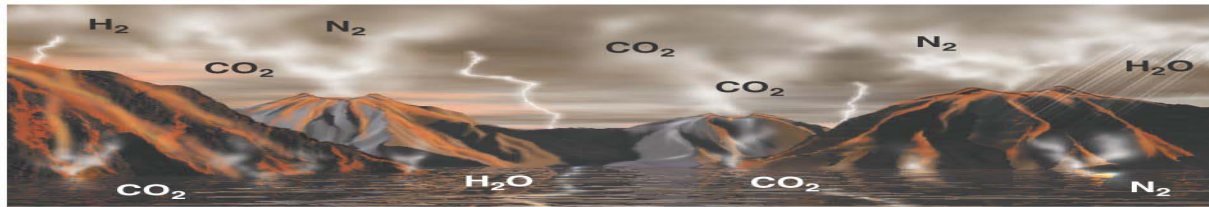


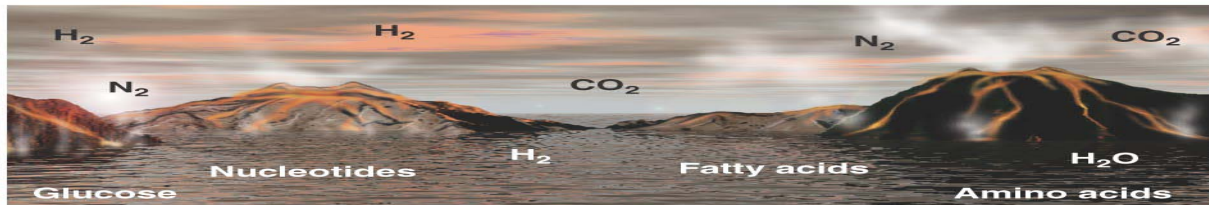
# **Evolution Topics**

- 1) earth evolution**
- 2) bio-chemical evolution**
- 3) biological evolution**
- 4) evidence for evolution**
- 5) human evolution**

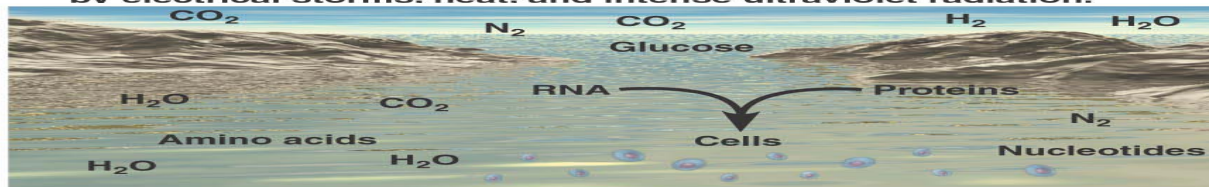
# Earth Evolution



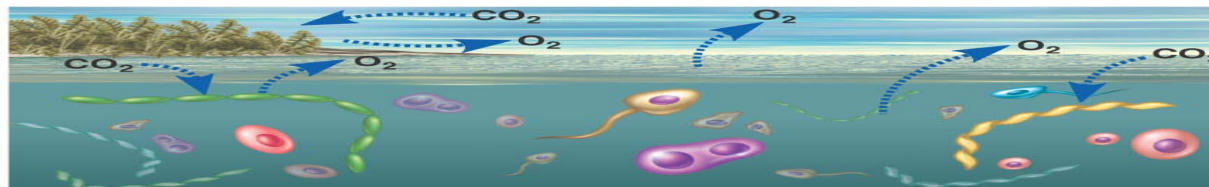
(a) The primitive Earth was hot and steamy with small, warm oceans.



(b) Simple organic molecules formed from atmospheric gases and dissolved in the oceans. The energy for their formation was provided by electrical storms, heat, and intense ultraviolet radiation.



(c) Self-replicating RNA probably formed on clay templates in shallow waters along the shorelines of oceans. RNA and other organic molecules became enclosed in a cell membrane and the first self-replicating cells were formed.



(d) The development of photosynthesis created oxygen gas. The presence of oxygen permitted the later development of aerobic forms of metabolism.

