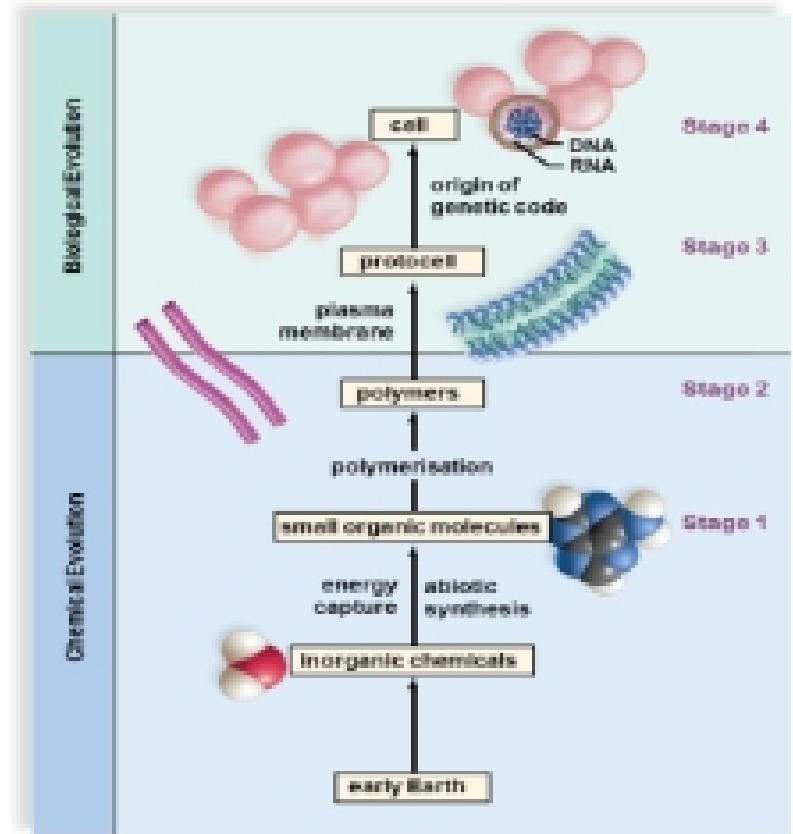


## Chapter 22: Human Evolution

### Origin of life through chemical evolution

- Steps of chemical evolution
  - Gases of the primitive atmosphere formed small organic molecules.
  - Molecules combined to form macromolecules.
  - Only RNA might have been needed to form the first cells; this is supported by the fact that RNA can act as enzymes called ribozymes (RNA-first hypothesis).
  - Protocells made of proteins and lipids could metabolize by using oceanic organic molecules, but could not reproduce.
  - The true cell can reproduce and has DNA as its genetic material.



