

# 生物多樣性 (Biodiversity) :

陸生、海洋和其他水生生態系等所有生態系中活生物體的變異性，它涵蓋了所有從基因 (gene)、個體(individual)、族群(population)、物種 (species)、群集 (community)、生態系 (ecosystem)到地景(landscape)等各種層次的生命型式，其內涵廣博而複雜，基本上分為遺傳多樣性(genetic diversity)、物種多樣性(species diversity) 和生態系多樣性 (ecosystem diversity)。

多细胞物种主要为昆虫。生物学家对这种最常见物种的真实多样性与生态意义却所知甚少。



昆虫

物种总数 (最佳估计值): 8,750,000  
已命名物种数: 1,025,000



真菌

1,500,000  
72,000



细菌

1,000,000  
4,000



藻类

400,000  
40,000



线虫与蠕虫

400,000  
25,000



病毒

400,000  
1,550



植物

320,000  
270,000



其他生物

250,000  
110,000



软体生物

200,000  
70,000



原生生物

200,000  
40,000



甲壳类生物

150,000  
43,000



鱼类

35,000  
26,959



鸟类

9,881  
9,700



爬行类

7,828  
7,150



哺乳类

4,809  
4,650



两栖类

4,780  
4,780





# 原始的生命

生物能夠複製（繁殖），主要的機制是什麼？

DNA → RNA → Amino acid → Protein

為什麼RNA可能是最早的基因？

1. RNA splicing, polymerization,
2. Amino adenosine + Ester 小分子複製的例證

最早的生命形態是什麼樣子？

簡單的細胞外膜，細胞內質無膜 → 原核生物Prokaryotes

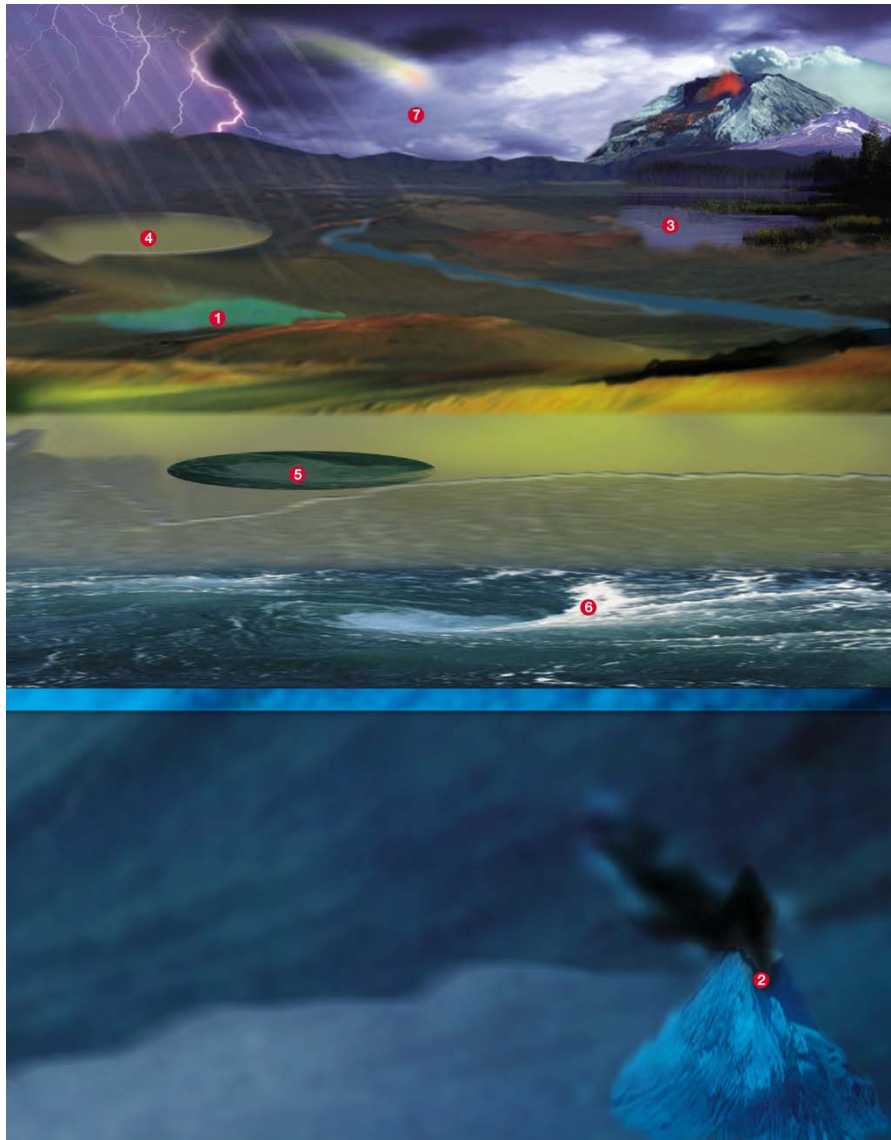


