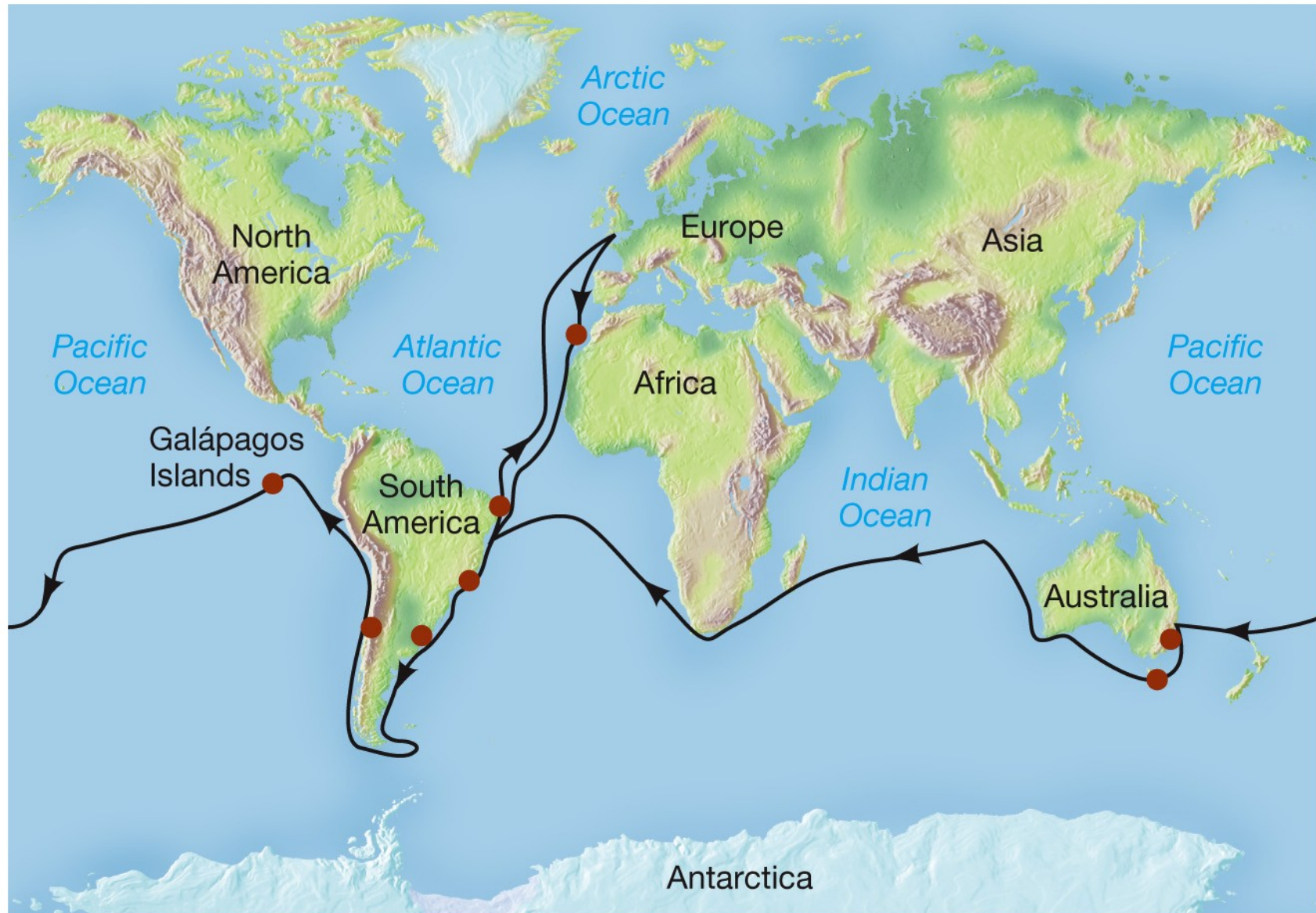


Happy Birthday Charles Darwin!



Voyage of the Beagle (1831-1836)

