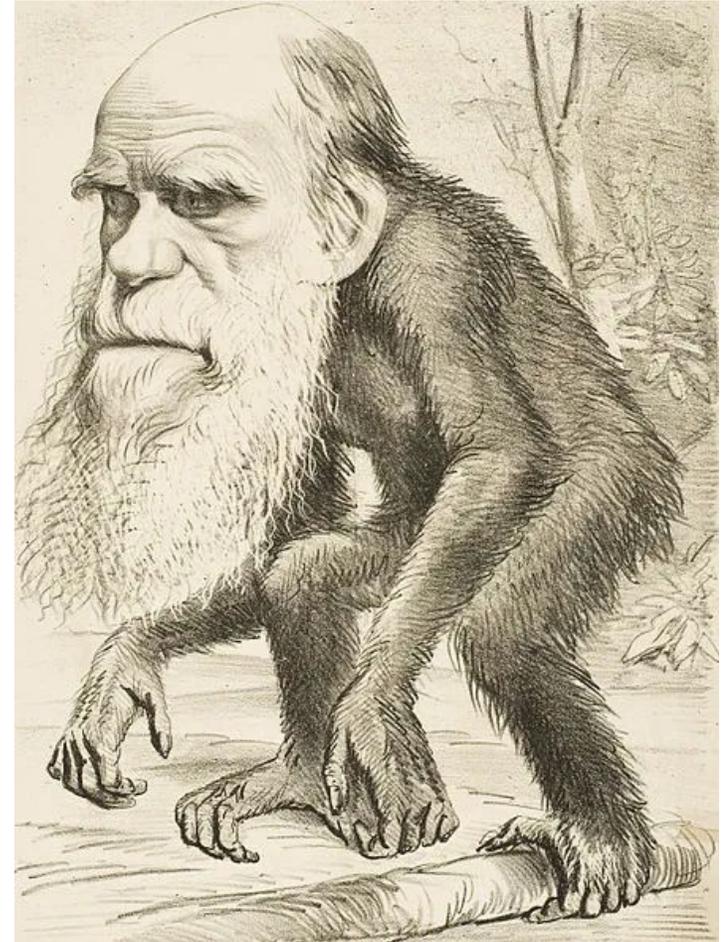


Week 3: The Theory of Evolution



Douglas J. Burks



A Complex Theory

- Ernst Mayr has argued that Darwin's theory of evolution are five interconnected theories. If any of the five theories fails, they all fail.

1. Evolution as such.

1. *Evolution as such. This is the theory that the world is not constant nor recently created nor perpetually cycling but rather is steadily changing and that organisms are transformed in time.*

2. Common descent.

1. *This is the theory that every group of organisms descended from a common ancestor, and that all groups of organisms, including animals, plants, and microorganisms, ultimately go back to a 'Single origin of life on earth.'*

3. Multiplication of species.

1. This theory explains the origin of the enormous organic diversity. It postulates that species multiply, either by splitting into daughter species or by "budding," that is by the establishment of, geographically isolated founder populations that evolve into new species

4. Gradualism.

1. *According to this theory, evolutionary change takes place through the gradual change of populations and not by the sudden (saltational) production of new individual's that represent a new type.*

A Complex Theory

5. Natural selection.

1. According to this theory; evolutionary change, comes about through the abundant production of genetic variation in every generation. The relatively few individuals who survive, owing to a particularly well-adapted combination of inheritable characters, give rise to the next generation.

Directly quoted from Mayr, Ernst. 1991. One Long Argument: Charles Darwin and the Genesis of Modern Evolutionary Thought. Cambridge, Massachusetts. Harvard University Press. Pp 36-37.