Figure 9-1

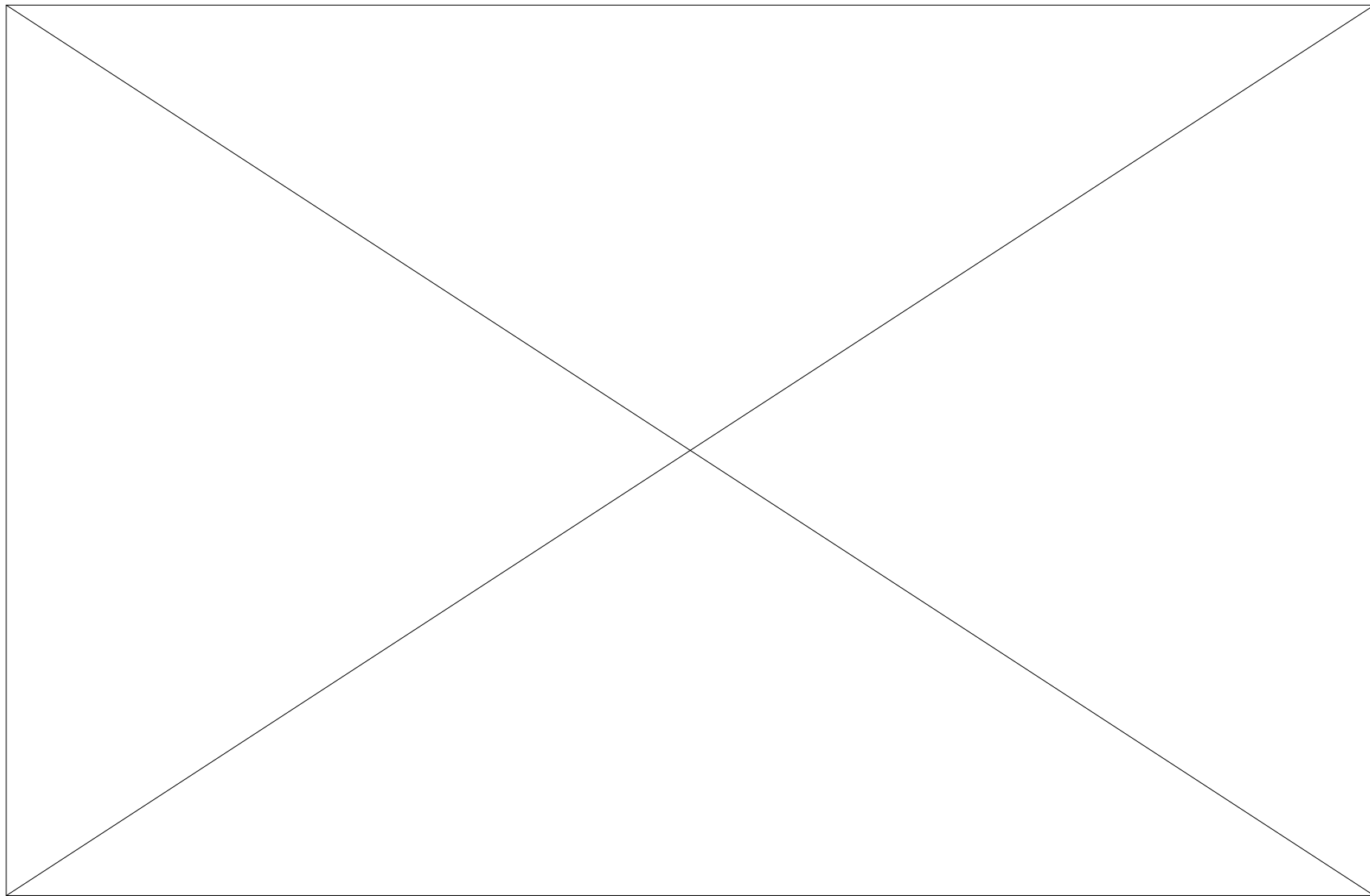


# **Biodiversity: How Diverse Is Life?**

Where did life on Earth come from? Was it brought here from some other galaxy? Did life originate on land or in the ocean? What conditions were necessary for life to originate? These are not easy questions to answer because none of us can return to that period in the Earth's history. We must rely on credible data from a variety of sources



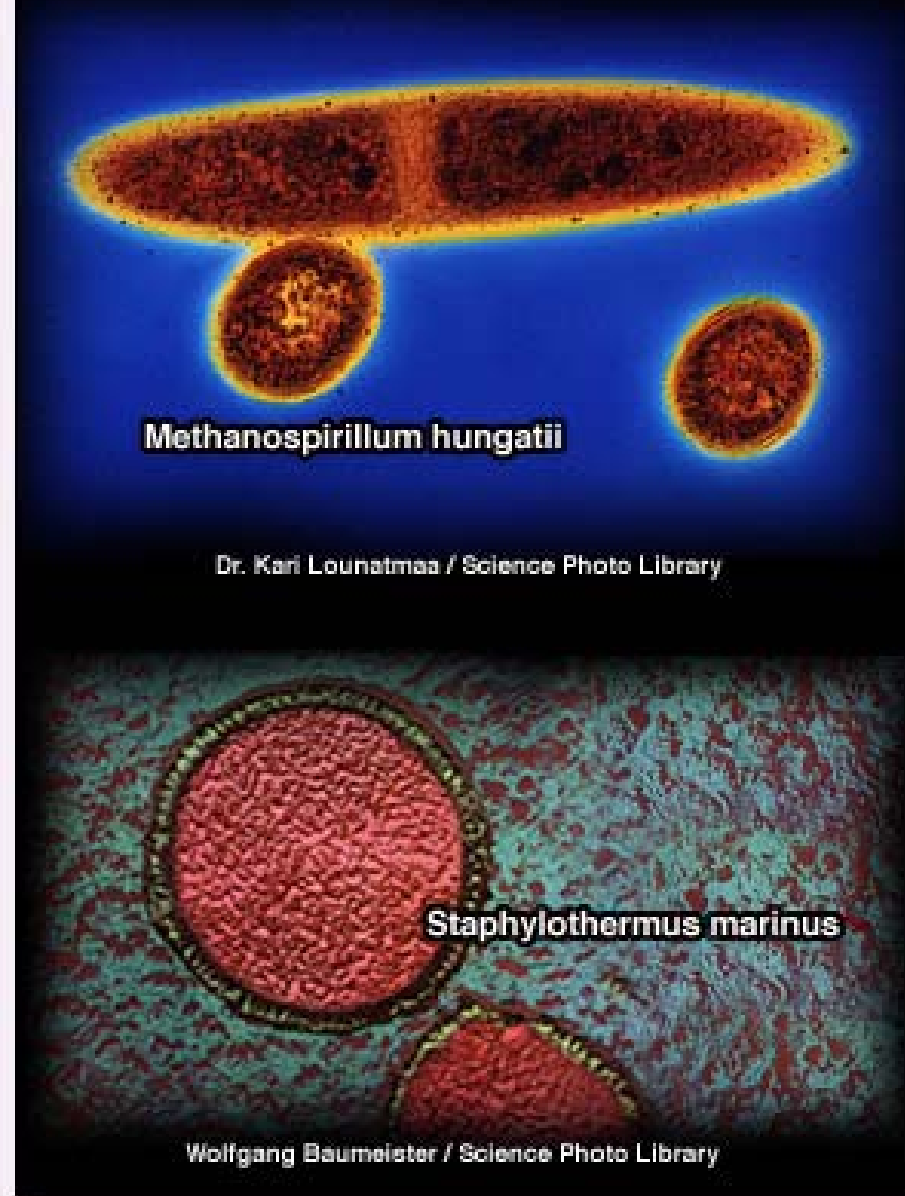
# 六界的分類結構





# Kingdom Archaeobacteria

The Archaeobacteria are **prokaryotes** that many believe are the most ancient group of living organisms. They are characterized by their **ribosomal RNA, lipid structure, and certain enzymes**. The Archaeobacteria inhabit extreme **environments** such as hot springs, sea vents, boiling muds, and volcanoes. Originally placed with the monerans, they now enjoy the position of being their own **kingdom**.