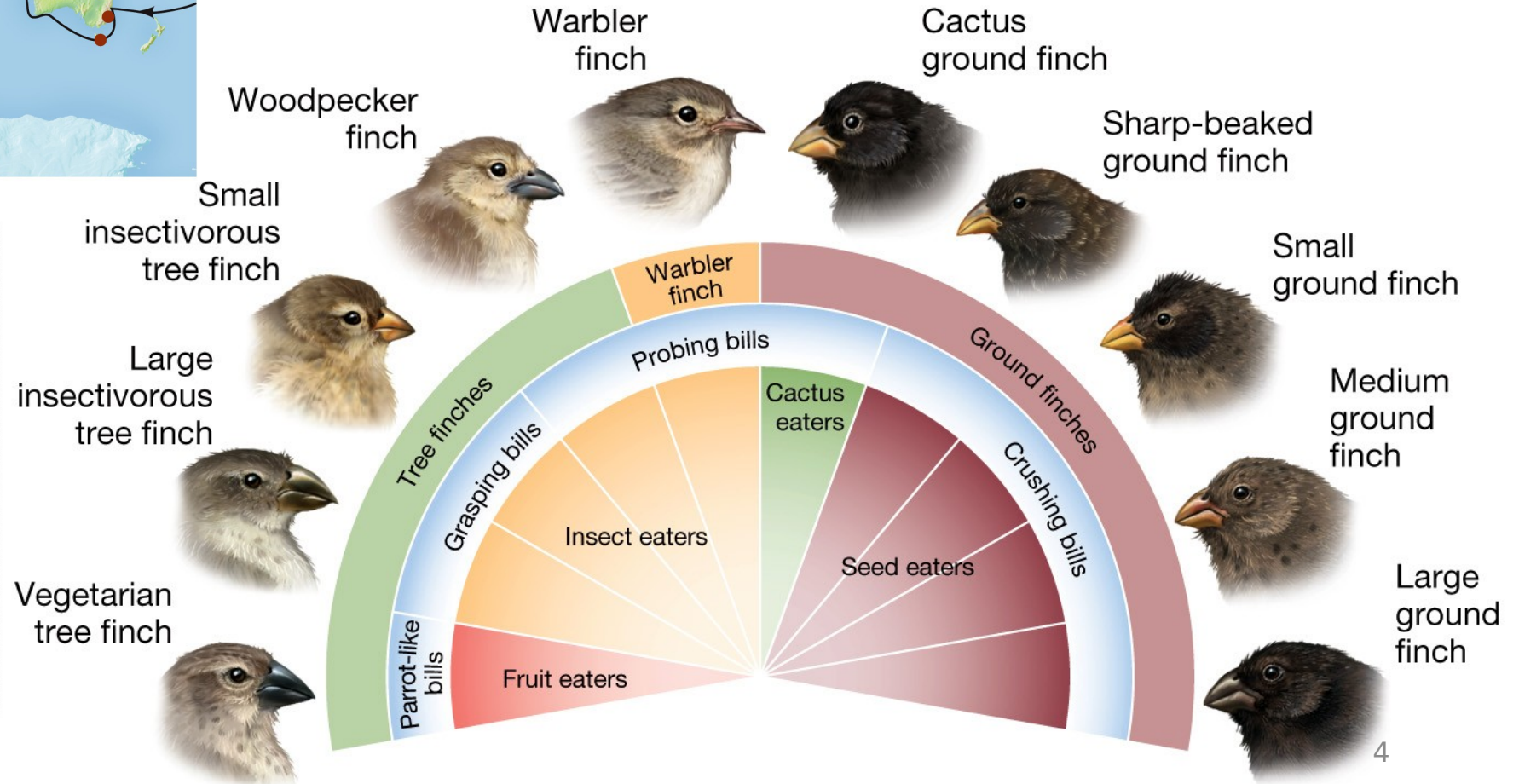
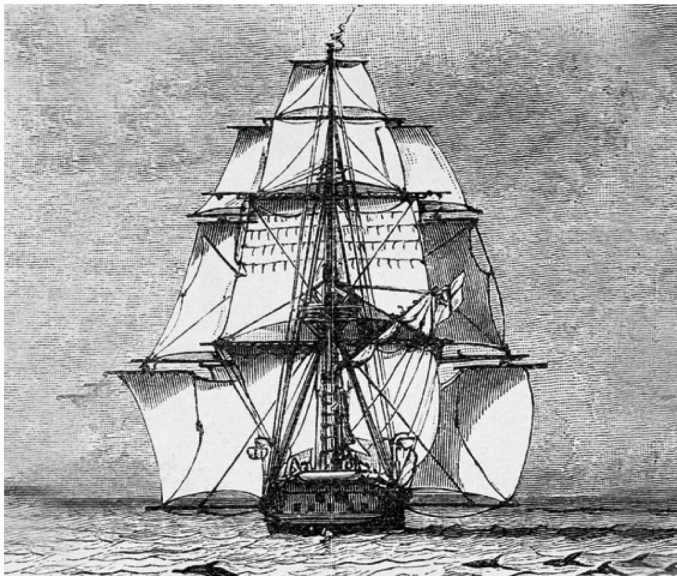


Where do different species come from?