### Biological evolution

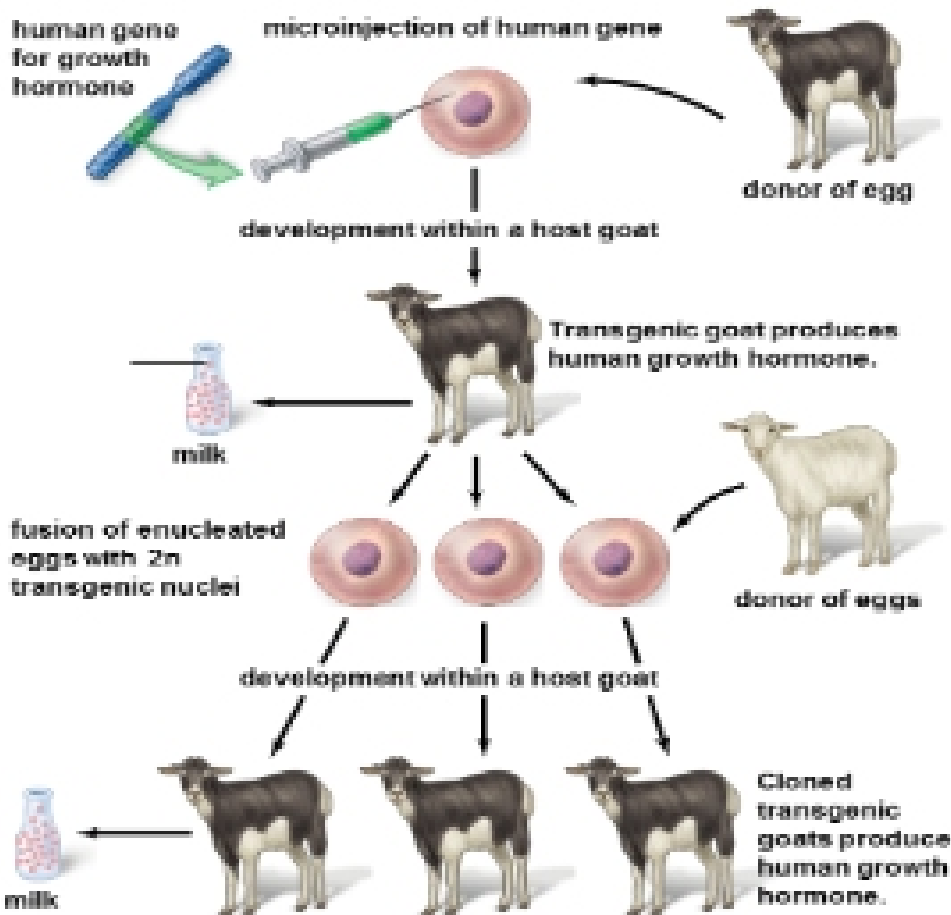
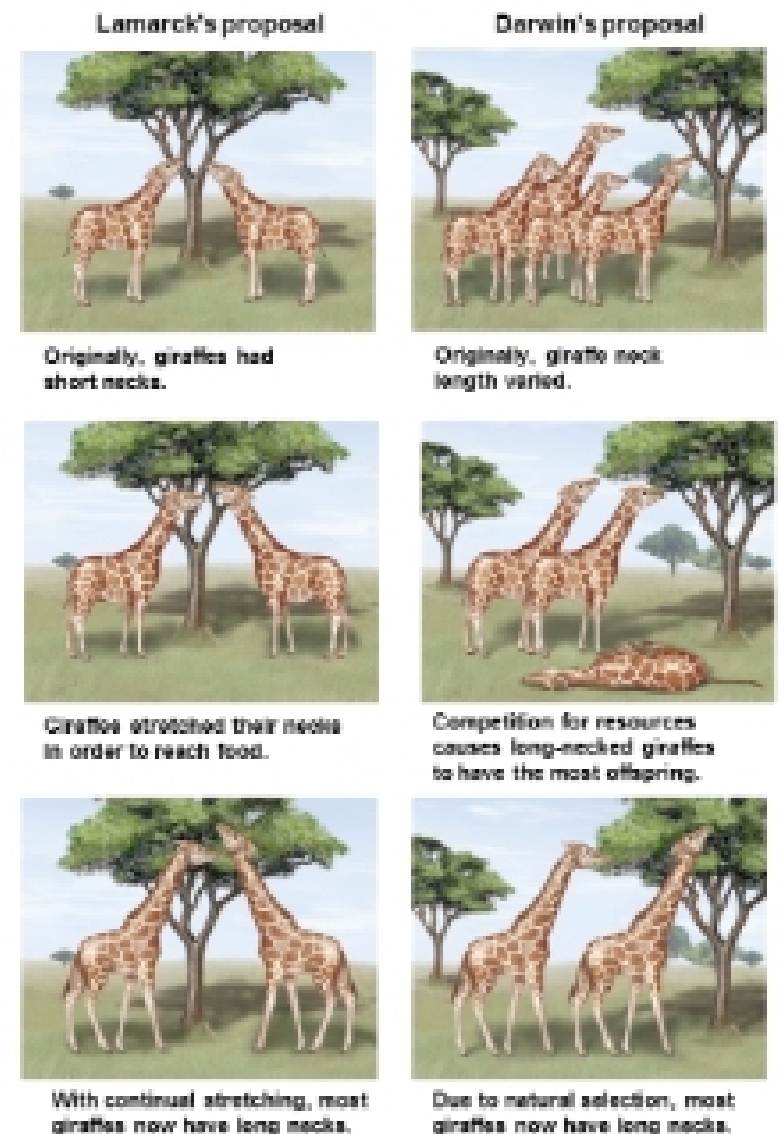
- Biological evolution – change in population or species over time
- 2 important points
  - Living things descended from a common ancestor and thus have common chemistry.
  - Living things adapt to their environment.
- Adaptation – a characteristic that enables an organism to survive and reproduce in its environment

