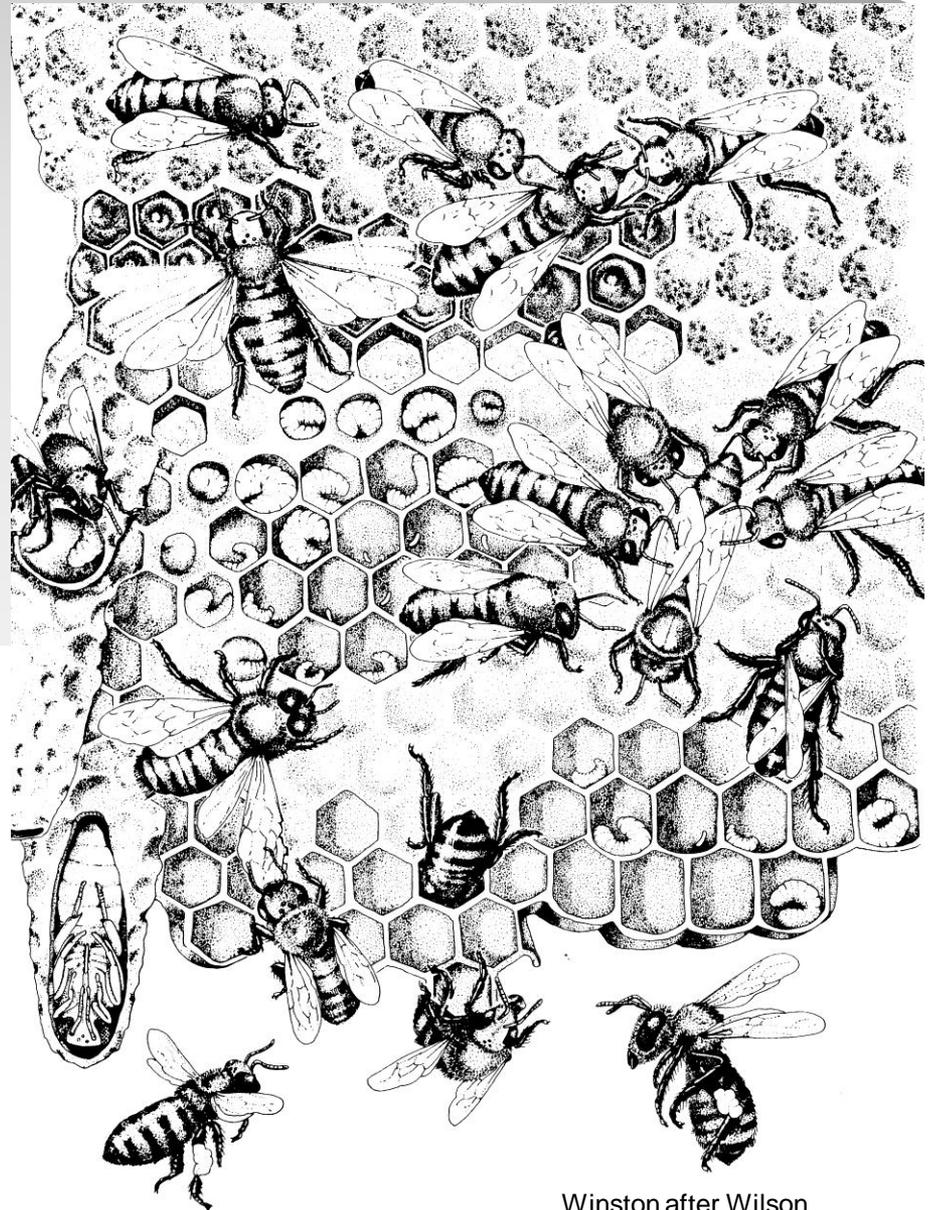
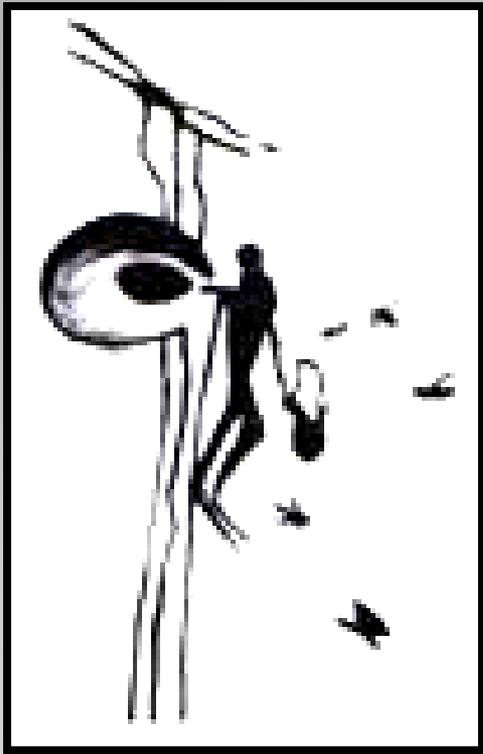


Honey Bee Biology: A Sweet Success

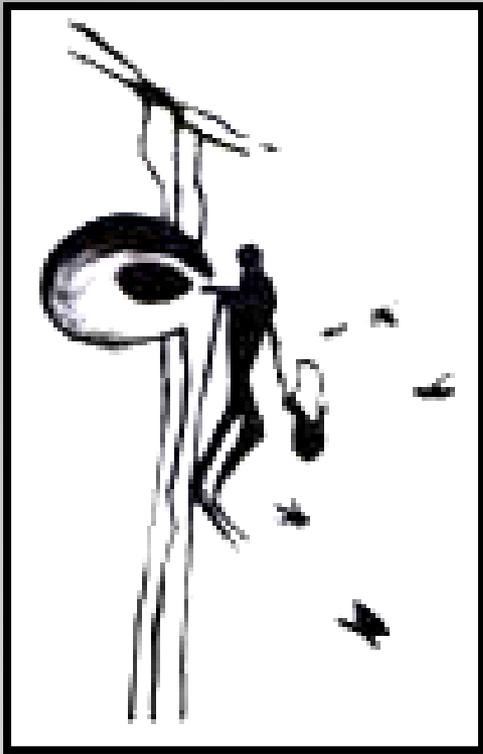
Jeff Littlefield
Dept. LRES
Montana State U. - Bozeman



Winston after Wilson



10,000 year old cave drawing - Spain

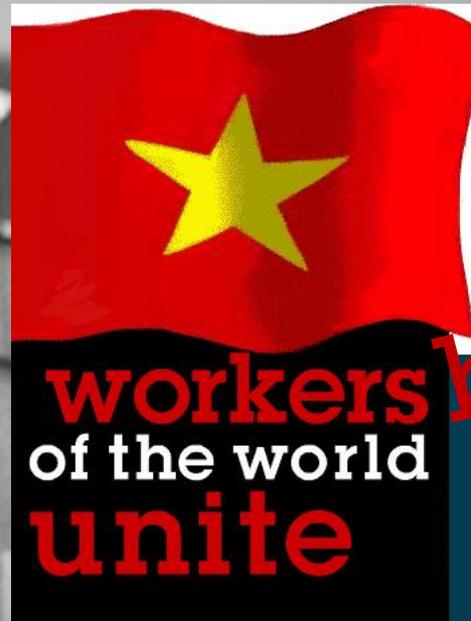


10,000 year old cave drawing - Spain

The Enslavement of Bees

“The simple fact is that the bees are enslaved. What? Bees slaves? Yes, bees as slaves.”

