

Biol 112

Lecture 2: Evolution and Natural Selection

LAB REMINDERS

- PICK UP YOUR TICKET FOR THE HMNH.
- NEXT WEEK GO to the museum
- YOU CAN GO ANYTIME BUT YOUR TA's will be there during your scheduled lab time (except WED- will be there Sunday instead)
- If you want help from a TA it doesn't have to be yours
- TURN IN YOUR PIN FROM THE MUSEUM

Natural Selection- Darwin's observations

- Variation exists in populations
- Most organisms have a higher reproductive potential than observed number of offspring

Variation in populations



QuickTime™ and a decompressor are needed to see this picture.

Pinguicula.org

Heritability of traits

- Natural selection affects individuals with traits that are inherited (passed on from parents through genes)
- Some traits vary due to environmental factors. These traits would not be subjected to selection because the variation can't be passed on to offspring

e.g. of non heritable variation

- Hydrangeas grow different colors depending on soil acidity and availability of Aluminum ions.

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Pink or Blue flowers not a trait that is inherited through genes.

Low pH-acidic

High pH-basic

Edenscontainer.com

Overproduction of offspring



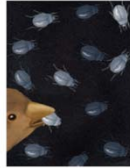

Coral Spawning



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Noaa.gov

Figure 1.20

- 1 Population with varied inherited traits
- 2 Elimination of individuals with certain traits
- 3 Reproduction of survivors
- 4 Increasing frequency of traits that enhance survival and reproductive success

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Evolution by Natural Selection

- Inference #1- Individuals whose inherited traits give them a higher probability of surviving and reproducing in a particular habitat leave more offspring than others
- Inference #2 This unequal ability of individuals to survive and reproduce leads to an accumulation of these traits in a population over generations

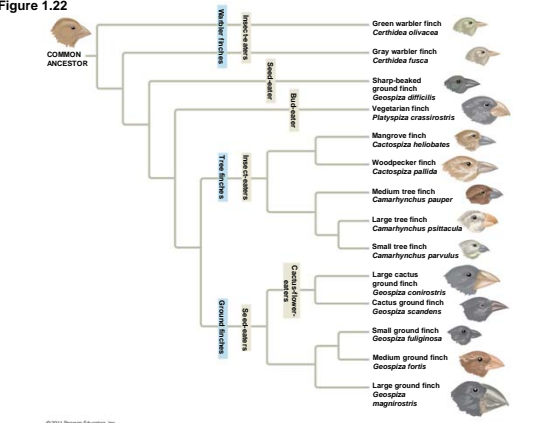
Summary of Natural Selection

- 1. There is variation of traits (morphological, proteins, transcription factors- turn genes on/off) in populations
- 2. Differential reproduction- A trait allows an individual to survive better and/or reproduce more will produce more offspring
- 3. If that trait is heritable (is based on genetics) more individuals in the population will have that trait in the next generation.
- 4. Natural selection increases adaptations to an environment over time.

More points to remember about natural selection

- Evolution occurs at the level of population : **INDIVIDUALS DON'T EVOLVE**
- Environments are variable between regions different adaptations may be more or less advantageous in different areas
- Environments also change over time resulting in populations of species adapting to these new conditions. This may give rise to new species

Figure 1.22



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Direct Observations of Evolutionary Change