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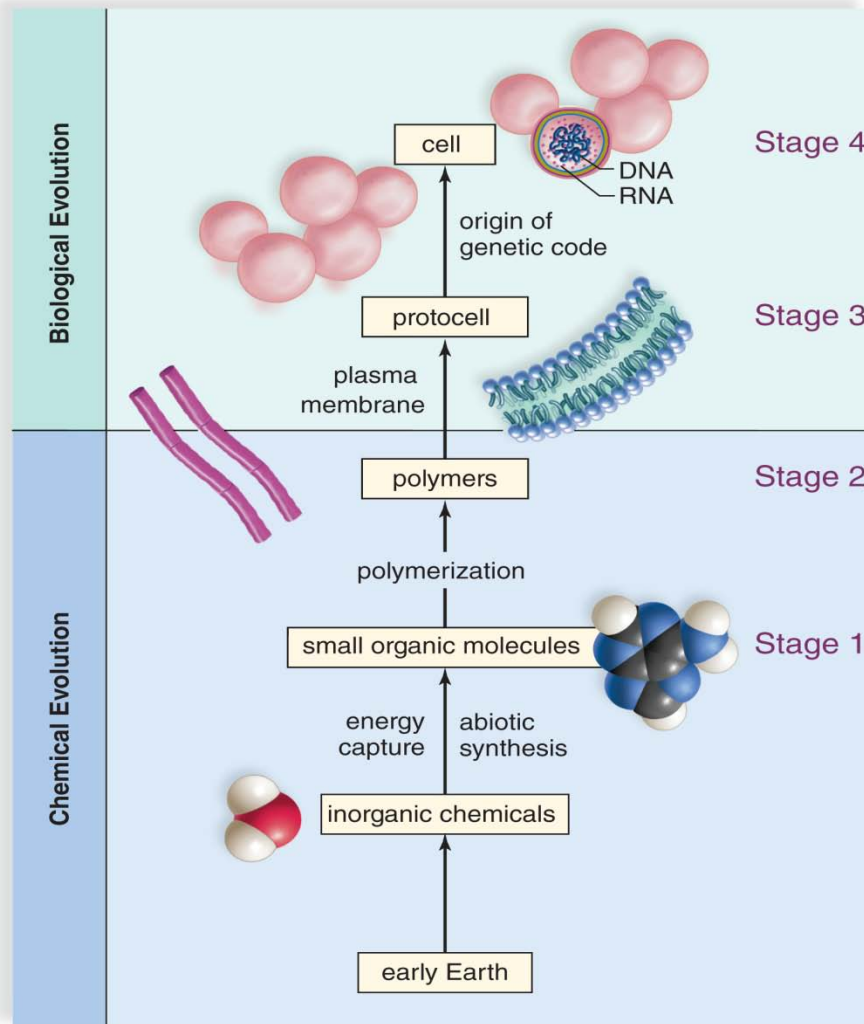
evol. of  
organic  
compounds

# Earth Timeline

<b><u>earth conditions</u></b>	<b><u>biochem. &amp; cell changes</u></b>
<b>a) hot, steamy</b>	<b>H<sub>2</sub>, N<sub>2</sub>, CO<sub>2</sub>, H<sub>2</sub>O</b>
<b>b) org. chem.</b>	<b>gluc., fatty acids, amino acids, nucleotides</b>
<b>c) RNA</b>	<b>self-replicating cell membrane 1st cell forms</b>
<b>d) photosynthesis</b>	<b>O<sub>2</sub> from CO<sub>2</sub> aerobic life forms</b>

# Biochemical Evolution

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- 1) **small organic molecules**
- 2) **macromolecules**  
- **protein, DNA, RNA**
- 3) **protocells**  
- **early prototype cells**
- 4) **true cells**  
- **nucleus**

# 4 Stages

## **Chemical evolution:**

### **Stage 1: small organic molecules**

**(H<sub>2</sub>, N<sub>2</sub>, CO<sub>2</sub>, H<sub>2</sub>O -> amino acids, nucleotides)**

### **Stage 2: macromolecules**

**(-> RNA, protein)**

## **Biological evolution**

### **Stage 3: protocell (prototype, cannot reproduce)**

### **Stage 4: true cell**

- DNA, can reproduce**
- prokaryotic, eukaryotic (true nucleus)**

# Biological Evolution

**natural selection - Charles Darwin**

**- leads to diversity of life forms**

**3 elements:**

**1) variation**

**- spectrum of every characteristic in individuals  
eg, height, intelligence, finger length**

**2) compete for limited resources**

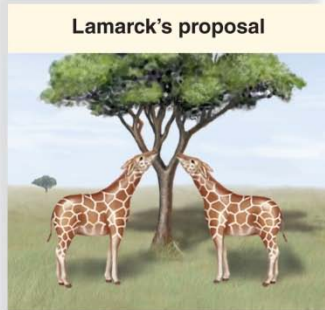
**- keeps population numbers about the same**

**3) adaptation**

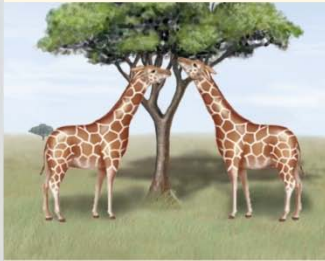
**- traits can give an advantage, acc. to situation  
- eg long legs for running fast**

# Lamarck vs Darwin

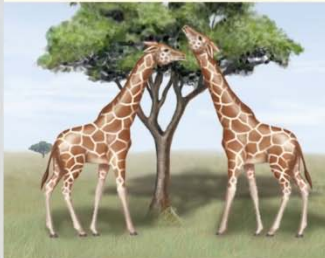
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Originally, giraffes had short necks.