Natural selection is a theory by Charles Darwin that describes a mechanism by which a species becomes adapted to its environment. (Charles Darwin – Father of evolution)

- 3 vital elements
  - Variation – there must be physical variations that can be passed from generation to generation
  - Competition – there must be competition for limited resources (food, mates, shelter), and those better adapted will survive and reproduce
  - Adaptation – subsequent generations will see an increase in individuals with the same adaptations, as long as the environment remains unchanged

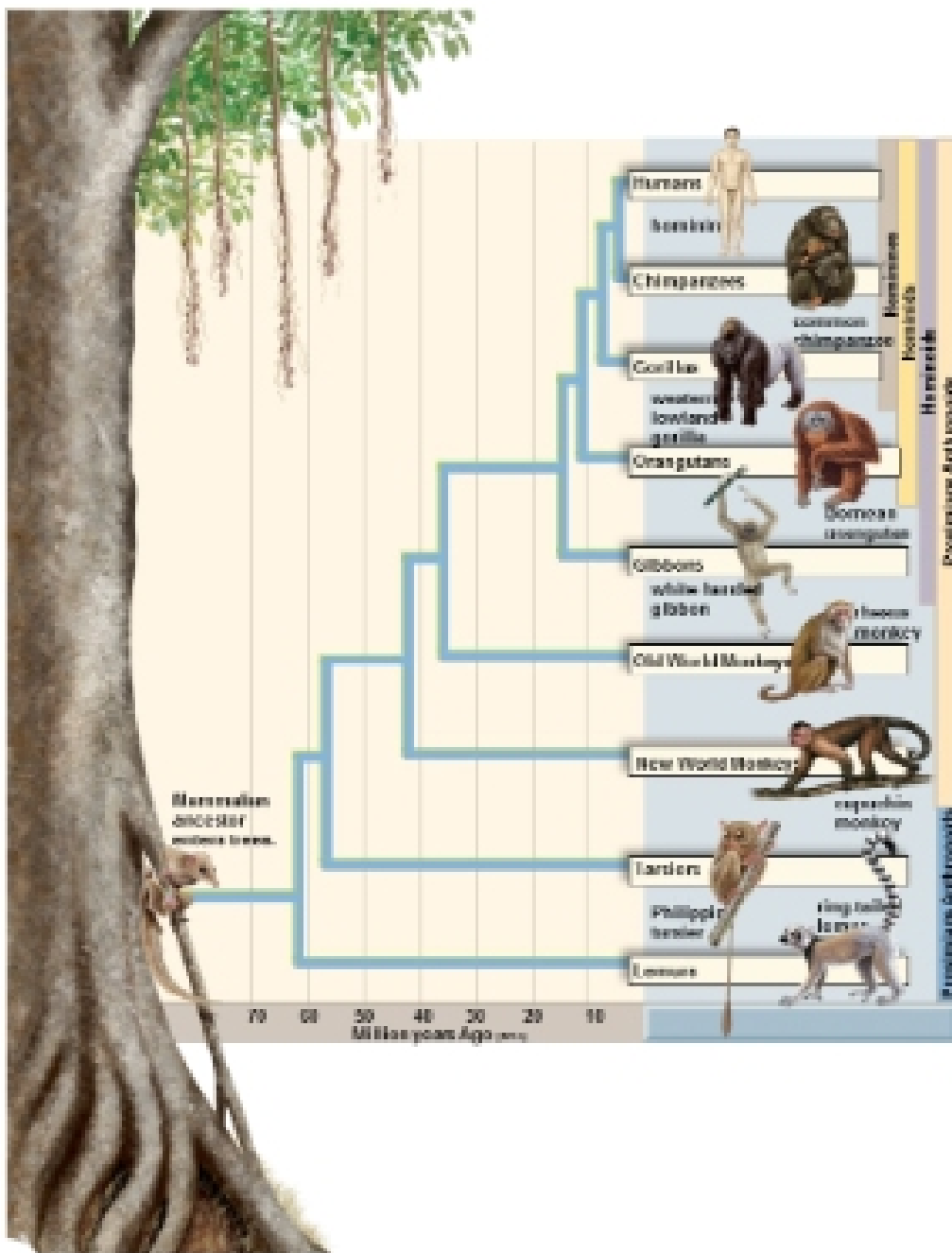
### Evidence to support the theory of evolution by common descent

