Darwin & Natural Selection

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Linnaeus

• Sir Carolus Linnaeus (1707-78): familiar name?
• Known for 2 notable contributions in use today?
• System of taxonomic classification, pneumonic devices used to help remember the ordering
• ...system of naming: binomial nomenclature
• System uses 2 names, Genus & species name
• Ex.: Homo sapiens or
• Canis familiaris & Canis lupus
Mnemonic Devices for Taxonomic System

- King Phillip Cried Out For Goodness Sakes! (or…)
- King Phillip Came Over For Great Sex
- Kingdom
- Phylum
- Class
- Order
- Family
- Genus
- Species
Linnaeus cont’d)

• Linnaeus devised his system w/o taking into account evolution. He was not an “evolutionist”
• Thus, though we use his syst. Today, we’ve had to modify it in light of updated evidence of evolution
• Speaking of evolution…
• Evolution: longterm changes in genetic frequency
• 1st person to provide a comprehensive explanation of the mechanism behind it?
• Jean Baptiste de Lamarck
Lamarck & Evolution

- Inheritance of Acquired Characteristics
- Evolution through Use & Disuse
- Example: Giraffes, known for?
- Lamarck suggested this trait developed due to a lifetime of stretching & craning & passing the acquired trait on to offspring
- Prob’s w/ this idea?
- You can’t inherit acquired traits!
Charles Darwin (1809-82)

• Evolution by natural selection
• Born to a high ranking family, dropped out of med. School, father sent him to study for the clergy. Darwin was not interested in this, applied for a post as naturalist on board a ship: *H.M.S. Beagle*
• Was to circumnavigate the globe
• On board, collected specimens that were useful to drawing up of his theory
• Highly influenced by Thomas Malthus
Malthusian demographics

• Malthus: predicted impending doom b/c human pop. increase geometrically, while food supply increases arithmetically

• Human Pop. | Food Supply
  - 2  | 2
  - 4  | 4
  - 8  | 6
  - 16 | 8
  - 32 | 10
Natural Selection

• Reasoning/Logic/Observations:
  - 1) superfecundity of species
  - 2) resources are scarce
  - 3) population is relatively stable
• 1st inference/conclusion: there is a struggle for life...
  - 4) individuals vary
  - 5) variation is inherited
• In the struggle...some will reproduce more successfully than others, a.k.a. differential reproduction (D.R.)
Natural Selection cont’d

• 3rd inference: as a result of D.R., longterm changes in genetic freqcy will occur (evolution)
• What natural selection is not: survival of the fittest
• Ex.: black widow spiders
• Darwin wanted to avoid controversy, did not publish his idea for a long while
• Waited so long that someone else came up w/ a very similar idea!
• Joint publication w/ Alfred R. Wallace
• How is this different than Lamarck’s idea?
• Using the giraffe ex., let’s take a look @ how natural selection accounts for the longer necks
  • [link](http://www.sciencedaily.com/releases/2006/12/061223092600.htm)
• Okay, so this sounds plausible & legitimate, but for it to be scientific we need more than that, what do we require?
• Evidence! Let’s take a look…
Evidence Marshalled by Darwin

• 1. Geologic Record: fossils of marine life found @ specific layer in the Andes Mtns.
  • http://query.nytimes.com/gst/fullpage.html?res=9B0DEFDC143CF931A25750C0A961948260

• Fossil Record: ground sloths, horses in N. Amer.
  • http://www.sciencedaily.com/releases/2005/03/050321083507.htm

• Biogeography: dist. of flora & fauna (meaning?)
• flora= plant life, fauna= animal life
  • http://www.pbs.org/wgbh/evolution/darwin/origin/index.html
  • (note to self: check volume, link has sound)
Evidence cont’d

• 4. Breeding: we’ve created tremendous variation in short periods of time with selective breeding, what could mother nature do with huge spans?
• 5. Comparative anatomy: homologous structures
• Anatomical similarities due to common ancestry
• 6. Vestigial structures: carry no current function in the organism
Do we have any?
Evidence cont’d

• We’re not the only ones w/ vestig. Structures:
• Phyton’s vest. Pelvis, genes for teeth in chickens
• 7. Embryology: ontogeny recapitulates phylogeny
• Individual development restates evolutionary history
• http://www.abovetopsecret.com/forum/thread411052/pg1
• Presence of gill slits, tail, etc.
Prob’s for Darwin/Questions/Criticisms

1. Absence of transitional forms: have we answered this question since Darwin?
   - Yes & No: constantly filling in the fossil record, but does everything that lived become fossilized?
     - [http://www.sciencedaily.com/releases/2008/05/080521131541.htm](http://www.sciencedaily.com/releases/2008/05/080521131541.htm)

2. How is variation inherited? Have we answered this one?
   - Yes. W/ Mendelian genetics

3. What is the source of new variation/traits?
   - Genetic mutation
• Gregor Mendel: Austrian monk, utilized experiments w/ plants to understand heredity
• Was rather lucky: discrete traits: few set possibilities
• Continuous traits: on a spectrum, seemingly endless outcomes
• Utilized garden pea plants: flower color
• Garden peas: white or violet flowers
• Parental generation:
• Crossed pure strain white by pure strain violet
• results (1st filial): all offspring had violet flowers
• What happened to the white flower color?
• Decided to cross hybrids to find out:
• Results: (2nd filial): 75% offspring violet, 25% white flowers
Terms derived from Mendel’s experiments:

• Gene: a segment of DNA that codes for a trait

• Allele: alternate types or versions of a gene
• Each organism carries 2 alleles of any given gene
• Genotype: the actual combination of alleles present (& the letters used to represent them)
• Phenotype: manifestation of the genetic combo
• Relationship btwn alleles:
  • Dominant: requires only one copy (allele) to show up in the phenotype
  • Recessive: is hidden or masked by the dominant allele
• Genotype labels
  homozygous dominant: 2 copies of the same, dominant allele
• Heterozygous: 2 different alleles present
• Homozygous recessive: 2 copies of the same, recessive allele
• Let’s apply to the pea plants example
• Which of the flower colors appeared dominant?
Punnett squares

- Let’s fill in a punnett square to illustrate the pea plant experiment:
- 1st step: translate phenotype to genotype
- P. strain violet genotype? V V
- P. strain white genotype? W W

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• hybrid x hybrid cross:  \( W \ V \times W \ V \)

\[
\begin{array}{c|c|c}
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\text{W} & \text{W W} & \text{W V} \\
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• Interpret:
  1 in 4: \( W \ W \): white flowers: homozyg. recessive
  2 in 4: \( W \ V \): violet flowers: heterozyg.
  1 in 4: \( V \ V \): violet flowers: homozyg. dominant