

1 Wild Ride to Evolution

Mark Mayo
Cypress College

2 Aristotle

- He lived in 384-322 BC
- He employed descriptive visual examination – early classification of plants and animals
- Had problems with sponges – looked like plants, but did not make food and were not green
- Mushrooms were also troubling

3 Science of Biogeography

- Scientists of the time cataloged life across the planet
- As people traveled more we found more varied forms of life
- We communicated and wrote down findings
- We found more and more diversity across the planet

4 Science of Biogeography

5 Comparative Anatomists

- They had a very systematic study
- Organisms were grouped by body plans – called the science of taxonomy (classification)*
- Question came up – why are body plans so diverse? Why are some similar?
- Body plans were thought to be perfect (religious overtones)

6 Comparative Anatomists

7 Comparative Anatomists

8 Comparative Anatomists

- There were problems with vestigial organs* (parts that no longer function normally)*
 - tailbone
 - appendix
 - pelvic girdle in snakes

9 Geologists enter the picture

- They found that the earth had layers of rock and sand even “solid” rock appeared to be constructed of layers

10 Geology

- Fossils are preserved evidence of organisms

- 11  **Geology**
- Geologists found similar rock layers around the world
 - Beneath these top layers fossils could be found
- 12  **Geology**
- Fossils were found only in certain layers over the earth
 - Digs around the world had similar fossils
- 13  **Geology**
- As they dug deeper fossils they found certain constants
 - fossils got older as you dug deeper (usually)
 - fossils became simpler as you went back (more complex now)
 - certain fossils disappeared, some appeared
 - older digs showed more marine organisms, then completely marine!
 - at some point there are no more signs of life
 - the fossil world had creatures that are now extinct
- 14  **Geology**
- More on the geologist's views
 - Rocks come in a variety of compositions
 - A great length of time is needed to wear away soft ones to sand or soil with various agents of erosion
 - wind
 - rain
 - surf
 - ice
 - Hard rocks take even longer to erode
- 15  **Geology**
- To form sedimentary rock takes time to both build up and then erode
 - It is likely that the time periods involved in evolution are millions of years not thousands
 - Catastrophes occur every year: earthquakes, volcanoes, great storms, etc.
 - Theory of uniformity – slow, gradual change not just dramatic changes caused by major geologic events makes sense, but both theories used together is commonly accepted now
- 16  **Geology**
- Scientists were disturbed by obvious problems between geology and the biblical story creation
 - 6,000 – 10,000 year old earth
 - The event of all species created at same time in same place was not supported by fossil evidence
 - The thought that there could be NO new organisms since creation could not be supported
 - We find new species as we move to higher rock strata
 - The extinction of organisms is regularly observed
- 17  **Trouble Brews as science thinks about these facts in a religious light**
- Religious (Biblical) beliefs were hard to reconcile with geology
 - Fossils and elaborate rock formations took great time periods while the biblical account is 6 days and one day of rest
 - Biblical earth was thought to be 6-10,000 years (too short for geologists)

- It appeared as if multiple origin sites were indicated by geology – not one location and one creation
- Perhaps there was just too much evidence of change over time* (the definition of Evolution)*

18  **Fathers of Evolution Theory Before Darwin – *a mostly religious group***

- George Cuvier (1769-1832) –
- The Theory of Catastropism
 - He did not believe in evolution
 - He was religious person, a practicing Protestant

19  **George Cuvier**

- He founded vertebrate paleontology (first real practitioner)
- Vertebrate paleontology is the study of fossils with backbones.

20  **George Cuvier**

- He based his theories on series of abrupt changes in the earth which are seen in the fossil record caused by catastrophes
- A catastrophe can include: volcanic eruption, hurricane, flood, meteor strike

21  **George Cuvier**

- The Theory of Catastropism

22  **George Cuvier**

- He believed in a singular creation where all life was made
- He believed that after a catastrophe the population changed
- When major catastrophes killed off many – survivors repopulated the world
- We would see evidence in fossils after their numbers increased, they were always there (we just had not found them yet)
- With successive catastrophes we see more “new” organisms

23  **Jean Baptise Lamarck**

- Jesuit (a type of Catholic) seminarian
- Theory of acquired traits*
 - if you need to have a changed body part – just grow it
 - offspring would keep the newly changed body part
 - this theory worked well with creation

24  **Jean Baptise Lamarck**

- The force to change was a “drive to perfection”
- Fluida was the substance housed in our nerves that moved to the area where change was needed and caused the body part to change

25  **Jean Baptise Lamarck**

- Classic giraffe neck explanation according to Lamarck
 - giraffes had short necks at start
 - as food supply dwindled accessible to short necks there was a need for a longer neck to reach higher on trees
 - fluida caused the neck to lengthen
 - all offspring had longer and longer necks

- the environment was the causative agent of change

26  **Jean Baptise Lamarck**

- Darwin explains the giraffe
 - there is a diversity in giraffe necks after millions of years of existence
 - the leaves are eaten on the lower branches of the trees
 - giraffes with longer necks eat and are healthy enough to breed
 - short giraffes eat less, do not have as much sex and die off
 - the surviving "taller" giraffe's offspring inherit the trait for height
 - more giraffes are taller over time

27  **Jean Baptise Lamarck**

- He caused people to start thinking, but the theory of acquired traits was a failure then and now