# 細菌、病毒與原生生物

- 請分別舉一例說明是由細菌、病毒與原生生物所感染的人類疾病（什麼病是由什麼所感染），以及如何才能夠治療這些疾病？
- 流行性感冒是由什麼所引起的疾病？一般的醫生所開的藥是什麼？有效嗎？病是怎樣痊癒的呢？
- 登革熱是由哪一類的微生物所引起的疾病？有沒有特效藥可以治療？請說明其原因。
- 真菌和細菌、植物或是動物等三類生物中的哪一類比較類似，請說明其原因。
- 我們怎樣利用微生物的優點來幫忙做環保的工作？請舉一個例子。



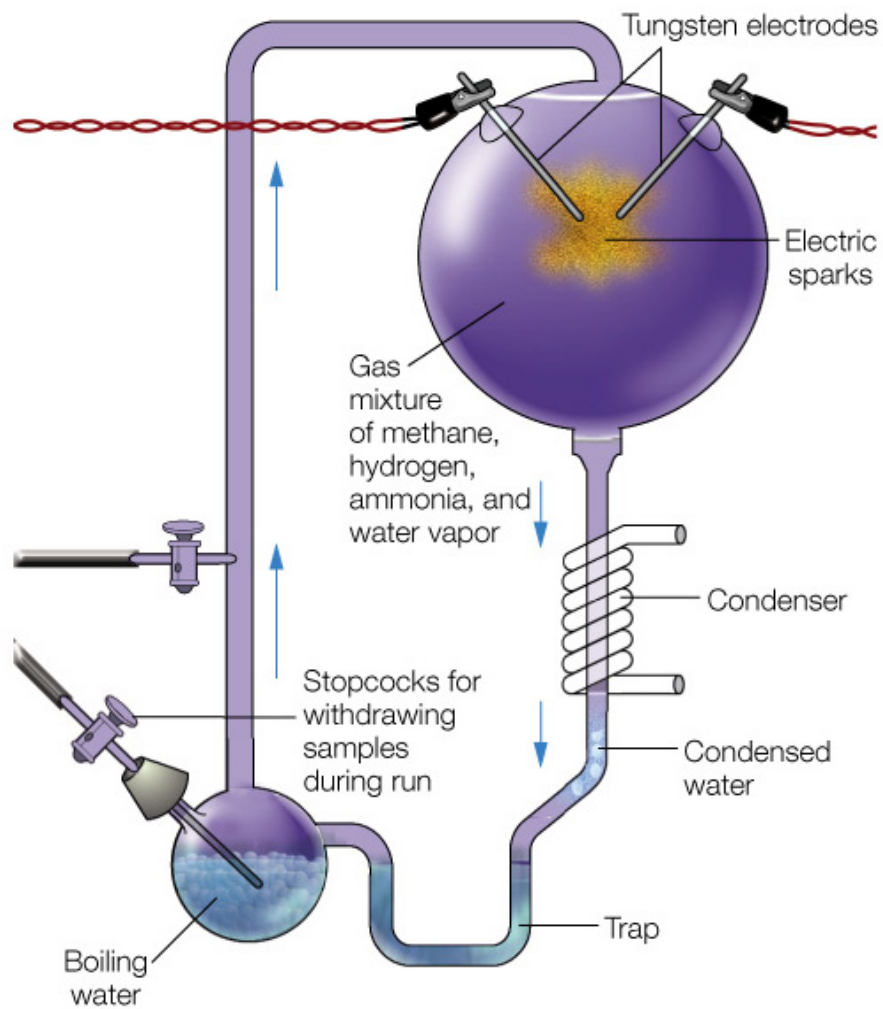


Figure 9-2

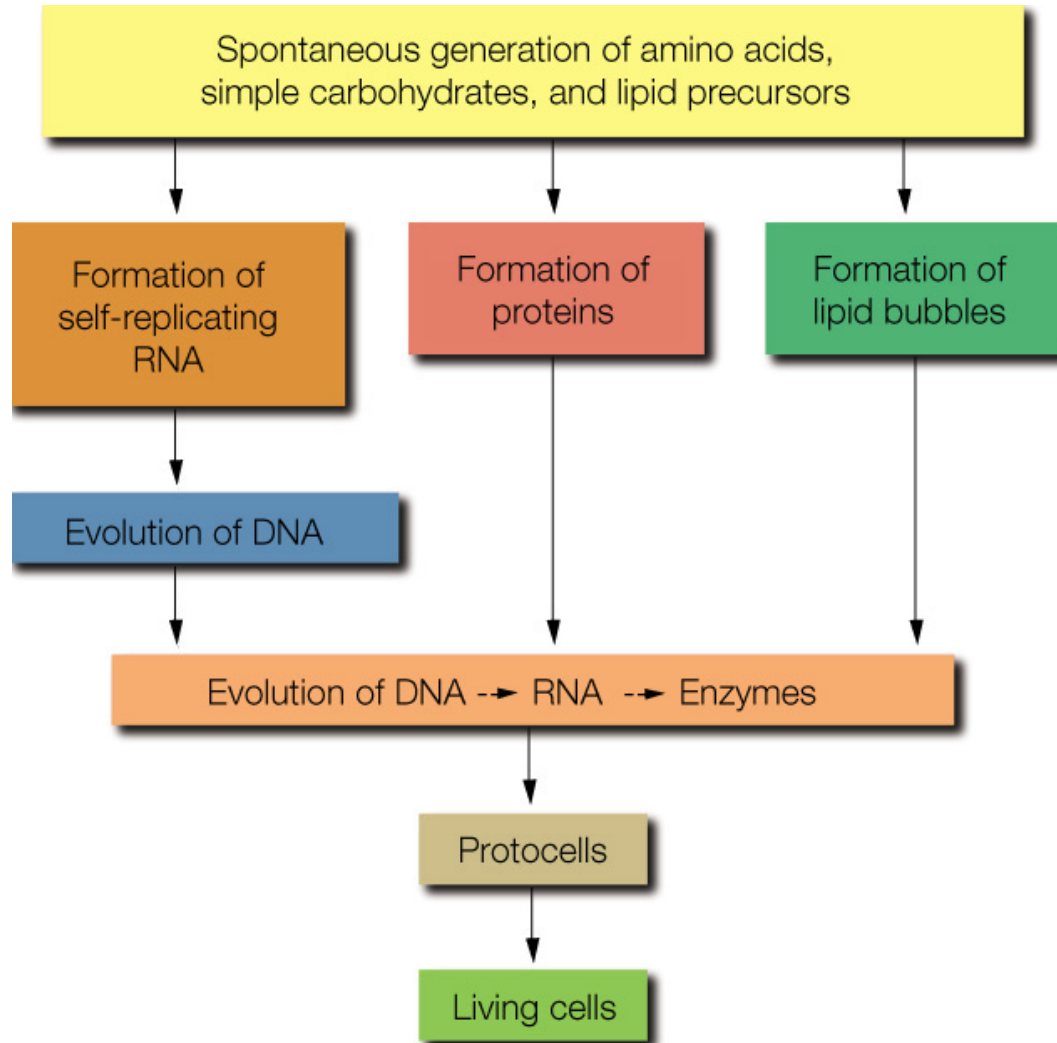


Figure 9-3 Key events in the chemical evolution of life.