<http://www.vegetus.org/honey/honey.htm>



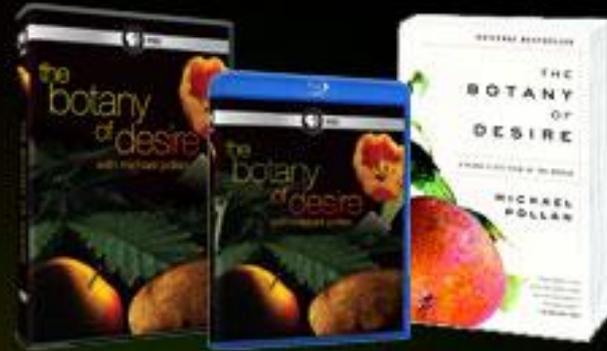
Power to the BEES!

THE BOTANY OF DESIRE



Featuring Michael Pollan and based on his best-selling book, see how four familiar species — the apple, the tulip, marijuana and the potato — evolved to satisfy our yearnings for sweetness, beauty, intoxication and control.

THE BOTANY OF DESIRE



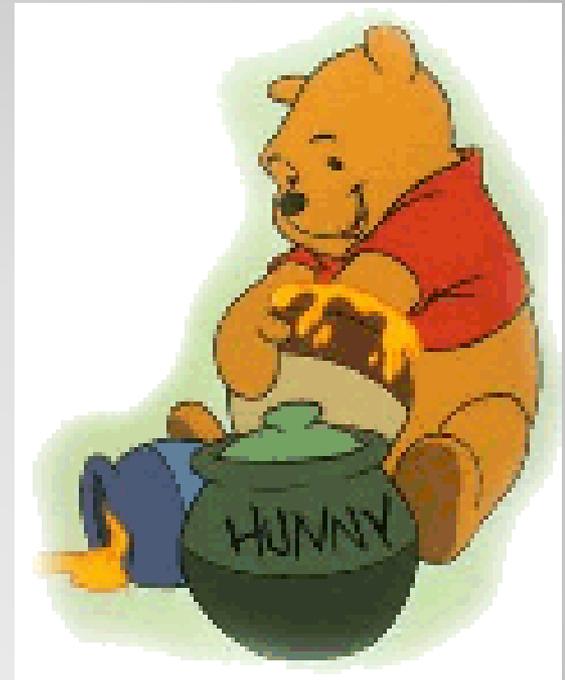
Featuring Michael Pollan and based on his best-selling book, see how four familiar species — the apple, the tulip, marijuana and the potato — evolved to satisfy our yearnings for sweetness, beauty, intoxication and control.



The Entomology of Desire

Why Are Honey Bees Important?

"The only reason for being a bee that I know of is making honey and the only reason for making honey is so that I can eat it." - W. T. Pooh



Importance of Honey Bees

Honey

- The FIRST sweetener
- Antimicrobial properties
- Fermentation product



Importance of Honey Bees

Wax, propolis, & other products

- Wax – candles, polish, cosmetics, etc.
- Propolis
- Pollen
- Royal Jelly
- Venom



Importance of Honey Bees

Pollination

- 14.5 billion dollars/year
- 130+ crops depend on bee pollination
- 80% pollination is by honey bees



<http://www.adunnphotography.com>

Importance of Honey Bees

Fun!!!



Bee History

- Evolved from wasps perhaps 150 million years ago
- A recently found fossilized bee dates back 97 million years
- First honey bee appeared 20-25 million years ago
- "Bee keeping" by humans occurred 3,500 years ago
- First time introduced into North America early 16th century



www.bursztyn.px.pl/.../boreallodape.html



Honey Bee Races

- Scientific name *Apis mellifera*
- Natural range Europe, Eurasia, Middle East & Africa
- Approximately 24 races
- Often mixed or artificially bred



Winston

Honey Bee Races

Race	Italian (Starline, Cordovan)	Carniolan	Caucasian (Russian)	German Black	Africanized (aka Killer Bees)
Species: Subspecies	<i>Apis mellifera ligustica</i>	<i>Apis mellifera carnica</i>	<i>Apis mellifera caucasica</i>	<i>Apis mellifera mellifera</i>	<i>Apis mellifera scutellata</i>
Origin	Italy	Alps, northern Yugoslavia	Caucasus Mts - Black & Caspian Seas	Northern Europe	Eastern Africa
Color	Golden yellow/ brown	Dark Gray/brown	Lead-gray	Brown/black	Golden yellow
Over wintering	Well (generally) Build quickly in spring	Well Build quickly in spring	Poorly Build slowly in spring	Well Build slowly in spring	Poorly
Other	<ul style="list-style-type: none"> - Most popular honey bee - Tend to rob other hives - Usually gentle 	<ul style="list-style-type: none"> - Swarms frequently - Construct comb slowly - Gentle 	<ul style="list-style-type: none"> - Gum up their hives with propolis (tree resins and beeswax) - Gentle to aggressive 	<ul style="list-style-type: none"> - Nervous in hive - Swarmy - Usually gentle but may be aggressive 	<ul style="list-style-type: none"> - Smaller nests and swarm more frequently - Aggressive

Why Are Honey Bees Successful?

Bees Are Social (Eusocial)

- Reproductive division of work
- Have sterile castes
- Overlapping generations
- Cooperate in care of young