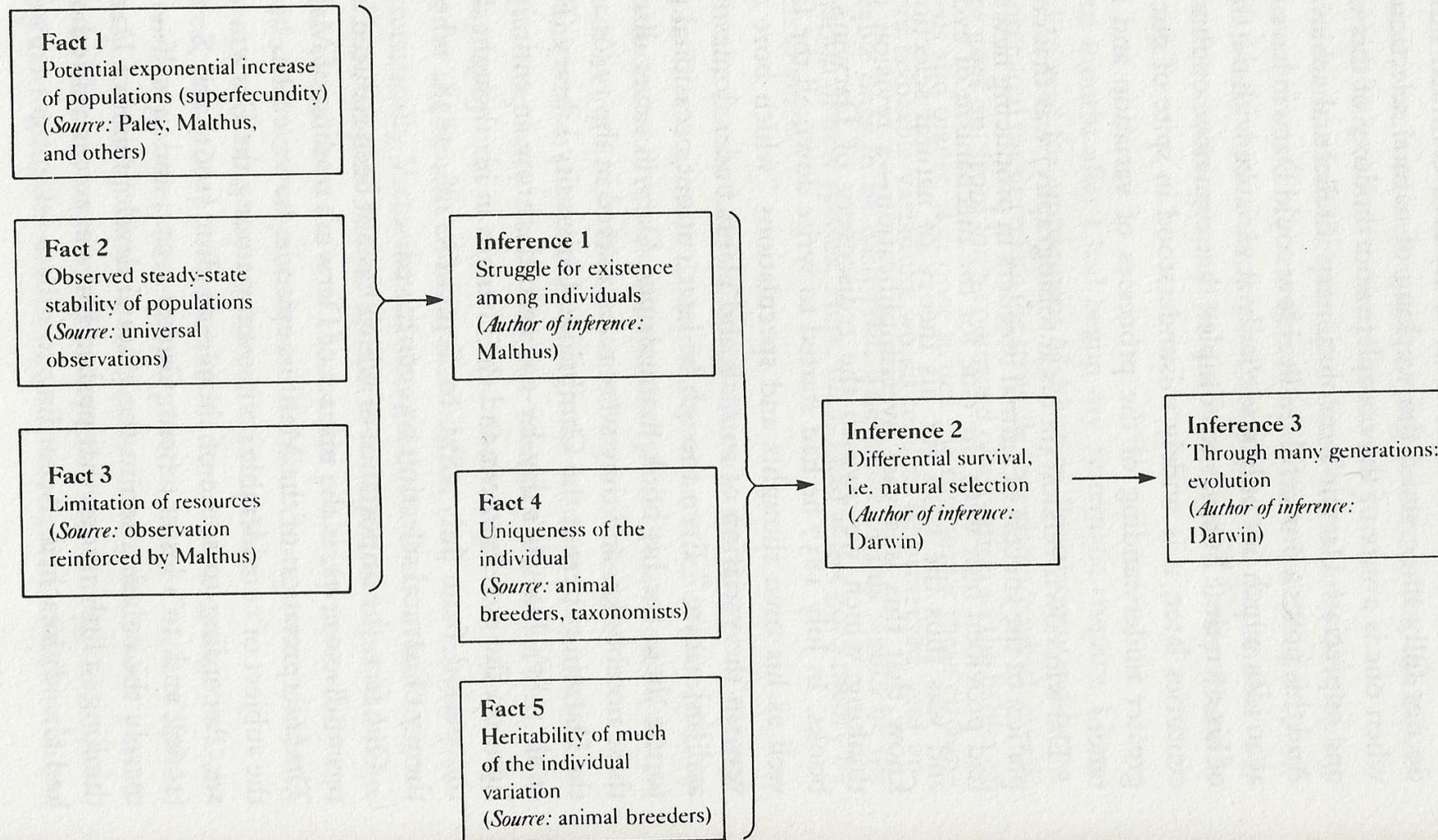
A Complex Theory

- The mechanism that leads to change is natural selection. It has several distinct components.
 1. Entails the idea that there is a competition for resources and those best fit give their traits to the next generation.
 1. Like begets like:
 1. Parents pass on traits (through genes/DNA) to offspring
 1. There are rare mutations or changes in genes that are then passed on
 2. Variation:
 1. Differences occurs in all species. Individuals show differences (due to mutations)
 3. Reproductive excess:
 1. more are born than can survive to reproduce
 4. Environmental Selection (natural selection):
 1. With reproductive excess members of species compete for resources and the environment selects those who will succeed in mating and leaving more offspring.
 2. Obtaining food, shelter, escaping predators, finding mates, finding moisture ...
 5. Environmental Change:
 1. The environment changes over time
 2. The environment is diverse, and selection is different in different areas