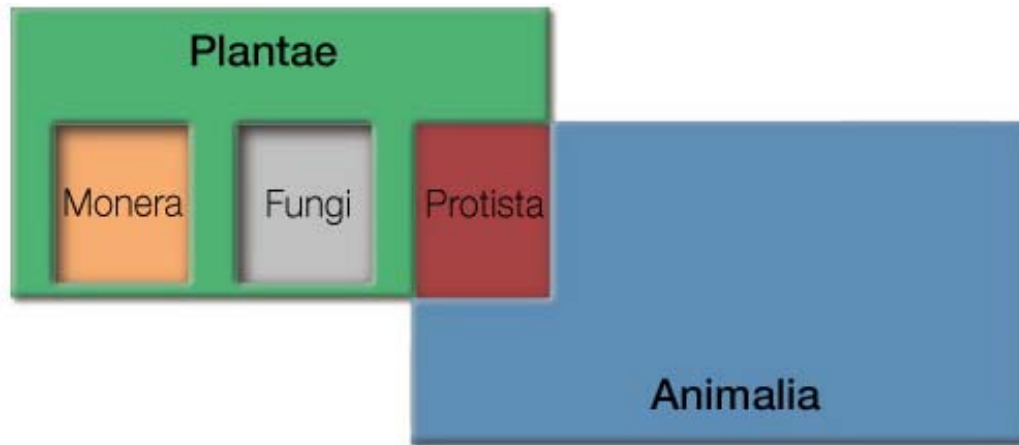


Figure 9-10

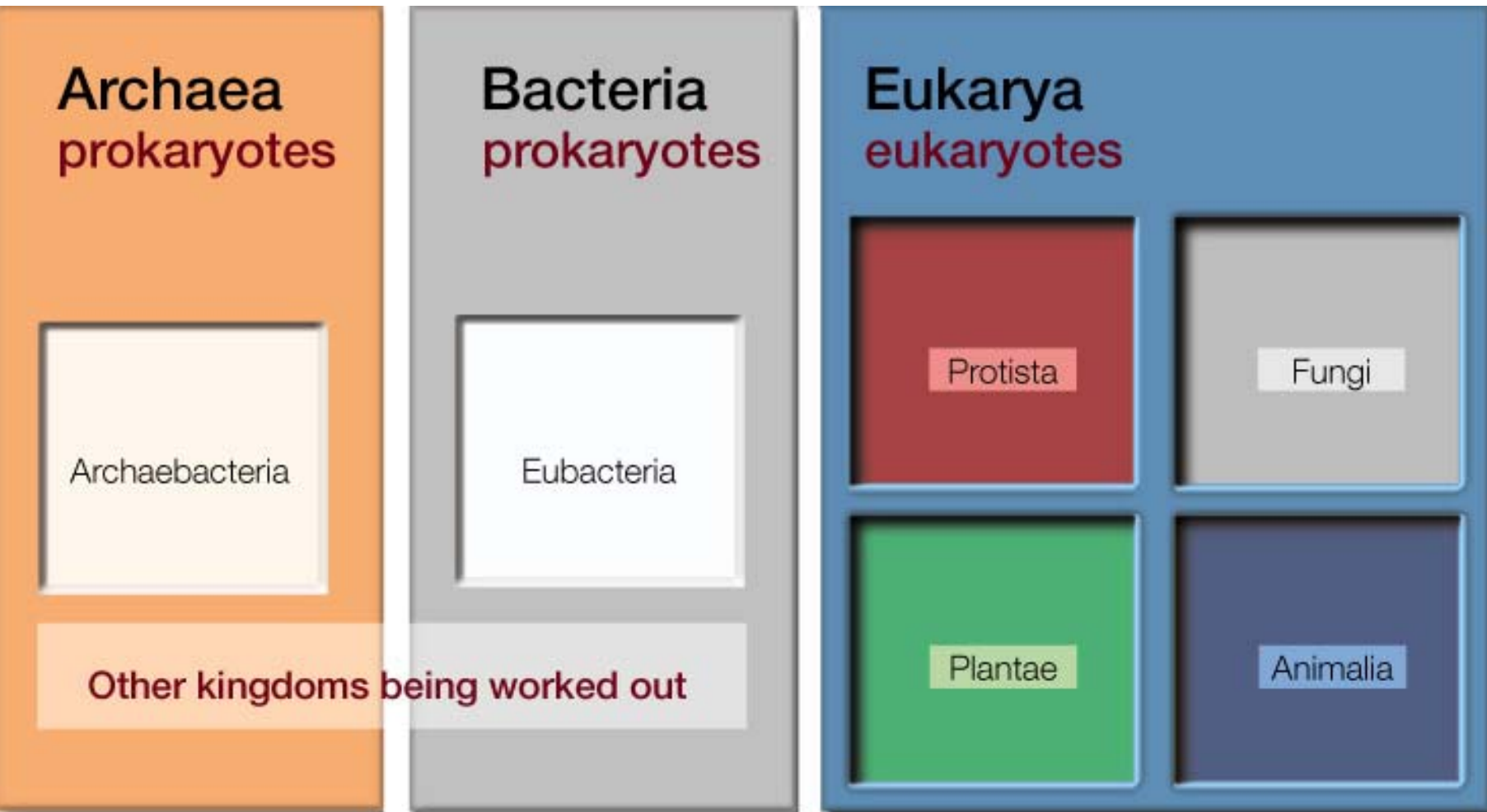


Figure 9-11

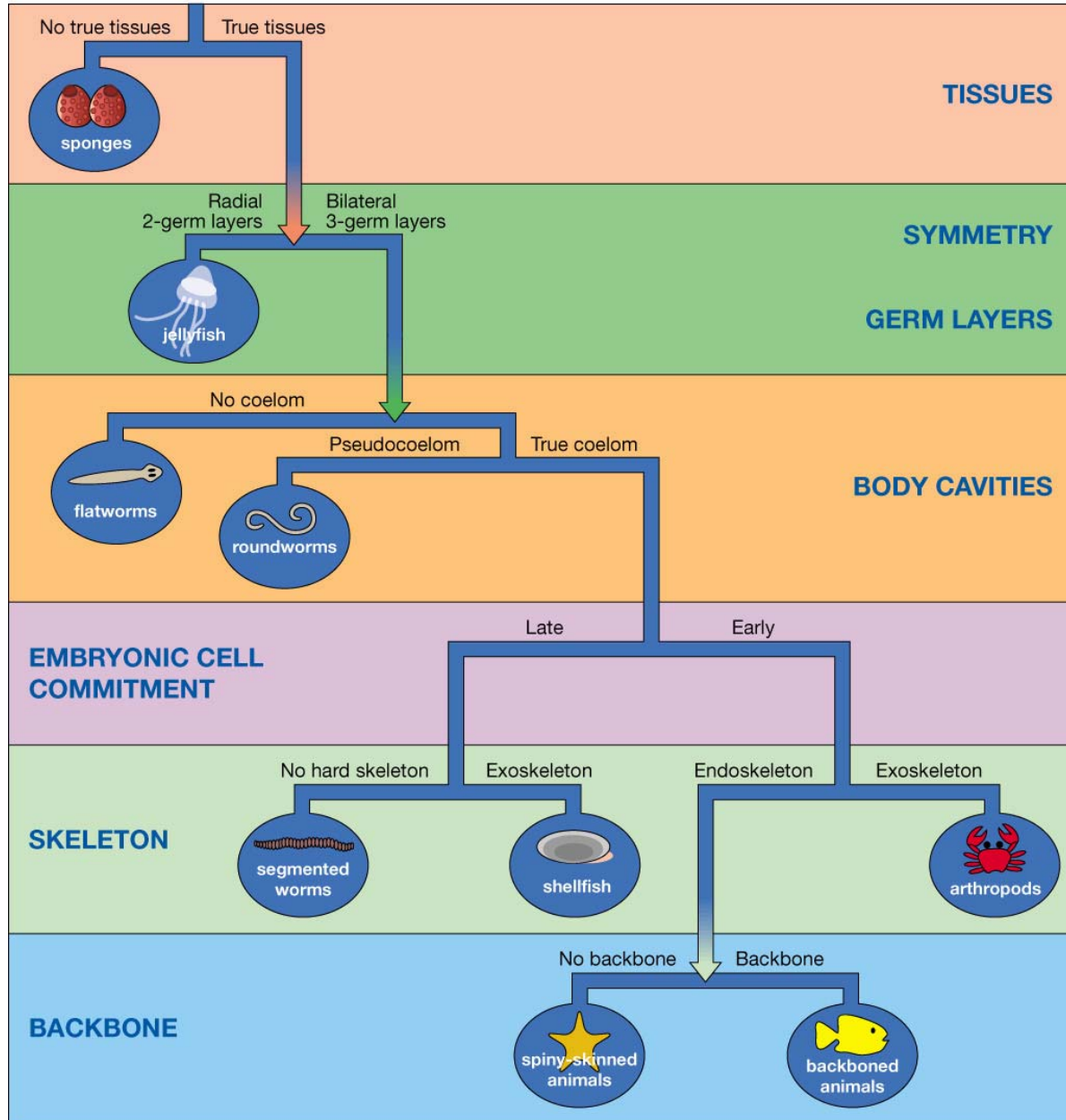


Figure 9-5 Milestones in the evolution of animals

# The origin and evolution of microbial life: Prokaryotes 原核生物 and Protists 原生生物

地球的形成 → 無生物的世界 → 主要的成份為何？

生物如何形成？

生物與非生物的區別為何？

# 原核生物

- 和真核生物Eukaryotes的差別在哪裡？
- 原核生物的細胞膜 → peptidoglycan
- 為什麼抗生素（例如penicillin）能夠抑制細菌，但是對人體卻沒有害？



# 細菌的形態

- 球菌cocci (singular coccus)
- 桿菌bacilli (singular bacillus)
- 螺旋菌spiral-shaped

# 細菌的生活形態

- 繁殖速度 → 10-20minutes/generation
- 有絲分裂mitosis或是減數分裂meiosis ?

# 細菌的營養來源

自營性Autotrophs → cyanobacteria

異營性Heterotrophs

# 自然界的細菌

- archaeobacteria → lipid membranes, methanogens
- eubacteria → peptidoglycans, chemoheterotrophic nutrition

# 自然界的細菌

放線菌 actinomycetes eg. *Streptomyces* →  
streptomycin

藍菌 cyanobacteria eg. *Anabaena*, water  
blooms → Red Sea

致病菌 pathogen → bacterial poisons:  
exotoxins  
endotoxins



# 共生關係symbiotic relationship

內共生假設endosymbiotic hypothesis

- 粒線體mitochondria, 葉綠體chloroplasts

# What Is a Protist?

Some **protistans** are **animal-like**, some are **plant-like**, and others are **fungus-like**. Some, such as Euglena, can alternate being either animal- or plant-like. However, there are some characteristics that most **protistans** share. Most are **unicellular**, lack **tissues**, and seldom demonstrate **cell specialization**. All are **eukaryotic**.



