Species and evolution
Speciation

- Divergent evolution

Figure 11-4  Biology: Science for Life, 2/e
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Speciation

• Divergent evolution
Homology

- Any characteristic...
  - Genetic
  - Morphological
  - Developmental
  - Biogeographic
- …that is shared by common descent
Homologies

Turtle   Platypus   Kangaroo   Beaver
Homologies

Vertebral column

Turtle
Platypus
Kangaroo
Beaver
Homologies

Hair and mammary glands

Turtle

Platypus  Kangaroo  Beaver
Homologies

Turtle

Platypus

Kangaroo

Beaver

Gestation
Homologies

Order Primates

Family Hominidae

Subfamily Homininae

- Squirrel monkey
- Orangutan
- Gorilla
- Common chimpanzee
- Bonobo
- Human

Mammal ancestor

- Increase in size of genital structures
- Delayed sexual maturity
- Broad incisors
- Shortened canine teeth
- Enlarged brow ridges
- Elongated skull
- Reduced hairiness
- Large brain
- No tail
- More erect posture
- Increased flexibility of thumb

Figure 9-11 Biology: Science for Life, 2/e
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Homologies and classification

Domain
Kingdom
Phylum
Class
Order
Family
Genus
species
## Classification

<table>
<thead>
<tr>
<th></th>
<th>Human</th>
<th>Blue Whale</th>
<th>Giant octopus</th>
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<tr>
<td><strong>Domain</strong></td>
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<tr>
<td><strong>Kingdom</strong></td>
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<td><strong>Phylum</strong></td>
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<td>Cephalopoda</td>
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<tr>
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<td>Cetacea</td>
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<td>Balaenopteridae</td>
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<tr>
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<td>Balaenoptera</td>
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<td>sapiens</td>
<td>musculus</td>
<td>dofleini</td>
</tr>
</tbody>
</table>
Classification

• Comparative anatomy

Figure 9-12  Biology: Science for Life, 2/e
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Classification

• Comparative anatomy
  – Vestigial traits
    • Traits that are functional in one species, but non-functional in another
Classification

- Development
  - Embryonic and early development may show similarities

Sunflower

Maple tree
Classification

- Biochemistry
  - Protein sequences
  - DNA sequences

Comparing DNA sequences

Species A: ATGCAACTGGTATCGAGTTCTAC
Close relative: ATTGGCAGTGGATCGAGGTTCTAC
Distant relative: ATTTGGCAGTGGATCGGGTTCTAC

2 differences in 25 nucleotides
2/25 = 8% or 92% similarity

4 differences in 25 nucleotides
4/25 = 16% or 84% similarity

Similarity to human DNA sequences

- African monkey: 96.66%
- Gorilla: 98.90%
- Chimpanzee: 99.01%
- Human: 100%
Classification

• Biogeography
  – Organisms that are closer together in space are likely more closely related than organisms far away from each other
Classification

• Use information from many different sources
  – What if they don’t all agree?
Classification

- Using homologies
  - Parsimony
    - Use the simplest hypothesis that can explain the facts
    - Minimize # of evolutionary changes
      - The best explanations use traits as homologies
  - Generally use many traits to create trees
    - Consensus trees
      - Retains all splits found in most all the most parsimonious trees
      - Some lineages unresolved, because other trees disagree on split
Classification

Bird genera
Based on DNA sequences at 2 genes
Consensus tree-based on 27 trees

From Barker et al, 2002