

PreDarwinian Biology Lecture 1 - September 14, 2015

MIDTERM

- write in room assigned, check on website

GOALS:

- identify and understand the major events and findings in biology
- be able to place the main findings biology in a historical context
- explain how biology differs from the other sciences
- understand how biology is done - scientific method in natural sciences

Main topic : Major events

- biology is a “young science”
- Defining biology: wasn't considered a discipline until 1800s, defined as "The subject matter of our investigations will be the various forms and manifestations of life, the conditions and laws controlling their existence, and the causes by which this is effected ”
- types of biology
 - molecular, biochemistry
 - genetics
 - cell bio
 - physiology
 - devel bio
 - morphology
 - evolutoin and systematic biology
 - ecology
 - behavioural biology
 - nutrition
 - disease mechanisms
 - pharmacology
 - genomics
 - proteomics
- 3 major major events
 - PreDarwinian and the natural sciences (400 BCE - late 1800s)
 - 400 BCE - 450CE : greek and Roman ages (big impact on western culture, massive infrastructure)
 - 450 - 16 century : medieval ages
 - 16 - 18 century: renaissance and the scientific revolution
 - Darwin and evolutionary thought (late 1800's - mid 1900's)

- Modern theory of evolution and more (mid 1900s - present)
- 16 - 18 century: The scientific revolution and the start of modern sciences
 - Douglas Adams 1952-2001 (Hitchhikers guide to the galaxy)
 - Said time can be divided into four ages of sand (first , second, third, fourth) the heating of sand to make glass)
 - first - telescope 1608 (heating sand into glass, glass manufactures scopes, new tool, new observations)
 - second - microscope 1678 (observe smaller things, cell theory led to cat scans, MRI)
 - third - computer chip 1961 (able to do calculations, math faster than humans, encoding knowledge)
 - fourth - fiber optics 1980s (data transmission across great distances, increasing connections to people)
- 450 BCE- 450 : Greek and Roman Ages
 - Hippocrates 460-370 BCE
 - he collected from everyone notes about their medicine, practices, known anatomy
 - took all the work and assembled the hippocratic corpus (the core of human biology)
 - Aristotle 384 - 322 BCE
 - as cultures move around the world, Aristotle creates an inventory of the known animal/plant kingdom in the “*Scala Naturae*” or ‘Ladder of Life’
 - tried to organize all this mass of information in the list
 - organized as how similar they are to a human
 - Theophrastus 371-287 BCE
 - student of aristotle
 - studied plants (very important for medicinal plants, agriculture, fibre : wood, cotton)
 - he produced 10 books, divided them on reproductive structures and seeds, 9 of them still exist
 - “*historia plantarvm*”
- Some initial definitions about naming
 - classification (act of ordering things)
 - taxonomy (adding a rule to classification)
 - hierarchical (inclusive)
 - systematics (
- types of taxonomies
 - folk (word of mouth, shaman/healer/mistic, person of the knowledge for the community, passed down)
 - artificial (Aristotle and Theophrastus made lists on physical appearance)
 - mechanical
 - natural(evolutionary)
 - cladistic(phylogenetic)
- 450 BCE - 450 Greek and Roman Ages
 - scala natura - the great chain of being
 - Essentialism: every thing has a certain essence about them that preserves the integrity of them, diversity of planet explained by essentialism
- 450 - 16th Century: Medieval Ages