Voyage of the Beagle

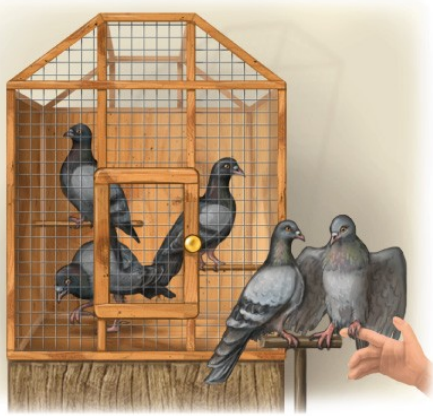


“ . . . a naturalist, reflecting on the mutual affinities of organic beings, on their embryological relations, their geographical distribution, geological succession, and other such facts, might come to the conclusion that each species had not been independently created, but had descended . . . from other species.

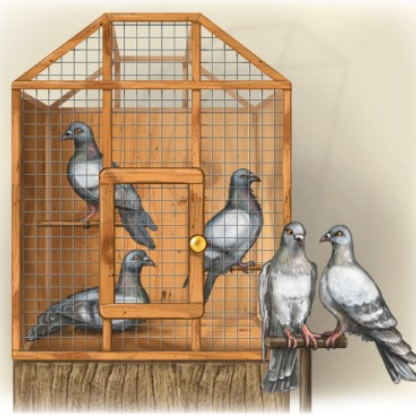
Nevertheless, such a conclusion . . . would be unsatisfactory, until it could be shown **HOW** the innumerable species inhabiting this world have been modified . . . ”

The Origin of Species (1859)