Giraffes stretched their necks in order to reach food.



With continual stretching, most giraffes now have long necks.



Originally, giraffe neck length varied.



Competition for resources causes long-necked giraffes to have the most offspring.



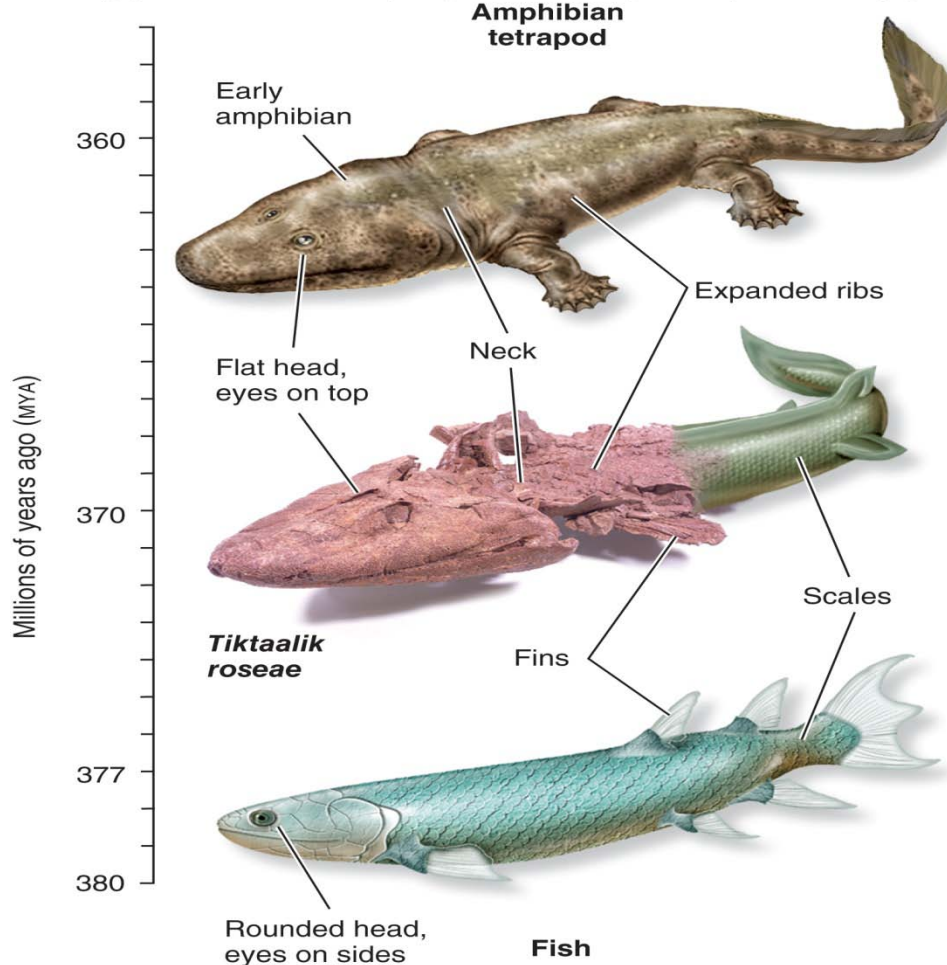
Due to natural selection, most giraffes now have long necks.