P. Denke

Bees Are *Superorganisms*

► Biology of the **Individual**



► Biology of the **Colony**

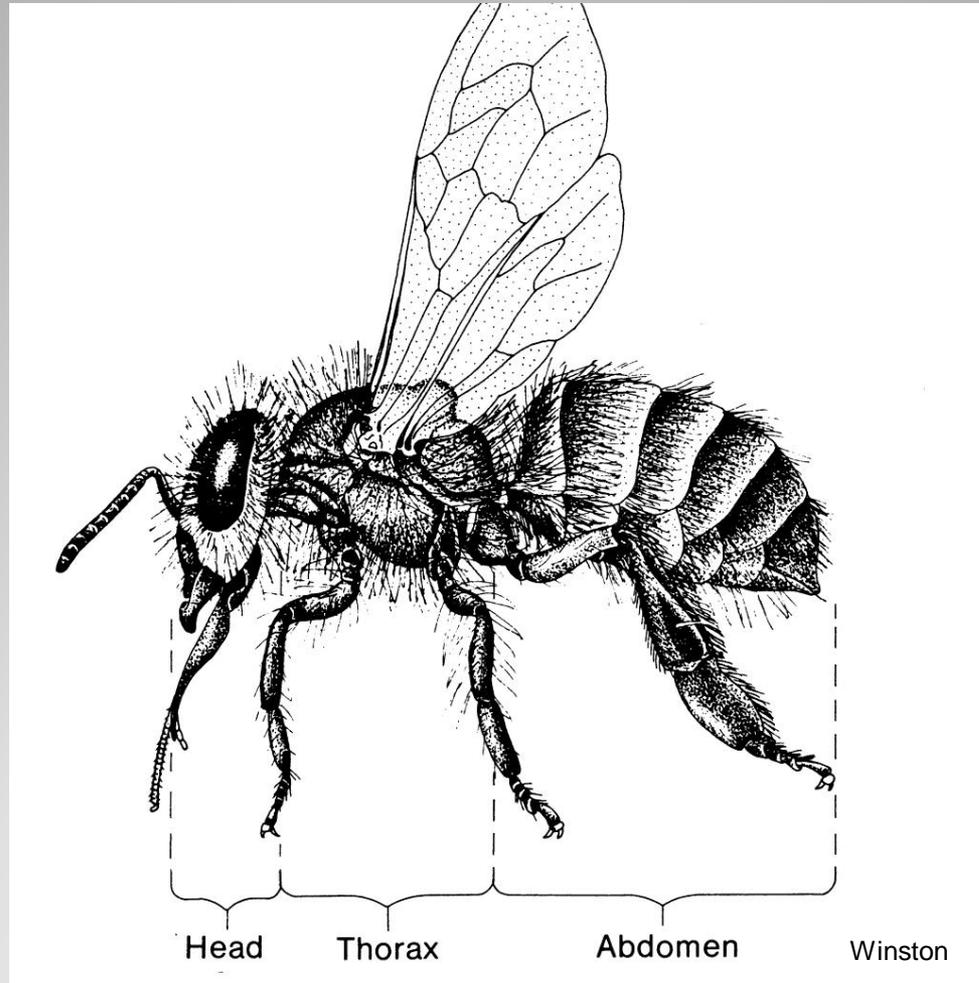
Get the Buzz on Honey Bees



This Program
Aligns with
National Standards
in Science and
Geography

scholastic.com

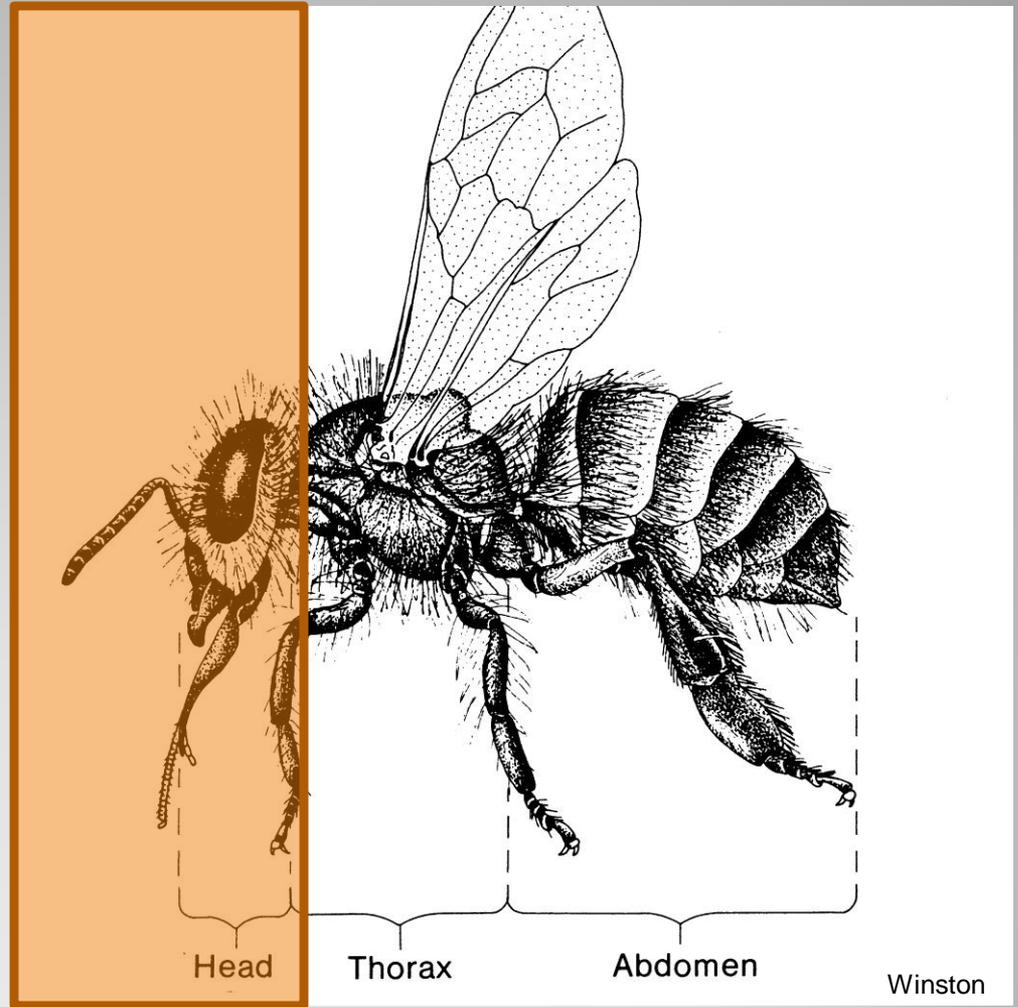
External Anatomy



External Anatomy



Z. Huang



Head

Thorax

Abdomen

Winston

External Anatomy



External Anatomy



Common buttercup

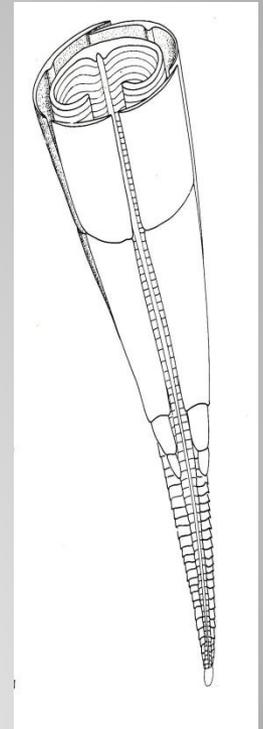
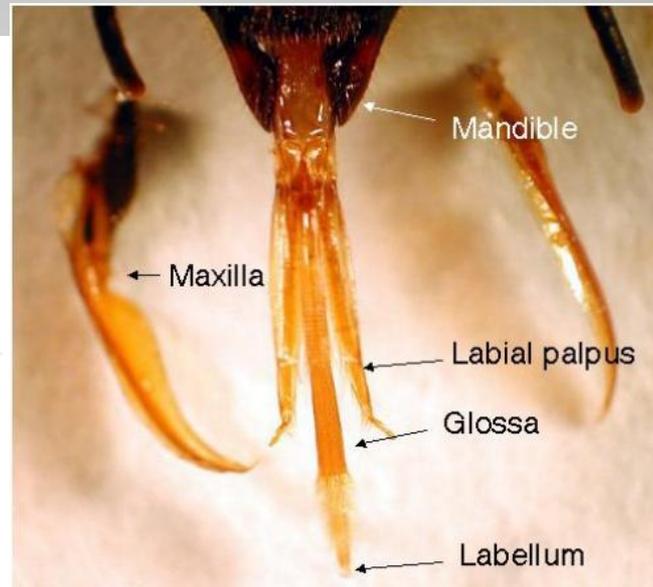
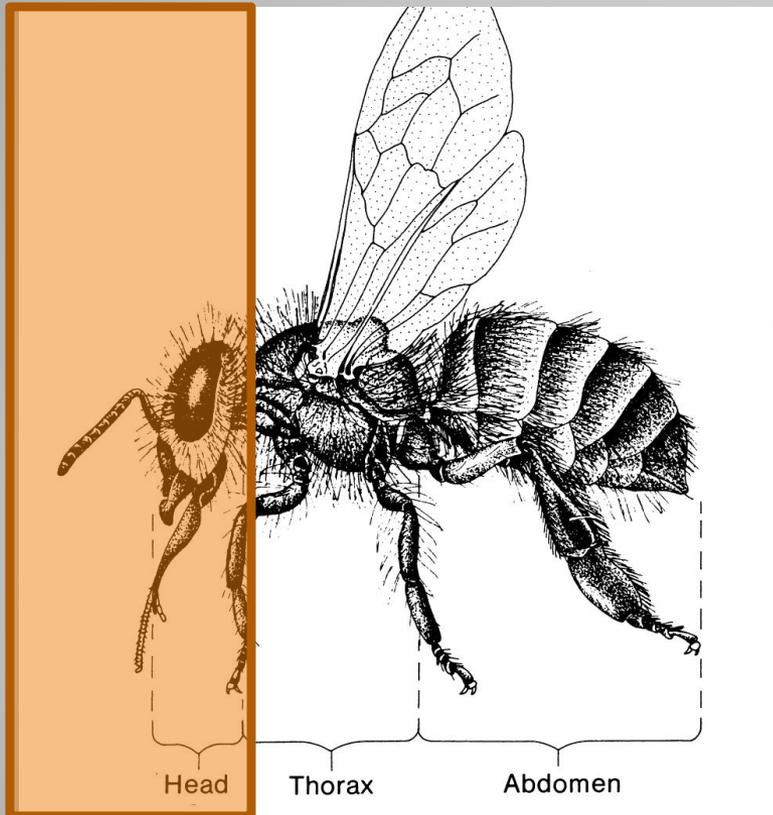
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http://www.naturfotograf.com/UV_flowers_list.html