28  **Charles Lyell**

- Theory of Uniformity
- 1797-1875
- He started his career as a lawyer – later turned to geology and zoology
- Lyell rebelled against geology based in biblical timing and catastrophes as the only causes for change
- He thought gradual change of earth with much more time (billions vs. thousands of years) seemed more logical

29  **Charles Lyell**

- Gradual changes can cause major changes in the earth as shown in these photos of the Grand Canyon

30  **Charles Lyell**

- His work led to the book – Principles of Geology
- *Darwin read his book* just before he left for voyage of the Beagle
- Another evolutionary scientist named *Wallace also read his book*

31  **Thomas Malthus**

- Principle of population
- 1766-1834
- Religious
- He thought that famine and poverty were divine institutions to keep us from being lazy

32  **Thomas Malthus**

- Humans produce far more offspring than can survive
- The larger the population, the more they would reproduce
- Living space, food supply and other resources could not support population
- Competition increases
- People would starve, get sick and start wars
- He saw that conditions were deteriorating in society
- He thought that unless population was controlled that all life would cease

33  **Thomas Malthus**

- Almost anyone has seen overcrowding in cities, especially in third world cities

34  **Thomas Malthus**

- He had a great influence on both great evolutionists:
Darwin and Wallace

35  **Charles Darwin (1809-1882) – Father of Theory of Evolution**

36  **Charles Darwin**

- His life before Beagle
 - naturalist at heart
 - tried medicine – quit
 - tried clergy, earned a degree in theology
 - He was somewhat religious

37  **Charles Darwin**

- He sailed away on a 5 year voyage of Beagle*
 - no formal training as a naturalist – but hired to be ship's* naturalist
 - job of voyage was to map world
 - studied South America, Australia, many islands
 - found unbelievable diversity in life forms
 - found life forms never before seen and found nowhere else (Australia)
 - after his return he devoted his life to study of evolution

38  **Charles Darwin**

- Darwin's enhancement of Malthus, Lyell mixed with Beagle information
 - moved Malthus people only theories to all organisms
 - fish, frogs, insects do produce thousands to millions of eggs
 - most offspring do not survive (eaten, die because of some weakness or competition)
 - the environment keeps population in check
 - Beagle showed Darwin that there was great diversity (EXTREME)
 - he decided that diversity exists to allow an advantage in competition
 - this advantage is called adaptation (biological term)
 - he figured that variety is good and needed to allow for changing conditions over time

39  **Charles Darwin**

- Darwin's finches
 - 13 species of finches found in Galapagos Islands
 - each species varied by their beaks and feet*
 - short and strong beak
 - long and narrow beaks
 - sharp beaks
 - medium beaks
 - each modification allowed the bird species to survive and forage for food effectively based on its local environment

40  **Charles Darwin**

41  **Charles Darwin**

- One example of finch evolution
 - a variety of beaks exist at start (long, short, strong, weak, etc.)
 - if seeds available become mostly hard (the weather changed)
 - birds with stronger shorter beaks are the ones best able to eat seeds
 - if you eat more, breed more and you stay alive
 - if the stronger bill is caused by a gene that can be passed to bird's offspring, then offspring too have stronger beak

- over time the environment would SELECT for birds with a particular beak structure
- the most ADAPTIVE version of the bill trait (GENE) would become common
- the population would change over time = EVOLUTION

42 Charles Darwin

- Natural Selection
 - natural selection was and is a Darwinian idea
 - it alarmed Darwin who was religious with a theology degree
 - wrote down his ideas in "Origin of the Species"
 - he was a bit afraid to speak up
 - his wife said he would for sure go to hell and so might she if he published his work
 - he kept it unpublished for 10 years!

43 Charles Darwin

44 Alfred Wallace (1823-1913)

- he traveled like Darwin to Spice Islands in Indonesia
- he found great diversity
- Wallace also read Malthus and Lyell
- he published "On the Law which has regulated the Introduction of New Species" in 1858
- later, he published with Darwin
- he forced Darwin to publish
- Wallace agreed Darwin had idea first

45 Charles Darwin

- Origin of the Species is published in 1859
 - accepted by naturalists and some scientists
 - rejected by religious and other scientists
 - after 70 years genetics finally makes theory much stronger
 - genetics lets us know how genes code for traits and how they are passed down

46 Darwin's Theories

- any population can evolve (change over time) when individuals differ by one or more heritable trait (can be passed on to offspring) that are responsible for differences in the ability to survive and reproduce
- not just survival of the fittest – must be able to produce more offspring
- natural selection – difference in survival rates among individuals of a given population that differ from one another in one or more heritable traits*
- natural selection results in a modification of traits within a line of descent
- over time natural selection can result in a new species
- SPECIES – group of individuals that can mate and produce fertile offspring

47 Charles Darwin

48 Artificial Selection*

- Selective breeding*
 - we have been breeding selectively for all recorded time
 - this causes man-made evolution!
 - breed ones we like, eat or kill ones we don't like*
 - we breed for a variety of reasons:
 - Size
 - Strength
 - Color
 - sex (American Indians/Indians from Asia)

- early horses were small
- early dogs were tree-climbing and very small
- corn was colorful and much smaller
- genetic engineering is new frontier