Ernst Mayr. 1991. One Long Argument

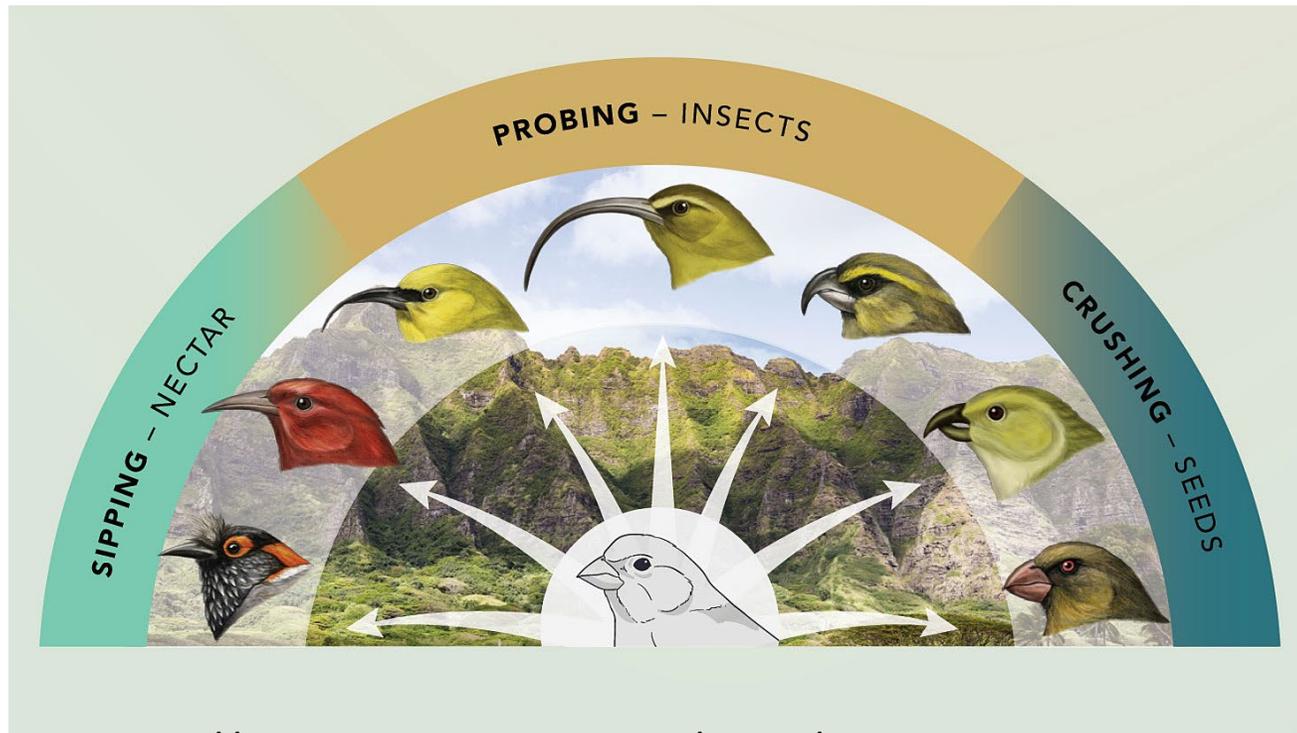
FIGURE I

Darwin's Explanatory Model of Evolution through Natural Selection

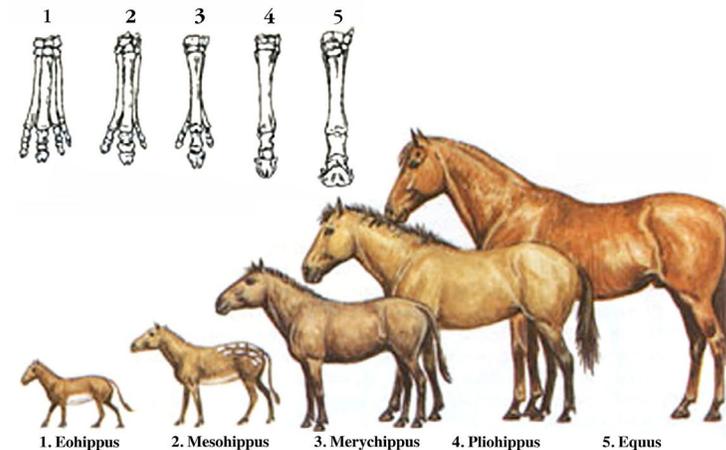
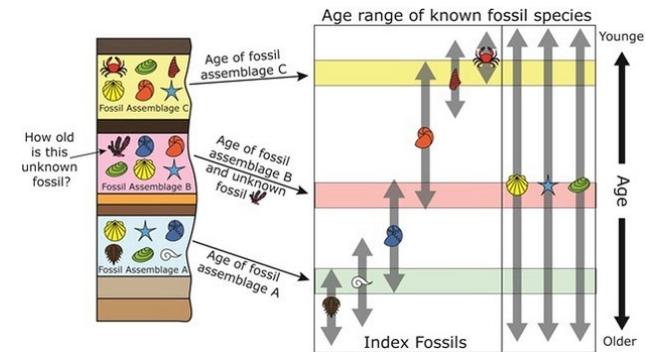