External Anatomy

External Anatomy

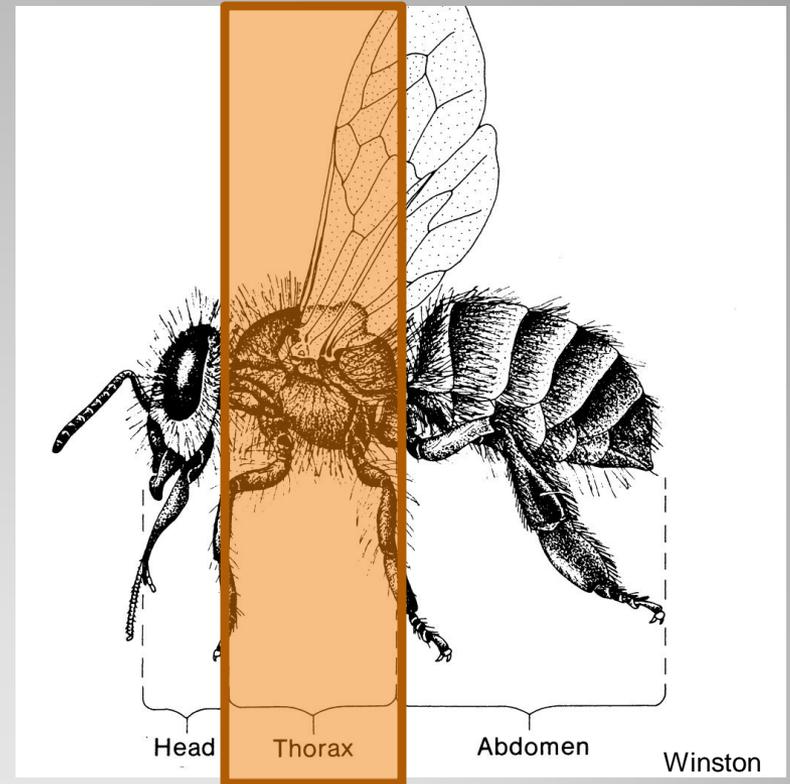
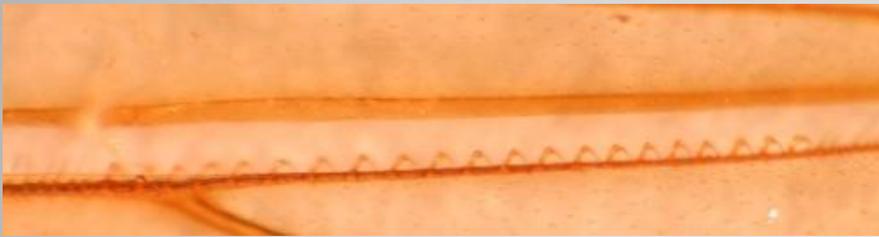


Winston

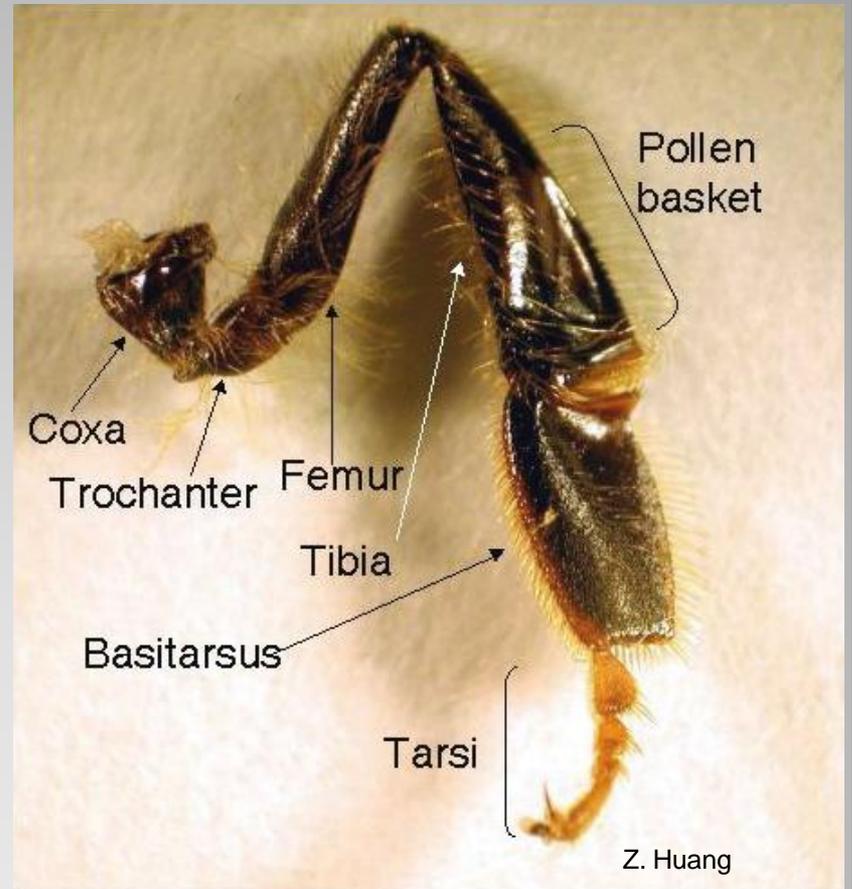
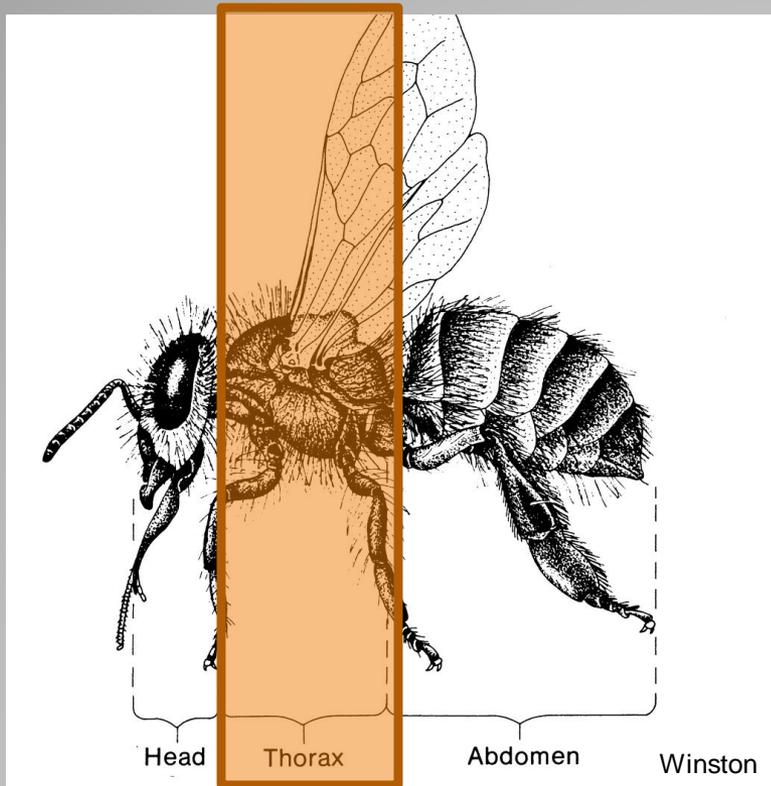
Mackean