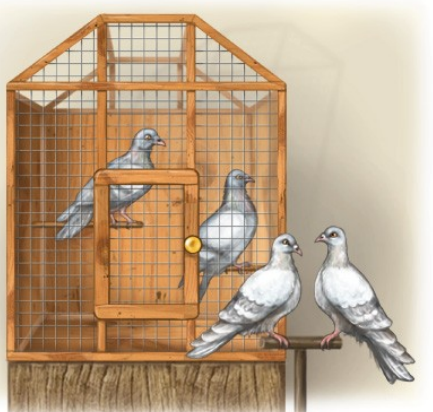
Generation 1



Generation 2



Generation 3



Generation N



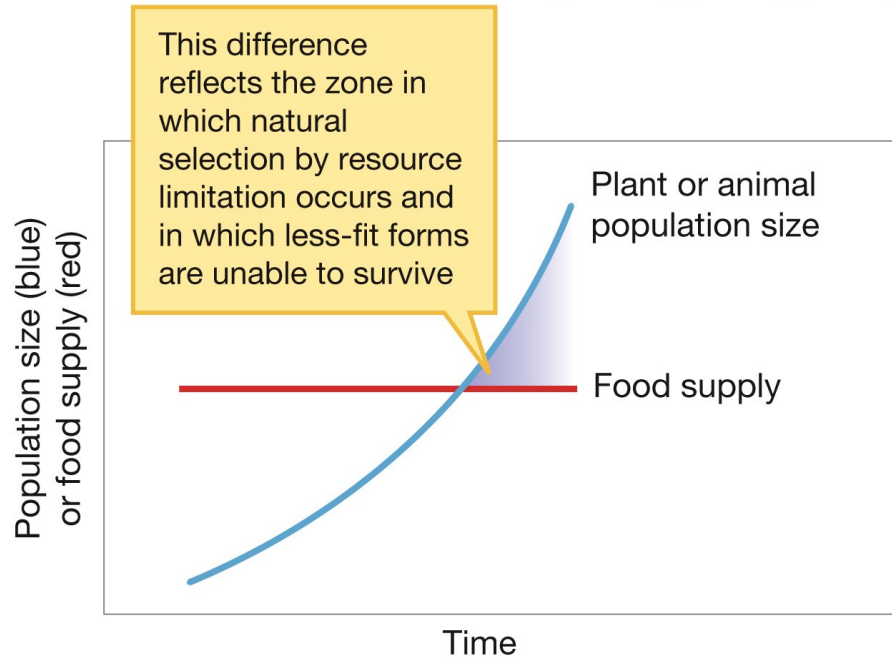
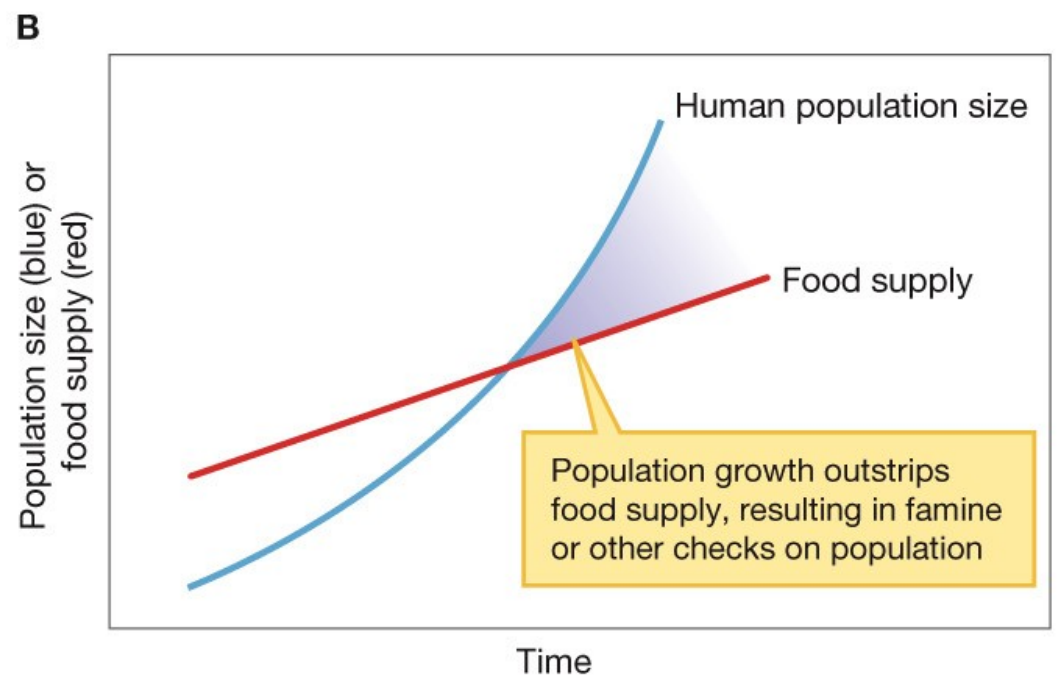
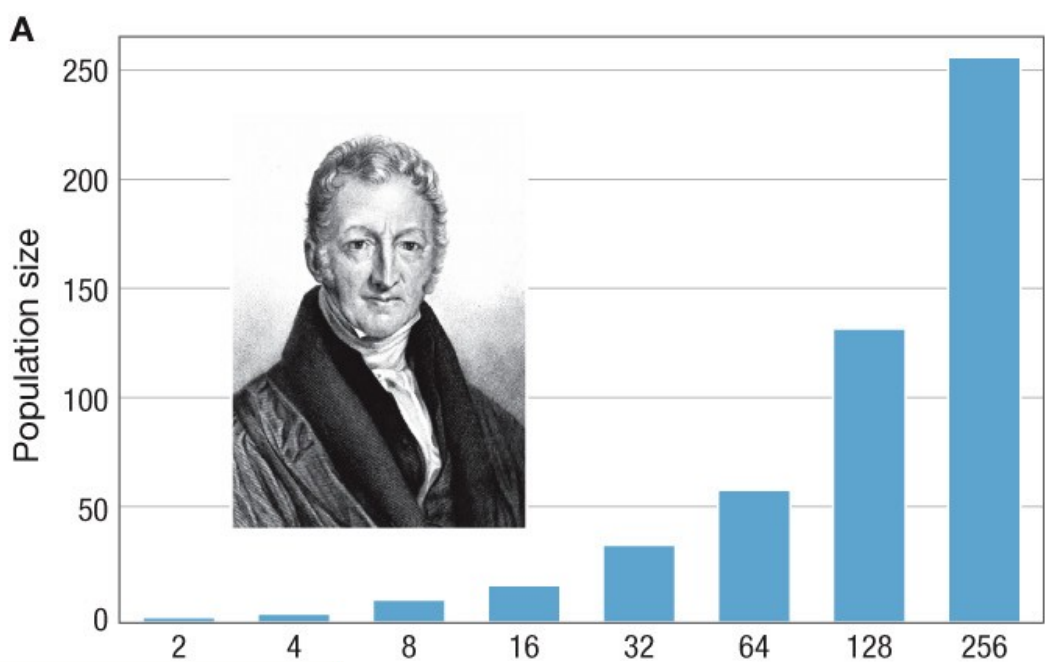
Darwin thought that by starting with the process of **artificial selection** that describing the process of **natural selection** as a generator of new species would be less controversial.

It wasn't.

Darwin's process

Darwin's four postulates explain why/how evolution occurs:

1. Individuals within populations are variable
2. Some of these variations are passed onto offspring
3. Not all individuals produce the same number of offspring
4. Individuals with certain heritable traits produce more offspring



Darwin borrowed ideas from **Malthus (1798)** to show how **natural selection** operated as a **population process**

Darwin's process

Let's distill the 4 postulates to their essence

Natural selection occurs when:

