An infinity of these tiny animals…

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1

What is entomology?
Who are insects related to?
Why are insects so successful?
What do they perceive?
What are they doing out there?
How do you collect them?



2

Entomology--why bother?

What is entomology?
The study of insects.
A large and diverse field of study.

Most animals on Earth are insects,
for both number of species and number of individuals.

Arthropods make up approximately 75% of all species, and
the majority of arthropods are insects.


3

~1,500,000 insects
~142,000 non-insect arthropods

Insects are related to all other arthropods

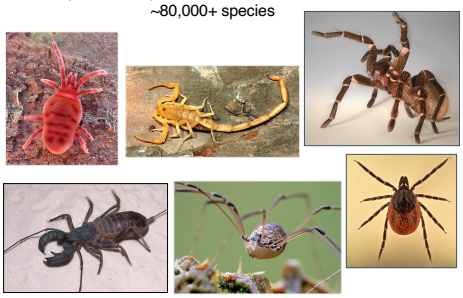
43,000 chordates
248,000 vascular plants

mammals

4

Arachnida

spiders, scorpions, ticks, mites, harvestmen
~80,000+ species



5

Chilopoda

centipedes
~2,600 species

6

Diplopoda

millipedes
~10,000 species




7

Malacostraca

(Crustacea)
crab, shrimp, lobsters, crayfish, pillbugs
~50,000 species




8

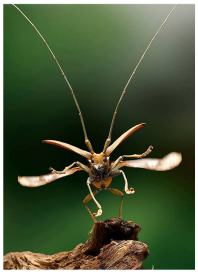
Insecta

~1,500,000 species

Contains ~31 orders
Largest class of animals
Three body parts or regions


9

One pair antennae
Three pairs of legs
Usually with 2 pairs of wings



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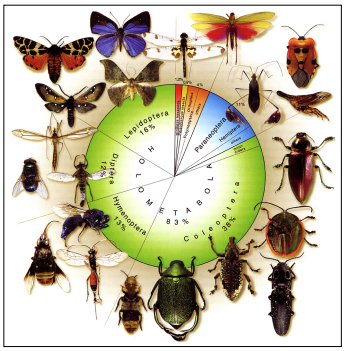


11

new species are common

12

Estimated ratio of insects to humans is 200,000,000:1

Estimated 400 million insects per acre

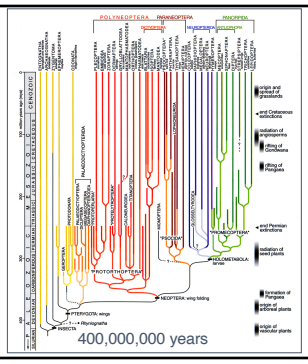
13

Animal biomass:
birds = 1 lb./acre
insects = 400 lbs./acre (temperate)
insects = 2000 lbs./acre (tropics)

Collembola
100 million/meter^2 on Iowa farm

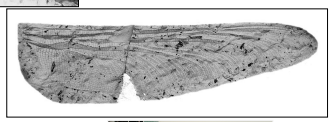
14

insects are a very old group ~400 million years old



15

Frank Carpenter
Harvard University
Elmo, KS



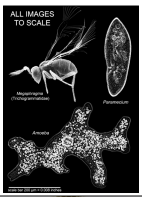
Megatypus schucherti
1939, Permian
F.A. Holmes

16

Insects are obviously very successful!
# of species, # of individuals, geological age
Why?