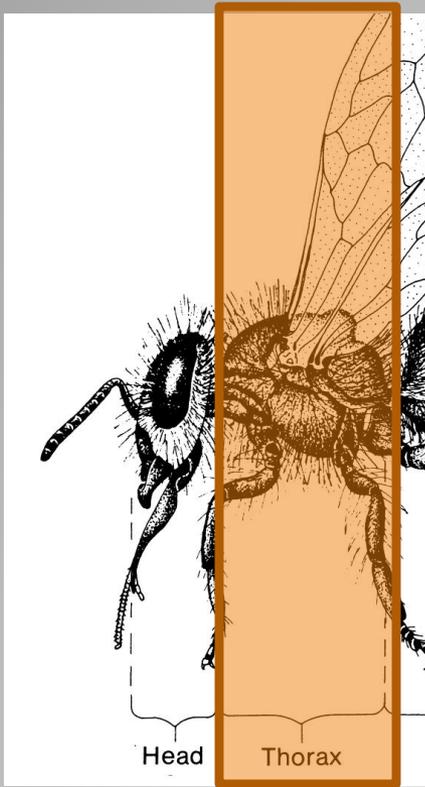
Z. Huang



External Anatomy



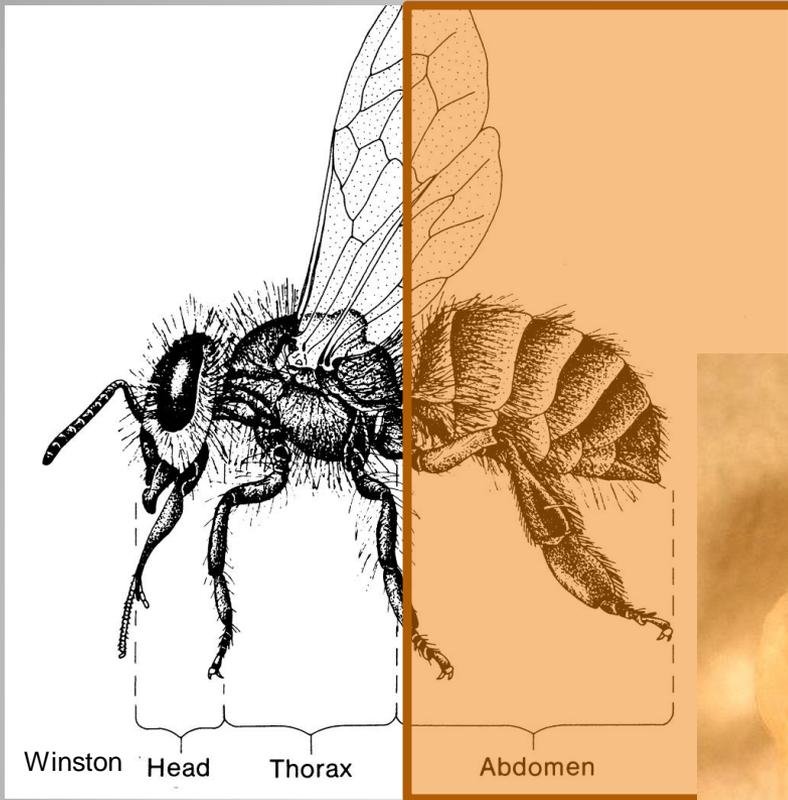
External Anatomy



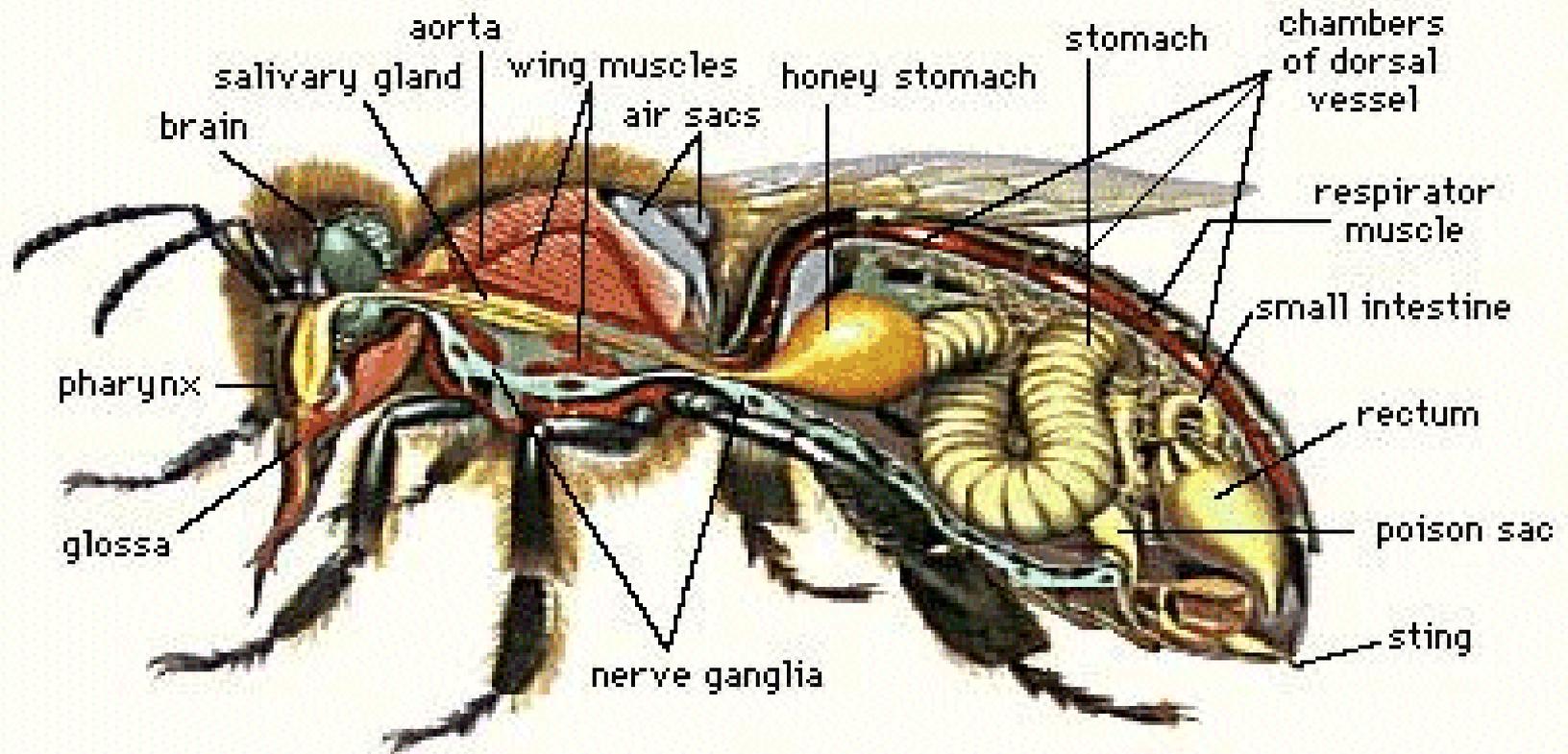
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External Anatomy