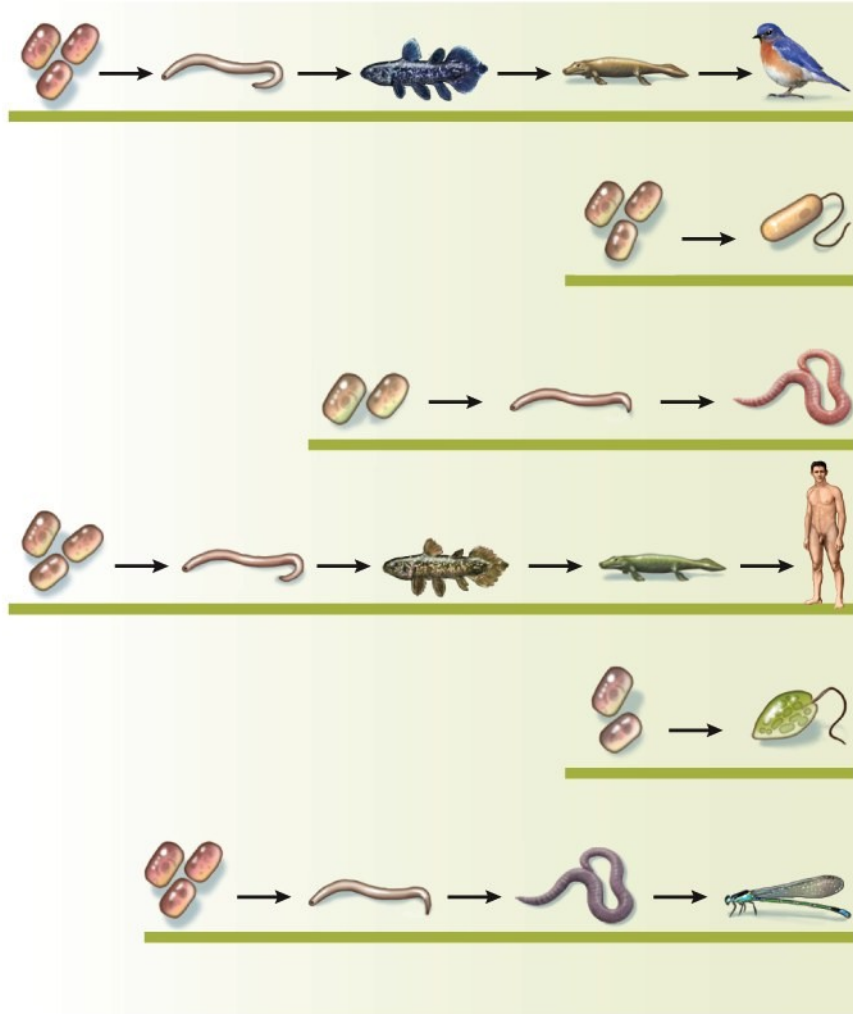
1. **Heritable variation**

leads to

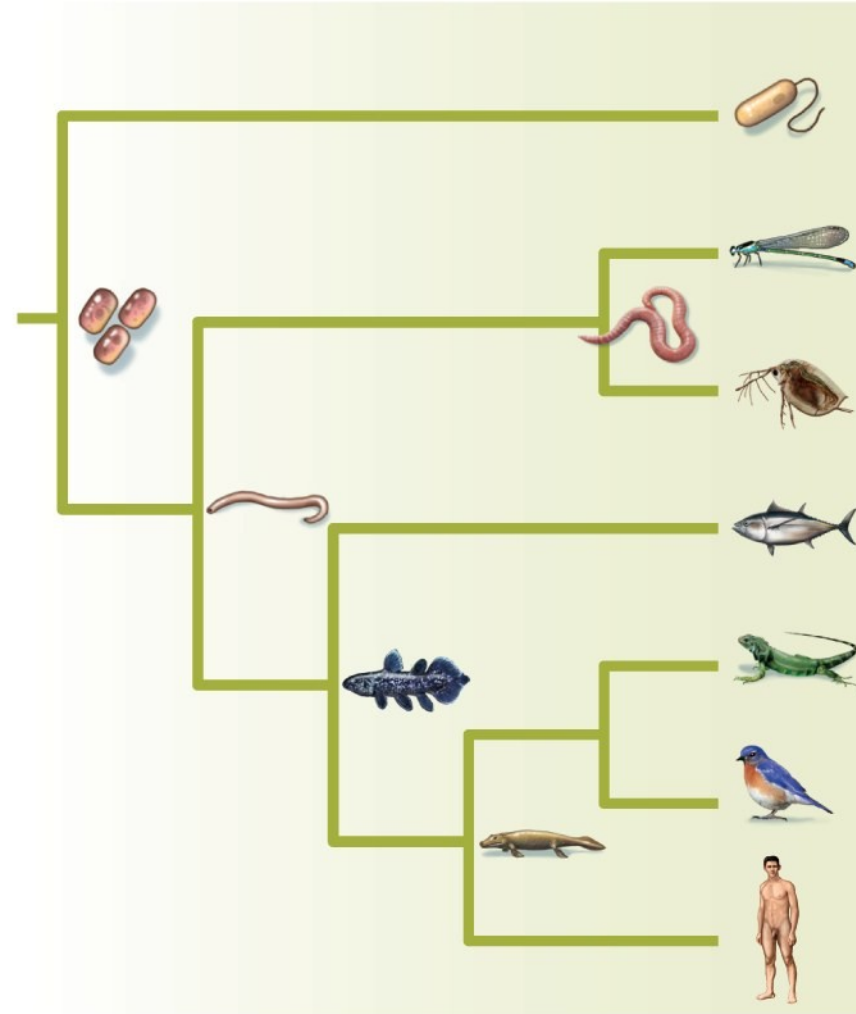
2. **Differential reproductive success**

KEY POINT: Evolution is simply an outcome (the pattern) of this process.

