• Reminder: Exam #3 Next Week

• Turn in Homework Assignment

• Chapter 13: Forces of Evolutionary Change

• Chapter 15: Evidence of Evolution

• Chapter 14: Speciation & Extinction
Headstander Beetle: Illustrates unusual adaptations and the unity & diversity of life
Evolution: genetic change in a population over time

- Darwin provided evidence and a mechanism
Darwin: “Descent with Modification”

Fig 13.3, pg 266
Natural Selection: Differential reproductive success of individuals with different phenotypes

**NOTE: Natural selection functions at the POPULATION level**
• Artificial Selection (selective breeding) provides evidence for natural selection
• More Artificial Selection…

Cabbage, kale, cauliflower, broccoli, and Brussels sprouts: all derived from wild mustard
• Gene pool – collection of genes (alleles) in a population at any one time
• Microevolution – changes in the gene pool
Natural selection is not “goal-driven”

• No formation of a supremely adapted “perfect” organism
3 Modes of Natural Selection

• Name and describe the 3 modes of natural selection. Give an example of each.
Chapter 15: Evidence of Evolution
• Direct Observations of Evolutionary Change
Fossils: Strong evidence for evolution

• How are they formed?

Fig 15.4, pg 311
Types of Fossils

- Hard parts
- Amber or ice
- Trace fossils
- Index fossils
Strata can tell us *relative* age.
Radiometric Dating can tell us **absolute age**

- Uses half-life of radioactive isotopes

Fig 15.6, pg 313
Other lines of evidence for evolution

- Biogeography – geographic distribution of species

Giant Galapagos tortoise: Closest relative is from South America
Biogeography + Plate Tectonics = More evidence for evolution!
• Homology – similarity resulting from common ancestry

Forelimbs: Same arrangement of bones, very different functions!
Some anatomical parts are analogous (evolved independently)

Wings: Same function, different materials & organization
Vestigial Structures

- Structures with little or no current importance but which were important in ancestors.
• Comparative Embryology – Comparison of early stages of development
Haeckel “fudged” his drawings, but photos now reveal true similarity in embryonic structure.
- Molecular Biology – Sequencing of DNA and encoded proteins gives clues to evolutionary relationships (Molecular Homologies)

### Cytochrome c Evolution

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<th>Organism</th>
<th>Number of amino acid differences from humans</th>
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<tr>
<td>Chimpanzee</td>
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<td>Rhesus monkey</td>
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<td>Rabbit</td>
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<td>Cow</td>
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<td>Yeast</td>
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Fig 15.14, pg 319
Chapter 14: Speciation & Extinction
Macroevolution

- Evolutionary change on a large scale, including the origin and extinction of species
What is a species?

- Biological Species Concept: A group of populations whose members have the potential to interbreed and produce viable, fertile offspring.

- Western Meadowlark
- Eastern Meadowlark
- Both *Pheidole barbata* (NOT the same species!)

- (The same species!)
What is a species?

- Morphological species concept: Species are defined by measurable anatomical traits
Ecological species concept: Species are defined by their “niche” (role in the environment)
• Phylogenetic species concept: Defines a species as the smallest group of individuals that share a common ancestor.
What prevents species from interbreeding?

• Prezygotic Barriers – *prevent* mating or fertilization

1 – Temporal isolation: Mating occurs at different times

Eastern Spotted Skunk

Western Spotted Skunk
2 – Habitat Isolation – Populations live in different habitats within same region

Aquatic Garter Snake

Terrestrial Garter Snake
3 – Behavioral Isolation – No sexual attraction between species

Male fireflies flashing in unison to attract female fireflies of same species
Mechanical Isolation – Genitalia with structural differences or flower structures to prevent pollen transfer.
5 – Gametic Isolation – Copulation or spawning may occur but gametes die before uniting
• Postzygotic Barriers – Operate after hybrid zygotes are formed

1 – Hybrid Inviability – The hybrids do not survive

Green frog (Rana clamitans)  Wood frog (Rana daemeli)
2 – Hybrid Sterility – Hybrids live but cannot reproduce

Ex: Horse + Donkey = Mule
Mules are sterile

Ex: Lion + Tiger = Liger
Ligers are sterile
3 – Hybrid Breakdown – 1\textsuperscript{st} generation hybrids are healthy & fertile but subsequent generations are weak or sterile
How does speciation occur?

• Name and describe the three main modes of speciation. Give an example of each.