Italians; • Superb comb builders; • can be bred into any race of honeybee.	• Very gentle, productive • excellent housecleaning techniques • Very good overwintering ability • Excellent honey producers • Low swarm instinct • very small amounts of propolis	• highly resistant to parasites • overwinter well. • Adaption of brood in times of dearth • guard their hive vigilantly, • Good housecleaning • tend to have queen cells almost all the time	• Excellent honey producer: • Very defensive against predators; • Resistant to Varroa mites; • Well suited to tropical climates; • reproduce faster
CONS	• Continuous brood rearing continues after honey flow ceases • More likely to starve during long winters • Poor flight orientation, highly prone to drifting • Aggressive foragers, causing tendency to rob	• Less productive in terms of honey than some other races; • They are slow to build up the colony in spring; • nervous and excitable on the comb and aggressive to interference; • Moderate swarming; • Poor housekeepers,	• in spring, they build up the colony quite slowly • excessive propolis production • In some cases, they make makes wet capped comb, which is poor for honey comb sale; • susceptible to Nosema disease	• excessive swarming	• Preference for pollen not focused on honey production • Excessive swarming • Only for tropical areas • Highly aggressive and defensive behavior	• Consume large amounts of food in winter; • May perform poorly under cold wet conditions; • more prone to robbing than Italians.	• similar robbing tendency like Italians; • Moderate spring population buildup • If colonies are left unmanaged for one or two generations, they can become extremely defensive and aggressive.	•Brood rearing is highly dependent on forage availability •Increased swarming •Tend to propolize •Susceptible to infection by Nosema fungus •Aggressive	• Extremely defensive and highly aggressive, • Smaller nests; • Frequent swarming ; • Difficult to keep near to human habitations and livestock; • Overwinters poorly in temperate climates.
FUN FACT	*They are considered to be strong honey producers also because of their tendency to rob other colonies and take away their honey.*	*Despite developing worker bees more quickly than other races, the German bees are less productive.*	*They have a long tongue.*	*Some beekeepers say they neither have to use protective clothing nor smoke when inspecting the hives!*	*In Africa, managed honeybees can abscond from hives to become wild again, and therefore the wild and managed honeybees are all related.*	*It is not clear what caused the Cordovan bees to separate themselves from Italian strains and become their own race of bees.*	*When crossed with some different races, sometimes the second generation becomes an extremely aggressive colony.*	*They engage in "head butting" rather than stinging potential threats!*	*The media call them "Killer bees": If perceived as a threat, they are able to chase a person up to a quarter of a mile.*

https://bees4life.org/wp-content/uploads/2018/03/bee-races2.jpg

Races of Bees

<https://bees4life.org/bee-extinction/solutions/sustainable-beekeeping/guide-honey-bee-races#_edn1>

Overview of all honey bee races and their traits

BEE RACE	*Italian*	*German*	*Caucasian*	*Carniolan*	*African*	*Cordovan SUBSET*	*Buckfast HYBRID*	*Russian HYBRID*	*Africanized HYBRID*
Color	Light	Dark	Dark or gray	Black	Dark	Bright yellow	Light	Dark	Light
Disease resistance (general)	LOW	LOW	MEDIUM	MEDIUM	HIGH	LOW	LOW	HIGH	HIGH
Varroa mite	not resistant	not resistant	no data	not resistant	Resistant to Varroa	not resistant	not resistant	Resistant to Varroa	Resistant to Varroa
Tracheal mite	not resistant	not resistant	no data	no data	no data	not resistant	Resistant to Tracheal mite	Resistant to Tracheal	no data
Nosema fungus	no data	no data	not resistant	no data	Resistant to Nosema	no data	no data	not resistant	Resistant to Nosema
American Foulbrood	not resistant	not resistant	no data	Resistant to AFB	no data	not resistant	no data	no data	no data
European Foulbrood	not resistant	not resistant	Resistant to EFB	no data	no data	not resistant	no data	no data	no data
Gentleness	Moderate	Low	High	High	Very low	High	Low-Mod	Low-Mod	Very low
Spring buildup	Good	Low	Very low	Very good	Good	Good	Low	OK	OK
Over-wintering ability	Good	Very good	Very good	Good	Very bad	Medium	Good	Very good	Bad
Excess swarming	MEDIUM	MEDIUM	NO	YES	YES	MEDIUM	NO	MEDIUM	YES
Honey production	Very high	medium	Low	high	Low	Very high	high	medium	HIGH
Propolis production	Low	medium	High	Low	medium	Low	Low	medium	medium
Other traits	Heavy robbing	Short tongue, nice white cappings	Long tongue, low robbing, good honey comb producing	Low robbing, good comb builders	focus on pollen, not on nectar	Heavy robbing	Resistant also to Chalkbrood and wax moth	Queen cells always present	Difficult to keep

<https://bees4life.org/wp-content/uploads/2018/03/bee-races1.jpg>

Other Races/Stocks Not Listed

- **Starline** – hybrid Italians. Can be very prolific and productive.
- **Cordovan** – a subset of Italians that are very yellow. They are gently, and more likely to rob.
- **Midnite** – A hybrid of Caucasian and Carniolan
- **Buckfast** – a mixture of bees that are gentle, and build up rapidly in the spring, excellent honey produces, some mite resistance
- **LUS** – small black bees that have good production and temperament, and have some mite resistance
- **All American Bee** – Italian hybrid for mite resistance, quick build up, gentle, and good housekeeping
- **VSH bees** – Varroa sensitive hygiene

Why is all this talk about honey bee races Important?

- ✓ Because there is so much variation in honey bees, you can select the race/stock of bee that is most suitable to your situation
- ✓ If you are looking for the best bee for beginners, you might select **Italian** bees
- ✓ If you want to manage mites without control products, you might select a **Russian** or a Varroa Sensitive Hygene (**VSH)** bee
- ✓ New stocks/races are continually being developed to accommodate different issues

Summary

- ✓ The key similarity of all of the mentioned races/stocks is that they all can be "**managed**"
- ✓ Beekeeping occurs on all continents (except Antarctica)
- ✓ Beekeeping can be practiced in most environments (rural, suburban, urban, agricultural, etc.)
- ✓ Beekeeping can be done by a beginner hobbyist to a large scale commercial beekeeper for multiple purposes (leisure, honey, pollination, etc.)

Why are bees so effective at pollen & nectar collection?

Background

- External Anatomy
- Internal Anatomy

Honey bee foraging on Borage or Starflower (*Borago officinalis*)

General External Anatomy

IS IT A BEE?

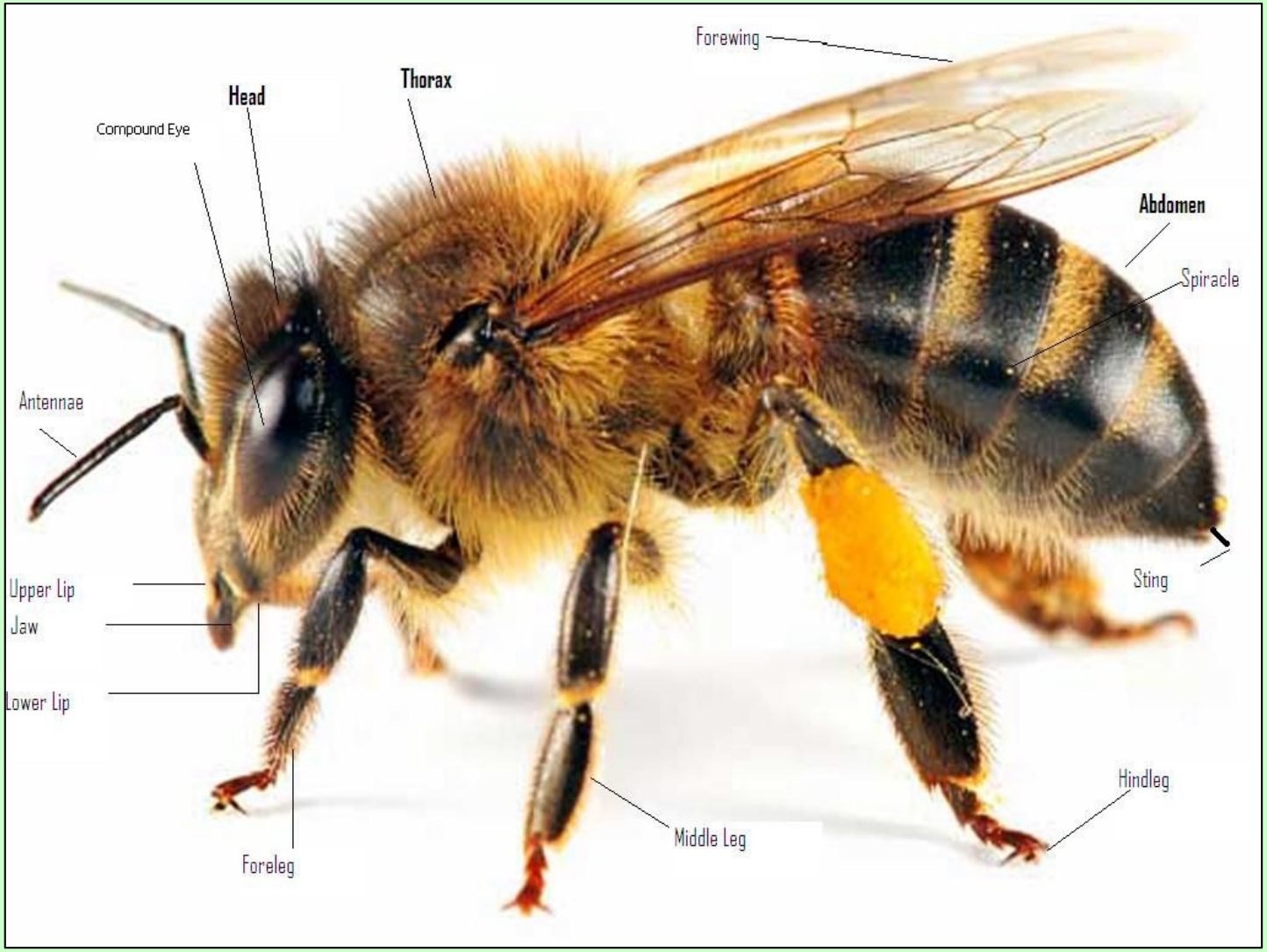
Look for:

- **Body shape** hourglass, with 'waist' and cylindrical abdomen & thorax.
- **Pollen-carrying hair** (scopa) on legs or abdomen
  (for many females, not all)

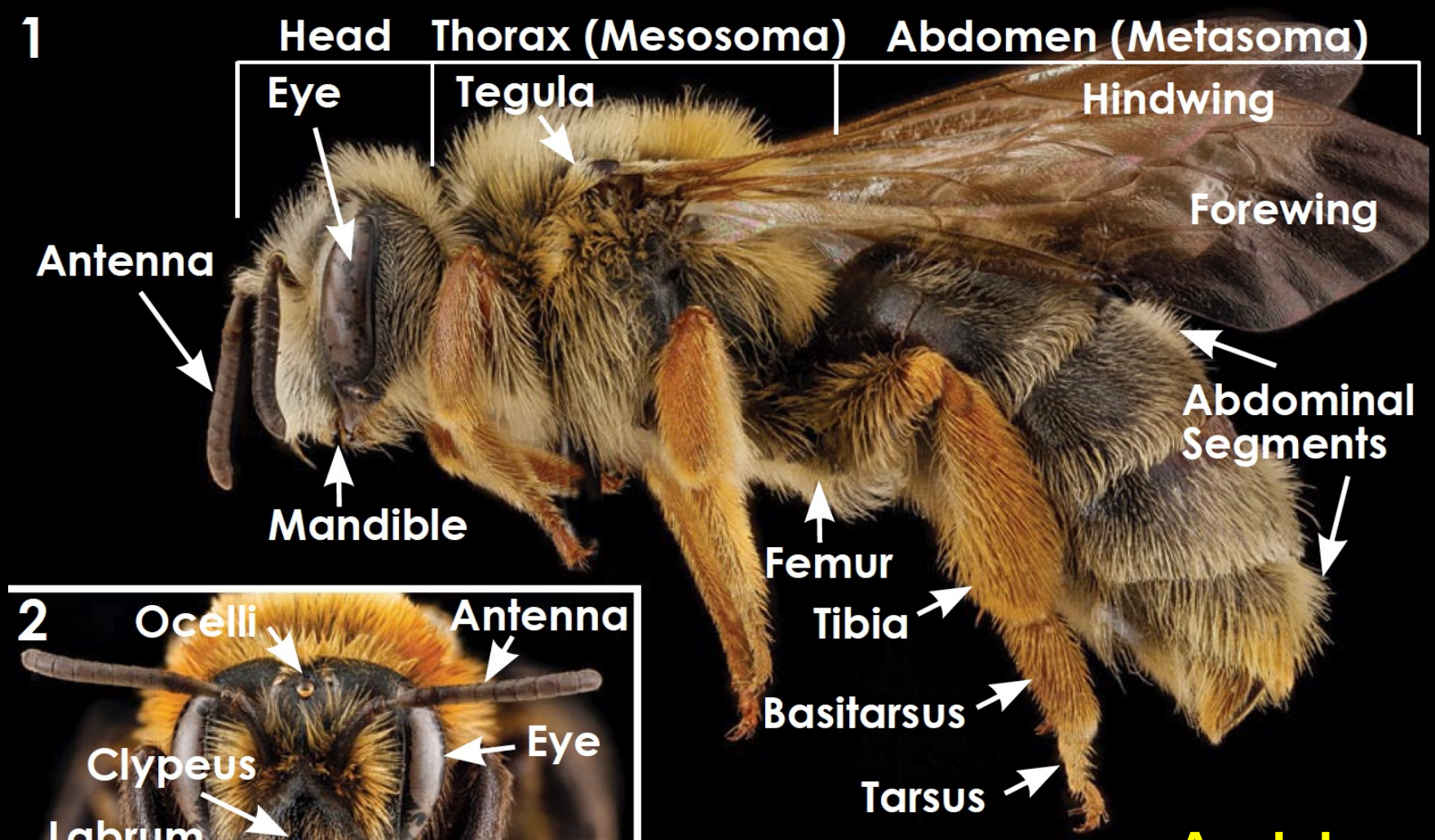
- **Long antennae** often with kink/elbow
- **Eyes** long, oval, at side of 'face', often black

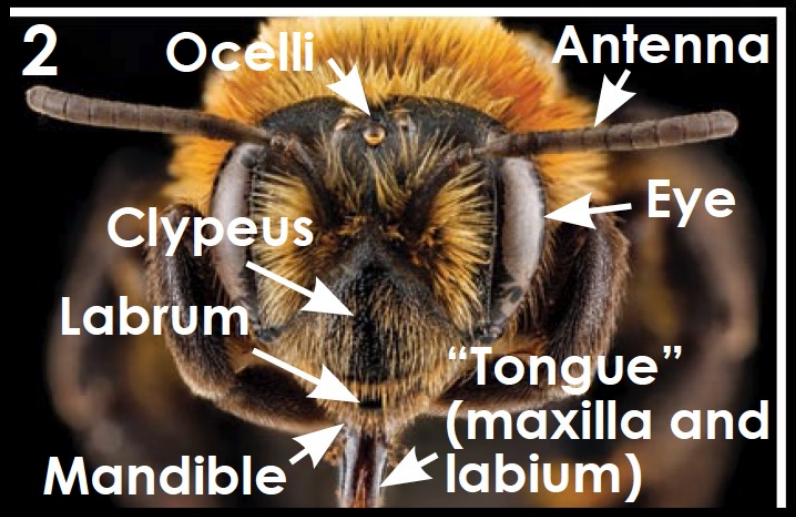
- **Wings** often on back at rest and shorter than the body (2 pairs)
- **Head** triangular or tear-shaped

Worker Honey Bee External Anatomy



Body Plan





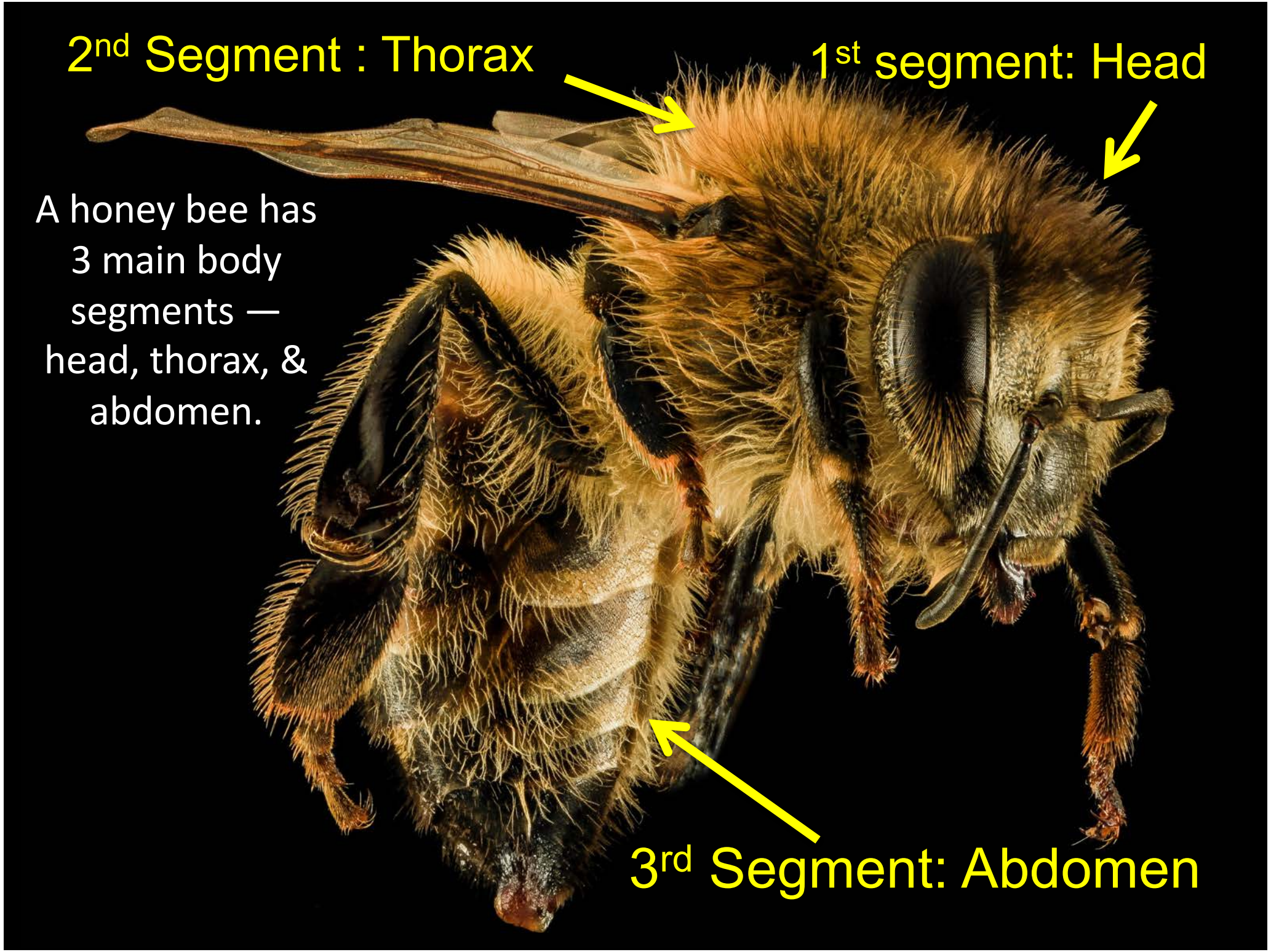
Mining Bee
(Andrena commode)