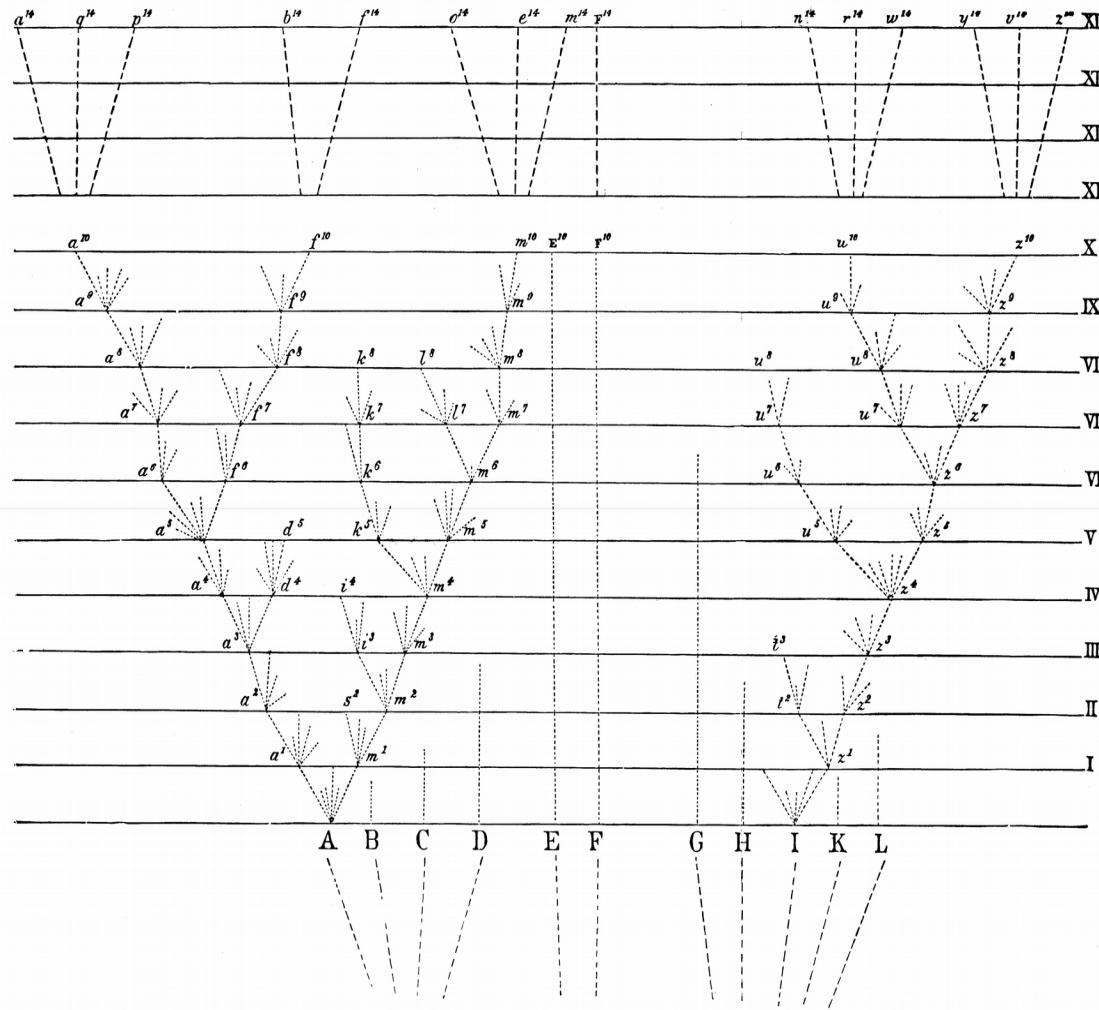
Lamarck: independent progression



Darwin: branching tree of life

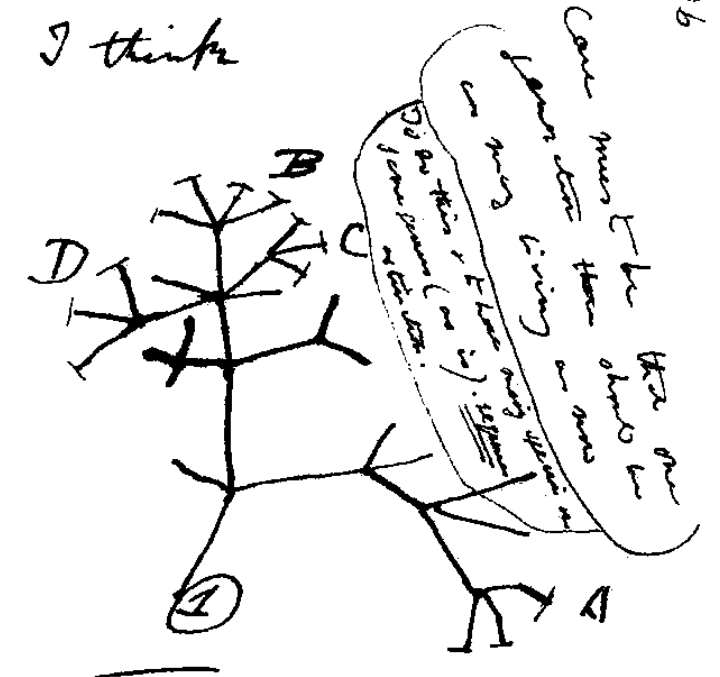


Evolutionary relationships -- « tree of life » -- phylogeny



Darwin (1859)