External Anatomy

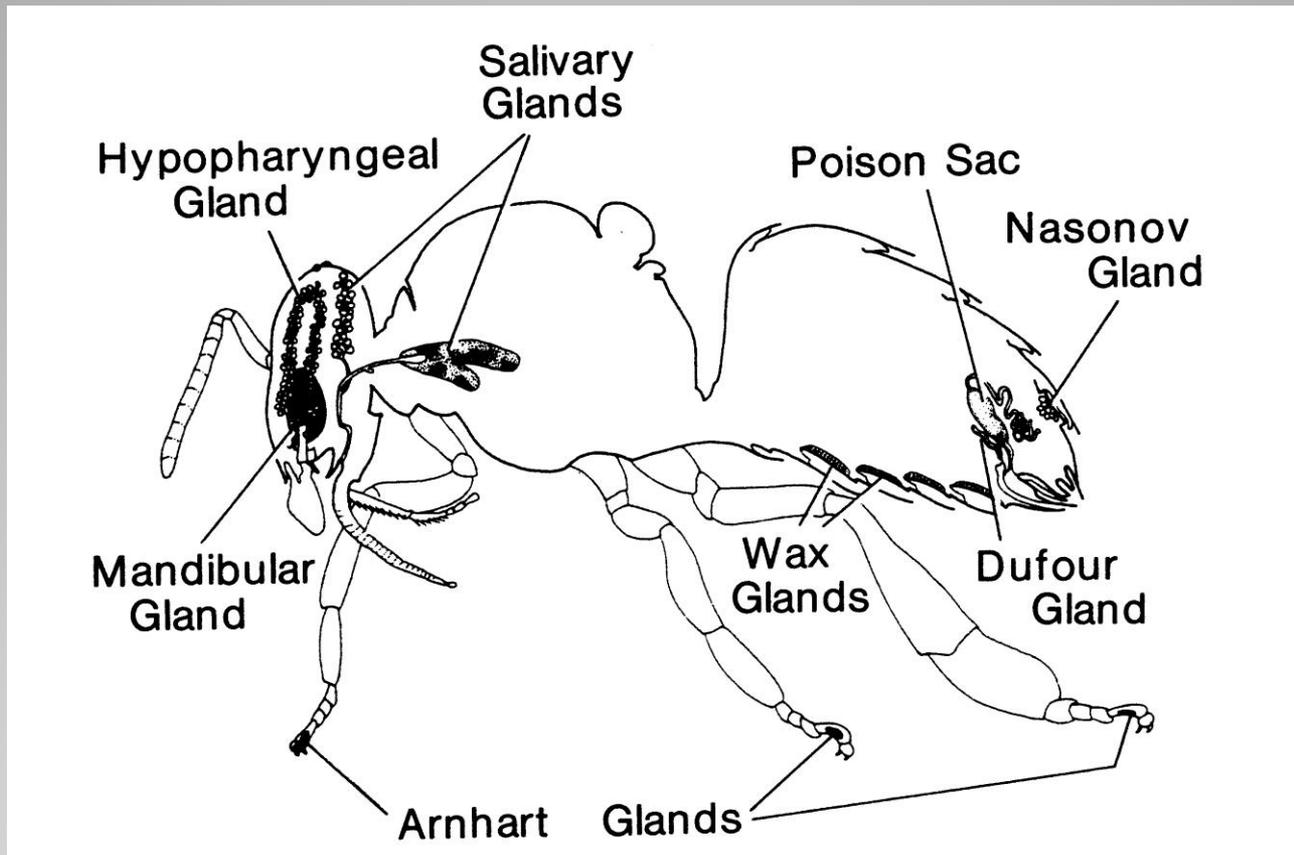


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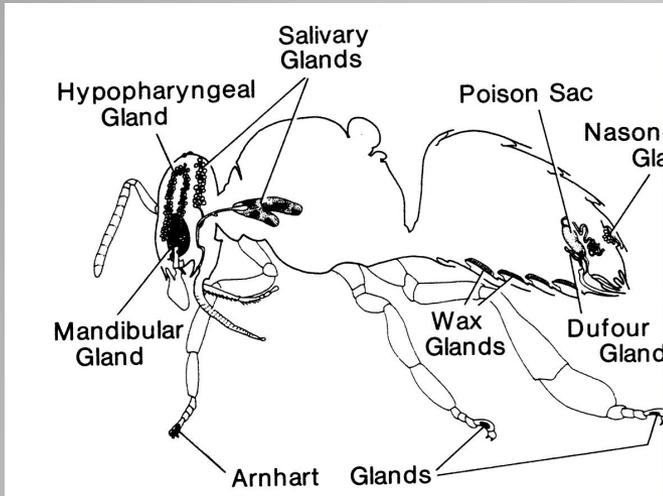