17

1. Small size
low energy & nutrient requirements
exploit microhabitats
high dispersal ability - even wind
put more energy into reproduction
instead of growth & maintenance



18

2. Short generation times

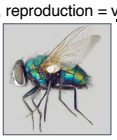
fast population growth
adapt and evolve rapidly
evolution occurs over generations

bison: slow growth & reproduction = slow generation time

grasshopper: rapid growth & reproduction = fast generations


19

fly: very rapid growth, reproduction = very fast generations

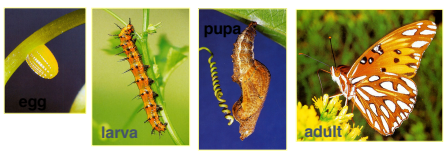


insects can go through 1000s of generations in a short time
compared to the lifetime of one vertebrate evolve faster


20

3. Metamorphosis

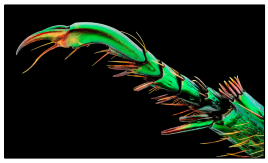
limits intraspecific competition
resistant life stages - egg, pupa
division of "labor" - feeding/growth vrs. reproduction
able to exploit different niches or resources



21

4. Exoskeleton

protection
structures
allows for complex movements



22

5. Flight

beat birds by at least 150,000,000 years!

23

6. Complex behaviors

sophisticated behaviors
social structure

ant ranchers

honey bees

jewel wasp

24

7. Coevolution with angiosperms (flowering plants)

diversity driving diversity
evolutionary arms race
use of plant chemicals

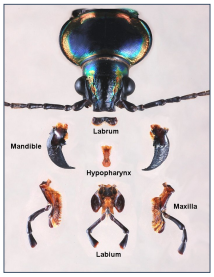
25

Exoskeleton is great stuff!

26

Chewing mouthparts

most common type and least evolved



27

28

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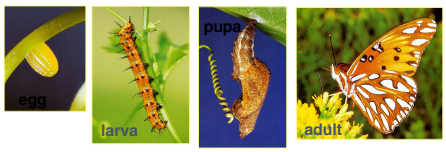

31

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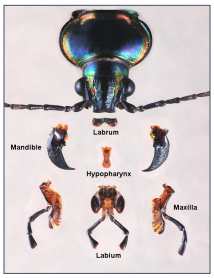


37

38

Modifications of basic chewing mouthparts allow insects to exploit a wide variety of food sources

39

Let's take a break!

40

Wings made of exoskeleton

41

A major reason insects are so successful

1. Provide excellent mobility
2. Carry to food source
3. Used to find mate, in courtship displays, and mating flights

4. Can be used for thermoregulation, directly or to cool nest

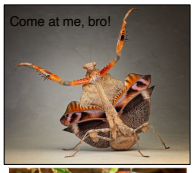
42

5. Can serve as a "gill" in aquatic insects
diffusion of oxygen


6. Produce sounds for communication


43

7. Used in threat or startle displays





44

Wings do not merely flap up and down
they twist, move forward and backward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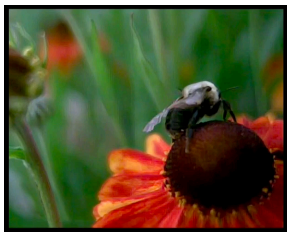


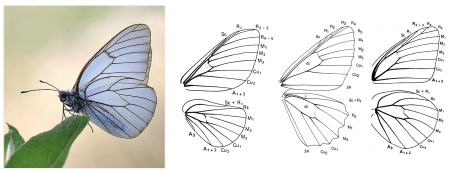
https://ultraslo.com

46

Wingbeats per second:		Speed:	
dragonfly	28	dragonfly	18 mph
butterfly	9-12		
honey bee	100-250	honey bee	13 mph
house fly	190	house fly	4 mph
mosquito	279-587	deer fly	24 mph

47

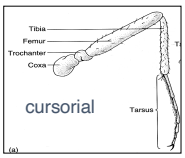
Wing veins often important to identify insects



Wings open up many niches and frontiers for insects, are a critical factor in the success of insects.

48

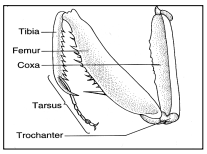
Legs can be modified for specific functions



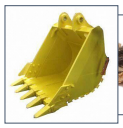
tiger beetle 5 mph
120 body lengths/second

Usain Bolt
27 mph
6 body lengths/second

49



raptorial



fossorial

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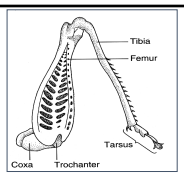

saltatorial

51