Historical Geology II - GEOL 30143
Lectures & Lab for Spring, 2009
Dr. Arthur B. Busbey III

Class: Tuesday & Thursday, 8:00 AM- 9:20 AM
Lab: Tuesday 1 to 3:20 or thereabouts
Instructor: Dr. Arthur B. Busbey III Email: a.busbey@tcu.edu
Prerequisite: Geology 30133 or Permission of Instructor
Office: SWR 254
Office Hours: Officially MW 1-1:50 but feel free to come in at any time.
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Historical II

• Focus on actual history
• Start with a few lectures on theory
• Lectures focus on history of earth and life on earth
• Labs focus on learning a variety of marine invertebrate fossils
• You will need to purchase a ‘lab notebook’. In this you will take notes, make sketches, answer questions. You can use these notes (not my handouts) in lab exams so you should take some time to make sure they are complete.
• Most labs are hands-on with fossils.

• Many labs may take more than the scheduled lab time to finish. As such, though the labs are on Tuesday, the lab notebook will not be due until the Monday of the next week.

• Since it is not easy to make up a lab you should do your best to be there ON TIME.

• Make SURE you have no conflicts with the scheduled field trip. 25% of your lab grade is based on a report on the fossils collected and you will not be able to duplicate the trip after it has happened.
Geologic Time Scale
A MUST KNOW!
Eons, Eras, Periods and Cenozoic Epochs.
Dates associated with the boundaries.
Evolution

Organic Change Through Time
Who came up with Evolution?

• NOT Darwin - the concept predated Charles Darwin by nearly 200 years

• Many naturalists began to realize that there must have been some kind of transitions of organisms as they began to study them.

• There were ‘gradients’ of similarity that suggested some constant continuity of life.

• The term ‘Evolution’ was coined before Darwin by Jean Baptist Lamark.
Evolution

Comparative Anatomy

Bird
Bat
Horse
Whale
Human
Evolution

Homologous

Bird

Bat

Analogous

Fly
Early naturalists, as they began to look at fossils in detail, also began to realize that major groups of organisms were no longer around. They were ‘extinct’.
Evolution

Extinction

Number of Genera


57%  50%  84%  47%  47%
Mass Extinctions

![Graph showing mass extinctions over geological time.

- Late Ordovician
- Late Devonian
- End-Permian
- End-Triassic
- KT (K-T boundary)

Geological time (myr.)

Total extinction rate

Cm O S D C P Tr J K T

600 400 200 0

12
Evolution

Jean Baptist de Lamark (1744-1829)
Evolution by Inheritance of Acquired Characters
Evolution
22 when Darwin started

H.M.S Beagle (1831-1836)
Evolution

Darwin’s Finches
Evolution

(b) The Galápagos finches

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Evolution
Evolution

Darwin/Wallace
Evolution by Natural Selection

On the Origin of Species

1859
Evolution
Evolution
Evolution

Lines of Evidence

I. Comparative Anatomy
Evolution

I. Comparative Anatomy - vestigial organs
II. Embryology
Evolution

III. Fossil Record
Evolution

Main Scientific Objections - mid 19th Century

- Fossil record not that good - seems to show new forms arriving with no predecessors.

- Not enough time for process to occur

- No way to inherit the random variation in characteristics that appear in each generation - (Blended Inheritance)
The 20th Century

Darwin was finally vindicated, on all counts, during the 20th century. Let us look at the evidence.
Evolution  Now there are many transitional forms!

Archaeopteryx
oldest bird
Evolution

*Ichthyostega*
oldest amphibian

‘Mammal-like reptiles’
Not really reptiles but called this in many books
Evolution

Cetaceans (Whales)

Transitional sequences

Equines (Horses)
Transitional sequences
Evolution

Now we know there is plenty of time for evolution to have occurred!
Evolution

Now we know that inheritance is particulate - we can pass on known characters!

Modern genetics also supports evolution with gene sequencing, which supports evolutionary models based on anatomy!
Evolution

Sympatric Speciation

Entire gene pool changes in time.

Chronospecies

Allopatric Speciation

Gene pool isolates change in isolation.

Darwin’s Finches

Another colonization event
Patterns of Evolution
Evolution
**Evolution**

**Divergent evolution** is the development of different characteristics in sibling taxa.

**Parallel evolution** is the development of similarities in separate but related evolutionary lineages through the operation of similar selective factors on both lines.

**Convergent evolution** describes the process whereby organisms not closely related independently acquire similar characteristics while evolving in separate and sometimes varying ecosystems.
Parallel evolution
Convergent Evolution
Convergent Evolution

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<tr>
<th>Niche</th>
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<th>Australian Marsupials</th>
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<td>Burrower</td>
<td>Moie</td>
<td>Marsupial mole</td>
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<td>Anteater</td>
<td>Anteater</td>
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<td>Tasmanian “tiger cat”</td>
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