Keywords 1

Ages of sand	**Douglas Adams four ages of sand.** Look at period of innovation based on his four ages of sand (silica glass): - **first stage (telescope 1608):** sand ground to form lenses that allowed human kind to look ingot he distance and observe the universe and the planets of our solar system. along with these observation findings of the scientific revolution are accompanied - **second stage (microscope 1676):** use of glass lens to look into the smaller world around us and begins the invention of the smaller world. This new tool starts to unravel the details of the cell, fundamental unit of all living things - **Third stage (computer chip 1961):** gives science the access to computational strengths permitting the analysis of data and asking question that were until then impossible to answer. mathematical models of biological systems, ecosystem structures, even unravelling the evolutionary structure of organisms becomes possible. As it becomes more affordable everyone starts to have it - **fourth stage (fibre optics 1980s):** use of sand in fibre optic cables which allows the transmission of huge amounts of data and informational lightening speed around the world. social and peer- to-peer networking allows for scientists and the other great thinkers of the world to world together on a global scale problems
Al-Dinawari	- he takes Theophrastus' book and adds more plants (including herbs) to it and adds the descriptions of the plants - he was in the field of botanical science and catalogued plants
Alhazen	first to create and describe the scientific method: observations, statement of problem, formulation of hypothesis, testing of hypothesis using experimentation, analysis of experimental results, interpretation of data and formulation of conclusion, publication of findings

Al-Jahiz	- animals engage in a struggle for existence; for resources, to avoid being eaten and to breed. Environmental factors influence organisms to develop new characteristics to ensure survival, thus transforming into new species. animals that survive to breed can pass on their successful characteristics to offspring - in his book “The Book of animals” he addresses the struggle for existence, the food chain, and evolution
Aristotle	- He wrote the first classification, scale natura - he tried to organize the living world in his scala naturae where the gods where at the top with the humans right beneath them. at the bottom was the inert world and the elements and in between all the other types of living things - he gave us rules, you must fit a certain criteria to be included in a certain group
Avicenna	- experimentation in medicine. his book in medicine was used till the 17th century. he added medicine from arab and indian world. - he summarized greek, indian and muslim medicine
Artificial Taxonomy	- plato and his students aristotle (animals) + Theophrastus (plants) were the first to use this to organize the living world - what they did was write down the info.contained in the folk taxonomies compiling lists of all living things - these texts translated into and arabic becoming reference tool used around the world - these lists included animals and plants that were economically medicinally important - list grew longer and were based on detailed descriptions of the objects being classified rather than unique names for animals and plants
Binomen	- a name with two parts - first word is the genus the second the species epithet - first word was a latin noun and the second an adjective - genus of name always capitalized - always italicized

Biogeography	- a science that focuses on distribution of plants and animals in different geographical places and times
Chronological prediction	- used by the general public but not in science - involves foretelling of future events
Classification	- first classification is the scala naturae - method of scientific taxonomy used to group and categorize organisms into groups such as genus or species. These groups are known as taxa
Control	- a person, group, event, etc., that is used as a constant and unchanging standard of comparison in scientific experimentation - it will be used to compare to the manipulated variables
Cuvier (Georges)	- *(1769-1832) french natural scientist* - Comparative anatomy : Cuvier would look at bones of fossils found and compare them to others of similar structure = homology.These animals probably related to each other and there has been divergent over time. ex. divergent in what that limb is and does - catastrophe theory: he is the one to state that things have changes. Claims that there was a catastrophe so some of the original work disappeared as a result of this catastrophe. The people at the time thought flood and Noah so anything to survive must have been on the arc - extinction: organisms have gone extinct. Digs big bones and fossils and is able to assemble the organisms from their bones. Allows us to see an entire functioning groups of organisms that are not there today - when he starts putting this together, he is finding that if everything arrived on that one date, why are there dead organism, why have they disappeared and they are not on the planet anymore.Discovers that there are organisms that had been on the planet, dominated and disappeared