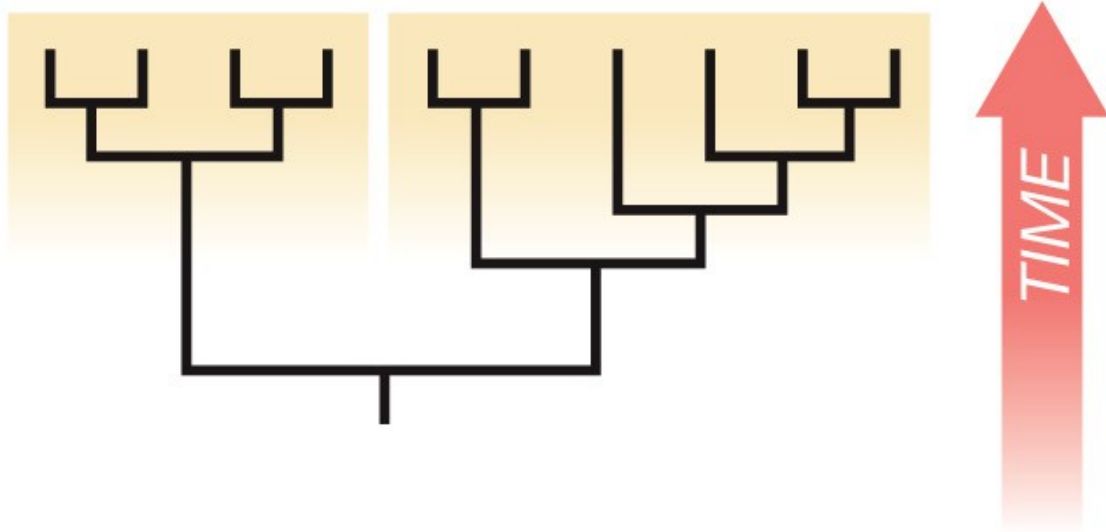
I think



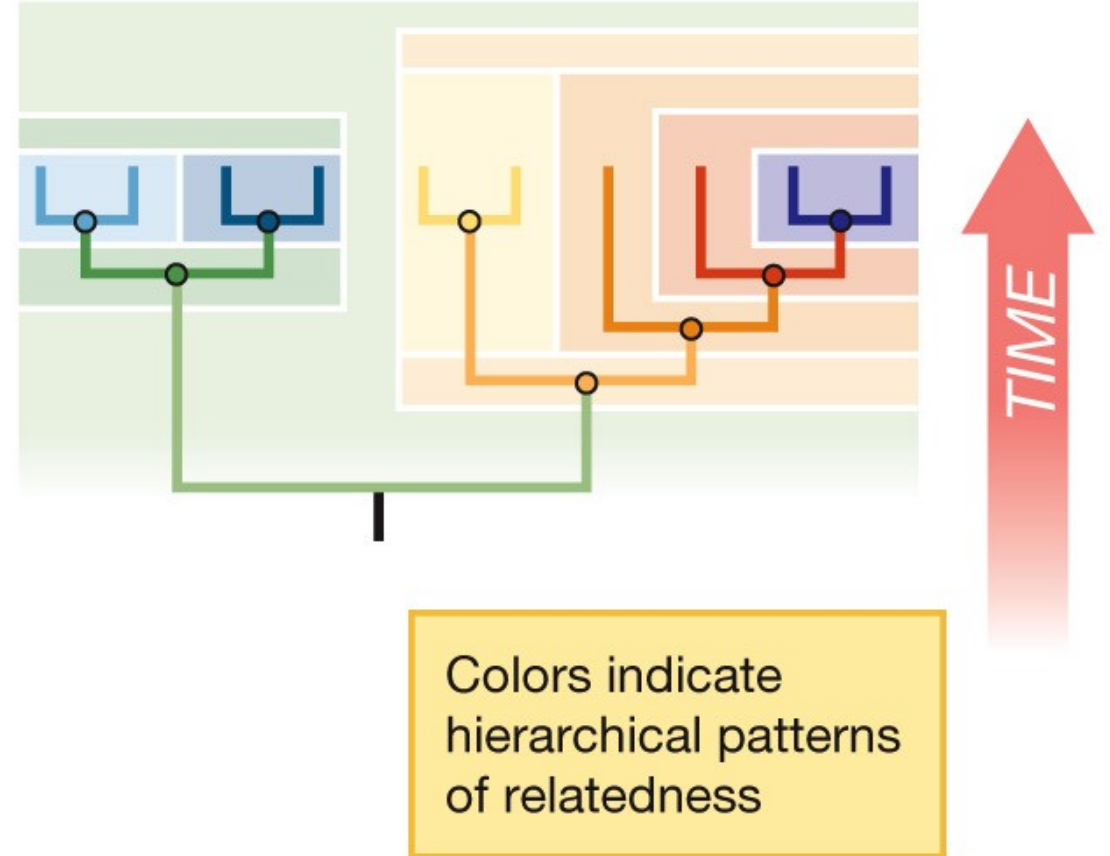
Then between A & B. various
 sort of relation. C & B. The
 first gradation, B & D
 rather greater distinction
 Then genus would be
 formed. - binary relation

Phylogenies exemplify **common descent**

A Clusters of species



B Hierarchical patterns of similarity



...hierarchical similarity also forms the basis for modern **systematics**

Darwin revolutionized biology

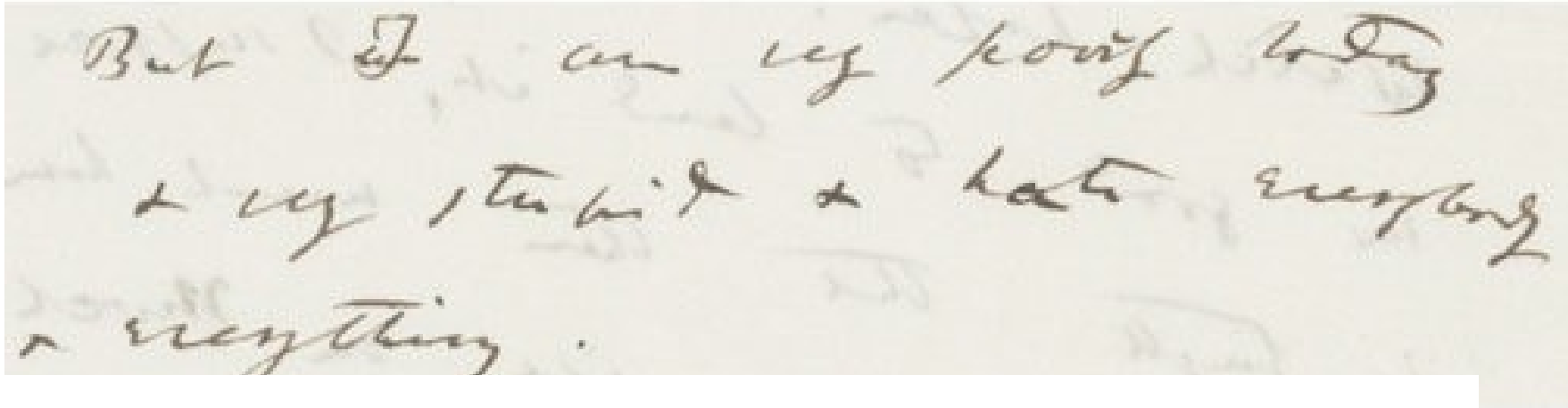
1. Population thinking

- Variation is key, not a mistake!

2. Tree thinking

- Thinking about the evolutionary relationships among species is integral to understanding the evolution of characteristics

Darwin had bad days too.



But I am very poorly today
& very stupid & hate everybody
& everything.

But I am very poorly today
and very stupid and hate everybody
and everything

Darwin, in a letter to Lyell
(1861)

Candy phylogeny

Imagine that these candies represent samples of different species, which have diversified through descent with modification.

Make a character state matrix

- 1) Take 8 different kinds of candies
- 2) Fill in a worksheet with 10 characters (you decide!), and the character state for each candy type
- 3) Add your data to the super-matrix on the board, if it is not already included.
- 4) Using a clementine as the outgroup, draw a rooted phylogeny and mark the synapomorphies on your tree
- 5) What is the score of your tree?
- 6) What are the splits in your tree?