For many weeks, the two species had lived in mutual tolerance of one another. And then, without provocation, the hornets began throwing rocks at Ned’s house.
Goals:

1. Define success
2. Compare insects to other living organisms, understand what insect adaptations have contributed to their success
3. Relate methods of attaining success to the human race

Assignment: Read: Chapter 22 or 23 or 11 depending on the book

Websites:
http://entowww.tamu.edu/images/insects/fieldguide/glossary.htm
http://www.hollowtop.com/finl_html/finl.html
http://www.antcolony.org/Army_ants.htm
http://www-micro.msb.le.ac.uk/224/Parasitol.html
http://www.uky.edu/Agriculture/Entomology/ythfacts/bugfood/bugfood.htm
http://www.aloha.net/~smgon/triloclass.htm
http://www.ucmp.berkeley.edu/diapsids/dinosaur.html
http://www3.sk.sympatico.ca/robss/overview_htm.html
http://www.belmont.edu/Science/Biology/Bio112/Arthropoda.html
http://scarab.msu.montana.edu/academic/204classif.html
http://www.earthlife.net/insects/anatomy.html
http://www.earthlife.net/insects/six01.html
http://www.biophotos.com/whitten/specimens.html
Biological Classification

Kingdom, Phylum, Class, Order, Family, Genus, Species

Binomial Nomenclature  *Leptinotarsa decemlineata*

Look this up for Humans and know it!
Phylum Arthropoda

1. Exoskeleton
2. Segmented body
3. Jointed appendages
4. Double ventral nerve cord
5. Open circulatory system
6. Bilateral symmetry
7. Sexual Reproduction
### Classes of Arthropoda

<table>
<thead>
<tr>
<th>Class</th>
<th>Common Name</th>
<th>Environment</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merostomata</td>
<td>Horseshoe Crab (5)</td>
<td>Aquatic</td>
<td>3-60mm</td>
</tr>
<tr>
<td>Pycnogonida</td>
<td>Sea Spider (500)</td>
<td>Aquatic</td>
<td></td>
</tr>
<tr>
<td>Pauropoda</td>
<td>None (380)</td>
<td>Soil</td>
<td></td>
</tr>
<tr>
<td>Symphyla</td>
<td>None (120)</td>
<td>Soil</td>
<td></td>
</tr>
<tr>
<td>Crustacea</td>
<td>Sow Bug, Lobster (26,000)</td>
<td>Aquatic</td>
<td></td>
</tr>
<tr>
<td>Diplopoda</td>
<td>Millipede (8000)</td>
<td>Terrestrial</td>
<td></td>
</tr>
<tr>
<td>Chilopoda</td>
<td>Centipede (3,000)</td>
<td>Terrestrial</td>
<td></td>
</tr>
<tr>
<td><strong>Insecta</strong></td>
<td><strong>Insects (1,000,000)</strong></td>
<td>Aquatic, Land, Air</td>
<td>.1mm-25cm</td>
</tr>
</tbody>
</table>
Class Insecta

1. Three Body Regions
2. Three pairs of legs
3. Most groups have functional wings
4. One pair of antennae
5. Tracheae respiratory system
6. Unique biology
Criteria for measuring success

1. Historically successful
2. Current diversity
3. Environmental impact
Historically Successful

1. Trilobites – 600x10^6 ago, fossils = hard exoskeleton
Historically Successful

2. Dinosaurs – 230 x 10^6 ago, first terrestrial egg

Died out 65 x 10^6 years ago
Historically Successful

3. Brachiopods - hard shells, diverse forms, Been around $545 \times 10^6$ years
Historically Successful

3. Insects -

- Oldest fossils $400 \times 10^6$ years old
- These fossils are already well developed
- Hard to find good insect fossils
Current Diversity

Tale of the Tape

Number of described species

- insects
- plants
- non-insect arthropods
- mulluscs
- fungi
- Protozoa
- algae
- mammals

Only 4,000!
Insects can be found in almost every ecosystem on earth.

Insects are vital components of food webs.

Insects have important human impacts as well:

- Transmit disease to us, our crops and our domesticated animals
- Feed on the same things we like to eat
- $$: \text{Pollination, silk, dyes, FOOD!}$$
Success?

1. Insects are arguably the most successful group of animals alive.

2. One-celled organisms may rival insects in number, but it’s hard to tell.

3. What about mammals?! Weight? size?
Life history strategies: The Tortoise vs. the hare

1. The Tortoise

• High survival rate, parental care, extended individual life, offspring training

2. The Hare

• Short lives, small size, high reproduction offsets high mortality
Insect adaptations that contribute to success

1. Exoskeleton
2. Jointed Appendages
3. Wings
4. Size
5. Metamorphosis
6. Ability to escape adverse conditions
7. Methods of Reproduction
8. Short generation time
9. Specialization
10. Methods of solving the water problem
Exoskeleton—Look ma, no bones!

- Overlapping chitin plates -- like a suit of armor
- Protectors from damage and water loss
- Attachment for muscles
Jointed appendages

Usually specialized for the insect’s lifestyle

Running, jumping, grasping, swimming, digging
Wings

- Insects have been flying for over 250 million years!
- Give an advantage over non-flying organisms
- Insects have been flying for over 250 million years!
Size matters:
Even the largest insects are small

• Easier to hide
• Easier to disperse
• Need less food
Why aren’t insects gigantic?

Largest Insect ever: Meganeura

Insects Limited By:
1. Respiratory system
   - Spiracles
   - Trachea
   - Air sacs

2. Musculo-skeletal system

http://ask.yahoo.com/ask/20011220.html
http://www.uky.edu/Agriculture/Entomology/ythfacts/bugfun/trivia.htm
Metamorphosis

• Allows one organism to utilize multiple habitats

• Or to become more specialized
Defense!!

- Flying away
- Hiding in plain sight
- Scaring away
- Brute force

Monarch
Poisonous

Viceroy
Non-poisonous

Hiding in plain sight
Diapause

- A period of slow development and metabolism
- Usually due to adverse weather: cold, lack of water, etc.

Hibernal diapause - winter

Aestival diapause - summer
Methods of solving the water problem

• Wax layers in cuticle

• Metabolic water

• Condense water from the air

• Conserve water by excreting pellets of uric acid, rather than urea
Methods of reproduction

Apis mellifera
The honey bee

Aphids

Tiger Beetles

Dragonflies

Argia moesta ovipositing
The insect with the shortest known generation time is the apple grain aphid (*Rhopalosiphum prunifoliae/fitchii*), which can bear live young only 4.7 days after being born. Other kinds of aphids are almost as prolific, bearing live young anywhere from five to seven days after being born. Such rapid-breeding aphids are parthenogenetic. They are so prolific that when they are born they already carry the embryos of their first children.

**Allows rapid adaptation**
Specialization
Entomophagy

Man eating Bugs
Proverbs VI: 6

Go to the ant, thou sluggard; consider her ways, and be wise.