Apidae

Diversity of Bee Species

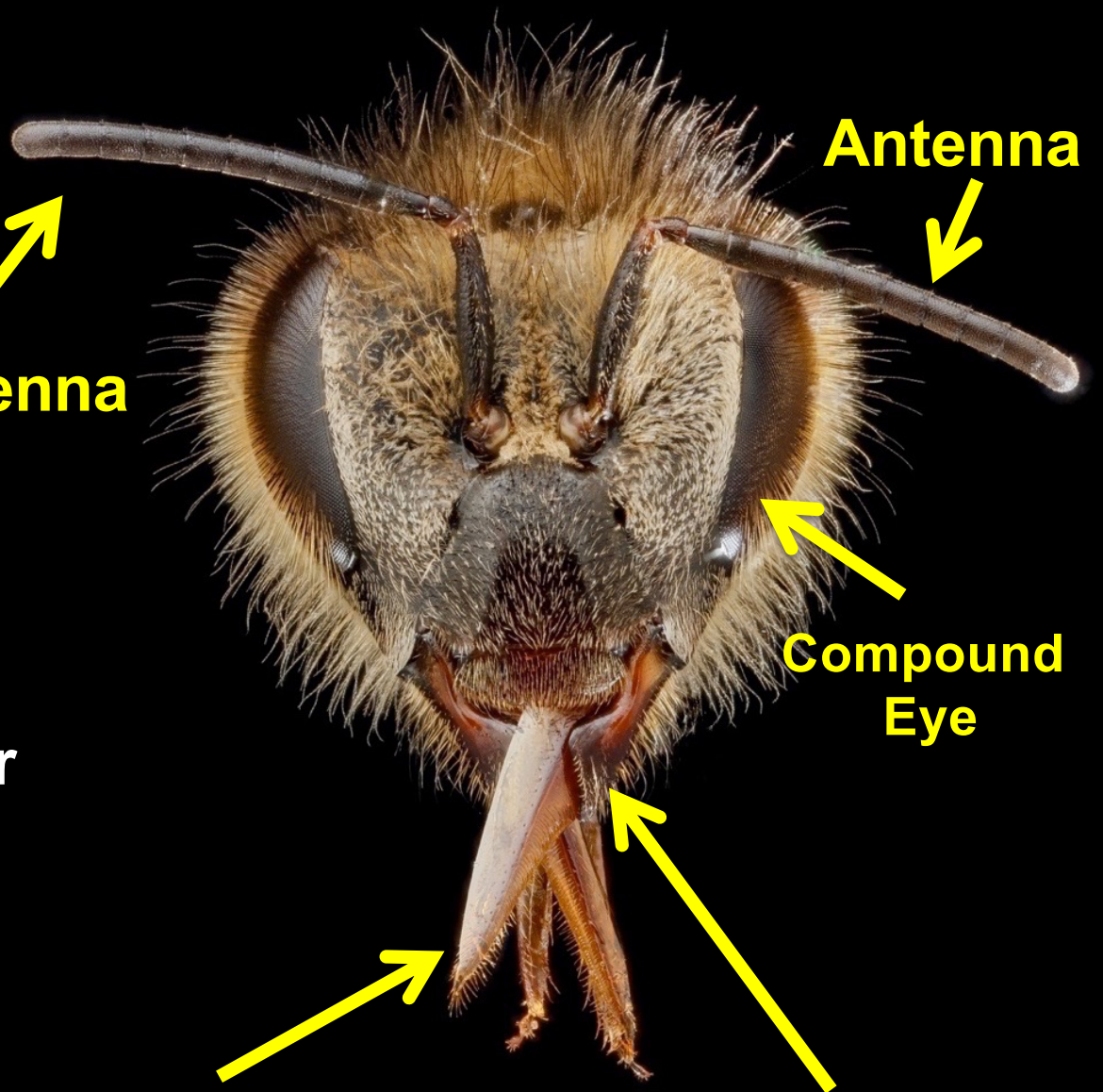
Worldwide	North America	NC	Piedmont area	Single yard
20,000	4,000	528+	100+	70+

ECOIPM: Steve Franks Lab Team @ NC State


2nd Segment : Thorax
1st segment: Head
A honey bee has 3 main body segments — head, thorax, & abdomen.
3rd Segment: Abdomen

1st Segment: Head

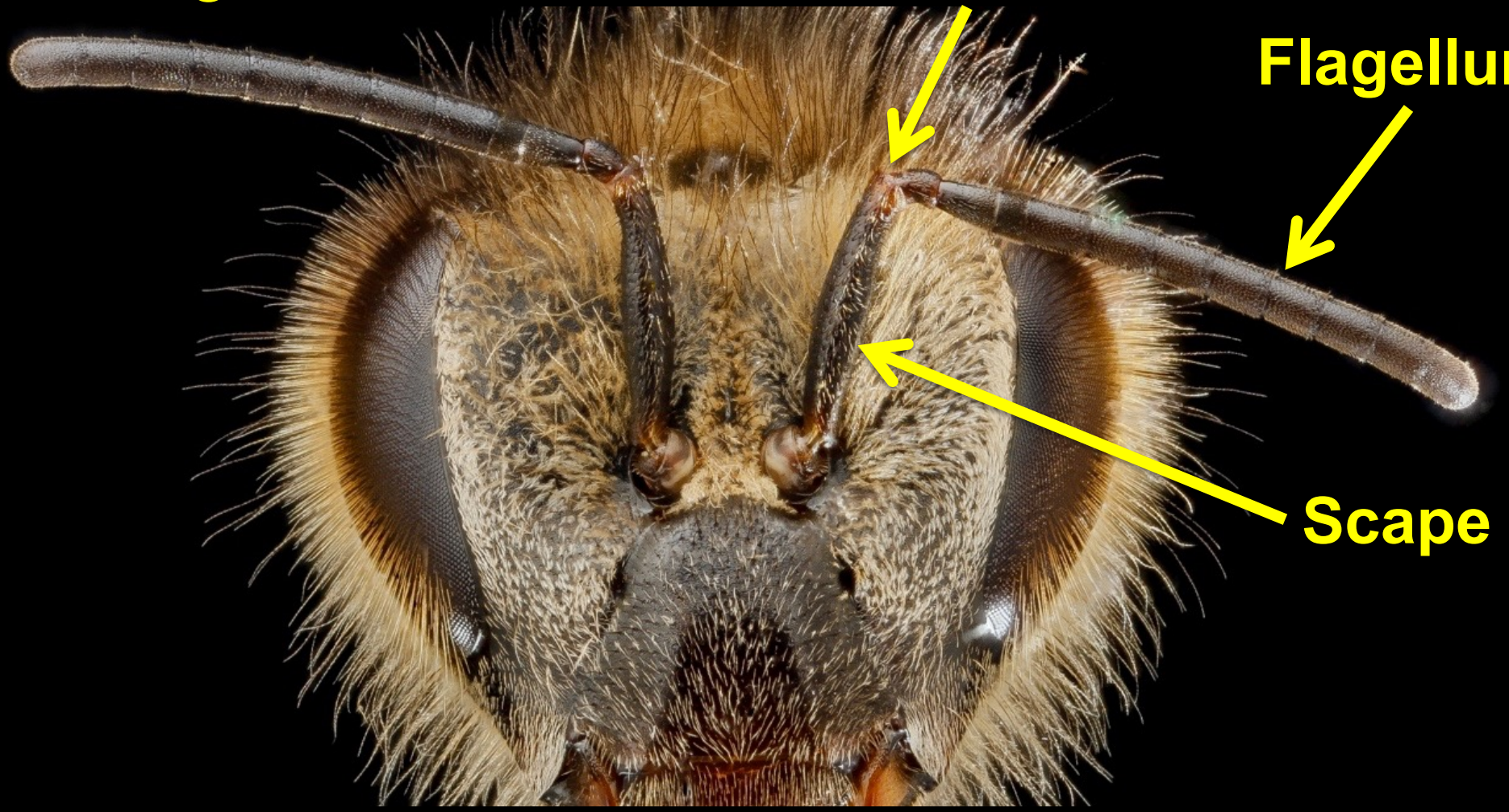
Major sensory region of the body



The worker bee's head contains 2 compound eyes, 2 antennae, a pair of mandibles, and the proboscis.

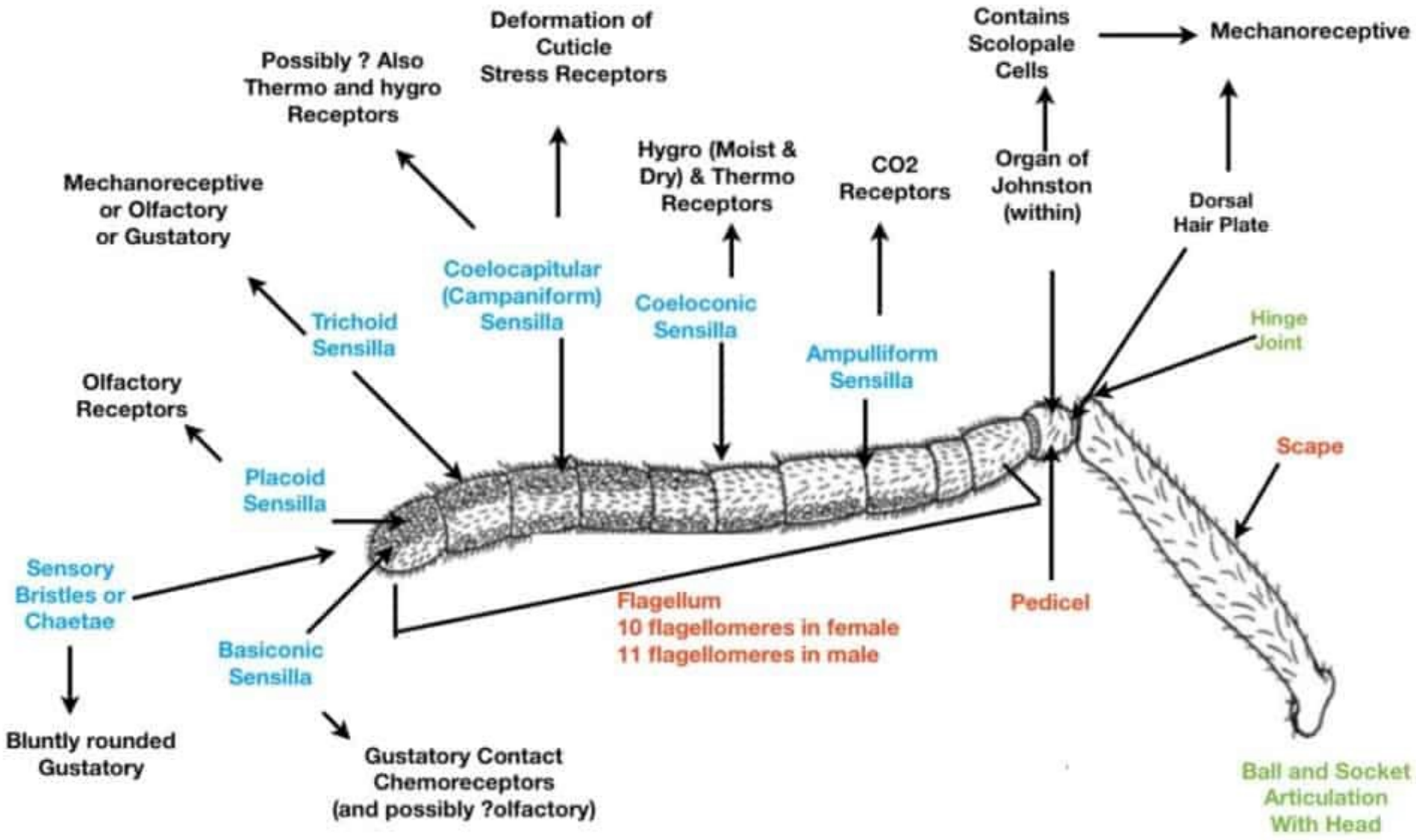
Photo credit USGS

1st Segment: Head



The honey bee's antennae are movable feelers that detect odors, sound, movement, sense temperature & humidity

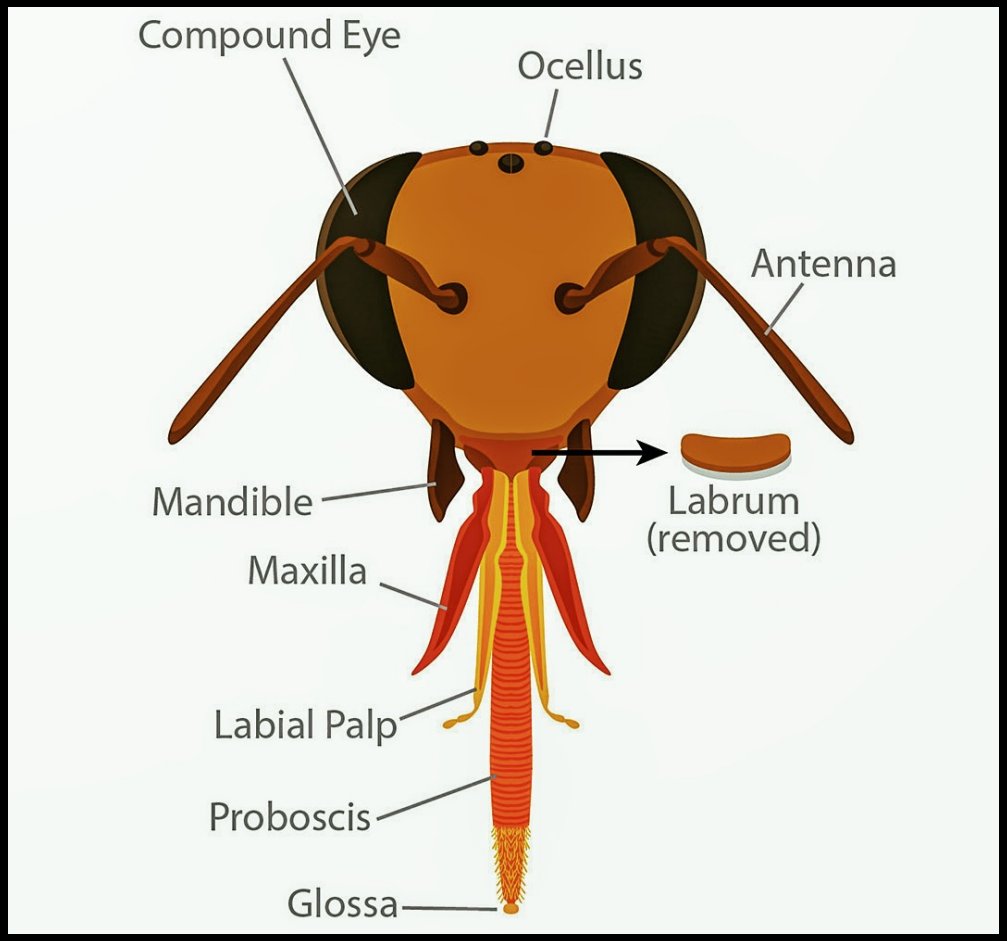
Bee Antennae, an amazing sensory array



https://honeybeehq.com/bee-antennae-an-amazing-sensory-super-highway/

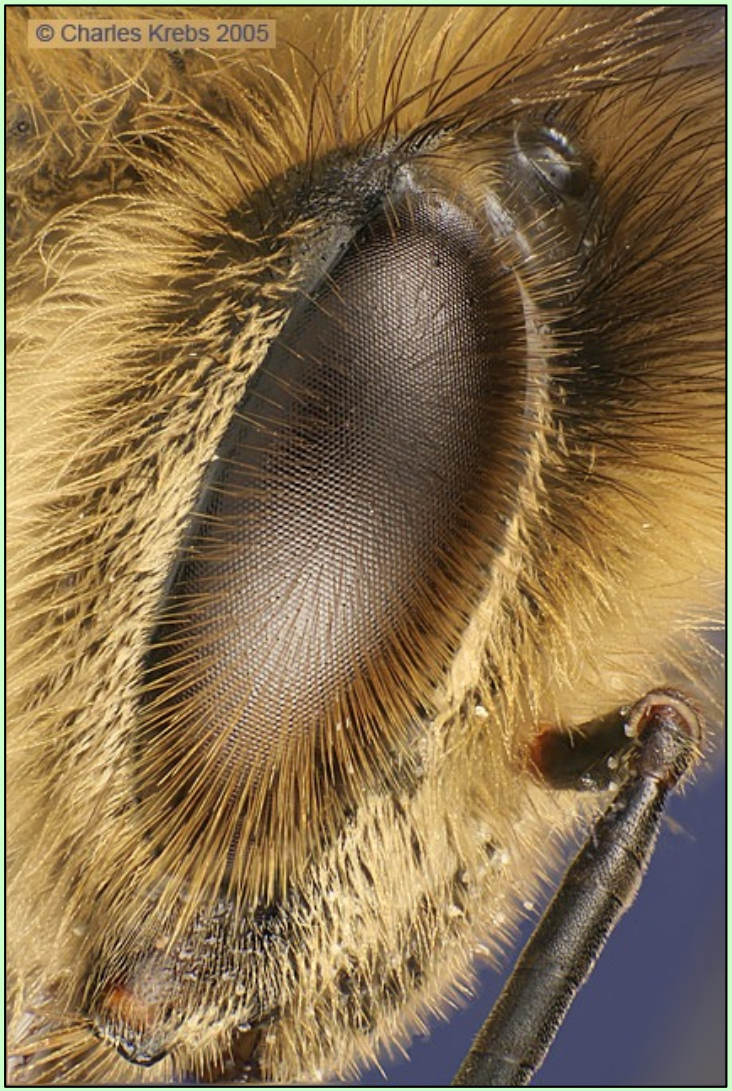
1st Segment: Head

One of three simple eyes (Ocelli)



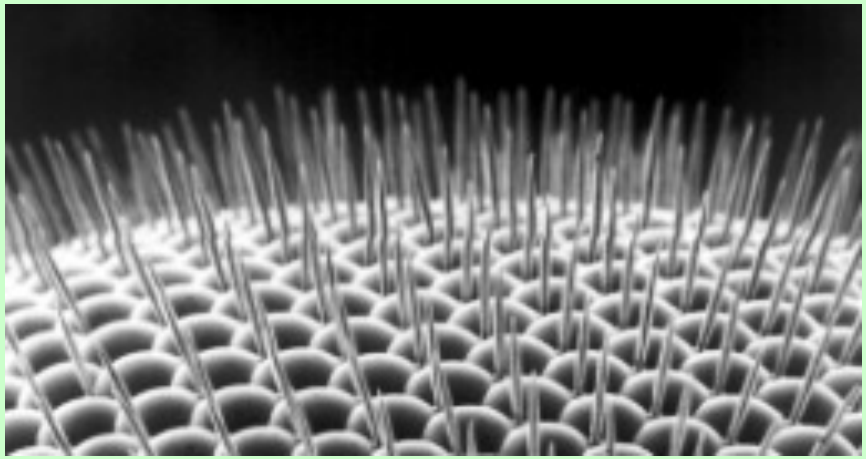
The proboscis is a straw-like tongue used to suck nectar, water or honey.