Evidence for Theory 1

- Evolution as such.
 - Evolution as such. This is the theory that the world is not constant nor recently created nor perpetually cycling but rather is steadily changing and that organisms are transformed in time.



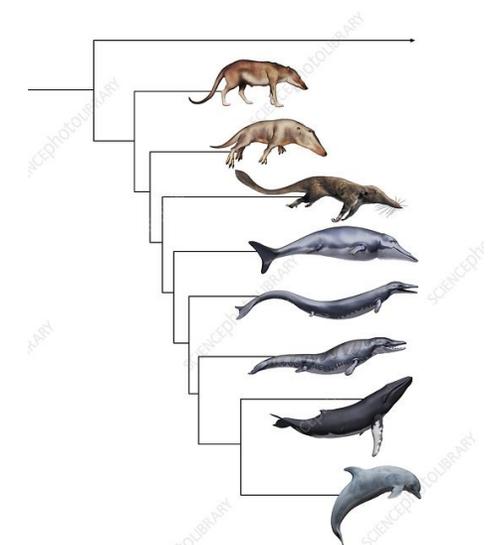
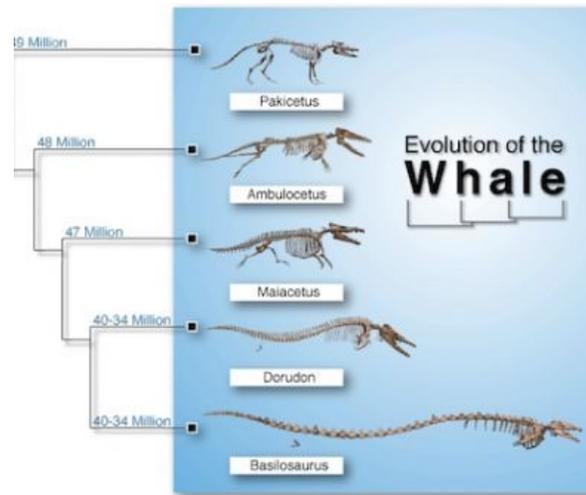
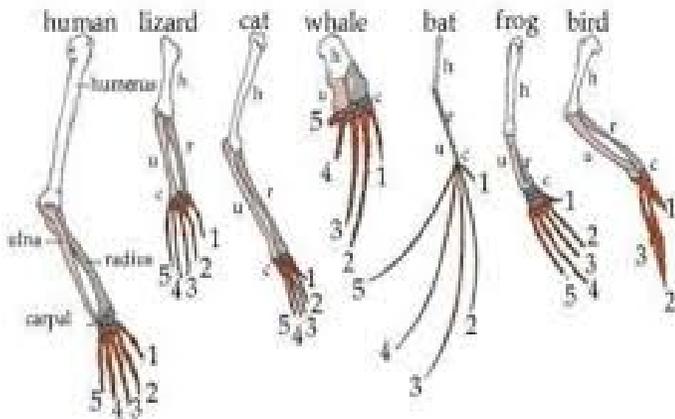
<https://www.allaboutbirds.org/news/wp-content/uploads/2018/12/AdaptiveRadiationGraphic.jpg>



Evidence for Theory 2

- Common descent.
 - This is the theory that every group of organisms descended from a common ancestor ,and that all groups of organisms, including animals, plants, and microorganisms, ultimately go back to a 'Single origin o f life on earth.'