1. Fossil record
2. Biogeographical evidence
3. Anatomical evidence
4. Biochemical evidence



## Primates

- Characteristics
  - Opposable thumb
  - Stereoscopic vision (depth perception)
  - Well-developed brain
  - Reduced number of offspring (usually a single birth) with an increased period of parental care
  - Emphasis on learned behavior and social interactions
- 2 major groups (suborders)
  - Prosimians – includes lemurs, tarsiers, and lorises
  - Anthropoids – includes monkeys, apes, and humans



**Table 22.1** Evolution and Classification of Humans

BYA/MYA <sup>a</sup>	Classification Category	Characteristics
2 BYA	Domain Eukarya	Membrane-bound nucleus
600 MYA	Kingdom Animalia	Multicellular, motile, heterotrophic
540 MYA	Phylum Chordata	Sometime in life history: dorsal tubular nerve cord, notochord, pharyngeal pouches
120 MYA	Class Mammalia	Vertebrates with hair, mammary glands
60 MYA	Order Primates	Well-developed brain, adapted to live in trees
7 MYA	Family Hominidae	Adapted to upright stance and bipedal locomotion
3 MYA	Genus <i>Homo</i>	Most developed brain, made and used tools
0.1 MYA	Species <i>Homo sapiens</i> <sup>†</sup>	Modern humans; speech centers of brain well-developed

ee

<sup>a</sup>BYA = billions of years ago; MYA = millions of years ago.

<sup>†</sup>To specify an organism, you must use the full binomial name, such as *Homo sapiens*.



Human spine exits from the skull's center; ape spine exits from rear of skull.

Human spine is S-shaped; ape spine has a slight curve.

Human pelvis is bowl-shaped; ape pelvis is longer and more narrow.