Grolier's Multimedia
Encyclopedia

Internal Anatomy



Internal Anatomy

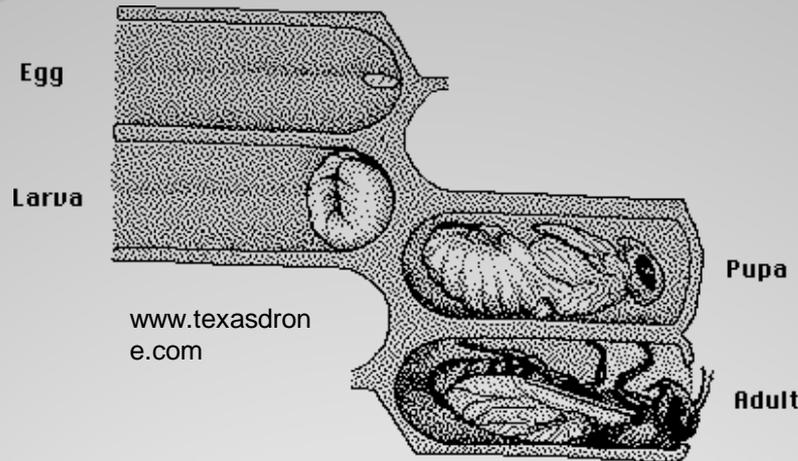


Internal Anatomy

Basic Biology Life Cycle

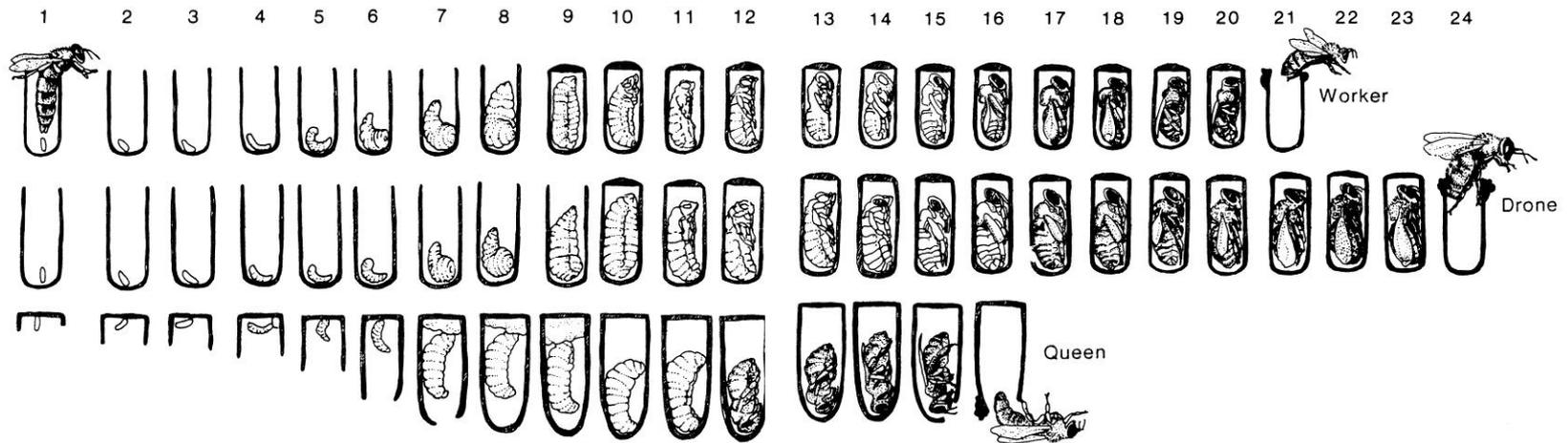


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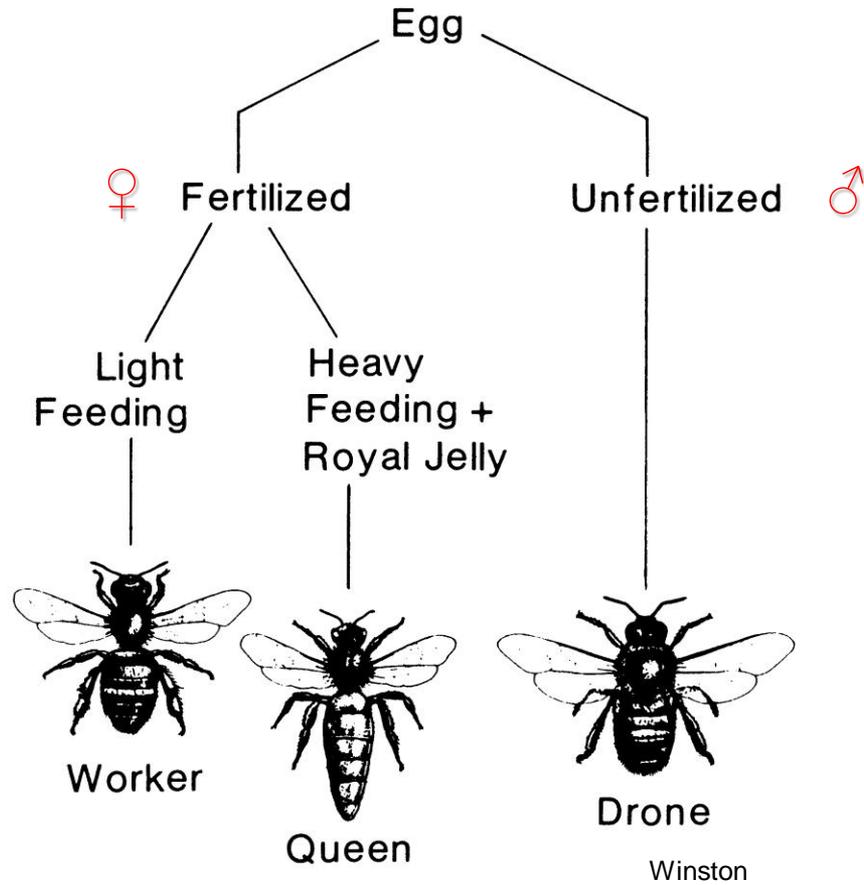
Z. Huang

Basic Biology Development



Winston

Adults



Queen

- One queen (normally)
- Only actively reproducing female
- Can produce 1,500 eggs per day at the height of the brood season
- Can live for 2-5 yrs.
- Controls the hive through pheromones





Workers

- Female
- Usually do not reproduce
- Responsible for most of the work
- Colony will have 20,000 - 70,000+
- Live for 4-6 weeks in summer, 4-5 months in winter

Drones

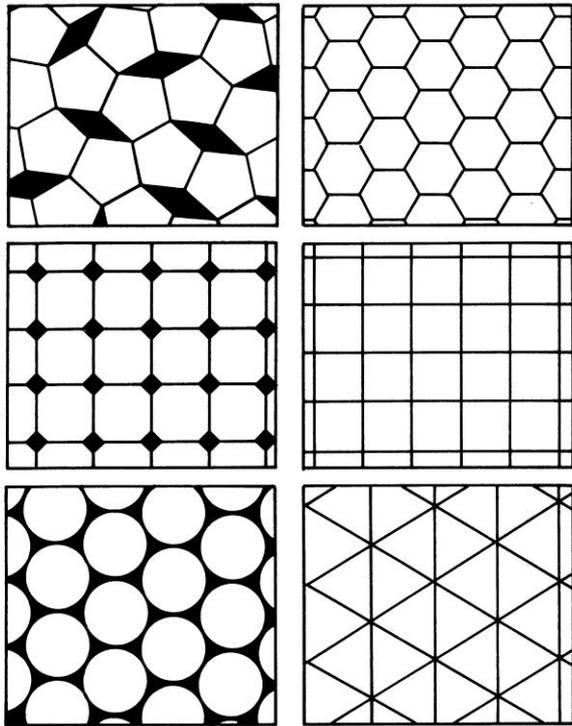
M. Frazier

- Males
- Sexually mature at 2 weeks
- Mate with female virgin queens while in flight
- Upon mating they die
- Removed from the hive in late fall



www.uni.uiuc.edu

Inside the Hive



Holldobler



Z. Huang



M. Frazier

Division of Labor

- Among females (reproduction)
- Among workers (tasks)
- Not fixed – somewhat plastic
- Depends upon
 - Age or development of the bee
 - Needs of the colony