Honey Bee's Five Eyes



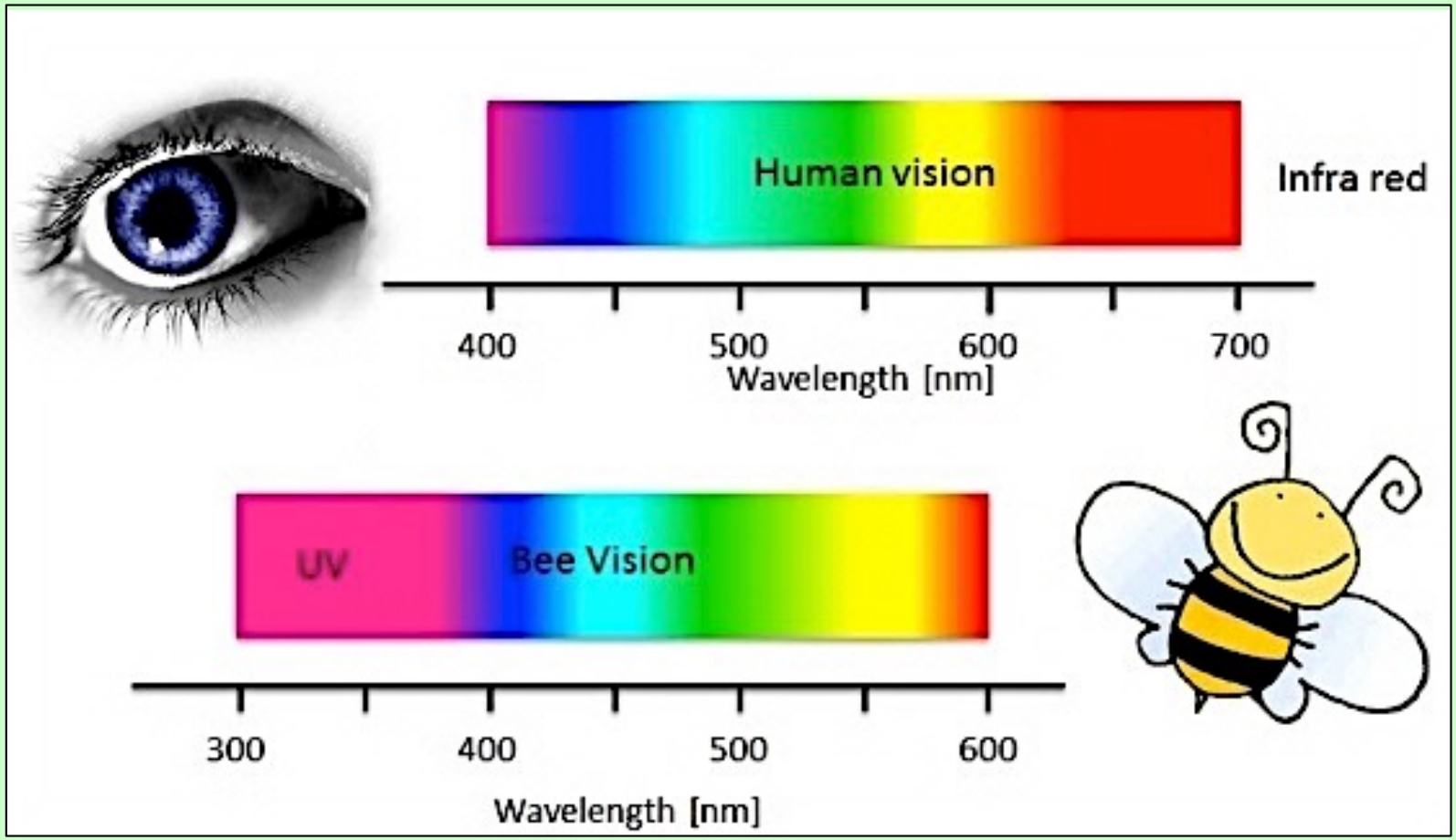
Two Compound Hairy Eyes
with 6,900 facets per eye

A = Two Compound Eyes
(UV/short wave)
B = Three simple eyes Ocelli
(Visible spectrum)



Human vs Honey Bee Vision

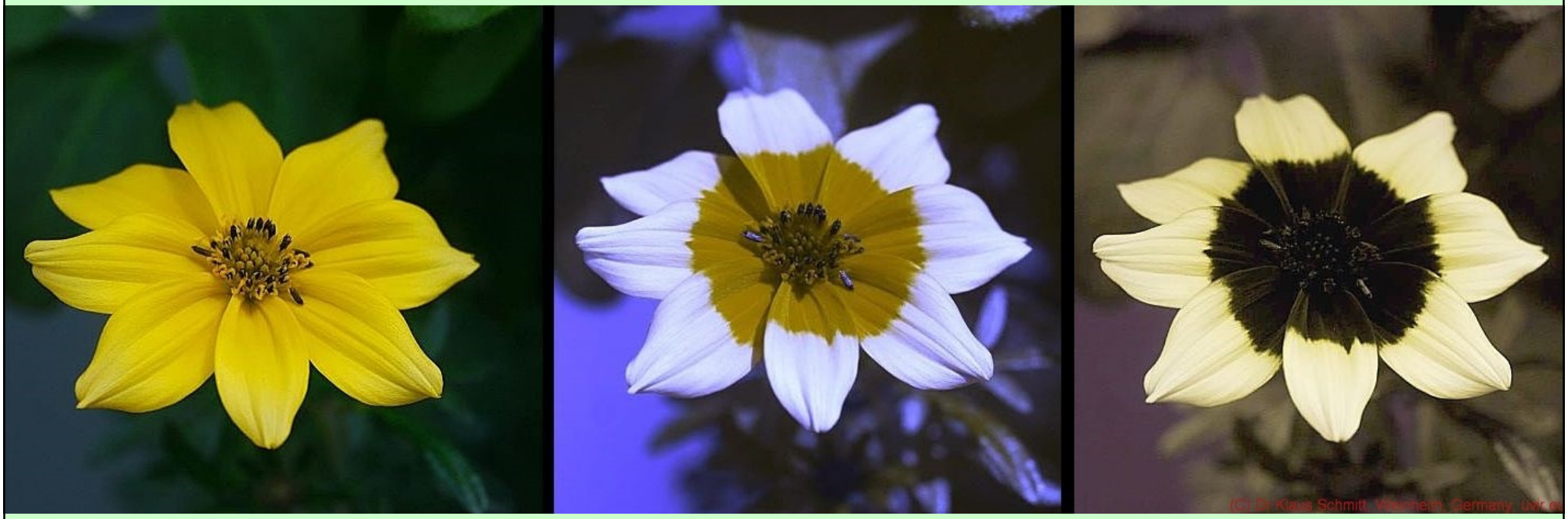
Green, Blue & Red Photoreceptors



Green, Blue & Ultra Violet (UV) Photoreceptors

Apache beggar ticks (*Bidens ferulifolia*)

Human vision | Simulated bee vision | Reflected UV



Pure sunlight

Green, blue & UV light with yellow bulls eye on iridescent white

UV only light with dark bulls eye on cream

http://photographyoftheinvisibleworld.blogspot.com

5 Minute Break

2nd Segment: Thorax

<u>Bees have six (6) legs</u>

1st Pair of legs:

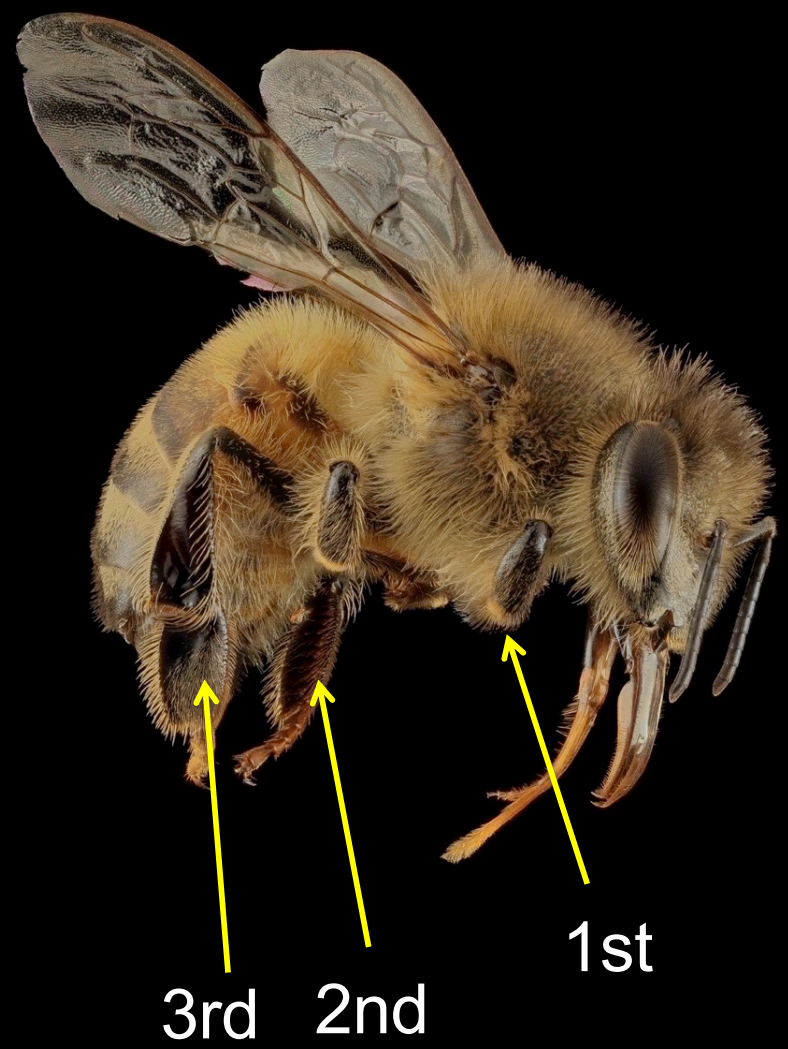
- Locomotion
- Clean antenna

2nd Pair of legs:

- Stability when walking
- Tibial spur for wax grabbing

3rd Pair of legs:

- **pollen baskets** used to carry pollen

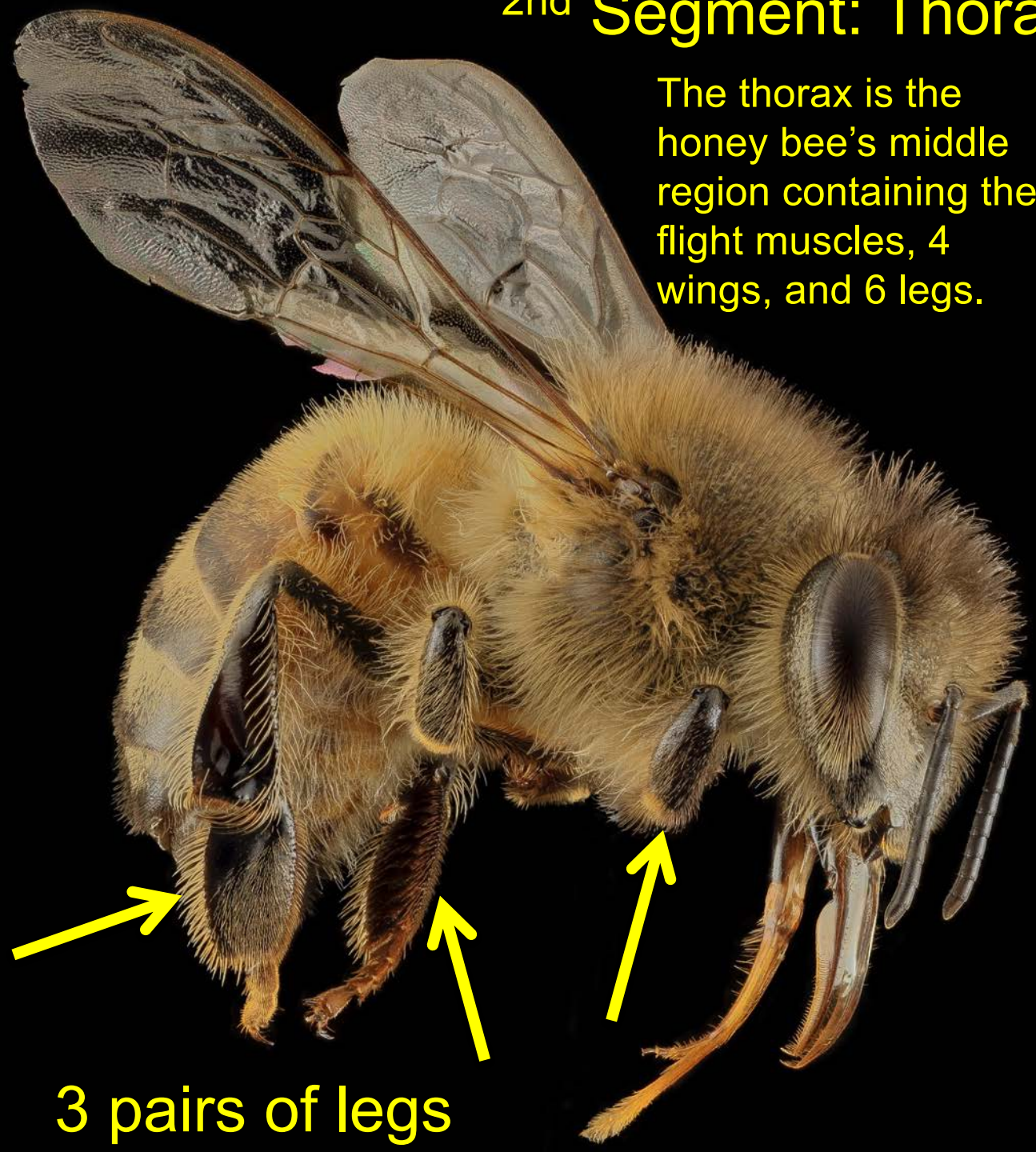


A honey bee has 3 pairs of segmented legs used for walking, dusting their antennae, brushing pollen off body hairs, and storing pollen.

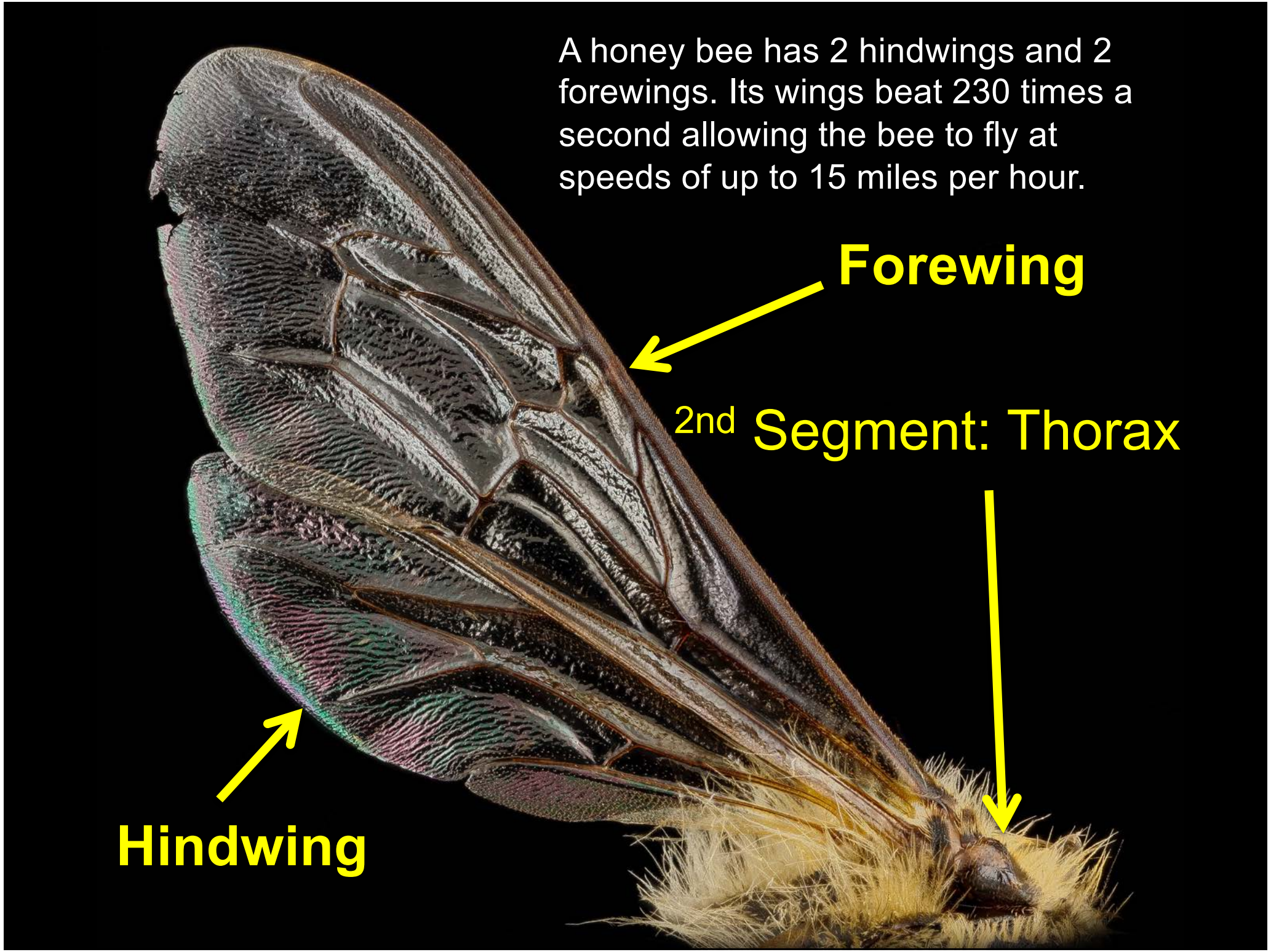
Photo Credit USGS

2nd Segment: Thorax

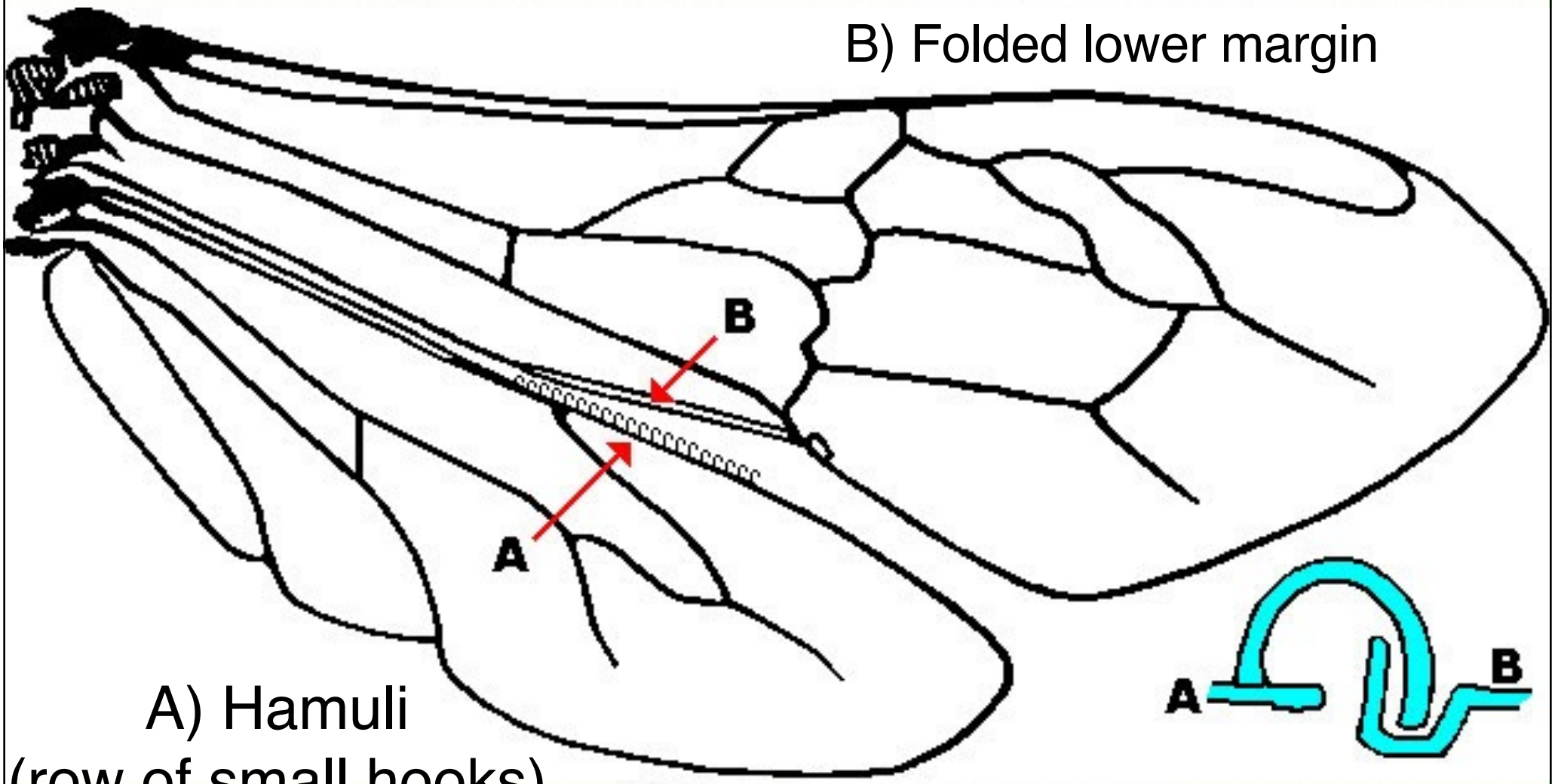
The thorax is the honey bee's middle region containing the flight muscles, 4 wings, and 6 legs.