Evidence for Common Ancestry



<https://biologos.org/articles/whale-evolution-theory-prediction-and-converging-lines-of-evidence>

Evidence for Theory 3

- Multiplication of species.
 - This theory explains the origin of the enormous organic diversity. It postulates that species multiply, either by splitting into daughter species or by "budding," that is by the establishment of , geographically isolated founder populations that evolve into new species

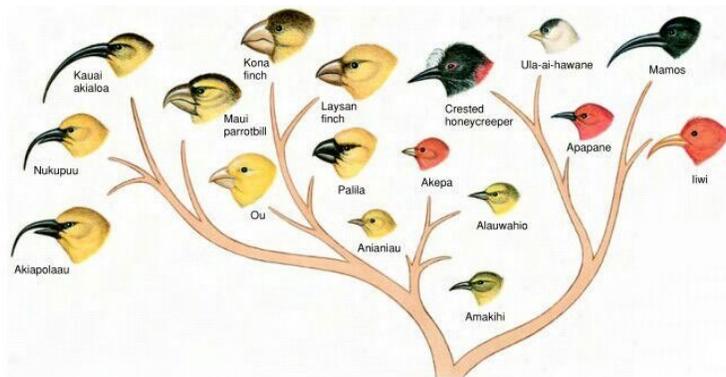
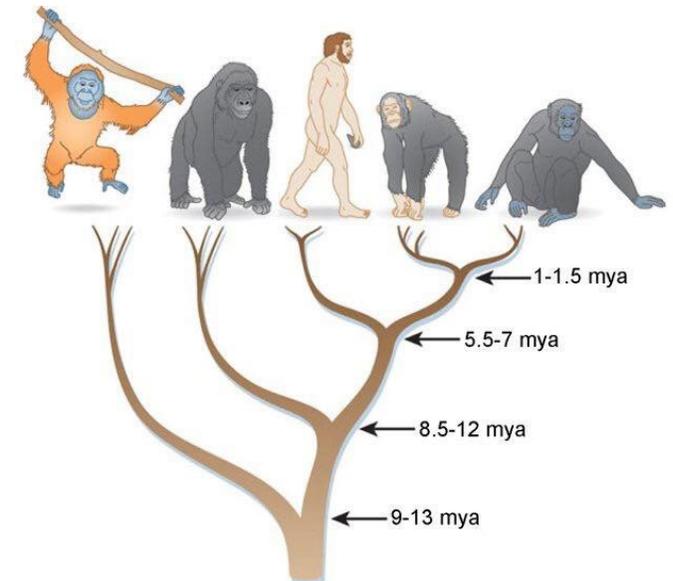
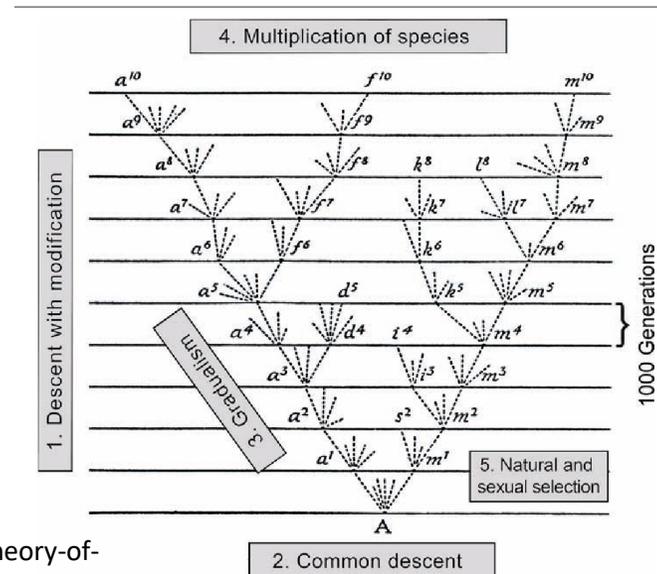


Figure 1-14
 Gradualism provides a plausible explanation for the origin of different bill shapes in the Hawaiian honeycreepers shown here. This theory has been challenged, however, as an explanation of the evolution of such structures as vertebrate scales, feathers, and hair from a common ancestral structure. The geneticist Richard Goldschmidt viewed the latter forms as unbridgeable by any gradual transformation series.