- evolution of long necks:**
- 1) short vs varied length**
  - 2) stretch to get food vs long neck advantage**
  - 3) results of stretch vs surviving offspring has long necks**



# Fossil - Transitional Form

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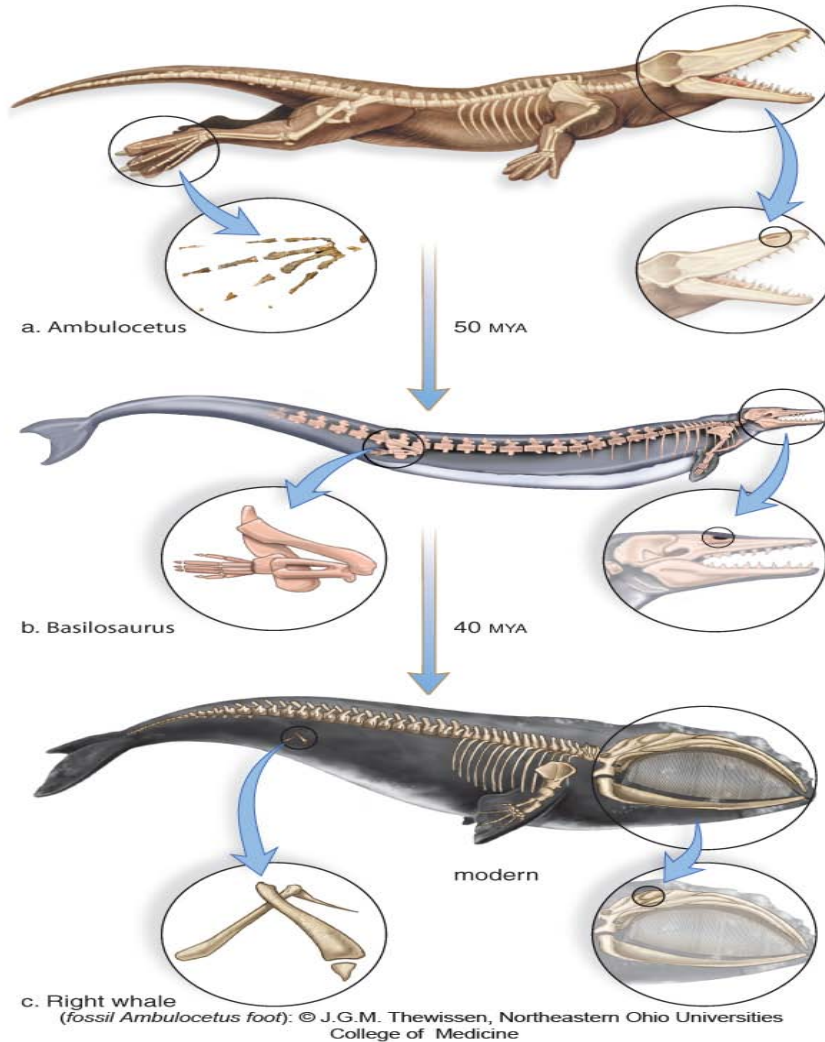
**fishapod:**  
transition form between  
fish and tetrapod  
(4 legged land animal)

**unfishlike traits:**  
flat head  
eyes on top of head  
ribs (lungs?)  
flexible neck



# Fossil - Whale from land animal

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**whales evolved  
from 4 limbed,  
air breathing  
ancestor**

**- hindlimb  
reduction**

**- nasal opening  
moves from  
tip of nose to  
tip of head**

# Marsupial Variation

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Sugar glider, *Petaurus breviceps*, is a tree-dweller and resembles the placental flying squirrel.



The Australian wombat, *Vombatus*, is nocturnal and lives in burrows. It resembles the placental woodchuck.



Kangaroo, *Macropus*, is an herbivore that inhabits plains and forests. It resembles the placental Patagonian cavy of South America.

(sugar glider): © ANT Photo Library/Photo Researchers; (wombat): © Photodisc Blue/Getty RF; (kangaroo): © George Holton/Photo Researchers

**connected 200m mya:  
Australia, Antarctica,  
& So. America**

**sugar glider  
- tree dweller  
(flying squirrel)**

**wombat  
- nocturnal burrows  
(woodchuck)**

**kangaroo  
- plains & forest**

# Biochemical Evidence

**similar/identical chem. compounds**

- **may indicate common ancestry**
- **mutations over time = history of changes**

**1) cytochrome c**

- **protein for energy metab. most life forms**
- **more # amino acid differences**  
**= more evolutionary distance**

**2) genes**

- **more nitrogenous base sequence**  
**difference in DNA = more evol. distance'**  
**eg very similar between chimp & human**

# Human Evolution

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**Table 22.1** Evolution and Classification of Humans

BYA/MYA*	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

<u>date</u>	<u>classification</u>
<b>2 bya</b>	<b>eukaryote (cell)</b>
<b>600 mya</b>	<b>animalia</b>
<b>540 mya</b>	<b>chordata (spinal cord)</b>
<b>120 mya</b>	<b>mammalia (mammary glands)</b>
<b>60 mya</b>	<b>primates (brain, trees)</b>
<b>7 mya</b>	<b>hominids (2 legs, walk erect)</b>
<b>3 mya</b>	<b>homo (dev. brain, tools)</b>
<b>.1 mya</b>	<b>human (speech)</b>