3 pairs of legs

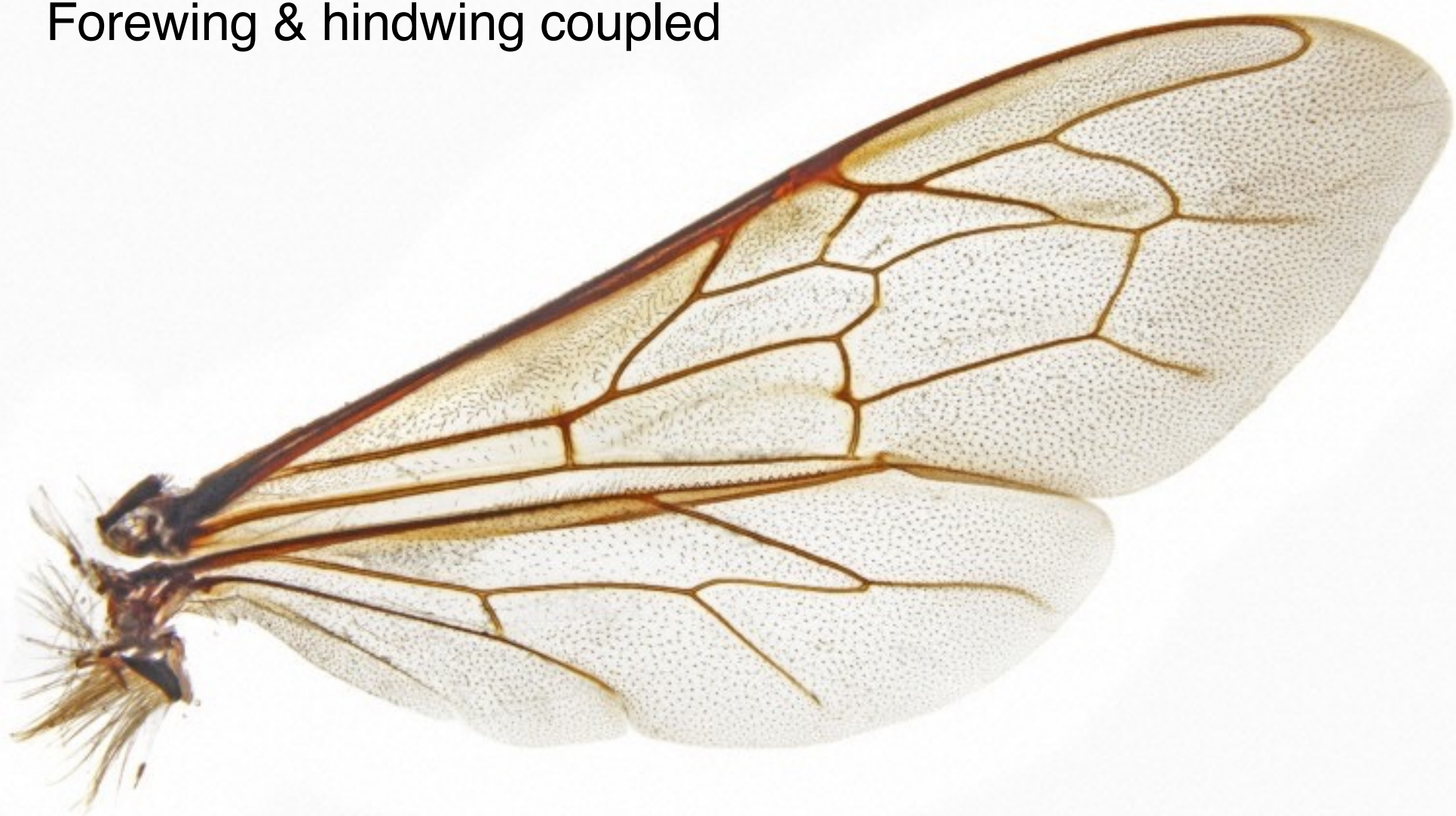

A honey bee has 2 hindwings and 2 forewings. Its wings beat 230 times a second allowing the bee to fly at speeds of up to 15 miles per hour.
Forewing
2nd Segment: Thorax
Hindwing

Forewing & hindwing uncoupled



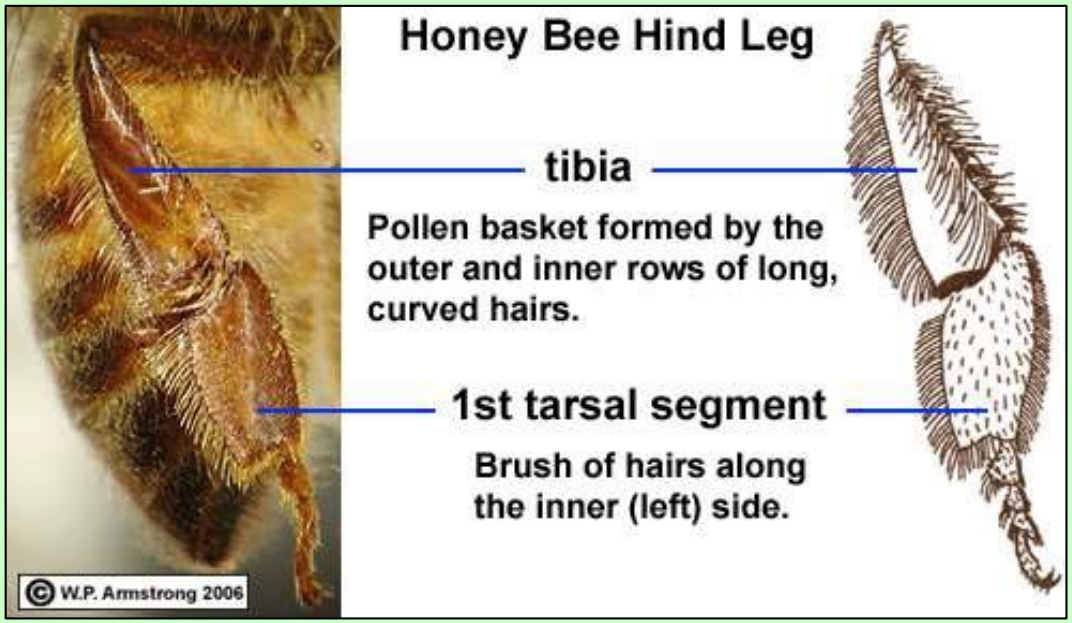
Honey Bee forewing and hindwing

Forewing & hindwing coupled



Honey Bee forewing and hindwing

The Pollen Basket

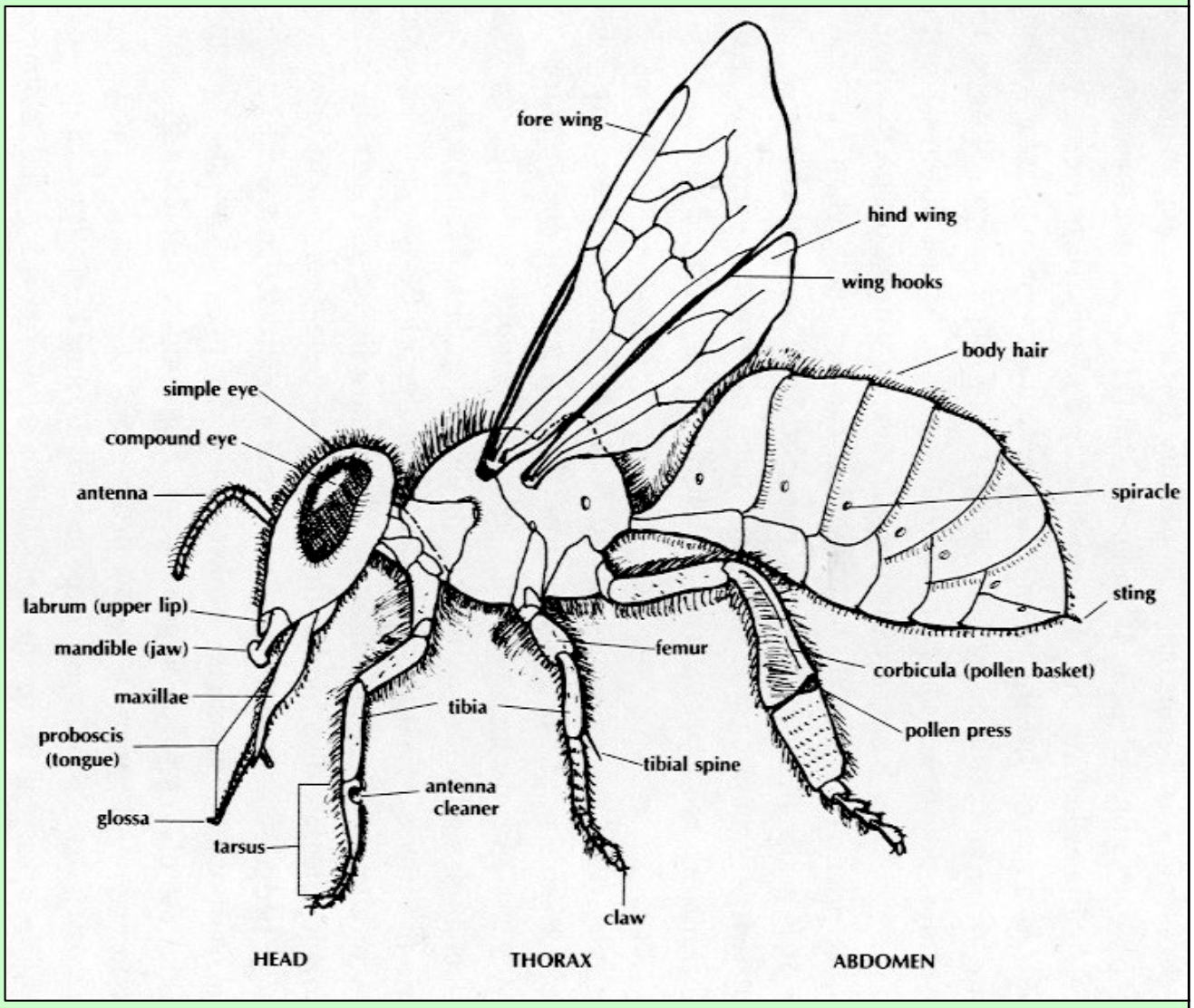


The hind legs of a worker bee contain a **pollen basket**–a collection of hairs where pollen is stored for transport.

Pollination!

Each hair is branched (plumose), enabling it to trap pollen grains more effectively

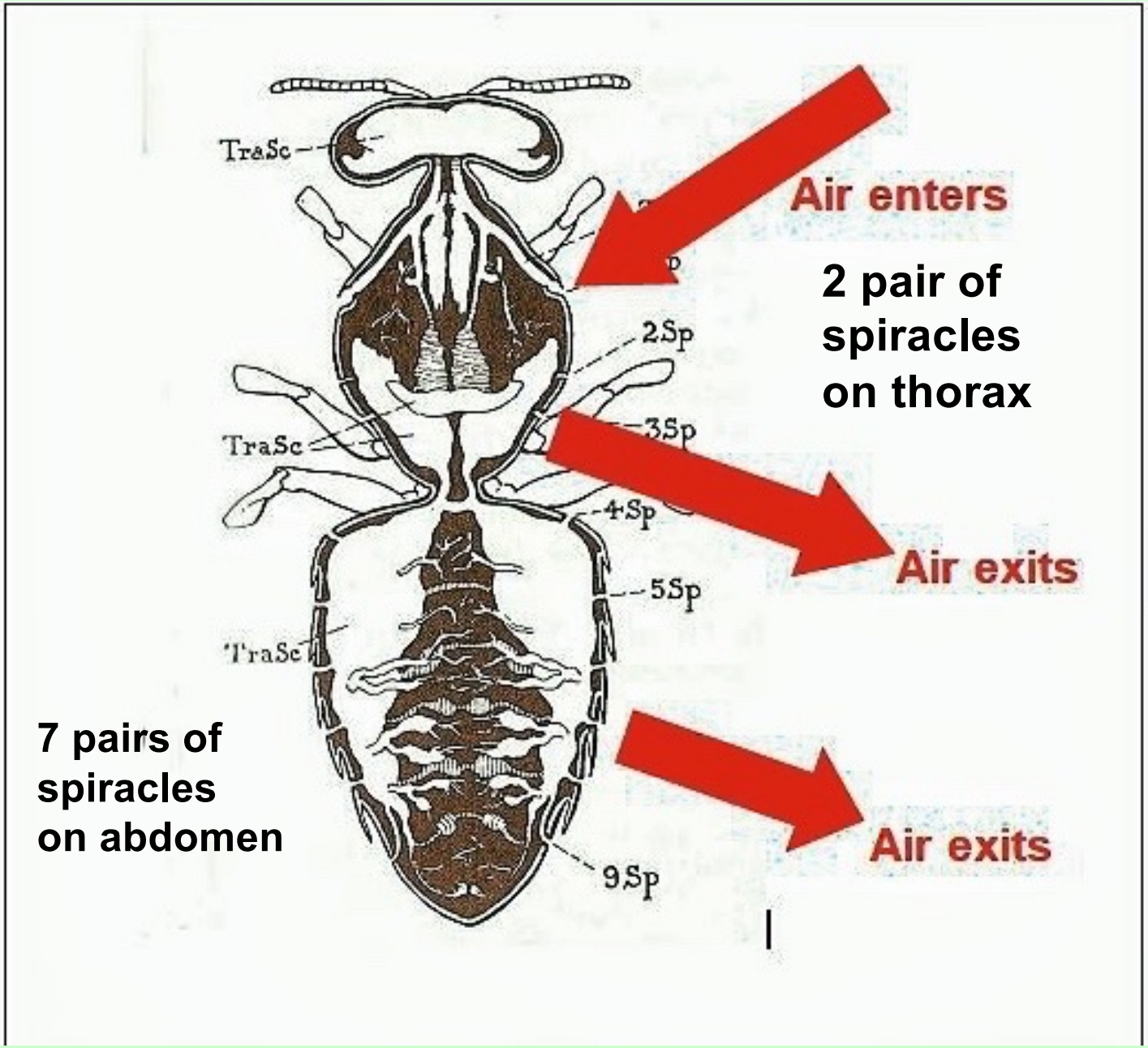
- ✓ Exoskeleton
  - ✓ No bones (Chitin)
- ✓ Outer body composed of hardened plates & flexible membranes
- ✓ All internal body parts, muscles, connective tissue, and all body parts are connected to exoskeleton



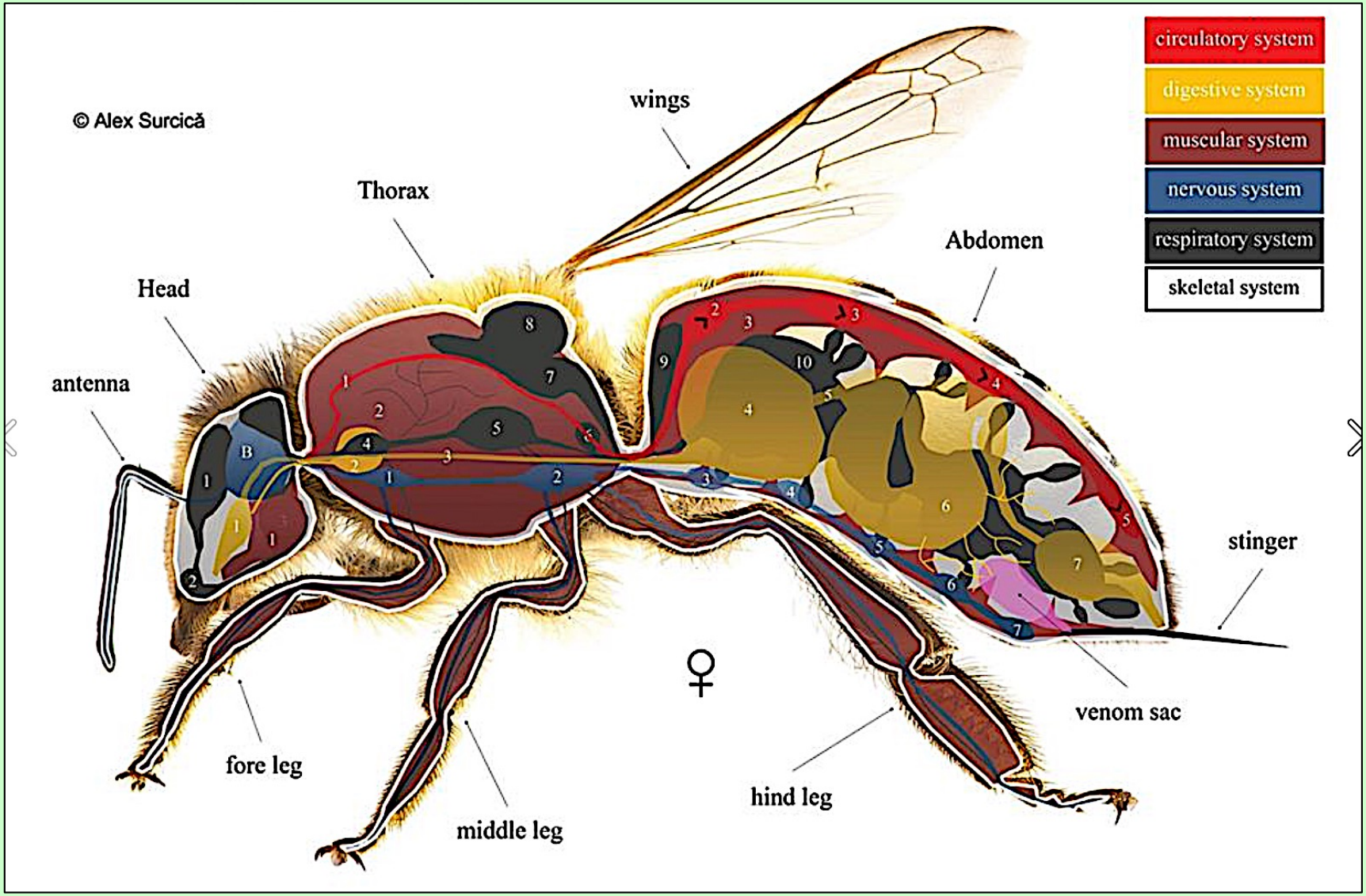
Internal Anatomy

- ✓Respiratory system
- ✓Circulatory system
- ✓Alimentary system
  - ✓Digestion
  - ✓Excretion
- ✓Reproductive system

Respiration system



Honey Bee External & Internal Anatomy



http://honeybee.drawwing.org/book/external-anatomy

Alimentary System

Digestive & Excretion

Nectar or Honey Stomach

- ✓ The first chamber of a three chambered stomach
- ✓ Is used by workers to carry loads of nectar or water
- ✓ The load is regurgitated from the honey stomach when the worker returns to the nest