I reproduction of the single illustration in Darwin's *Origin of Species* of 1859 (6. ed. 1872). This famous di

Punctuated Equilibrium

the hypothesis that evolutionary development is marked by isolated episodes of rapid speciation between long periods of little or no change.

However, the term "rapid," in evolutionary terms should be understood to mean approximately 500,000 years in some circumstances. So for example, a species of sea animals lives, breeds and dies for thousands of years.

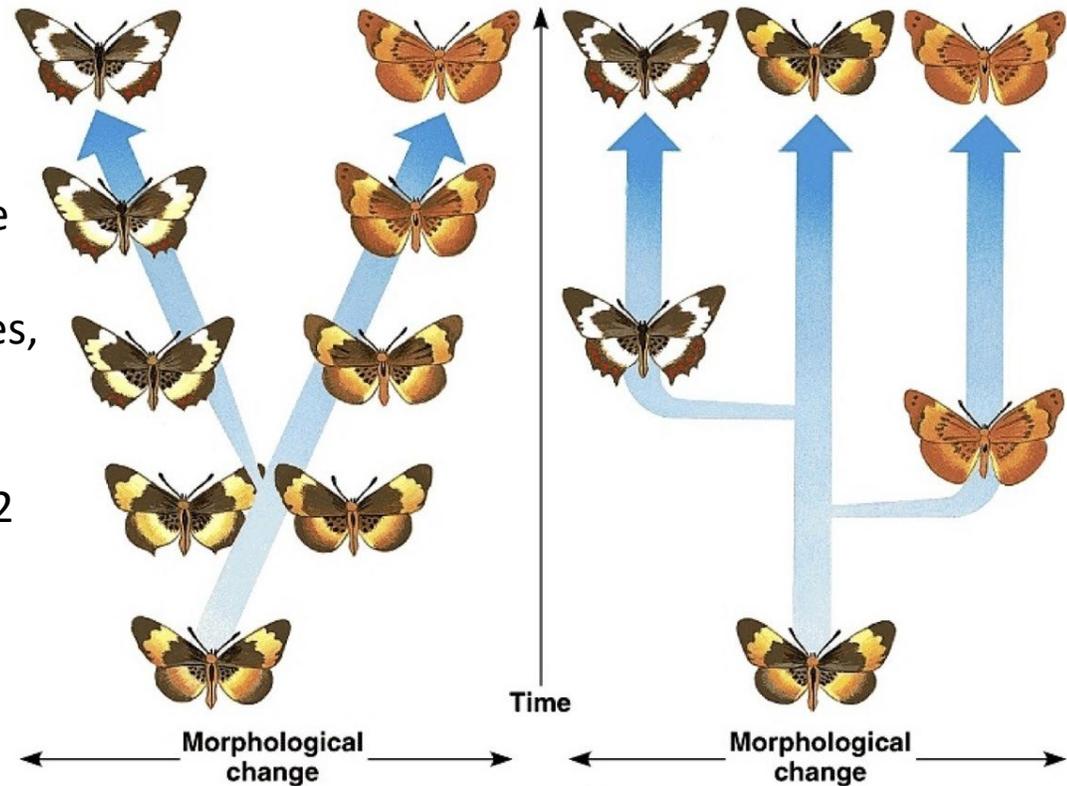
proposed by Stephen Jay Gould and Niles Eldredge in 1972