# Primates

**primates - placental mammals**

**- arboreal (tree dwellers)**

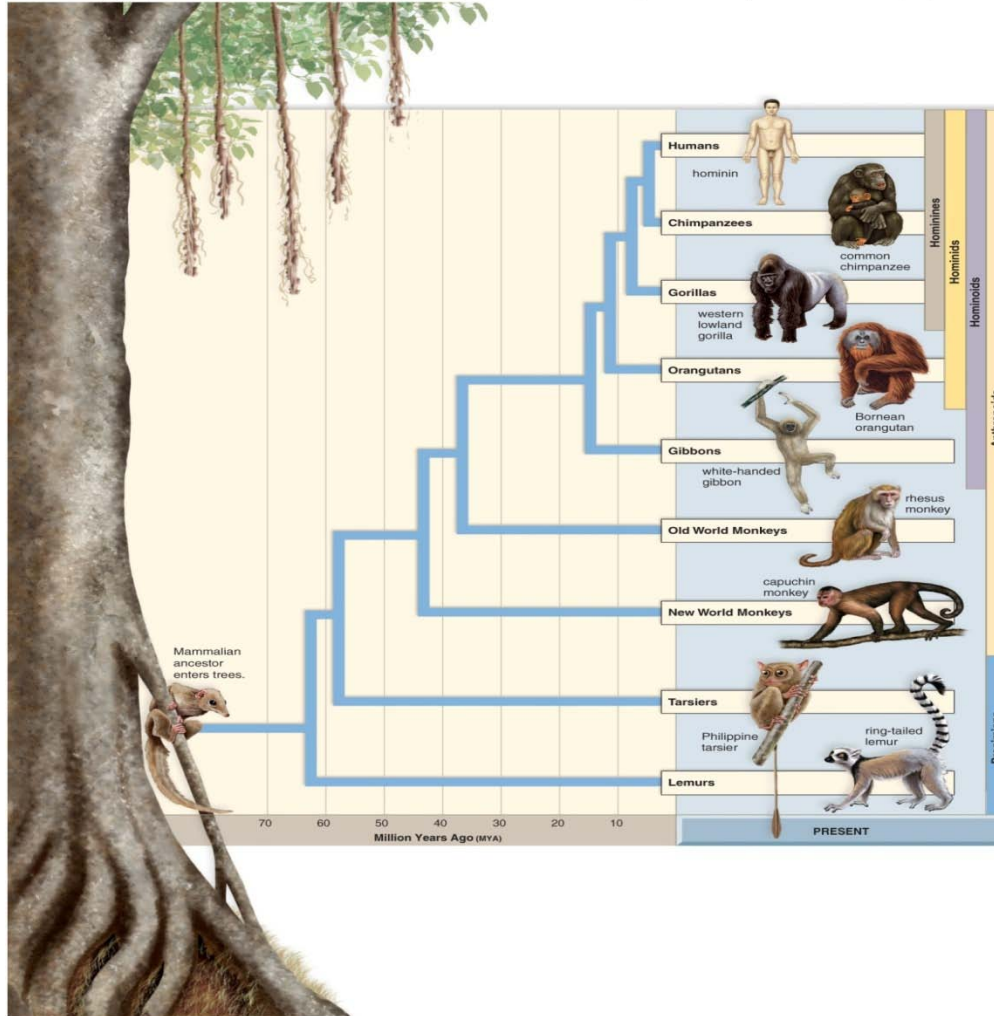
- 1) mobile limbs with grasping hands**
- 2) flat face with binocular vision**
- 3) large, complex brain**
- 4) slow reproductive rate**

**2 groups:**

- 1) prosimians - lemurs, tarsiers, lorises**
- 2) anthropoids - monkeys, apes, humans**

# Primate Tree

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**human ancestry:**

**lemurs (63 mya)**

**-> monkeys**

**-> gibbons**

**-> orangutans**

**-> gorillas**

**-> chimps**

**-> humans (today)**



# Human Timeline

<b>mil. yrs ago</b>	<b>primate level</b>
5.5	<b>Ardipithecus ramidus (tree dweller, Ardi)</b>
3.2	<b>Australopithecus afarensis (Lucy)</b>
2	<b>Homo habilis - tool maker</b>
1.6	<b>Homo ergaster</b>
1.4	<b>Homo erectus - stood up on legs</b>
.4	<b>Neanderthals</b>
.1	<b>Homo sapiens - big brain</b>

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