地衣 真菌與藻類的共生體



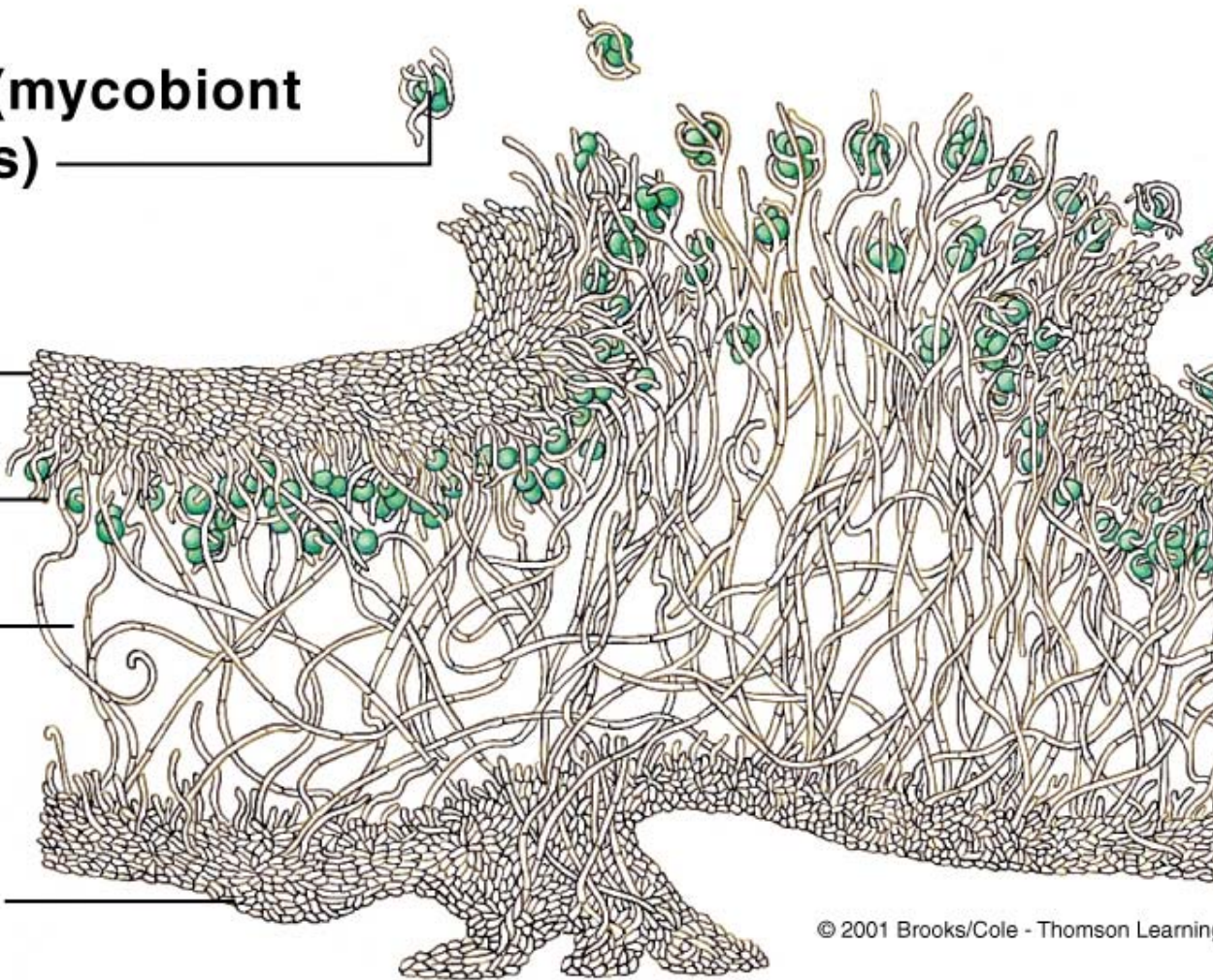
dispersal fragment (mycobiont  
and photobiont cells)

cortex (outer layer;  
the mycobiont)

photobionts

medulla (layer of  
loosely interwoven  
hyphae)

lower part of cortex



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分層的地衣



# 枝瑚菌



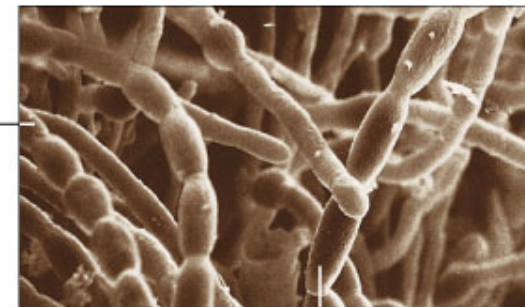
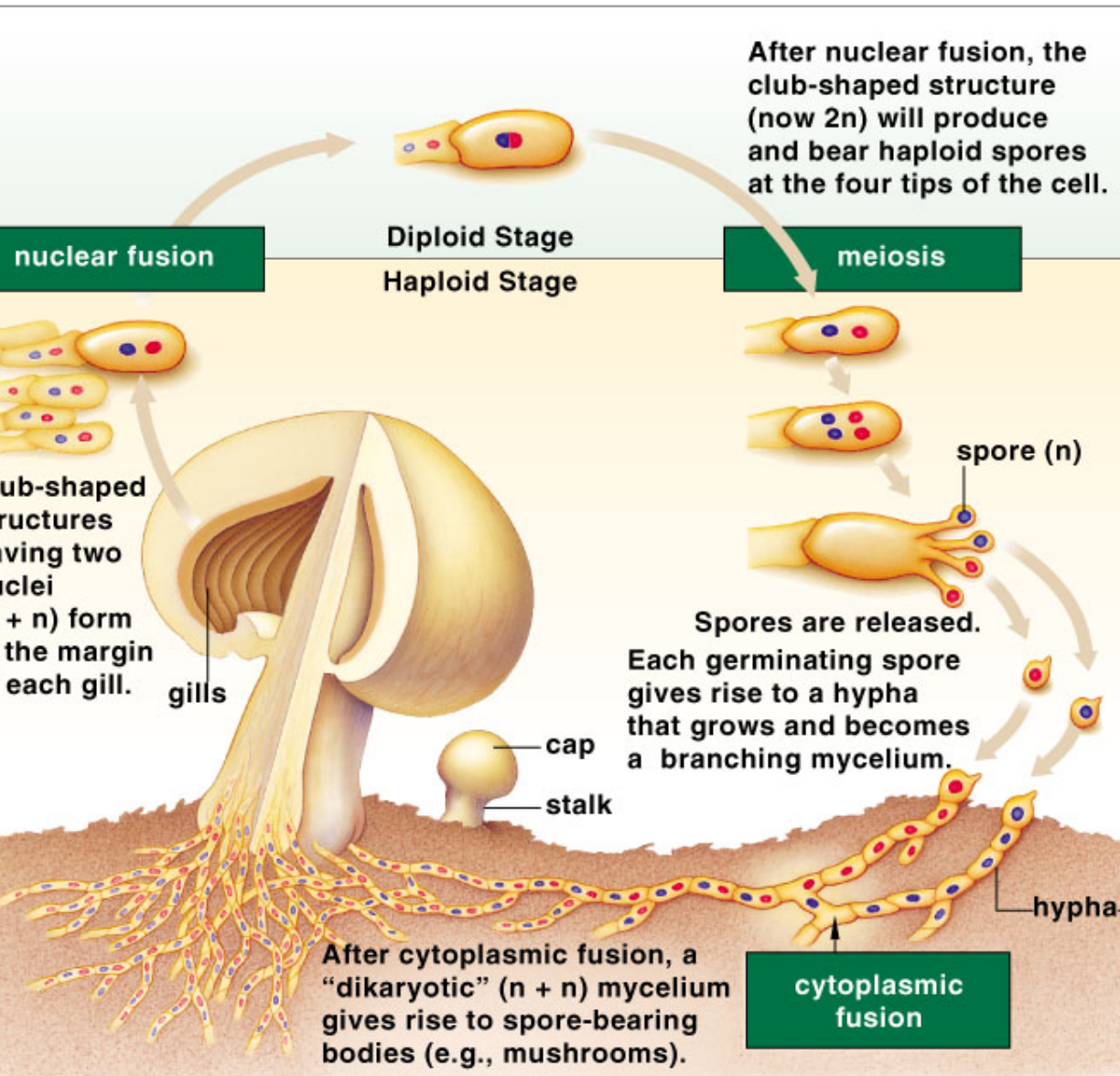