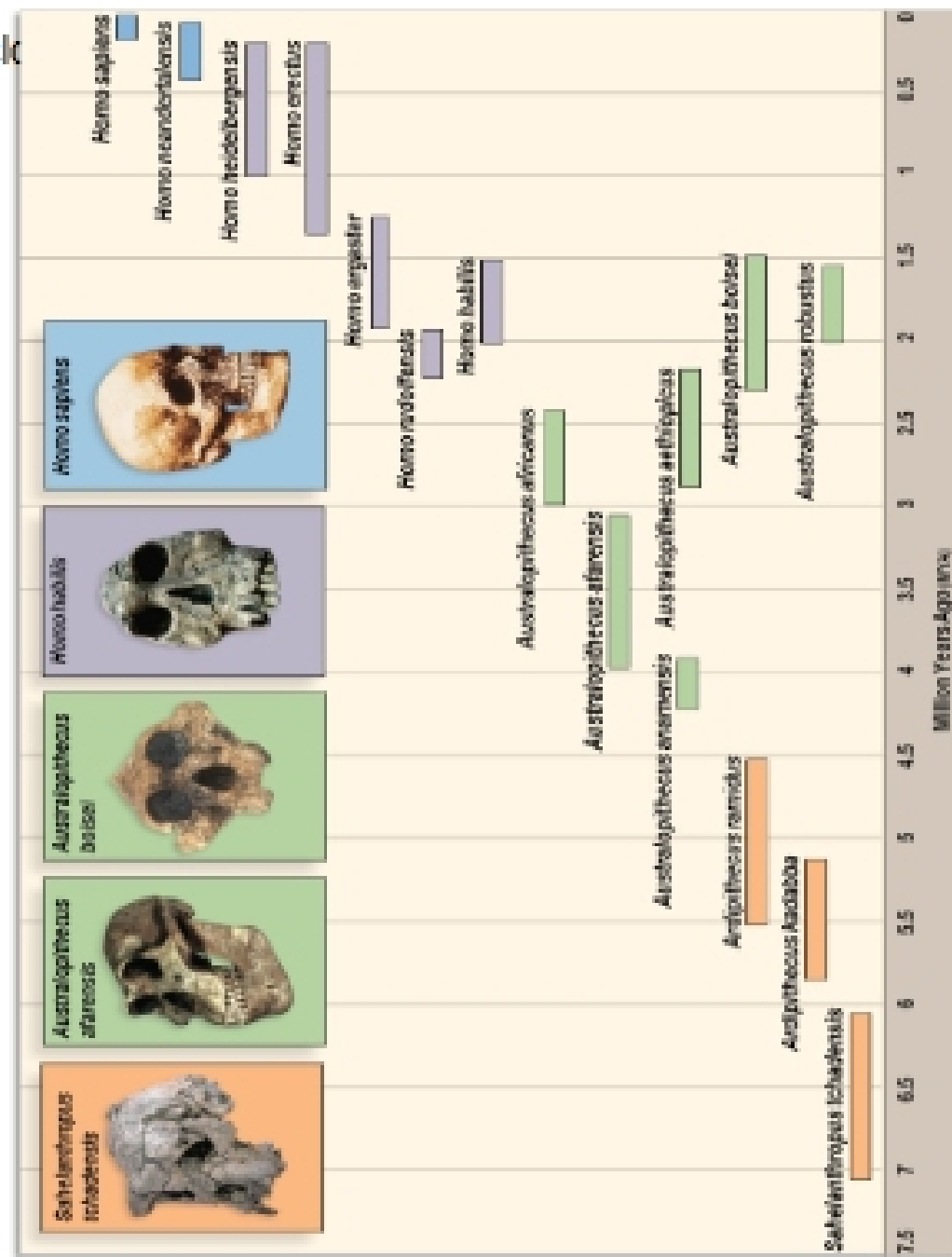
Human femurs angle inward to the knees; ape femurs angle out a bit.

Human knee can support more weight than ape knee.

Human foot has an arch; ape foot has no arch.

## Evolution of hominins

- Hominins – All species of the genus Homo and their close relatives
- Characteristics
  - o Bipedal
  - o Flatter face with more pronounced chin
  - o Brain size is 600 cm<sup>3</sup> or greater
  - o Evidence of tool use
  - o Jaw and teeth resemble humans
  - o Early Homo representatives
    - Homo habilis
    - Homo erectus
  - o Later Homo representatives
    - Neanderthals
    - Cro-Magnons



## Modern humans: Homo Sapiens

- Replacement model, or out-of-Africa hypothesis is the most widely accepted hypothesis.
  - o It proposes that modern humans evolved from archaic humans only in Africa.
  - o Then, modern humans migrated to Asia and Europe where they replaced the archaic species.

## Human Variations

- Human variations between populations are called ethnicities.
- Variations evolved as adaptation to local environments.
  - o Skin color ranges from dark to light
  - o Body shape
    - Bergmann's rule – colder regions mean bulkier build (more muscle mass for more heat) (High in a mountain, low oxygen Content, higher levels of hemoglobin)
    - Allen's rule – colder regions mean shorter limbs, digits, and ears.

## Chapter 23: Global Ecology & Human Interferences

### The nature of ecosystems:

- Biosphere – the regions of the Earth's waters, crust, and atmosphere inhabited by living organisms
- Ecosystem – a place where organisms interact with each other and their environment
  - o Terrestrial: several distinct types based on temperature and waterfall
  - o Aquatic: freshwater and marine