Division of Labor Workers

Young bees:

1 to 10 days

- Cell cleaning
- Tend brood
- Cap brood
- Attend queen



Z. Huang

Division of Labor Workers



M. Frazier

Middle-aged bees:
10 to 20 days old

- Receive nectar & pollen
- Comb building
- Hive cleaning
 - Debris removal
 - Undertakers
- Climate control

Division of Labor Workers

Old bees:

20 days until death
(30-45 days)

- Foraging
 - Nectar
 - Pollen
 - Water
 - Resin
- Hive defense



Division of Labor

Foraging - Efforts

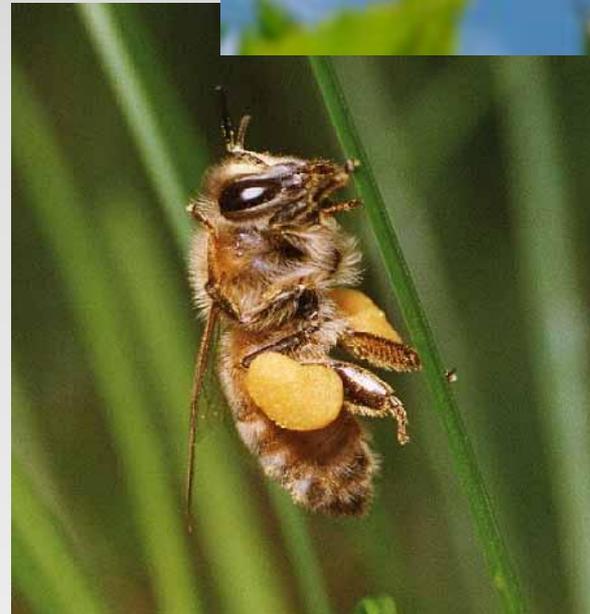
To make 1 lb honey

- Bees visit 2,000,000 flowers
- Gather 8-10 lbs nectar
- Fly 55,000 miles

The life work of 1 bee =
1/12 teaspoon honey

To make 1 lb wax

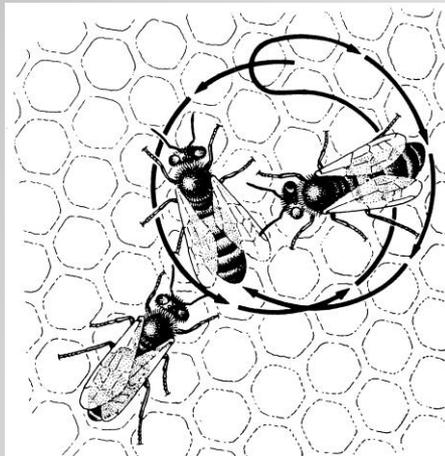
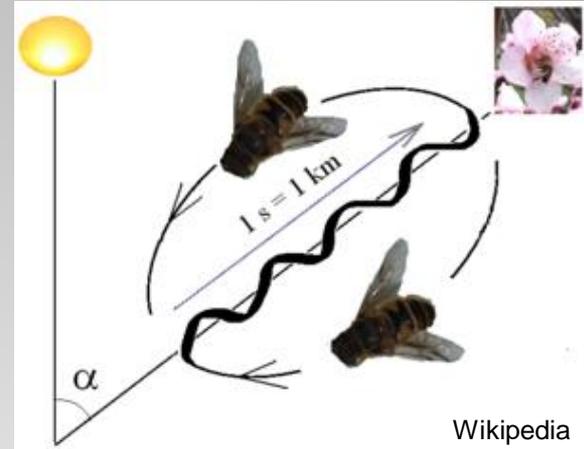
- Need to consume 8-10 lbs honey



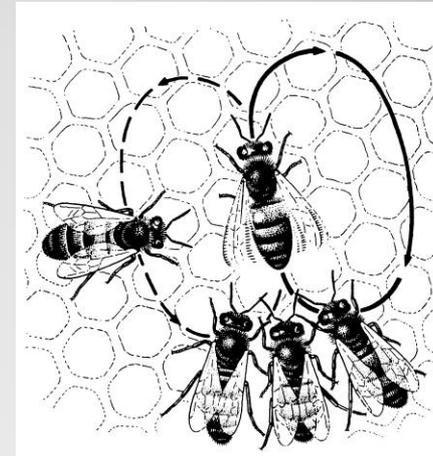
Z. Huang

Foraging

Dances – Conveys direction & distance to nectar and pollen sources



Crane after Von Frisch



Round Dance

Waggle Dance

Division of Labor Reproduction

- The Queen is the primary reproductive unit of the hive
- Fertilized eggs may become either workers or queens
- To become a queen, a larva must:
 - Be fed royal jelly
 - Be fed more food
 - Have a larger cell



Z. Huang

Division of Labor Reproduction



D. Sammataro

New Queens arise due to:

Swarming:

The queen initiates a new queen in the hive. She then leaves with a portion of the workers & starts a new hive.

Supersedure:

Workers kill off the old queen & new queens are formed. Generally to save the existing colony.

Division of Labor Reproduction

New virgin queen

- Seeks out cells and kills developing queens
- Fight to the death with other emerging queens
- She sexually matures within a few days & makes her mating flight
- Returns to the hive & begins to lay eggs after a few days



M. Frazier

If she does not return to the hive -



A colony of drones



M. Frazier



bees.limey.net/

Slide after M. Frazier

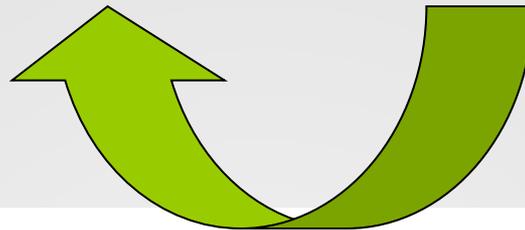
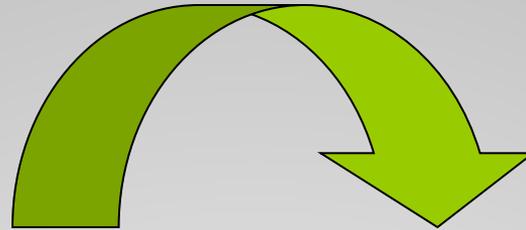
Seasons of the Hive

Winter

- Maintenance of colony & temperature
- Conservation of food

Autumn

- Maintenance of colony
- Conservation of food
- Reduce brood
- Death of drones



Spring

- Increase brood production
- Start of foraging

Summer

- Foraging
- Brood production
- Comb production
- Drone development
- Swarming & queen mating

Acknowledgements



Winston, Mark L. 1987. The biology of the honey bee. Harvard University Press. 281 p.

Crane, Eva. 1990. Bees and beekeeping : science, practice, and world resources. Comstock Pub. Associates. 614 p.

Frazier, M. Penn State University
Understanding Honey Bee Biology- The Key to Successful Beekeeping
http://www.ento.psu.edu/teaching/main/bees/honey_bee_biology010304.pdfHuang.

Bjørn Rørslett,
http://www.naturfotograf.com/UV_flowers_list.html

National Honey Bee Board, www.honey.com

Photos from Huang, Z. Michigan State U. Bee Photos. <http://photo.bees.net/gallery/>, and various other photographers & sources that I ripped off from the Internet.