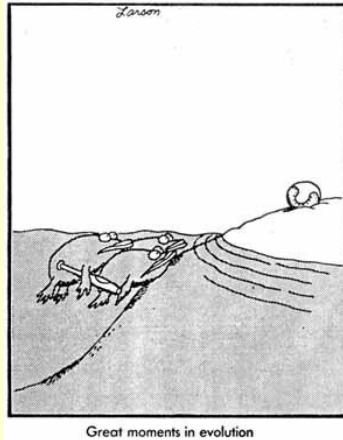


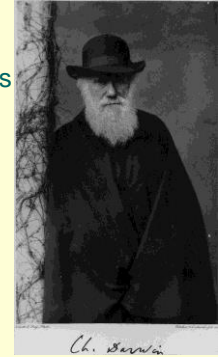
Darwin

Connecting all
of biology



Lecture outline

- Darwin timeline and influences
- Darwin's key advance(s)
- Darwin and Wallace
- Evidence for natural selection



Charles Darwin timeline (1)

- Born in 1809 in England to a wealthy family
- Medical school then Cambridge (clergy)
- Naturalist on HMS Beagle voyage from 1831 to 1836; Captain's pal



Fig. 22.5

What did he see?



(a) Cactus-eater



(c) Seed-eater

Fig. 22.6 a & c



Fig. 22.2



Charles Darwin timeline (2)

- Wrote in 1844, but did not publish, a 231-page "essay" on evolution by natural selection
- Published other books on Beagle observations, barnacles, coral reefs; kept working on "essay"; often ill
- Alfred Wallace sent his manuscript on natural selection to Darwin in 1858. Both ideas were presented to a scientific society in 1858. Published "On the Origin of Species..." in 1859
- Wrote later books on plants, earthworms, human evolution. Died in 1882

Have some time on your hands? <http://darwin-online.org.uk/>



His home



His "thinking path"

Influences: Population growth

- Thomas Malthus wrote an essay that argued population growth potential is extremely high (i.e., exponential)
- However, the Earth is not covered in all kinds of organisms
- Darwin's inference: there must be a "struggle for existence" (chapter title in the *Origin*)



Fig. 22.11

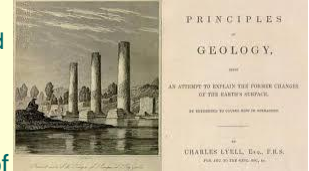
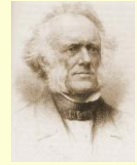
Influences: Fossils

- Darwin was aware of **Georges Cuvier's** founding work in **paleontology** showing
 - Older, deeper strata contain fossils that differ more from current species than do fossils found in more recent, shallower strata
 - Species appeared and disappeared from successive layers: Extinction Why? → **Catastrophism**
- Darwin found fossils in South America that resembled current species, yet were obviously different species, and
- He found fossils of marine species high in the Andes Mountains



Influences: Geology

- While on the Beagle, Darwin studied *Principles of Geology* by **Charles Lyell**
 - Uniformitarianism**—mechanisms of geologic change are constant over time and are the same as observed today
- "I always feel as if my books came half out of Lyell's brains".



Influences: HMS Beagle observations

- Many Galapagos species resembled mainland species, but these species were not found anywhere else
- Similar Galapagos species (like mockingbirds and finches) varied among islands and differed in appearance and behavior
- These differences seemed to be related to differences in the environment



How did Darwin explain his observations? (1)

- Species descended from their ancestors
 - Not his original idea, though
- 'Descent with modification' = **Evolution**

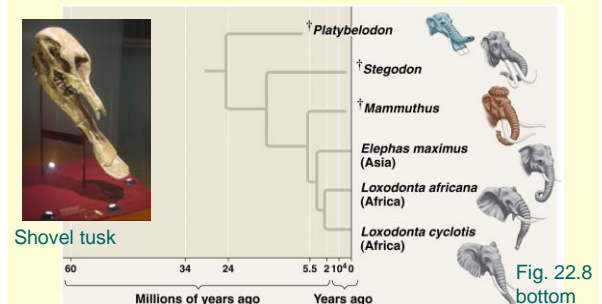


Fig. 22.8 bottom

How did Darwin explain his observations? (2)

• Natural selection

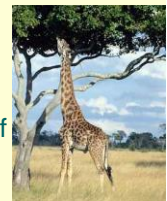
- Mechanism underlying evolution
- Organisms with certain inherited characteristics are more likely to survive and reproduce than are organisms with other characteristics



Fig. 1.18

What about Lamarck?