Niles Eldredge



Stephen J. Gould



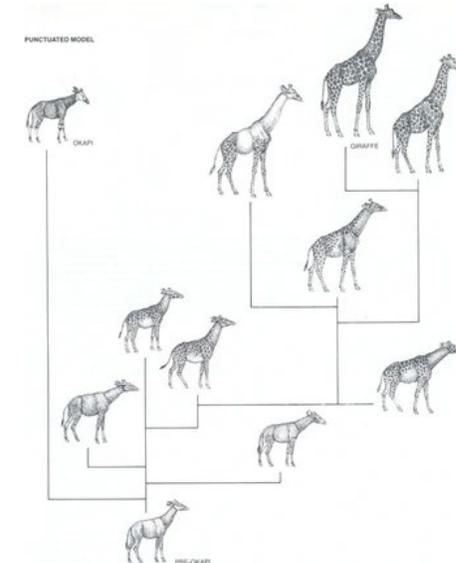
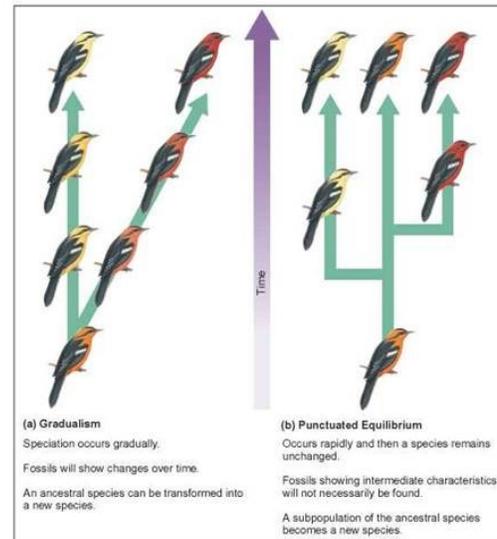
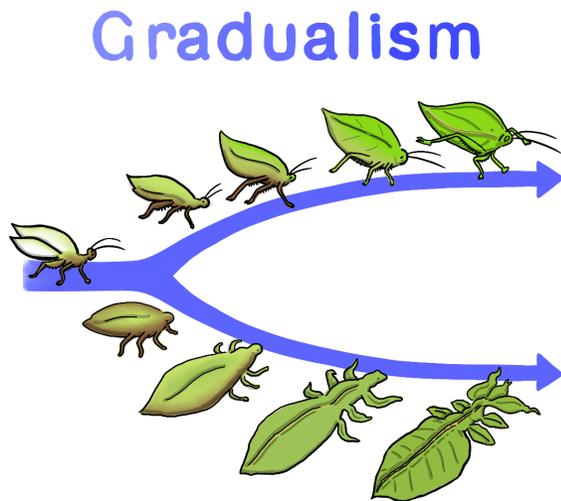
(a) Gradualism model

(b) Punctuated equilibrium model

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Evidence for Theory 4

- Gradualism.
 - According to this theory, evolutionary change takes place through the gradual change of populations and not by the sudden (saltational) production of new individual's that represent a new type.
 - What do we mean by gradual?



Evidence for Theory 5

Natural selection.

According to this theory; evolutionary change, comes about through the abundant production of genetic variation in every generation. The relatively few individuals who survive, owing to a particularly well-adapted combination of inheritable characters, give rise to the next generation.