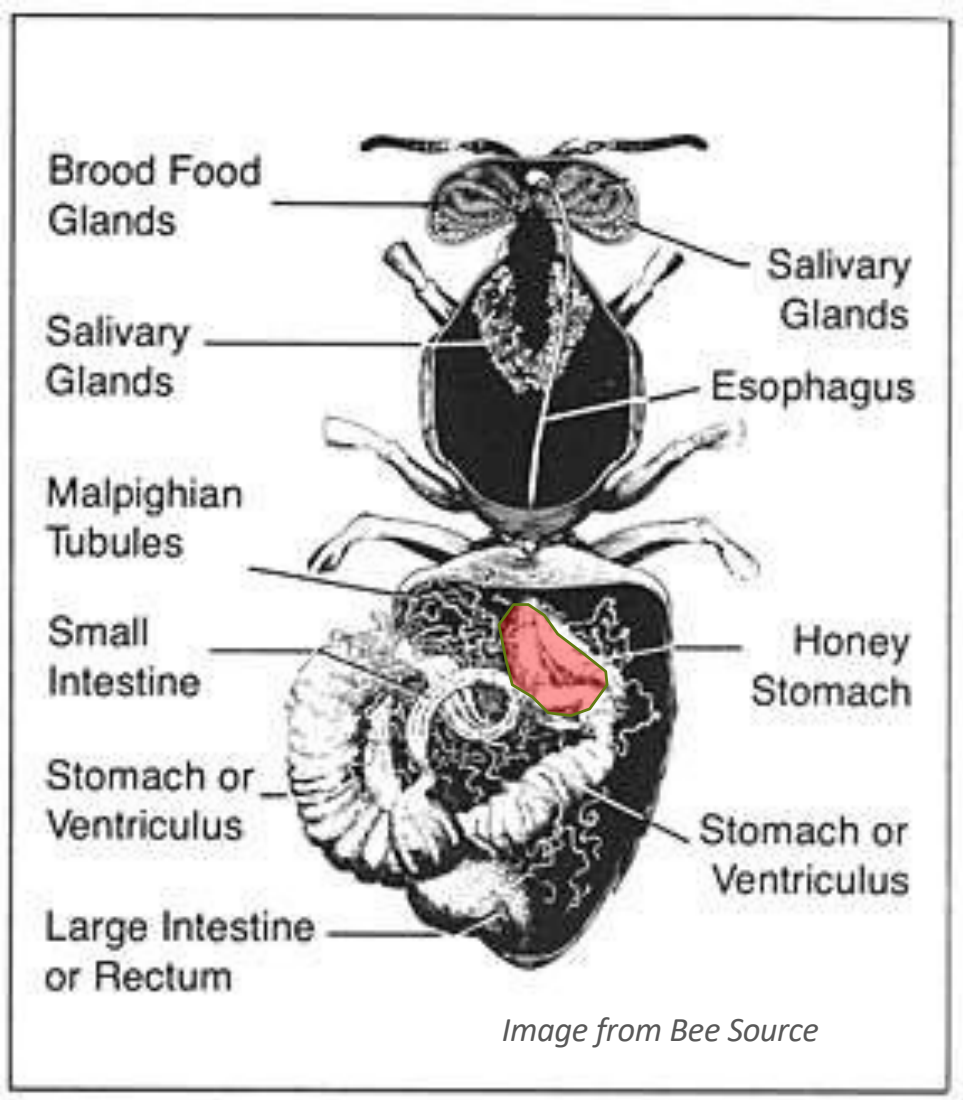
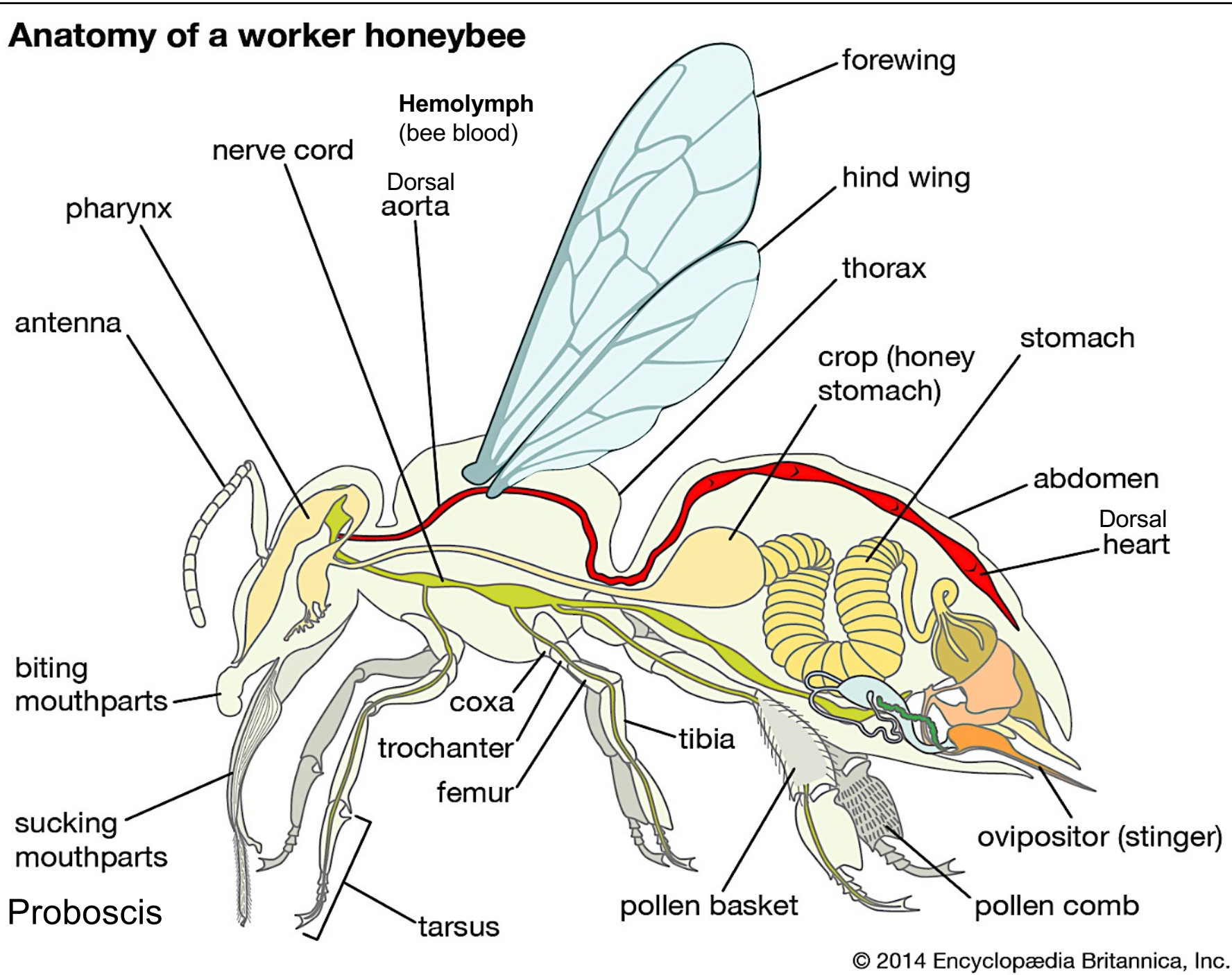
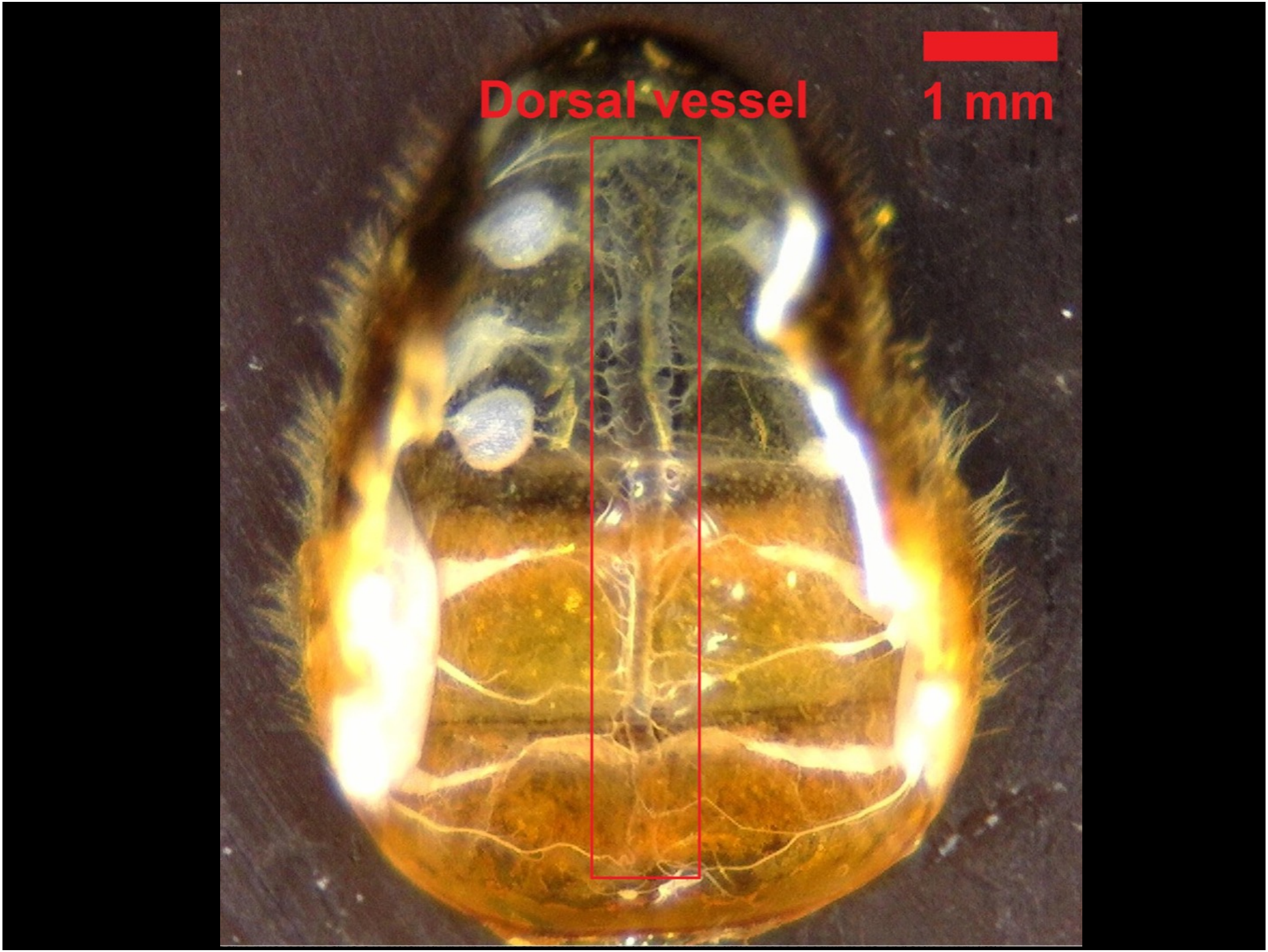


Image from Bee Source

http://honeybee.drawwing.org/book/digestive-system

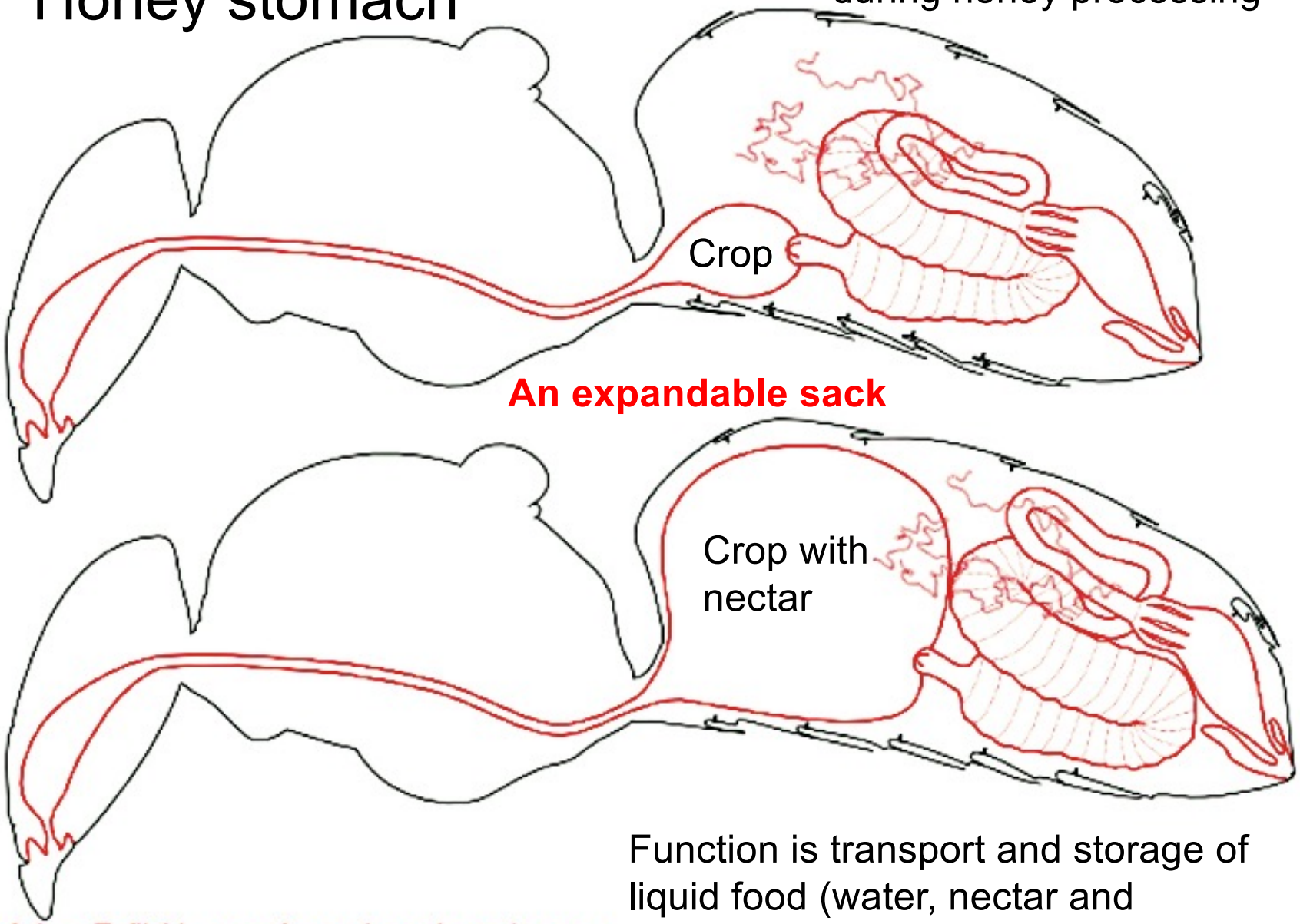

Anatomy of a worker honeybee
forewing
Hemolymph
(bee blood)
nerve cord
Dorsal
aorta
hind wing
pharynx
thorax
antenna
stomach
crop (honey
stomach)
abdomen
Dorsal
heart
biting
mouthparts
coxa
trochanter
femur
tibia
sucking
mouthparts
ovipositor (stinger)
Proboscis
tarsus
pollen basket
pollen comb
© 2014 Encyclopædia Britannica, Inc.


Dorsal vessel
1 mm

Crop

Honey stomach

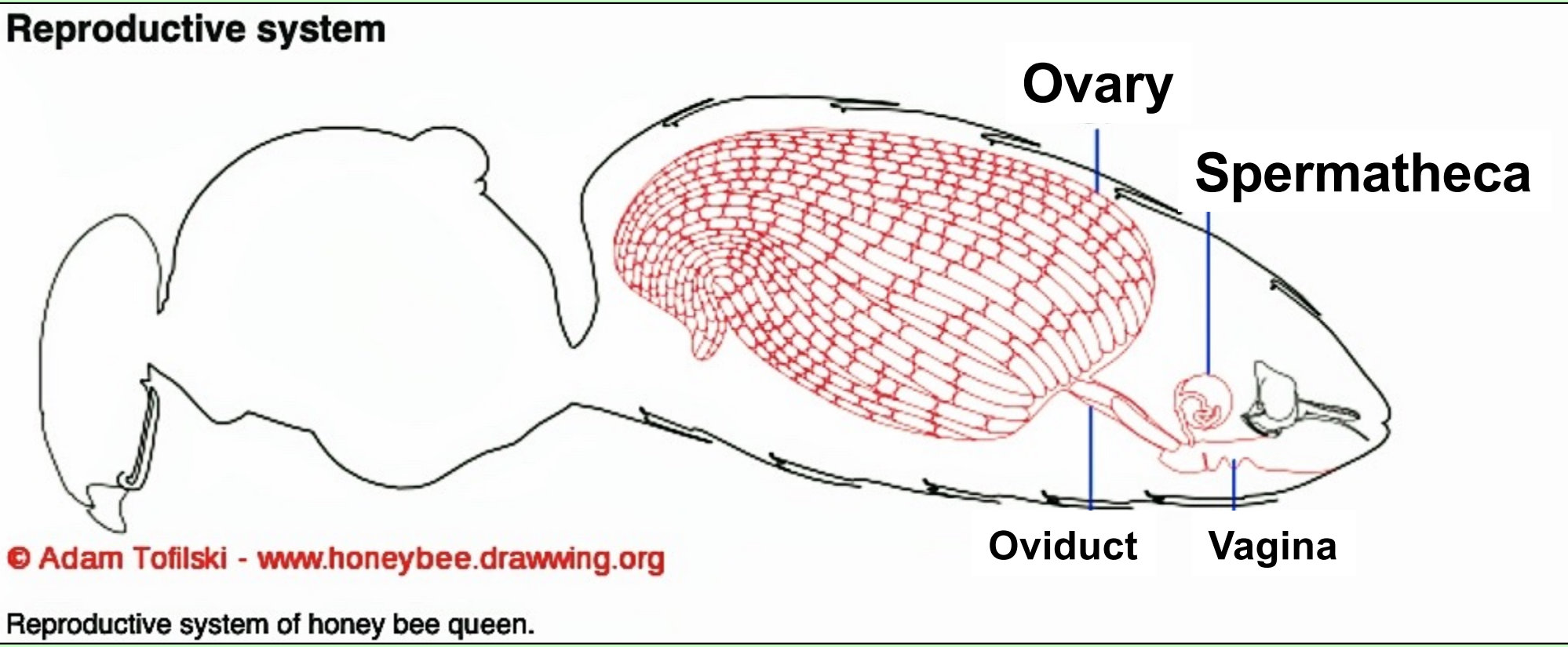
Also uptake of water from nectar during honey processing



Function is transport and storage of liquid food (water, nectar and honeydew)

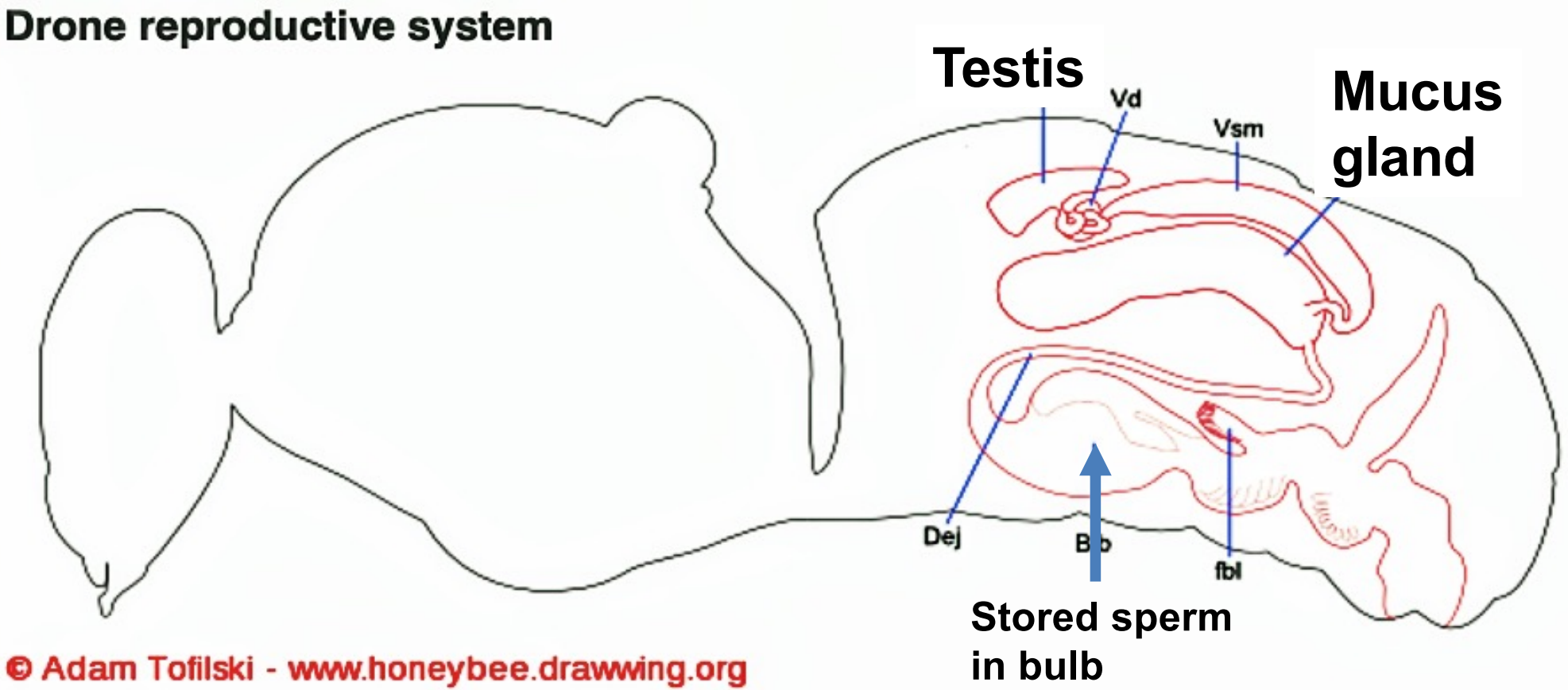
Crop of honey bee worker when empty (top) and filled with nectar (bottom). After Winston (1987, fig. 3.15) [1].

Queen Reproductive System

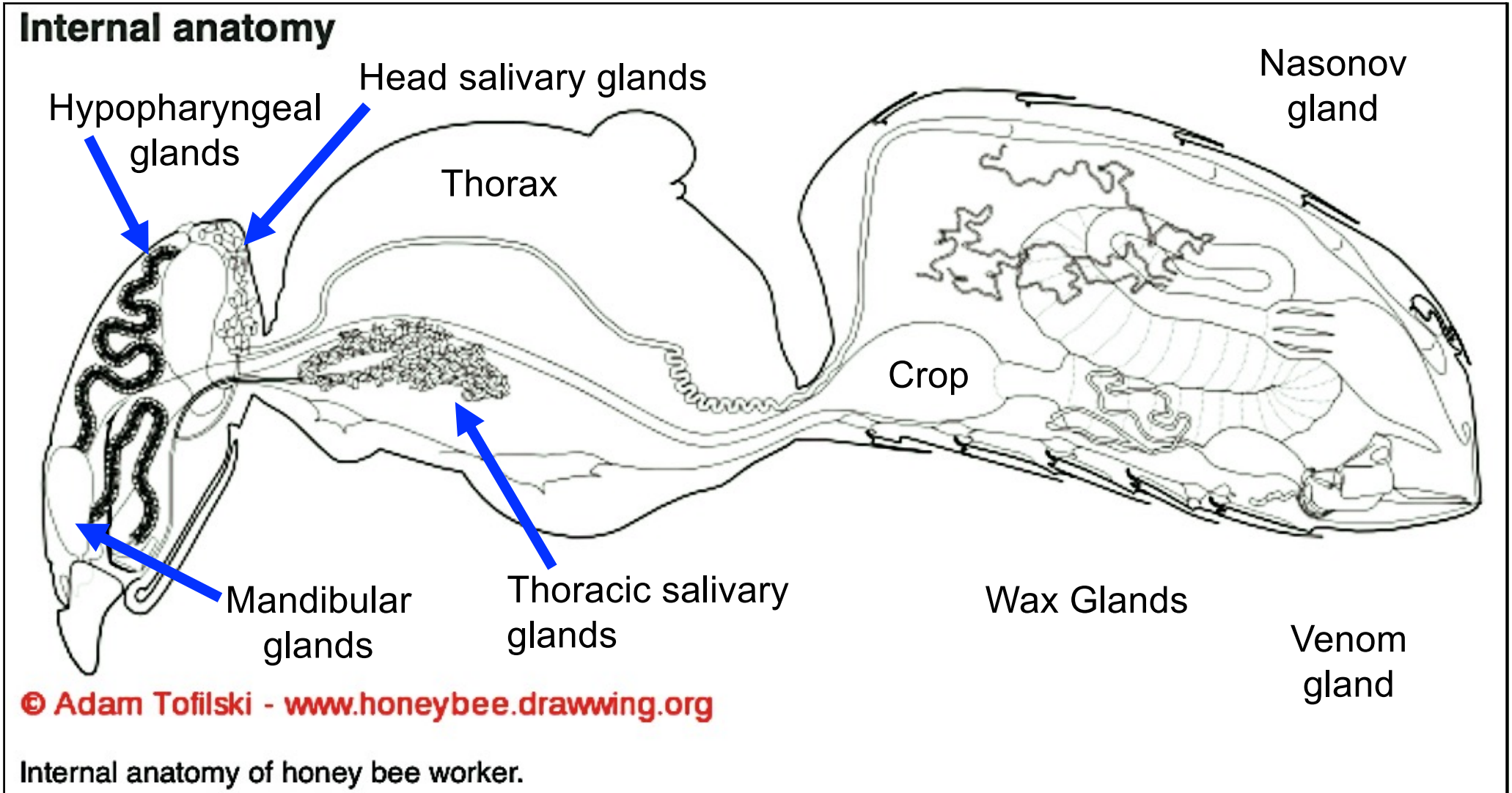


Reproductive system of honey bee queen.