- Jean-Baptiste Lamarck hypothesized in 1809 that:
 - Species evolved, but because of different mechanisms
 - Use and disuse
 - Inheritance of acquired characteristics
- Any problems?



What about Wallace?

- Alfred Russel Wallace (1823 – 1913)
 - British naturalist
 - Studied Amazon Basin, Malaysia, and Indonesia
 - Developed biogeographic regions of the world—"father of zoogeography"
- Independently arrived at evolution by natural selection



FIGURE 34. Wallace's Line (black) and Arc separates two distinct present-day land biotas.
Adapted from Open Stax (2019) University of Kansas, Indian Project.
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Darwin and Wallace

- Darwin wanted to be sure of his ideas so he collected much more data before he published
- Alfred Wallace in 1858 published his, almost identical, ideas about natural selection
- Publication = property rights
- Science not complete unless it has been communicated
- Why does Darwin still get almost all of the credit?

ON THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURABLE RACES IN THE STRUGGLE FOR LIFE.

By CHARLES DARWIN, M.A.,

FELLOW OF THE ROYAL SOCIETY, LONDON, ETC., WRITER OF "JOURNAL OF RESEARCHES INTO THE NATURAL HISTORY OF THE GALAPAGOS ARCHIPELAGO."

LONDON:

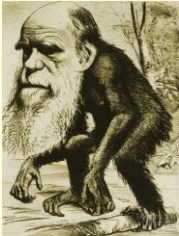
JOHN MURRAY, ALBEMARLE STREET.

1859.

The right of Translation is reserved.

Darwin's implications

- Age of Earth and organisms
- Humans are 'evolved animals'



Evidence for natural selection (1)

- **Artificial selection**
 - Quick enough for humans to see (and cause)
 - Darwin thought if we could do this, natural selection over millions of years could have profound results

The many forms of *Brassica oleracea*



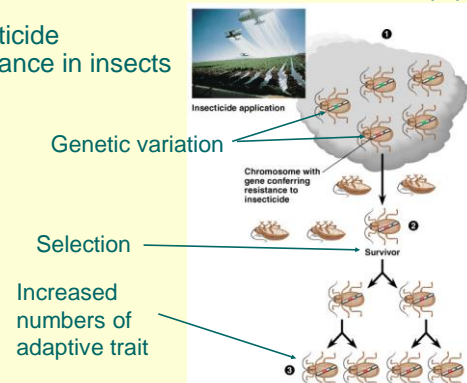
Fig. 22.9

15,000 years ago, these were all gray wolves



Evidence for natural selection (2)

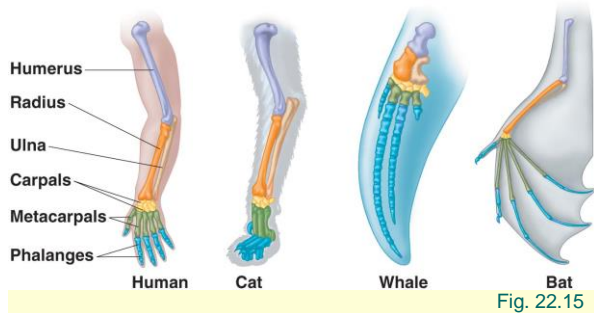
- **Insecticide resistance in insects**



Evidence for natural selection (3)

• Homologous structures

- Similar characteristics in different species as a result of having common ancestors



Not to be confused with...

• Analogous structures



Ruby-throated hummingbird

Hummingbird hawkmoth



Evidence for natural selection (4)

- Transitional forms in the fossil record



Archaeopteryx - discovered 1861

Evidence for natural selection (5)

- Genetic code for translating RNA to amino acids is nearly universal among all organisms

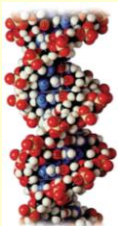
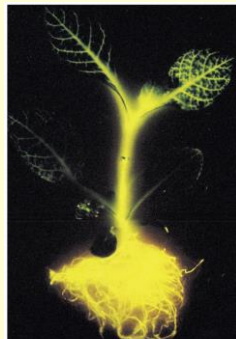


Fig. 17.7a



(a) Tobacco plant expressing a firefly gene