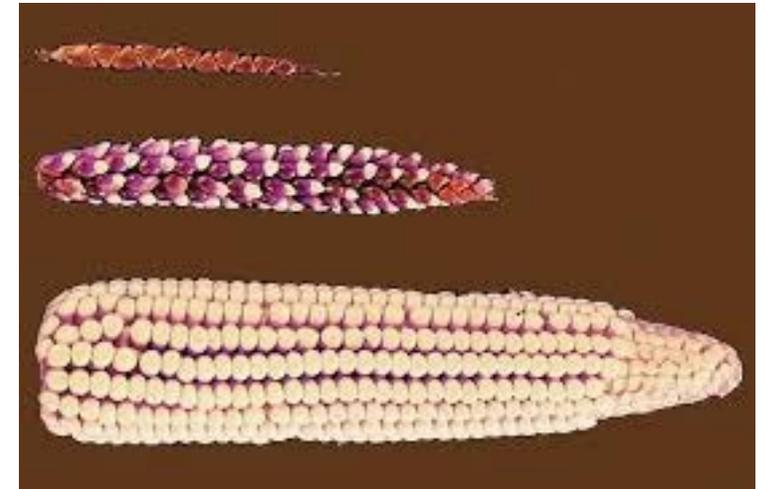
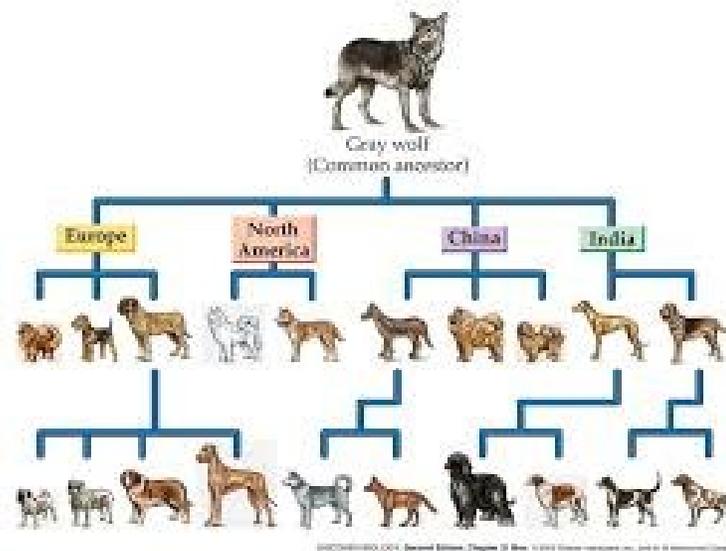
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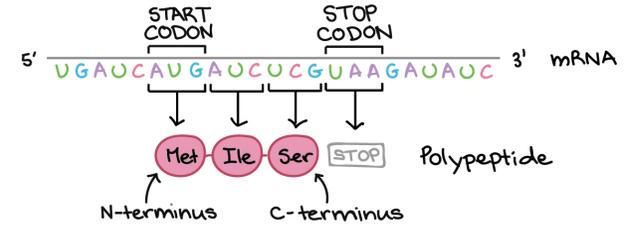
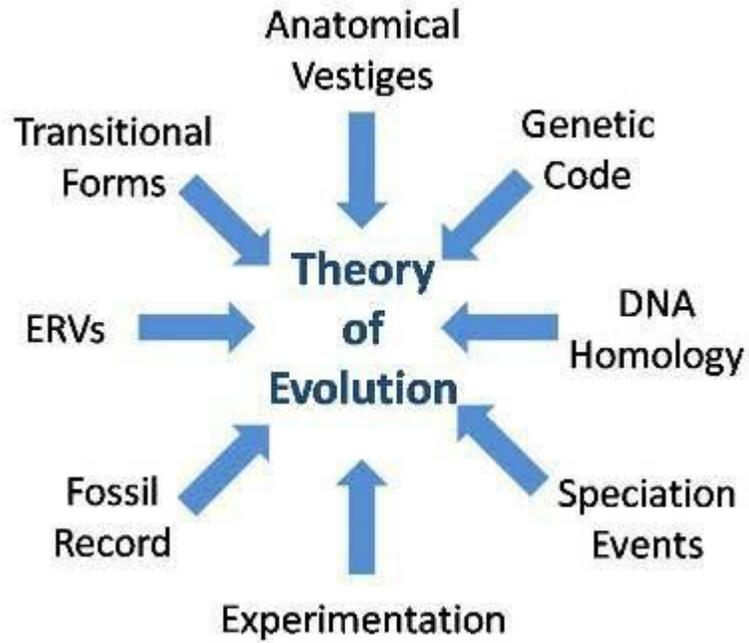
Amino acids reveal evolution

Cytochrome c Evolution

Organism	Number of amino acid differences from humans
 Chimpanzee	0
 Rhesus monkey	1
 Rabbit	9
 Cow	10
 Pigeon	12
 Bullfrog	20
 Fruit fly	24
 Wheat germ	37
 Yeast	42

A





https://aminoapps.com/c/science/page/blog/blog-5-charles-darwins-theory-of-evolution/nNCL_u8Wa2d7XlIXpB1RZ0mQdmaj7Q

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C	CUU } CUC } Leu CUA } CUG }	CCU } CCC } Pro CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } CGC } Arg CGA } CGG }	U C A G
A	AUU } AUC } Ile AUA } AUG Met	ACU } ACC } Thr ACA } ACG }	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }	U C A G
G	GUU } GUC } Val GUA } GUG }	GCU } GCC } Ala GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } GGC } Gly GGA } GGG }	U C A G

<https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/translation/a/the-genetic-code-discovery-and-properties>

Discussion

- Do you think the theory of evolution is only a scientific question?
- In the natural world do you see any evidence that contradicts the theory?
- What do you think people find most troubling about this theory
- What do you think is the strongest evidence presented in favor of the theory?
- Should we trust science?
- That so many individuals must die to lead to change troubles some people. Does it trouble you? Survival of the fittest entails the fit don't live to reproduce.