Drone Reproductive System



Reproductive system of honey bee drone.



Internal anatomy of honey bee worker.

Selected Honey Bee Glands

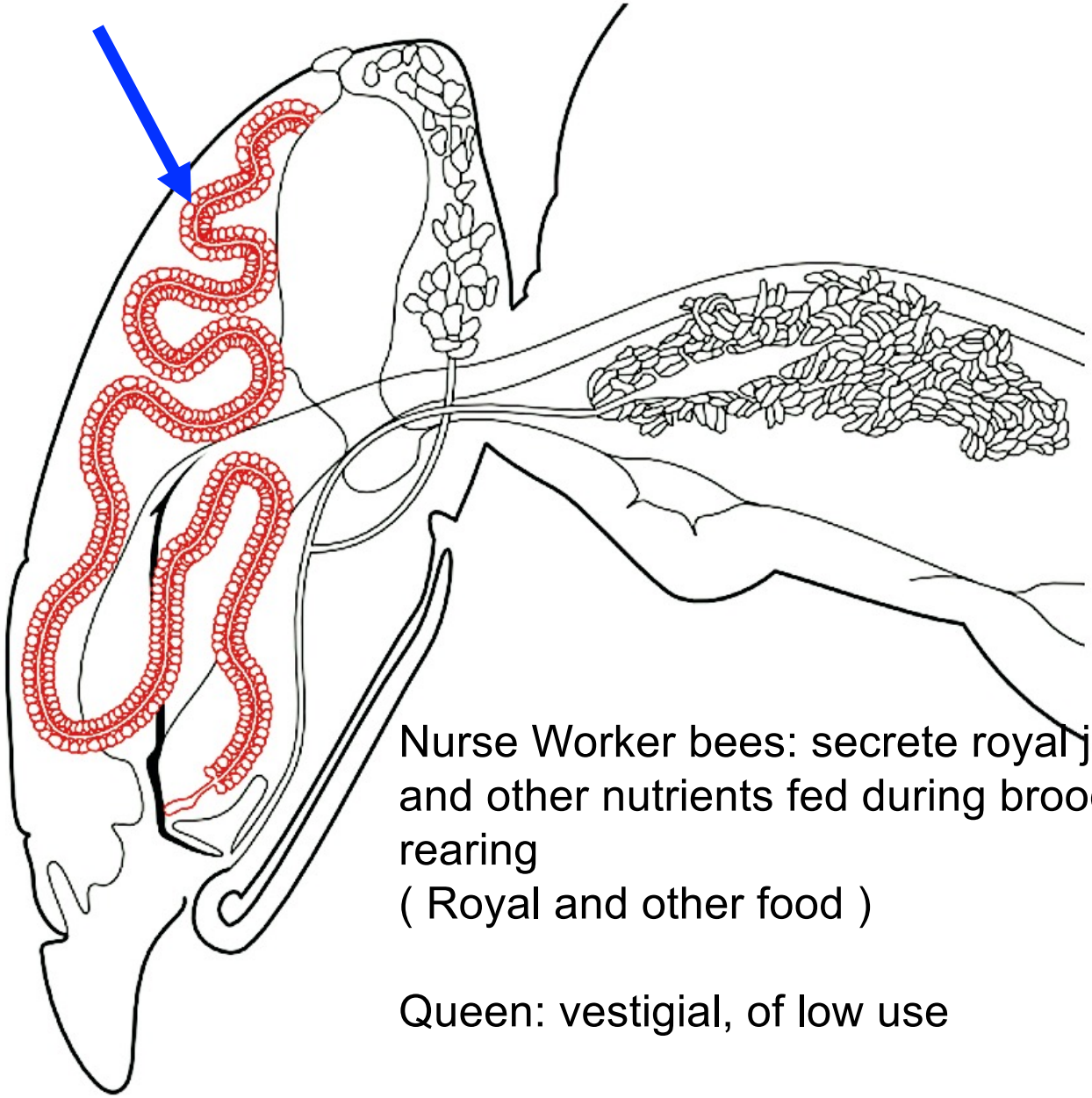
Glands of the Head & Thorax

- ✓Hypopharyngeal
- ✓Mandibular
- ✓Salivary

1st Segment: Head

Note hairy compound eyes with pollen grains

Hypopharyngeal glands, side view



Nurse Worker bees: secrete royal jelly and other nutrients fed during brood rearing
(Royal and other food)

Queen: vestigial, of low use

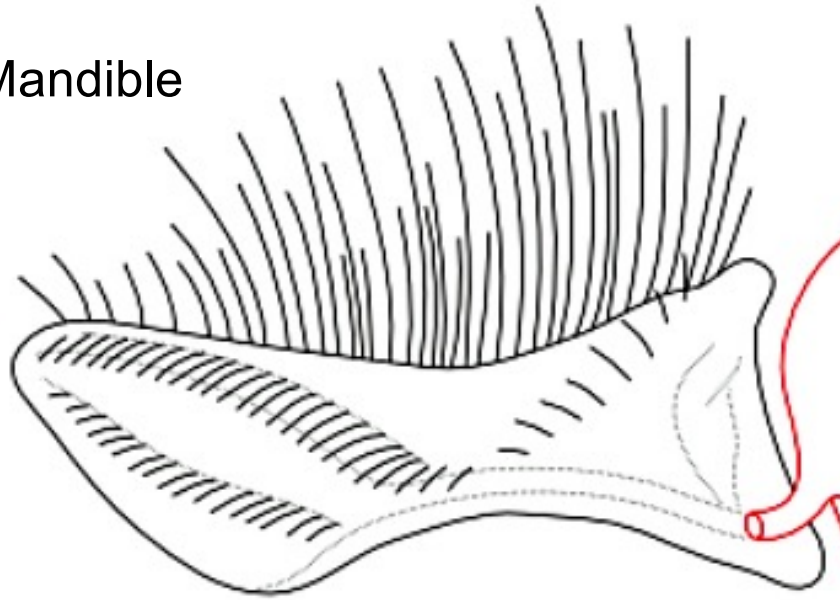
Drone: does not have one

Side view of hypopharyngeal glands (marked red) of honey bee worker (see also **dissected hypopharyngeal glands**).

Mandibular glands

Located in the bee's Head

Mandible



Mar

© Adam Tofilski - www.honeybee.drawwing.org

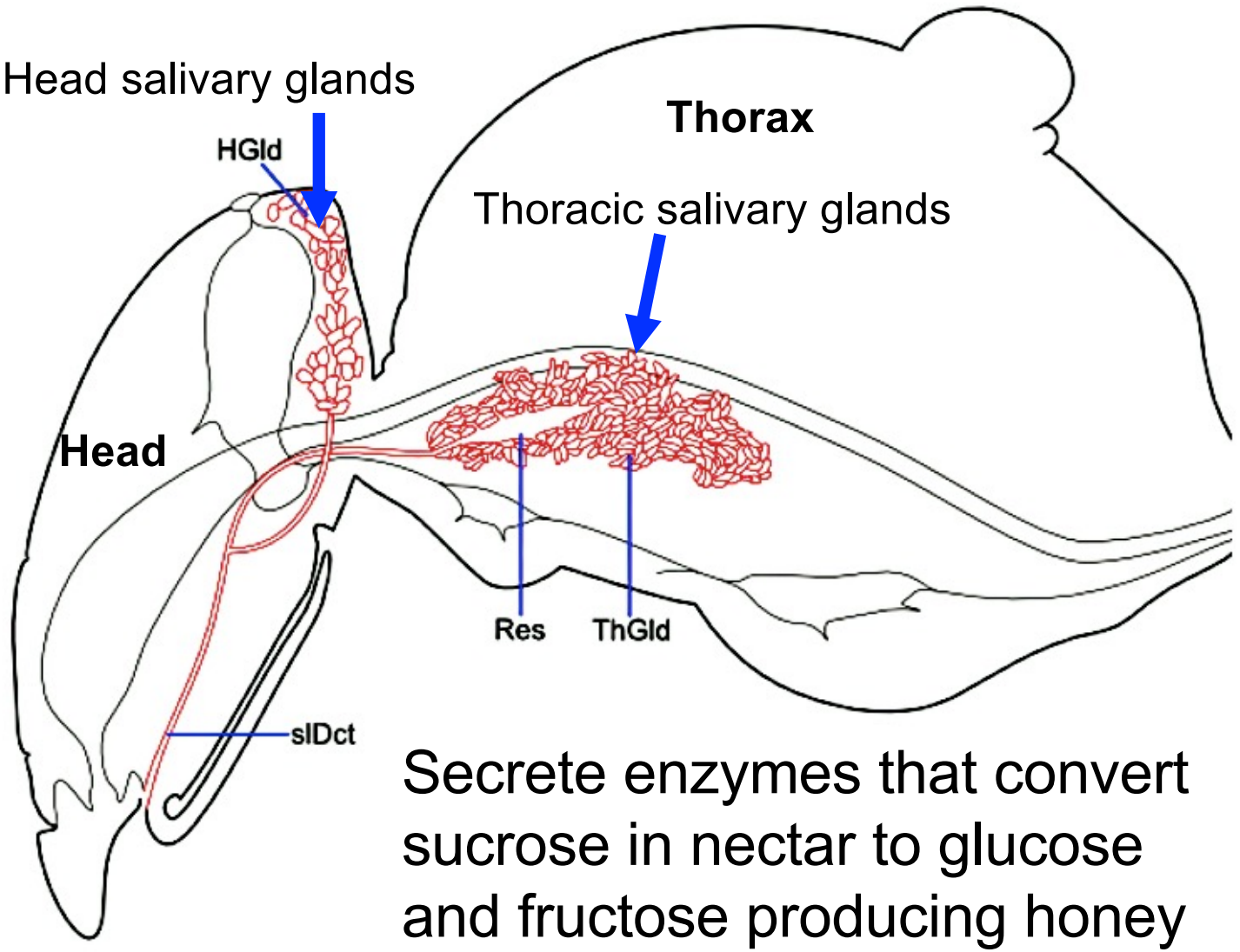
Left mandible (inner side) and mandibular gland (marked red) of honey bee worker. After Snodgrass (1956, fig. 23c) [1].

Worker: mandibular (along with another) secretes royal jelly that is fed to the brood (larvae)

Queen: mandibular (produces pheromones) "queen substance" and more NEXT Week.

Drone: has one, but it is extremely small and of no use

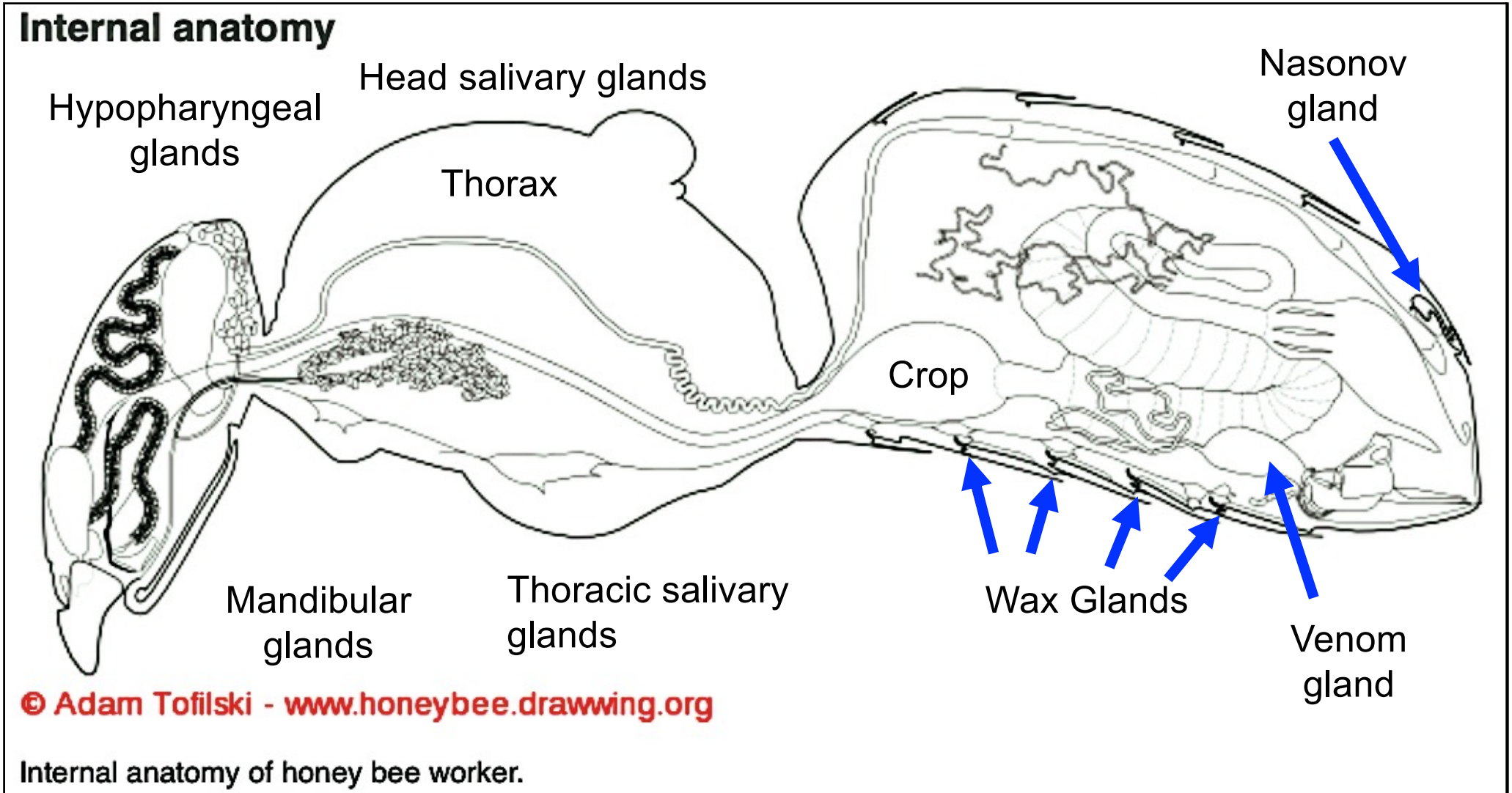
Salivary glands, side view



Secrete enzymes that convert sucrose in nectar to glucose and fructose producing honey

Side view of salivary glands (marked red) of honey bee worker (see also **dissected salivary glands**).

HGld - head salivary gland
Res - reservoir of thoracic salivary gland
slDct - common salivary duct
ThGld - thoracic salivary gland



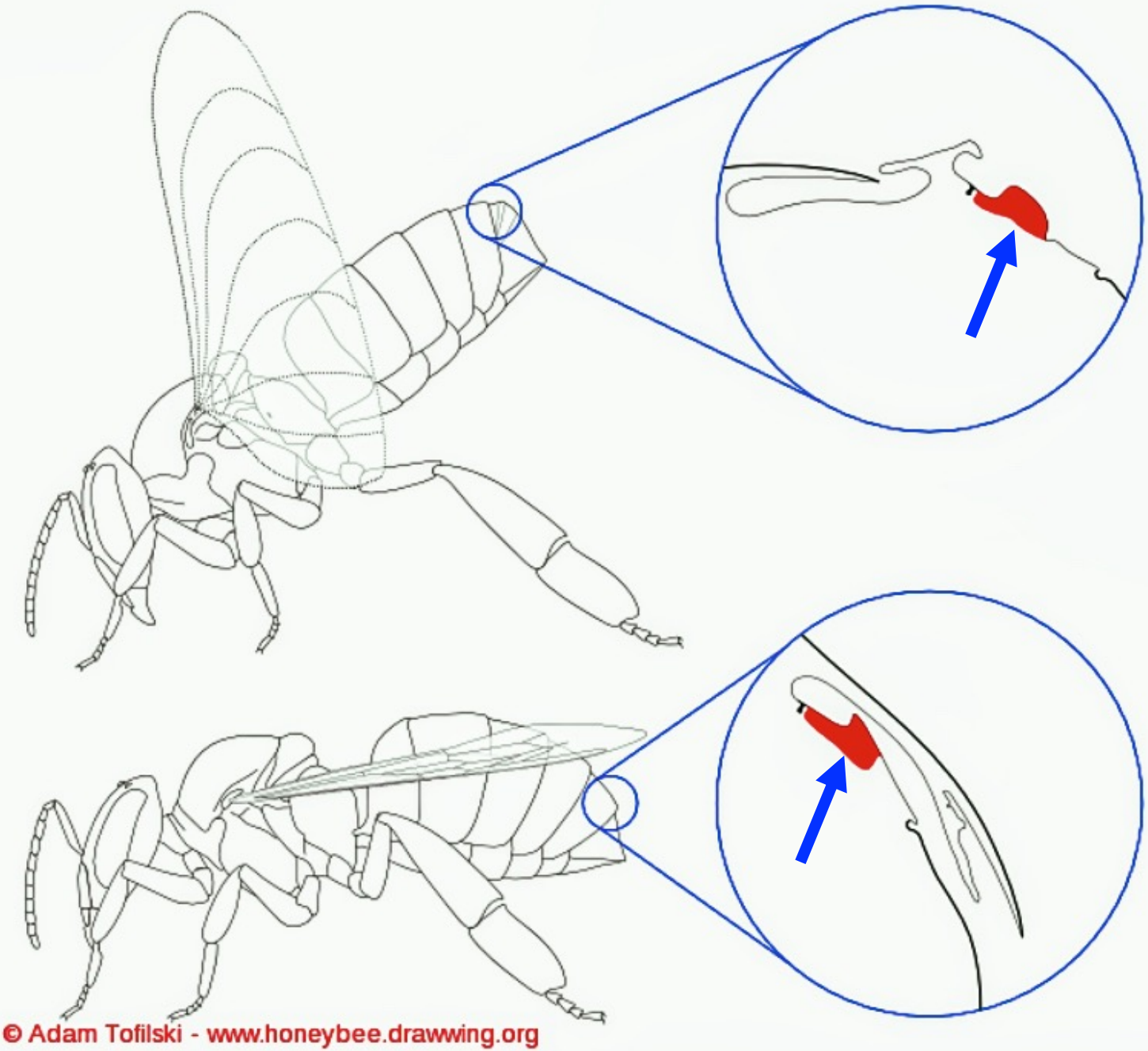
Internal anatomy of honey bee worker.