Deduction	- goes from general to the specific – you know what will happen and test to see that it does
Empirical Observation	- physical sciences is based on empirical observations - source of knowledge obtained by observation
Essentialism	- end of 17th century and nothing has changed since Aristotle put together this classification - a belief that things have a set of characteristics that make them what they are, and that the task of science and philosophy is their discovery and expression; the doctrine that essence is prior to existence - make sure everything stay the same and delivered by the same god or whatever greater power it might be - essence is something that makes the organism what it is, ability to capture energy so they're alive
Extinction	- organisms have become extinct - whole groups have changed and whole groups have disappeared
Fact	- fact is something unchangeable; it is what it is - it is viewed as the strongest piece of evidence by the general public
Folk Taxanomy	- documented by word of mouth (the knowledge held by one person of great knowledge in each village or city) - When the spoken word was the only way that the classification and its rules were passed between generations - No matter when and where they live, people around the world have used folk taxonomies to organize a variety of different things including the natural world that surrounds them - still used today - and among different cultures there are commonalities - traditionally distinguishes somewhere around 500 species or unique elements and this may reflect a limit to our cognitive capabilities for mentally keeping track of the different elements in the classification scheme

Great Chain of Being	- where the gods where at the top with the humans right beneath them. at the bottom was the inert world and the elements and in between all the other types of living things
Harvey	- 1650s, anatomy and physiology - 1578 -1657 - father of physiology - trying to understand how the body works, how blood and heart work together, and how the circulatory system functions as a whole
Hierarchial system	- kingdom, phylum, class, order, family, genus, species - organized plants and animals into his sestina nature into categories contained within larger categories - created by Linnaeus and originally only had two kingdoms, animals and plants
Hippocrates	- hypocratic oath - father of western medicine - travelled the known world at the time and collected all written pieces about medicine (human biology) and put them together creating a book called the *Hippocratus corpus*; which contained everything known about human biology at the time.
Historical Narrative	- natural science is based on this - making observations about things going on around them and making explanations based on those observations; results in a different way of thinking
Hypothesis	- slightly weaker than a theory - is arrived at by examining the existing literature on science or by observations of the natural world, and from these come an idea of how something works or behaves. The explanation is then the hypothesis and testing begins to be sure that it remains true under various conditions
Ibn Al Baitar	- created a pharmaceutical catalogue of medicinal plants that once translated into latin was used until the 18th and 19th century

Induction	- from the specific to general, used in natural sciences - when biologists observe things, not everything responds the same way. there is an inherent variability
Industrial melanism	- **industrial melanism,** the darkness—of the skin, feathers, or fur—acquired by a population of animals living in an industrial region where the environment is soot-darkened. The melanization of a population increases the probability that its members will survive and reproduce; it takes place over the course of many generations as the result of natural selection of the lighter, more conspicuous animals by predators. - change in frequency of an allele or gene = natural selection. gene composition shift cause of enviro

Lamarck (Jean-Baptiste)	- Transmutation of species = inheritance of acquired traits • change of species • gives us everything that has become wrong about the scala • over time as organism function in the environment they are in, they will change to match up with that environment • infusarium: basic organism that over time acquires traits and becomes more complex and improves - simple organism and transforming to ideal perfect organisms and species change over time in order to adapt to their environment - trying to explain how diversity on planet arises and diversity occurs over a long time and some organisms also disappear - organism starts out and its essence slowly changes due to its environment - inheritance of acquired traits that made giraffes necks longer - at this point he is not aware that their is common ancestor but sort of there cause kind of infusarium - he gives us the first explanation but inheritance of acquired traits is not something that would actually happen - he is an essentialist
Law	- must be universal but for biology haven't been able to see if it is universal since have only able to see it occur on the planet therefore continues to be theories in respect to biology - Mendell is a biologist who gave us laws

Leclerc (George-Louis-Buffon)	- Wrote Histoire Naturelle - as he traveled around the world, noticed that there were organisms with similar appearances. ex. cat like animals; predators, claws, etc. so he questioned why there would be so many organisms with the same bases with slight differences in appearance - tries to explain changing diversity - one of first biogeographers; certain organisms found in specific regions that have slight different appearances due to region of habitat - everything came on that day but foods being consumed by the organisms was different which altered the essence of that organism so they became slight different types of that one organism. Not all as it was on that date. - environment has brought about those changes; he gave us that mechanism - each organism has an essence; essence for everything that goes from 1 generation to the next so stays the same. but he says there was 1 that slightly shifted to make variations of that one organism
Linnaean taxonomy	- his scala naturae - his work signals beginning of mechanical taxonomy based on physical characteristics of organisms being classified
Linnaeus (carolus)	- (1735) - Systema naturae, classified things in a hierarchal system,binomen and mechanical taxonomy - accumulated every organisms in world, describes them, and starts to group them - he nests the classification. gave nested hierarchal organization of living world