# 多孔菌





# 擔子菌的生活史



hypha in mycelium

# 哈蟆菌

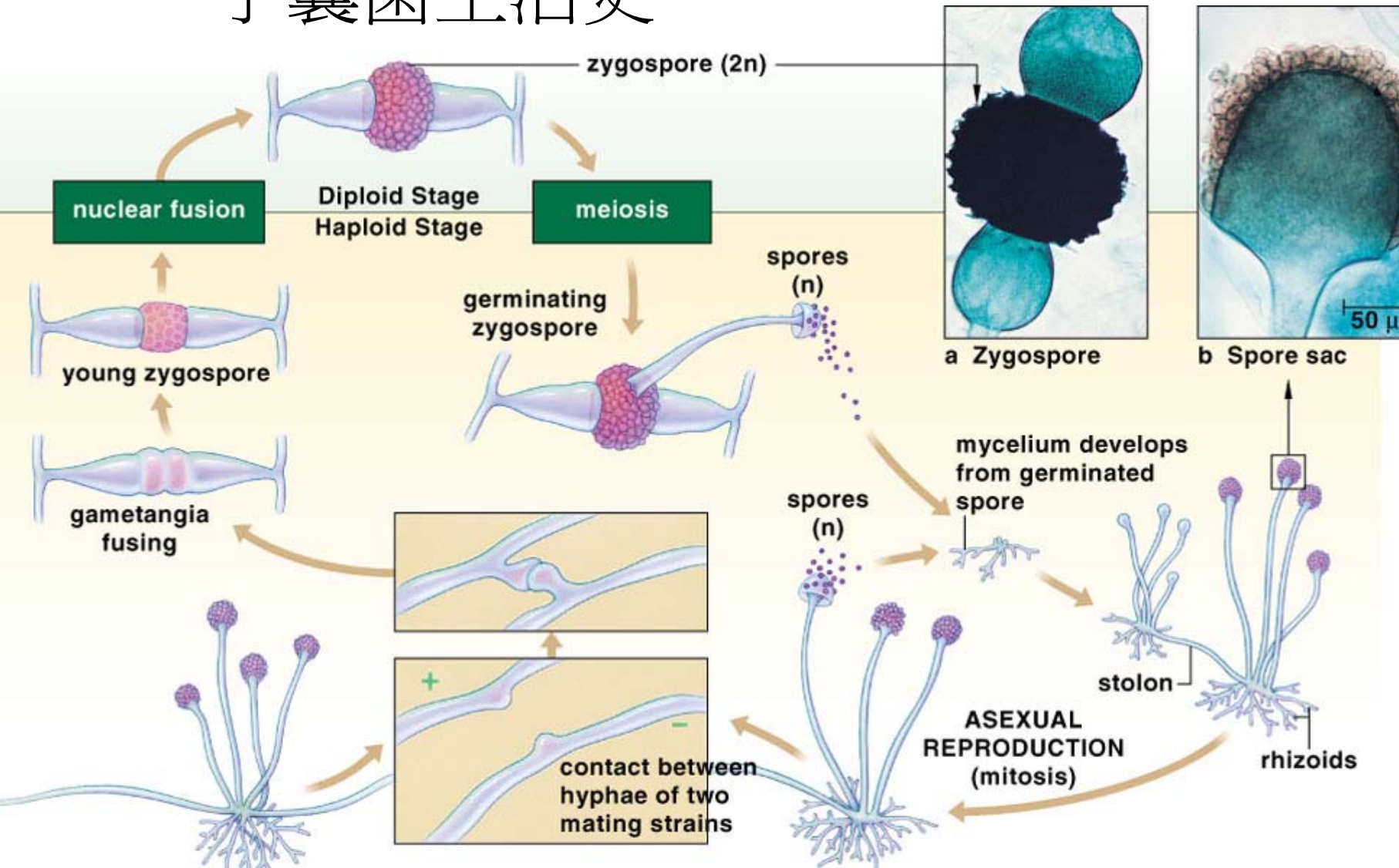




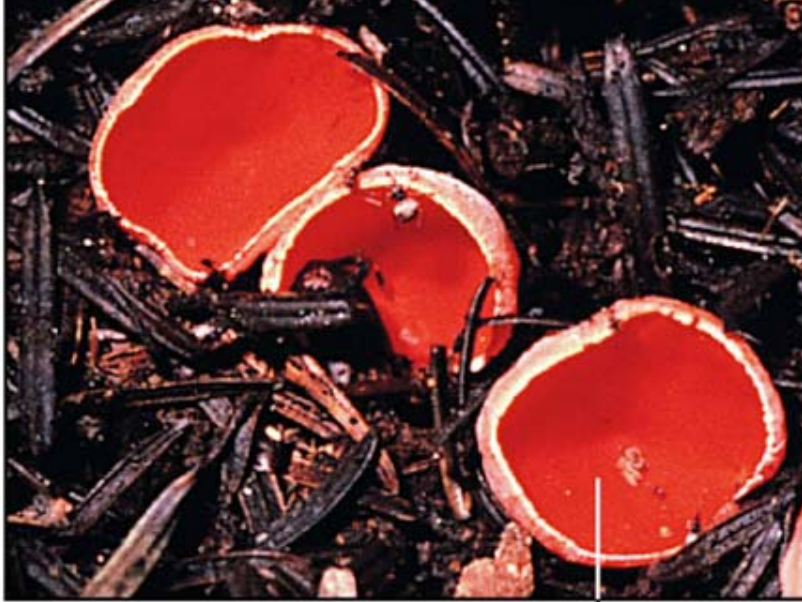


毒傘菌

# 子囊菌生活史







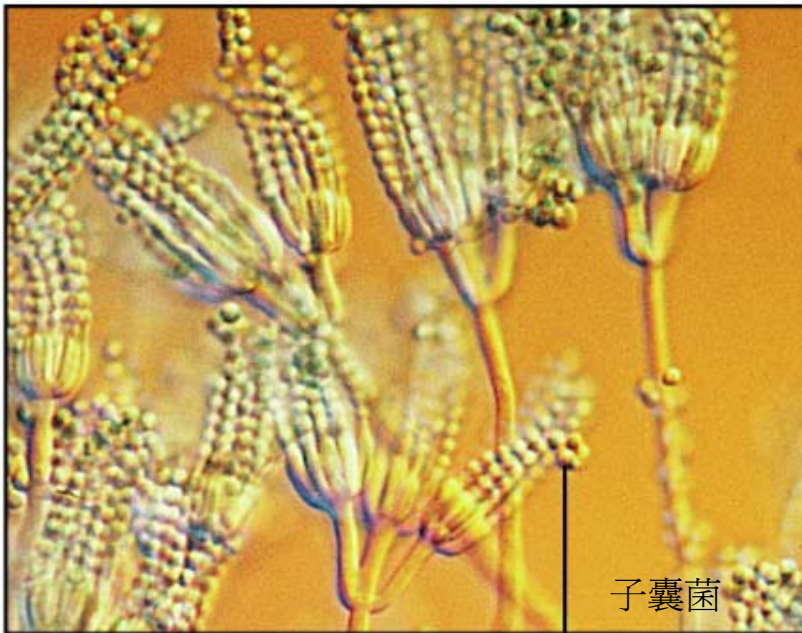
a

ascocarp

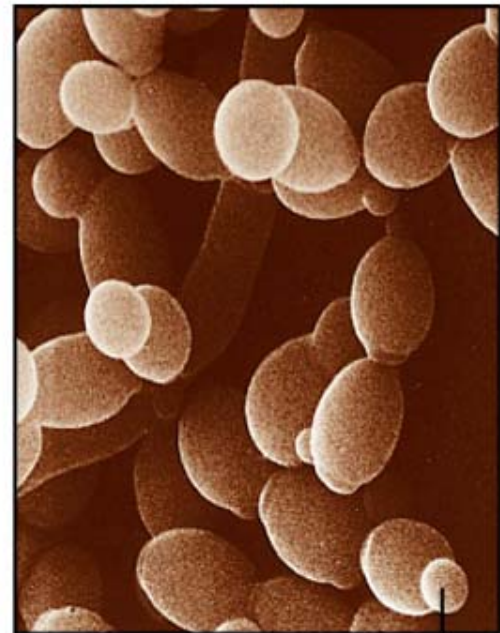


b

ascocarp



子囊菌



c conidia (chains of asexual spores) d budding yeast cell



香港腳表皮癬菌



# What Were the Major Milestones in Earth's Evolving Biodiversity?

Why do mitochondria and chloroplasts contain their own DNA, which allows them to