Selected Honey Bee Glands

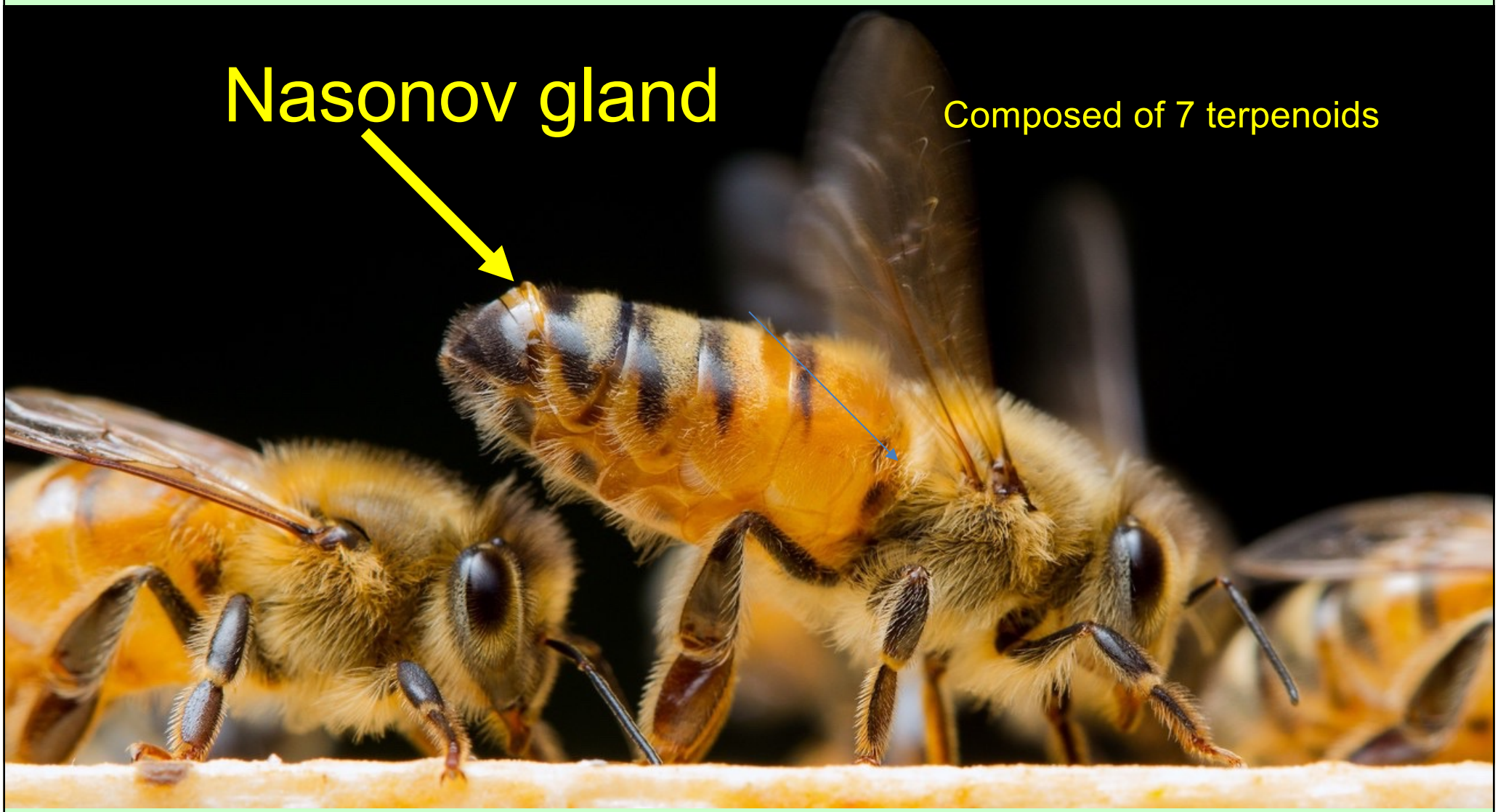
Glands of Abdomen

- ✓Nasonov
- ✓Wax
- ✓Venom gland

Nasonov gland



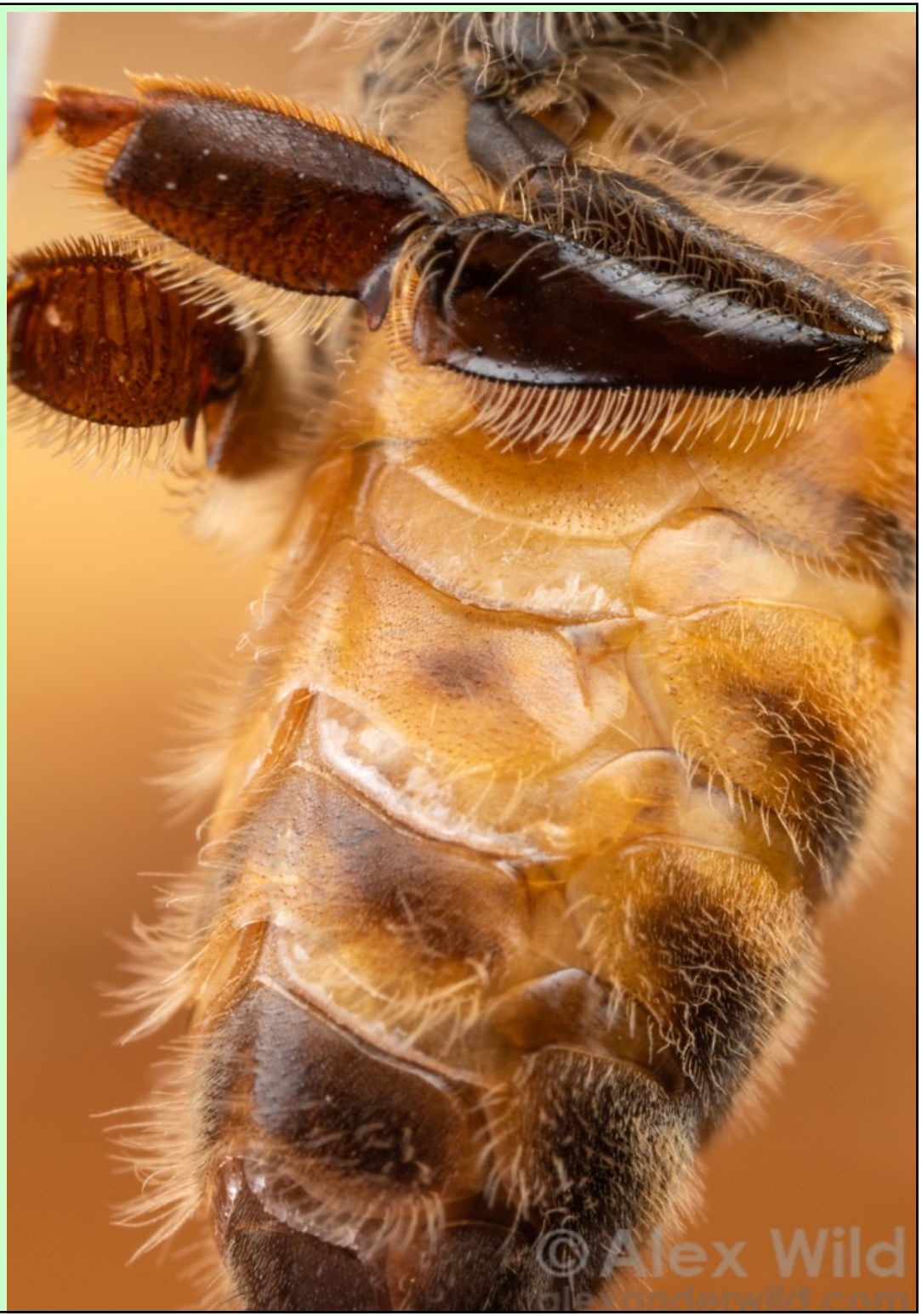
Nasonov gland (marked red) of honey bee worker. After Jacobs (1925, fig. 12a, 21b) [1], Snodgras (1956, fig. 57c) [2].
In the upper image the gland is exposed; in the lower image the gland is hidden between tergites.



A scent gland on the dorsal side releases a pheromone that is very attractive to bees and is released to help bees locate food and water and to help lost or disorientated bees to locate home or a swarm site. Only the female worker has this Nasonov gland; queens and drones do not have this 'homing' scent gland.

Wax Glands

- Only female workers have wax glands.
- Queens and drones do not have wax glands.
- The worker is capable of producing wax when she reaches about 12 to 16 days of age.
- There are four on each side for a total of eight glands.



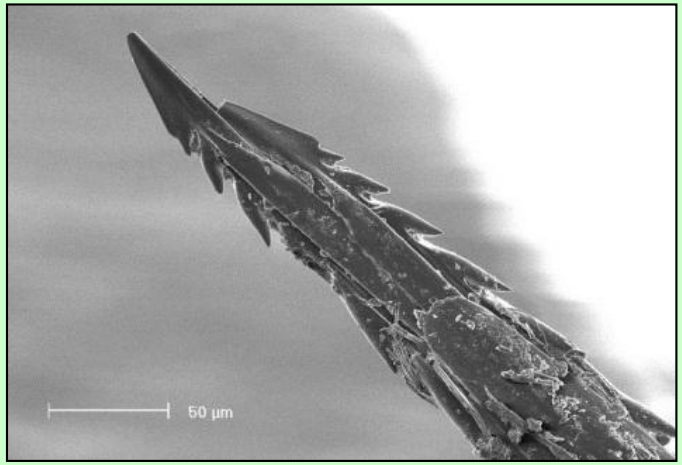
Worker Secreting Wax from 8 Abdominal Glands

Each wax scales is about 0.12 inches across & 0.0039 inches thick.
1,000 wax scales are required to make 0.035 oz.

The Stinger

Alarm pheromones released!

Kathy Keatley Garvey



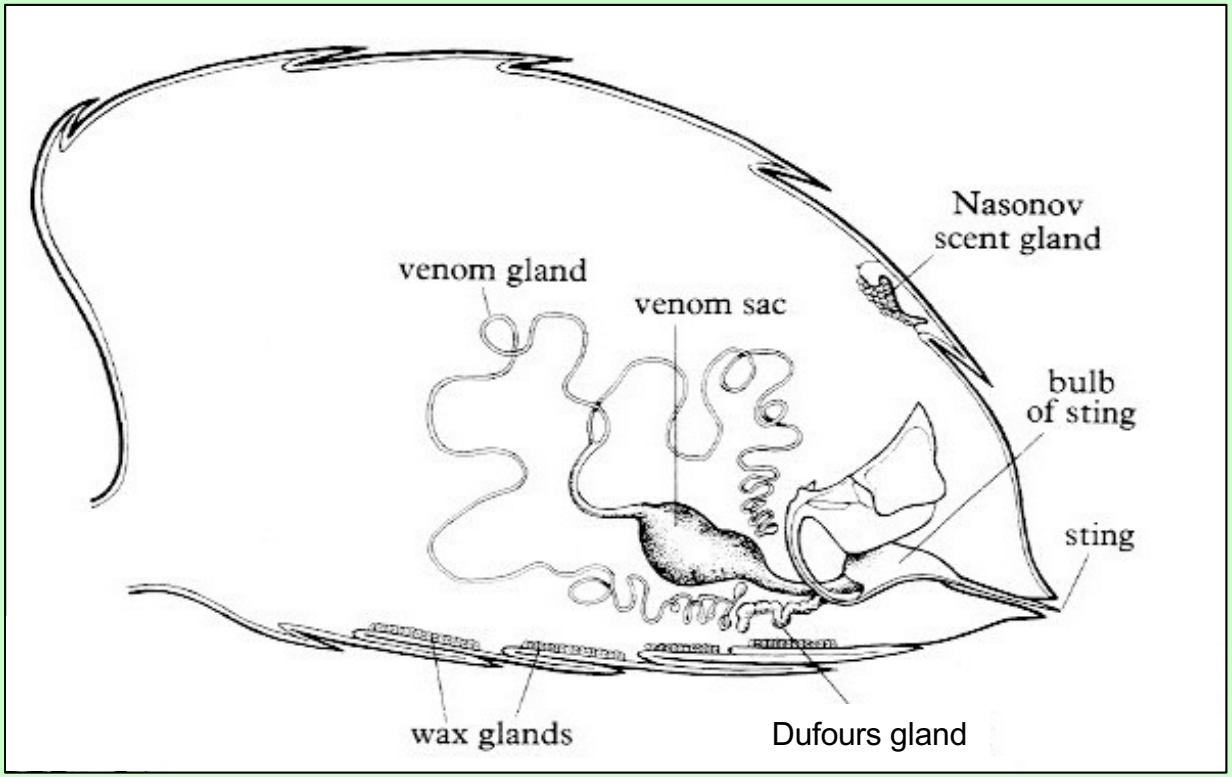
(SEM) Image: Ken Walker
Source: Museum Victoria

Internal Abdomen Anatomy

The Stinger

- ✓ When stung, one alarm pheromone is released smells like banana Laffy Taffy (Isoamyl acetate)
- ✓ A second is released from Mandibular gland in the head
- ✓ Sharp barbs enable the stinger to remain in intruder's skin (beekeeper?)
- ✓ Bee dies when stinger stays behind
- ✓ The main toxin is referred to as apitoxin (melittin)

http://honeybee.drawwing.org/book/glands



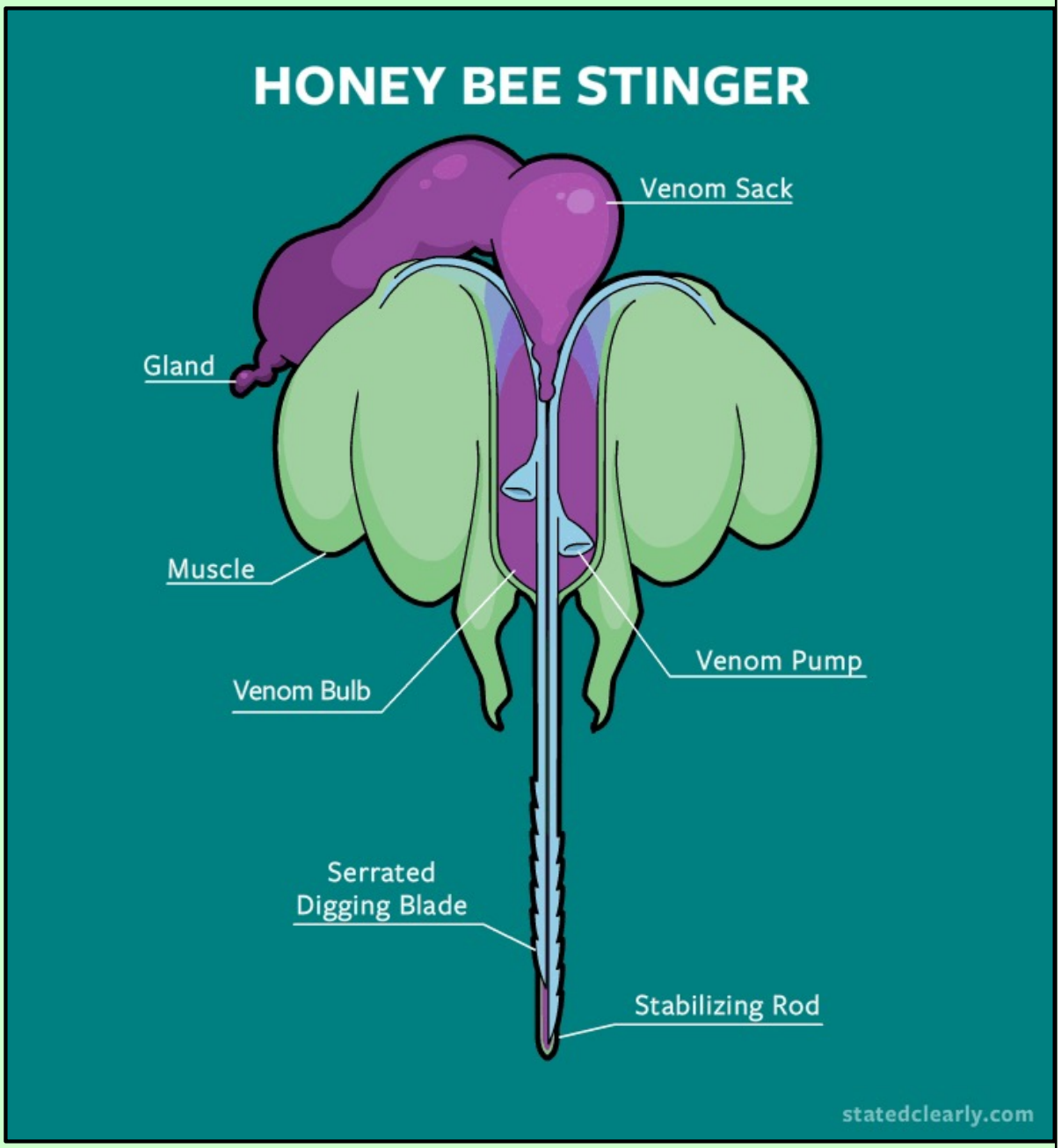
8 beeswax glands

Nasonov scent gland releases pheromones that serve as location signals

Dufour's: Egg Marker Compound

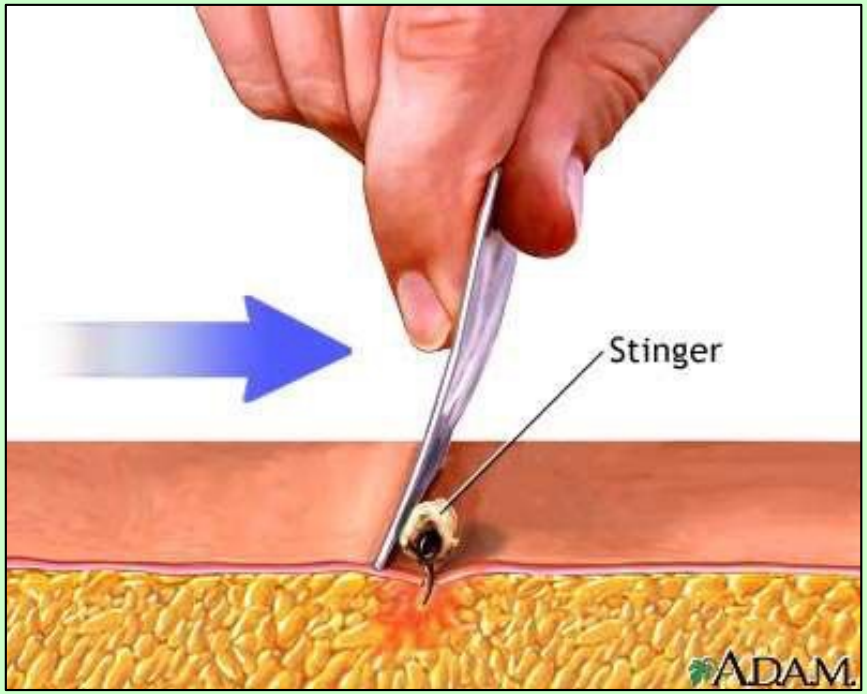
Honey Bee Stinger

- ✓ **Stinger** – a modified ovipositor used in defense (males do not have a stinger)
- ✓ **Venom Gland** – Produces the main toxic component of **bee venom**, contains proteins and enzymes that can be used in defense against attack
- ✓ **Barbed stinger** – makes removal of stinger difficult, and ensures venom sac will continue to inject venom once the bee detaches



Remove the stinger QUICKLY

- ✓ If stung, be calm, remove the bee, if necessary and smoke area of the stinger.
- ✓ Don't squeeze stinger, because you could squeeze the remaining contents of the venom sac into you all at once
- ✓ Always scrape or pull off the stinger as close to the skin as possible. A stinger releases 90 percent of its venom within 20 seconds!
- ✓ The quicker the stinger is removed, the less venom enters the skin



Scraping away a stinger has no advantage over grabbing or pulling it. Only speed makes a difference!