Soapberry bugs

MRSA

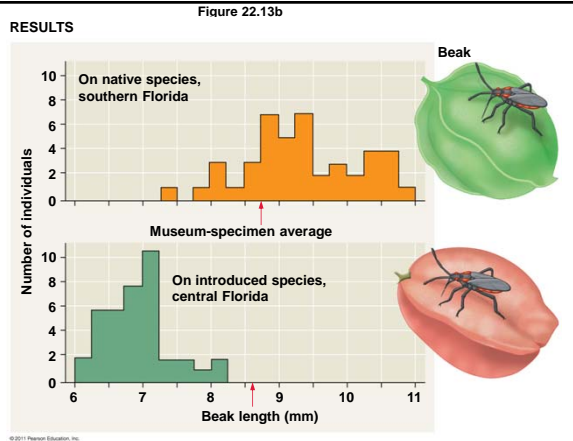
Pesticide resistance in insects

Figure 22.13a

FIELD STUDY



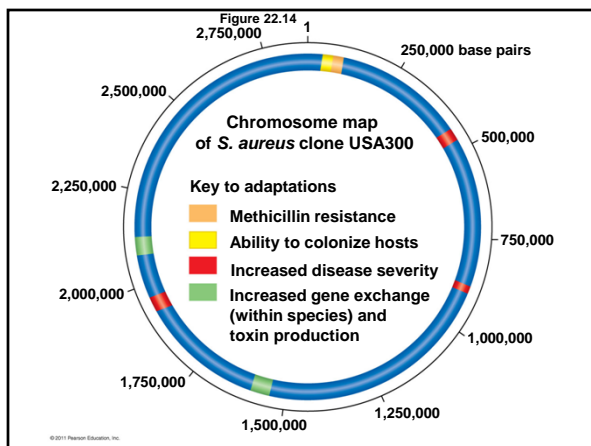
Soapberry bug with beak inserted in balloon vine fruit
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MRSA-Methicillin-resistant *Staphylococcus aureus*

- *S. aureus* is a common bacteria found on skin
- Antibiotics (Methicillin) use to kill off most *S. aureus* by inhibiting a protein used in the cell wall.
- Those that survived had a variation in the protein used to make the cell wall that allowed them to survive and reproduce in the presence of methicillin
- MRSA strains are now resistant to many antibiotics

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Pesticide resistance in insects

Major pest on potato crops

Populations have become resistant to 52 different pesticide compounds

Why? Live on plants with high toxicity thus have existing variation in toxic tolerance

High fecundity

Complicated life cycle

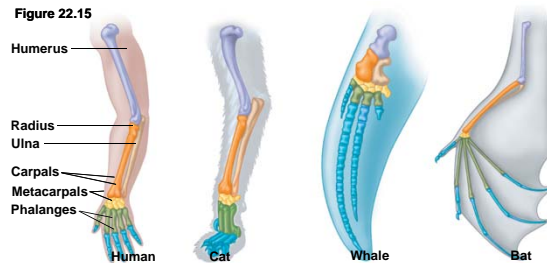
Colorado potato beetle

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Evidence for evolution

- 1. Homology
- 2. Hierarchical organization of life
- 3. Embryological similarities
- 4. Vestigial characters
- 5. Convergence
- 6. Fossils and intermediate forms
- 7. Geographic distributions

Homology is similarity resulting from common ancestry



- Comparative embryology reveals anatomical homologies not visible in adult organisms

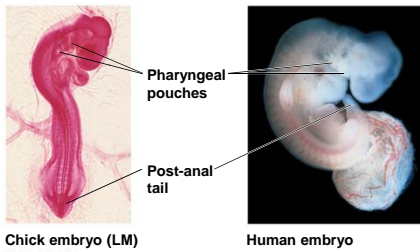


Figure 22.16

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Homologies and “Tree Thinking”

- **Evolutionary trees** are hypotheses about the relationships among different groups
- Homologous traits are used to infer relationships in a tree
- Evolutionary trees can be made using different types of data, for example, anatomical and DNA sequence data