Logical prediction	- most often expressed as an “if” and “then” statement – if I alter this variable in a controlled experiment then my hypothesis predicts that this should happen. This logical prediction is closely related to the deductive mechanism of an experiment - taking a bunch of facts putting them together forming a prediction
Mechanical Taxonomy	- based on physical characteristics of organisms being classified - uses similarities in appearance when grouping the organism’s characteristics
Middle Ages	- 400-700 early middle ages (dark ages) - 100-1300 high middle ages - 1300-1500 late middle ages (begin to come out of this period) - during the early middle ages you see the massive impact of the collapse of rome. people are living hand to mouth - during the high middle ages things start to build up. economy improves, there starts to be money. churches get money and they start to expand becoming a hub of culture and knowledge however black plaque sweeps in during (1347-1351) and kills 1/2-3/4 of europe and causes and economical crash. So almost all progress being made is lost. Plaque was transmitted by flea -> becomes bronchiole so get to a point were they can’t breathe. - but populations starts to grow and 200 years later civilization in europe starts to become viable - late middle ages: start to see exploration and europeans travelling around the world

Natural Sciences	- 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 - allow more than one explanation for how something is happening
Null hypothesis	- No relationship between two measurement or experiments or reactions
Organicists	- (1930) - vital force replaced by genetic program and the importance of emergence (swarm behaviour—> birds and fish (individual organisms come together as one)) • genetic program assembling things, but when separate counterparts come together they exhibit properties different than they did separately = emergence concept • because we solve genetics, and start to understand where factors come from, the vitalists and physicalists come together creating the organicists

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 —> if can be falsified by one doctor than must be abandoned - only have a single theory, only one explanation allowed
Physicialists	- physicialists - with the exception of humans all living things are machines (descartes, 17th century). - believe in chem, equations, mechanics so believes living things are like little machines. everything in the living world is a machine and if we find what is driving them can know how they function - mechanistic explanation
Primary Reference	- did the research, wrote the article, and had it published = expert/scientist does all the work
Proximate cause	- instantaneous cause, the cause happening at that moment = physical science
Sampling error	- error in measurement. when you measure and you are unaware of the error • can be seen when data is graphed and does not resemble a normal distribution
Scala Natura	- first one created by Aristotle, latter of life
Secondary Reference	- expert in the field has been asked to review and put together a review article. the writer is not the one who did all the research but is familiar and understands the researcher. The people who did the research are accredited for their work in the review article

Special Creation	- pattern - species don't change - each species created on October 23, 4004 BCE (a saturday); sets age for earth - essences make sure everything stays the same and delivered by the same god or whatever greater power it might be
Taxon (Taxa)	- name designating a group of organisms included within a category in the Linnaean taxonomy hierarchy
Taxonomy	- science of the classification of organisms into an ordered system that indicates natural relationships
Tertiary Reference	- never use in science, our textbook is a tertiary source. - the person writing is not an expert and mainly just did summaries on work that has already been researched and explained.
Theophrastus	- (371-287 BCE) - father of taxonomy - he organized the plants; this was important for medicine since many/all illnesses are treated with herbs. Also, attributed characteristics to the plants - he wrote 10 books and 9 of them still survive today - the sequence of classification that he used for plants is still for the most part correct today

Theory	- a theory is an explanation or model that explains events in the natural world and makes predictions on how they will occur - It is also based of a broad range of observations that have been backed up by multiple hypotheses that have tested the theory to be sure that it is sound and true. A scientific theory is required to be based on facts - not uncommon for multiple hypothesis to come together and create a theory
Ultimate Causes	- the why questions dig deeper and look for the fundamental underlying ultimate causes
Van Leeuwenhoek	• The father of Microbiology and is considered the first microbiologist • Created the first microscope, a double lens microscope
Vesalius	- (1514-1564) father of anatomy - he was the 1st to present the 1st drawings of the inner workings of the human body - author of one of the most influential books on human anatomy, De humani corporis fabrica; containing all illustrations of anatomy
Vitalists	- physical and chemical laws apply but living things have a vital force (essence). - something more than just a string of elements, science. life has something special about it to make it living, some vital force which is the essence that makes every organisms that way that it is

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