Bee sting

- Mild reaction
  - Instant, sharp burning pain at the sting site
  - A red welt at the sting area
  - Slight swelling around the sting area
- Moderate reaction
  - Extreme redness
  - Swelling at the site of the sting that gradually enlarges over the next day or two

You are allergic to a bee sting if you exhibit any of the following symptoms after a sting:

- Severe allergic reaction
  - Skin reactions, including hives and itching and flushed or pale skin
  - Difficulty breathing
  - Swelling of the throat and tongue
  - A weak, rapid pulse
  - Nausea, vomiting or diarrhea
  - Dizziness or fainting
  - Loss of consciousness

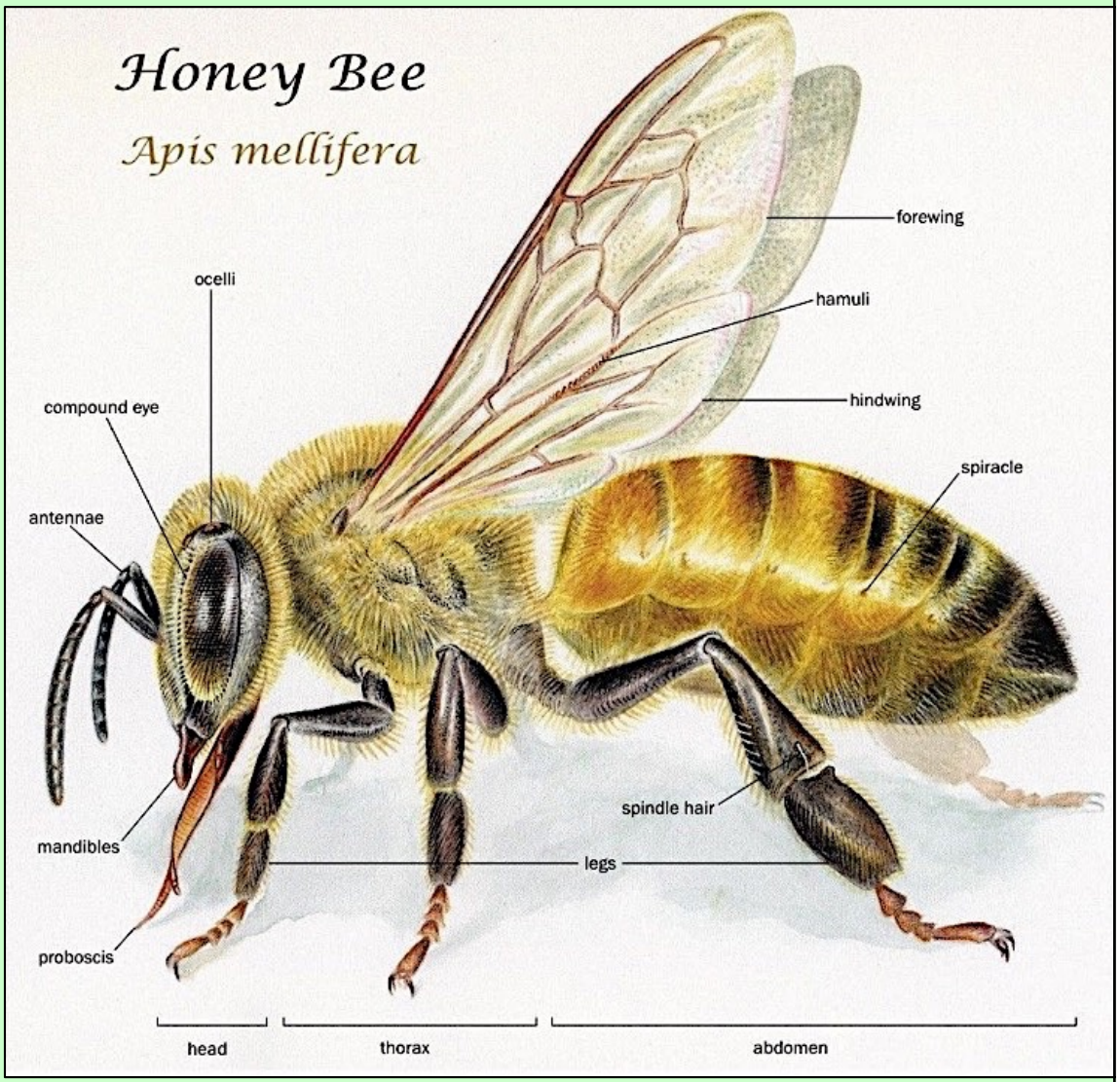
EpiPen (Epinephrine Auto-Injector)

Ask your primary care physician for a prescription

Honey Bees

Class: Insecta

- ✓ 3 body segments: (Head, thorax, and abdomen)
- ✓ Skeleton on outside of body (Exoskeleton)
- ✓ Pair of antennae
- ✓ 2 pairs of wings (4 wings total)
- ✓ 3 pairs of appendages (6 legs total)
- ✓ Undergo complete metamorphosis (*juvenile and adult stages look completely different*)



Africanized bee (left) and European bee (right) are indistinguishable to the un-aided eye. The color difference seen here can also be found in European honey bees. Credit: Scott Bauer. Courtesy: USDA-ARS

Differences Between European and African Honey Bees

Hive Defense and Stinging

European Honey Bee	Africanized Honey Bee
May send out 10–20 guard bees in response to disturbances up to 20 feet away (Figure 1).	May send out several hundred guard bees in response to disturbances up to 120 feet away (Figure 2).
Once agitated, will usually become calm within 1–2 hours.	Once agitated, may remain defensive for days.
Disturbed colony may result in 10–20 stings.	A disturbed colony may result in 100–1000 stings.

Swarming and Absconding

European Honey Bee	African Honey Bee
Swarm 1 or 2 times per year.	Can swarm 10 or more times a year.
Swarms are larger and need larger volume to nest.	Swarms contain fewer individuals, and therefore a much smaller cavity is needed (Figure 3).
Rarely abscond (completely abandon nest) from nesting location.	Abscond often and relocate to more suitable nesting locations.

Differences Between European and African Honey Bees

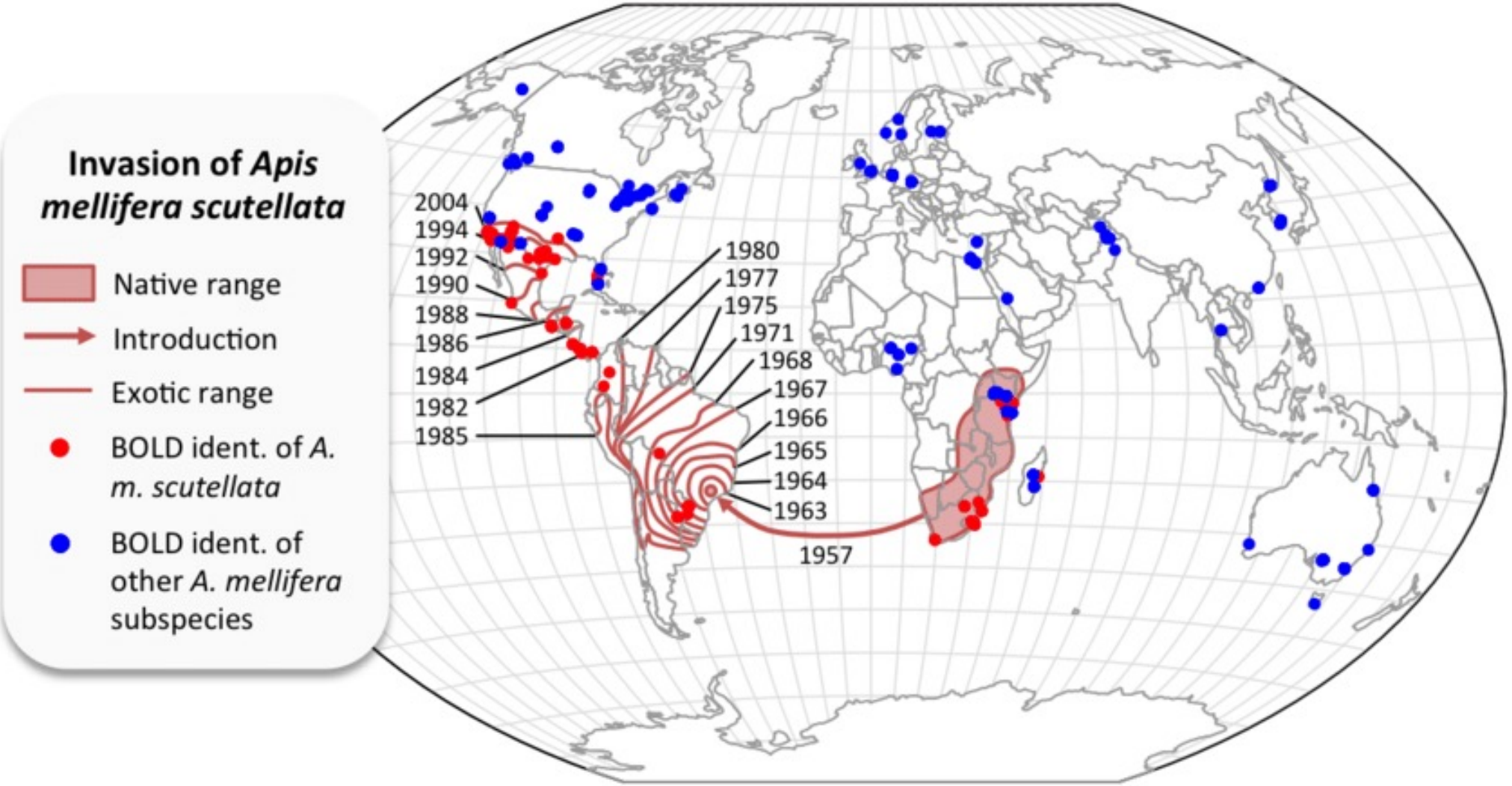
Selection of Nesting Site

European Honey Bee	African Honey Bee
Nest in large cavities, around 10 gallons in size.	Nest in smaller cavities, 1 to 5 gallons in size.
Typically nest in dry, above ground cavities.	Will nest in underground cavities with a high moisture content.
Nest in protected locations, rarely exposing the nest (Figure 5).	Will nest in exposed locations, (e.g. hanging from a tree branch) (Figure 6).
Due to larger colony size, nests are often easier to detect.	Due to smaller colony size, nests often go undetected until disturbed.

Table 1. The developmental time in days (from egg to adult) of European and African honey bees.

	European honey bees	African honey bees
Queen	16	14
Worker	21	19-20
Drone	24	24

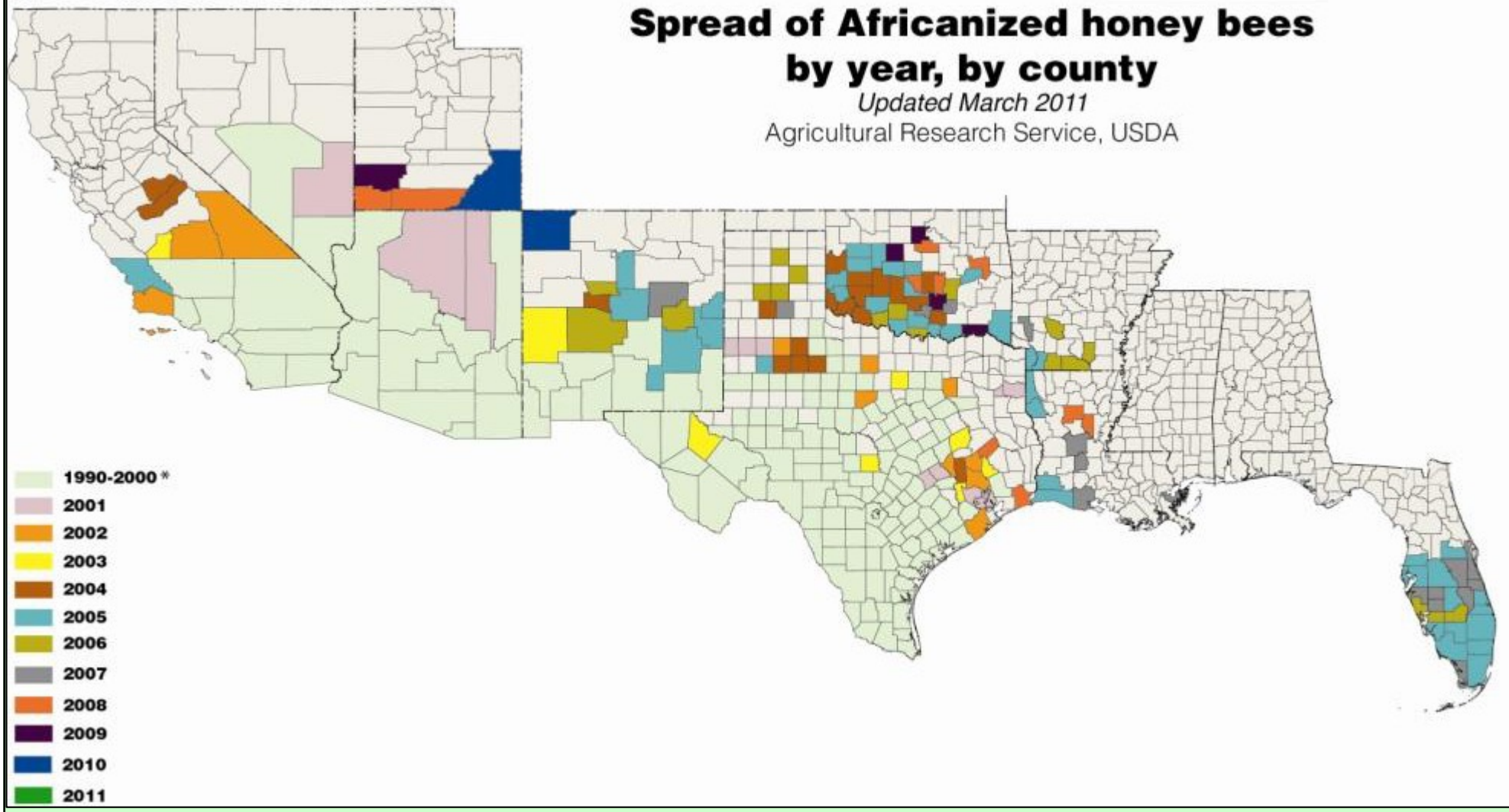
African honey bee Apis mellifera *scutellata* in the Americas.



Spread of Africanized honey bees by year, by county

Updated March 2011

Agricultural Research Service, USDA



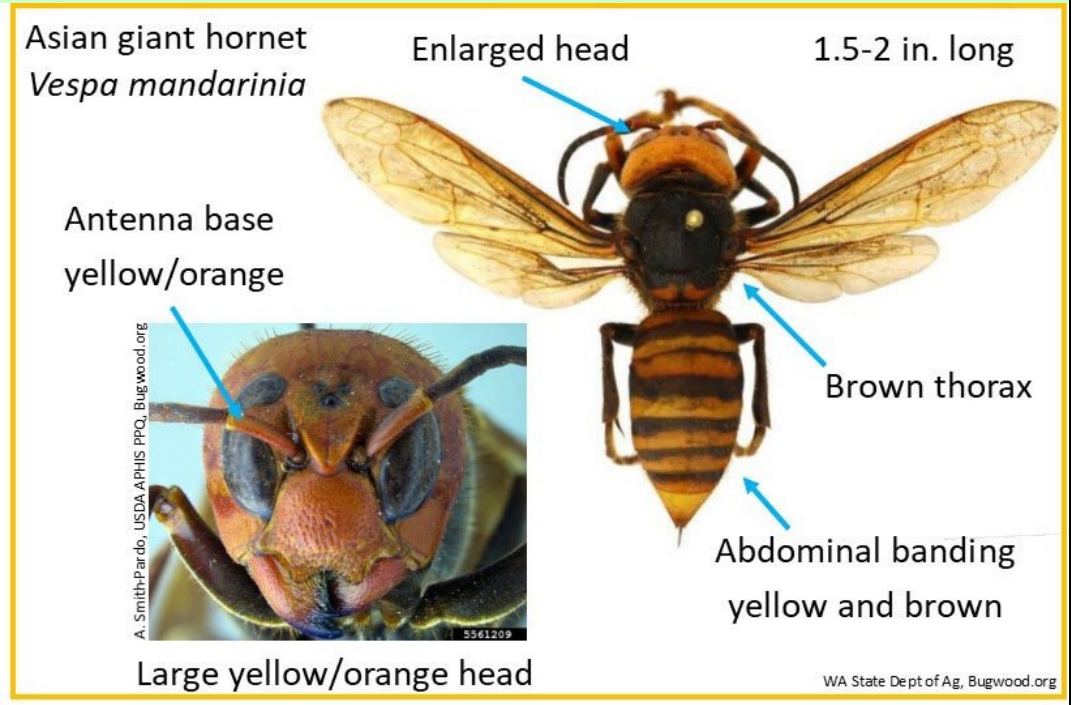
Africanized honey bee (AHB's)

Personal protective equipment (PPE) required

Stingers left behind on gloves after working with them @ University of Arizona. Each white structure is a venom sac attached to a stinger (Georgia Department of Agriculture, Bugwood.org)

Asian giant hornet

PPE also highly recommended!



Murder Hornet

Killer Bee

1 inch

Asian giant hornet

(Vespa mandarinia)

- Size large (1.25-2.5 inches long)
- Head large, completely orange-yellow
- Eyes far forward from back of head
- Antennae thin and elbowed
- Thorax dark with no light markings
- Abdomen with bold, well-defined black and yellow stripes
- Four wings (difficult to tell sometimes)
- Sparse, fine hairs all over body

honey bee

(Apis mellifera)

- Much smaller
- Dense amber hairs over much of body
- Abdomen orange-brown with brownish, often indistinct stripes

Two Hornets

Asian Giant Hornet *Vespa mandarinia* →
bright yellow head, a dark thorax, dark legs, and a dark abdomen with narrow straight yellow bands on abdominal segments
Size queens about 5 cm (2 in) workers about 3.5 cm (1.5 in)
Cheeks or genae pronounced, head rounded, nearly as wide as it is tall
space between antennal bases same color as the rest of the head
Upper lip or clypeus deeply incised

Figure 2a. Frontal view of an Asian giant hornet head showing a deeply incised clypeus. The genae are pronounced. Image credit: Allan Smith-Pardo, Invasive Hornets, USDA APHIS PPQ, Bugwood.org.

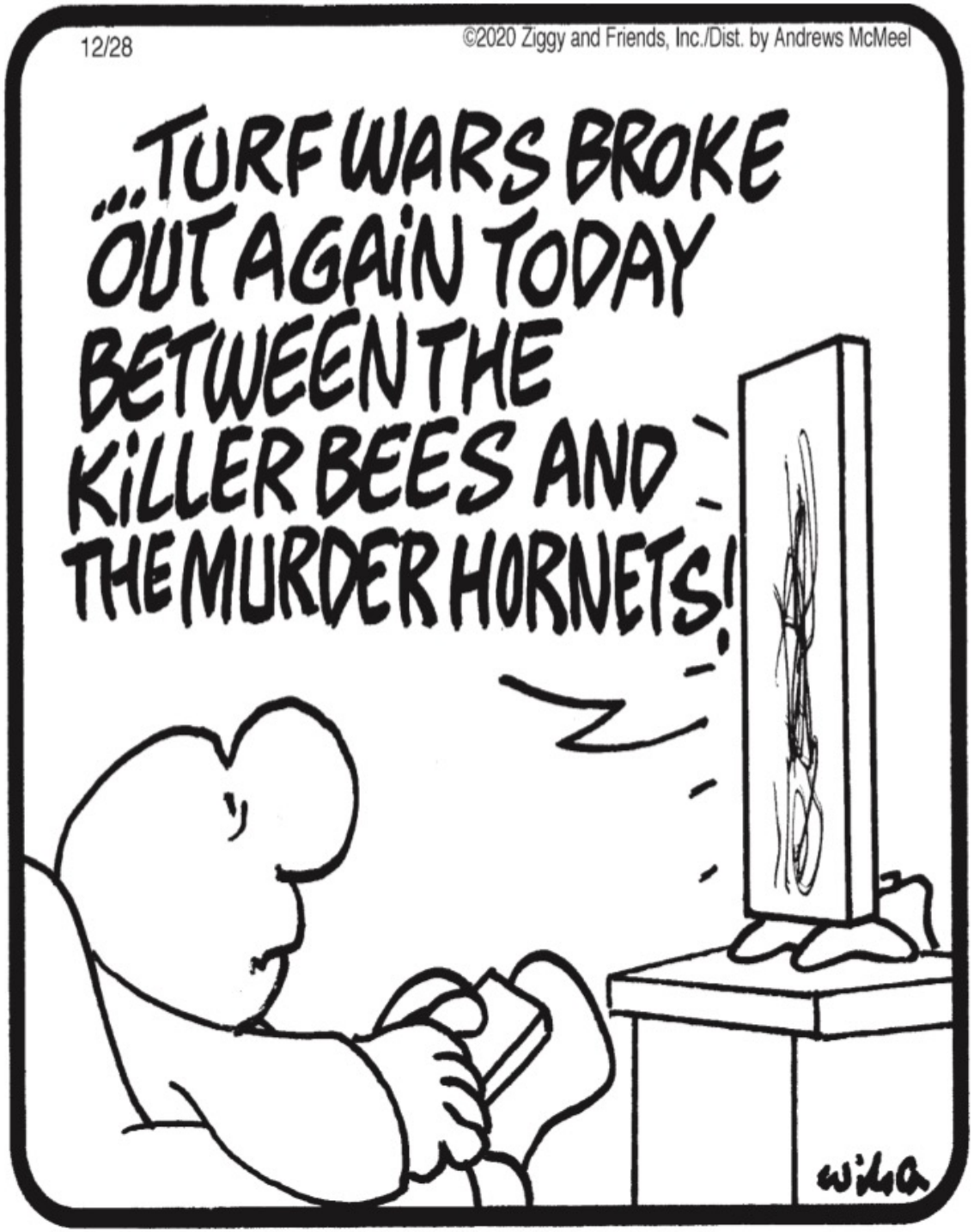
Figure 2b. Frontal view of a European hornet head showing black band between antennal bases and a shallowly incised clypeus. The genae are not pronounced. Image credit: Allan Smith-Pardo, Invasive Hornets, USDA APHIS PPQ, Bugwood.org.

Figure 1a. Lateral view of an Asian giant hornet body showing even narrow bands. The genae are pronounced. Image credit: Allan Smith-Pardo, Invasive Hornets, USDA APHIS PPQ, Bugwood.org.

Figure 1b. Lateral view of a European hornet body showing sinuous yellow bands. The genae are not pronounced. . Image credit: Allan Smith-Pardo, Invasive Hornets, USDA APHIS PPQ, Bugwood.org.

European Hornet *Vespa crabro*
← reddish/orange head and thorax, light-colored legs, and sinuous yellow bands on abdominal segments
Size queens about 3.5 cm (1.5 in) workers about 2 cm (0.8 in)
Cheeks or genae not pronounced, head more rectangular, taller than wide
dark band between antennal bases
Upper lip or clypeus not deeply incised

ZIGGY by Tom Wilson



See you next week!