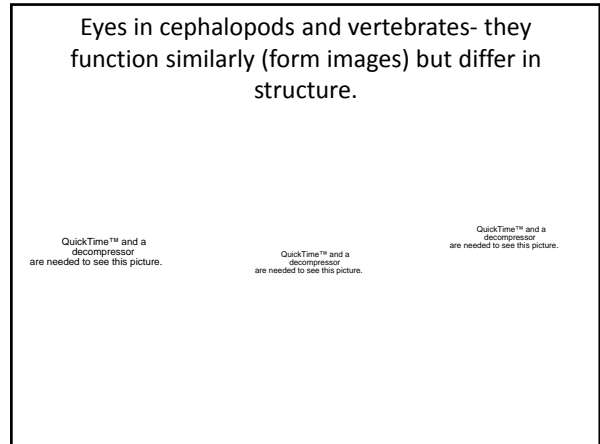
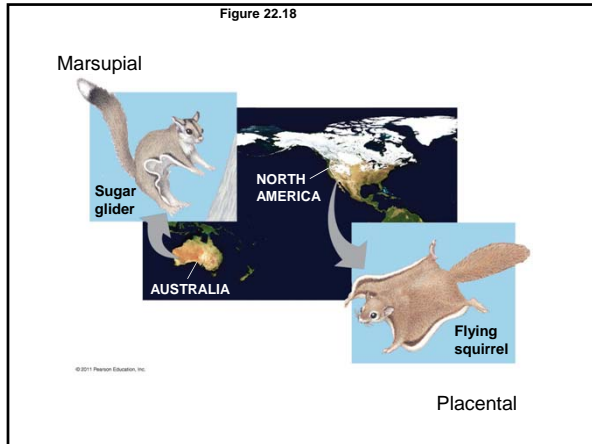
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Convergent Evolution

- **Convergent evolution** is the evolution of similar, or **analogous**, features in distantly related groups
- These traits often evolve under similar selective pressure or in similar habitats.

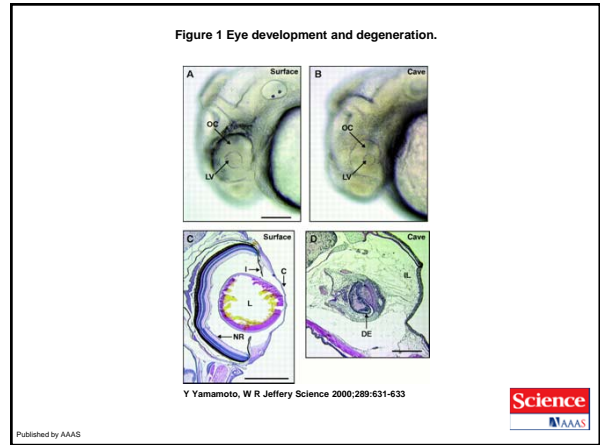
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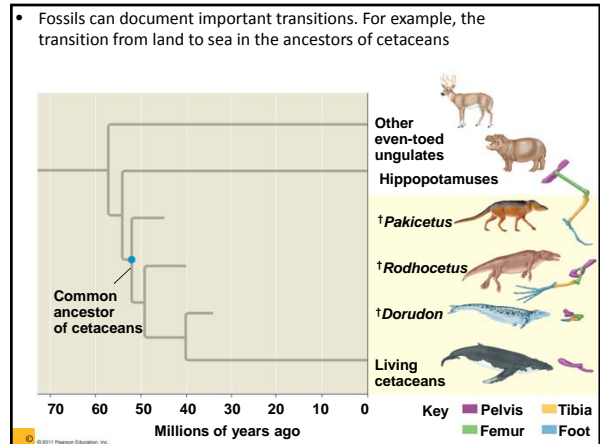
Vestigial organs

- Organs derived from an ancestor that no longer have a function (or a much reduced function).
 - Some cave dwelling species still have eyes even though they aren't functional



- The fossil record provides evidence of the extinction of species, the origin of new groups, and changes within groups over time

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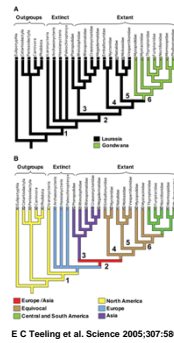


Biogeography

- **Biogeography**, the geographic distribution of species, provides evidence of evolution
- Earth's continents were formerly united in a single large continent called **Pangaea**, but have since separated by continental drift
- An understanding of continent movement and modern distribution of species allows us to predict when and where different groups evolved

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Fig. 3. Biogeographic reconstructions.



E C Teeling et al. Science 2005;307:580-584



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