- scala natura gets changed, only one god at the top adapted for monotheistic culture
- Essentialism: essentially the same, only change is there is one god
- Special Creation
 - Pattern
 - species don't change
 - Bishop Usher came out with statement each species created on Oct 23, 4004 BCE
 - Species are not old
 - Process
 - A designer of some sort
- 400 -700 Early middle ages (dark ages)
- 1000-1300 High middle ages(return of commerce, infrastructure)
- 1300-1500 Late middle ages (black plague (1347-1351) destroys society, catastrophic)
- the knowledge from philosophers goes to other cultures ex. byzantium and islamic world
- Byzantium and Islamic World
 - Al -Jahiz (781-869)
 - said natural selection through his own description
 - al-Dinawari
 - expanded on plants like Theophrastus
 - Avicenna
 - he took Hippocrates corpus and added all the medical info from islamic and indian
 - Alhazen
 - stated basis of scientific method
 - Ibn al-Baitar
 - creates pharmaceutical plants, puts together the largest pharmacopeia of medicinal plants (drugs, dosages, types)
- Crusades occur, western culture invades islamic controlled christian sites, copies the islamic knowledge and moves it into their knowledge base
- 16th - 18th Century: The scientific revolution and the start of modern sciences
 - mostly discovered by people in the church
 - Van Leeuwenhoek - first microscope
 - Andrea Vesalius - Anatomy
 - father of anatomy
 - dissected human bodies
 - Harvey - Anatomy and physiology
 - father of physiology
 - Linnaeus - Systema naturae - binomen
 - He invented binomial nomenclature
 - takes artificial taxonomy and mechanically organizes them, reduces to a 2 word description - binomial nomenclature
 - he first differentiated between plants and animals
 - than differentiates genus and species
 - mechanically - did it based on appearance similarities
 - his system nature is now hierarchical - set of rules for every section and subsection
 - Kingdom, phylum, class, order, family, genus, species

- animalia - multicellular ingestive eukaryotic heterotroph
 - autapomorphy - the characteristics that describe an organism
- Changing thoughts on what living things are
 - Physicalists - with the exception of humans, all living things are machines (Descartes, 17th century)
 - Vitalists - physical and chemical laws apply but living things have a vital force (essence)
 - Physical Science
 - inanimate objects
 - physical and chemical laws
 - universal
 - based on empirical observations
 - experimentation preferred method
 - single theory
 - single falsification enough to abandon a theory
 - Natural Science
 - animate objects
 - more than physical and chemical laws (genetics)
 - not universal
 - based on historical narratives
 - induction most used method
 - multiple theories
 - single falsification not necessary to abandon a theory
 - Deduction vs induction
 - deduction - from general to specific
 - induction - from specific to the general
 - Multiple theories
 - food competition
 - sexual competition
- Anatomy of a scientific explanation (theory)
 - two parts
 - pattern
 - mechanism or process
 - questions to be asked
 - what?
 - how(proximate cause)? or Why (ultimate causes)?
 - proximate causes(physical science - like biology)
 - phenotype - morphology and behaviour
 - mechanical (predicable)
 - here and now
 - genes in action
 - experiments
 - Ultimate causes (natural science - like biology)
 - genotype - genes and history
 - variable (probabilistic)
 - evolutionary past
 - changes in genetic programs
 - historical narratives (no math, using logical arguments)

- Merging of physicalists and vitalists
 - organicists (1930)
 - vital force replaced by genetic program and the importance of emergence, emergent (swarm example)
- Scientific Method
 - Some terms used in doing science
 - theory and fact
 - theory is an explanation for something that happened, explained multiple times
 - fact is
 - hypothesis is a baby theory
 - laws are universal explanations, biologists can't have laws because its restricted to earth
 - prediction (logical vs chronological), predictions is a logical thought
 - Steps or stages
 - a question that needs to be answered
 - gather information already known
 - develop a hypothesis and test it
 - interpret the results of the test
 - retest
 - publish results
 - null hypothesis
 - Additional experimental components
 - controls
 - control of variables
 - sampling error
 - repeat the test
 - Distribution of scientific facts
 - journal selection
 - manuscript preparation
 - peer review
 - review
 - revision
 - publication
 - Types of literature
 - primary - person who did the science is the author of the article
 - secondary - person who is writing the article but did not do all the work, combination of different works
 - tertiary - author may not work in field, experts in field were asked to review
- Natural selection - industrial melanism
 - evolution was frequency of genes at the time in the 1900s
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