self-replicate? Close observations of mitochondria and chloroplasts show their prokaryotic-like appearance. Could they in fact have once been prokaryotes? The theory of endosymbiosis suggests this.

According to this theory, mitochondria and chloroplasts were once free-living prokaryotes which were taken up by eukaryotic cells. At first this was a casual interaction but eventually evolved into a mandatory relationship.

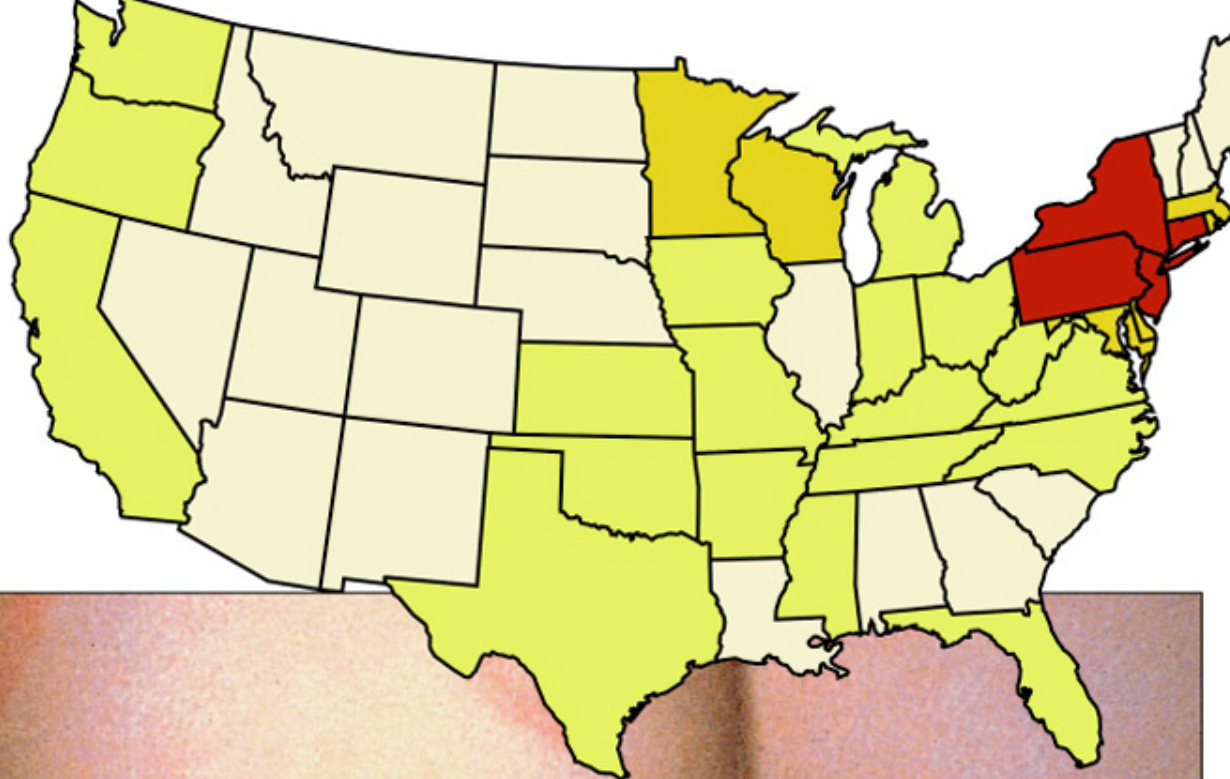
# 細菌、病毒與原生生物

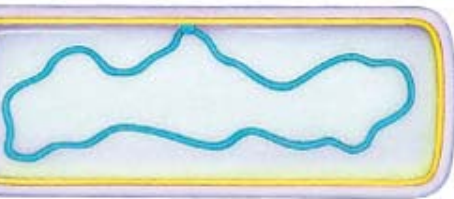
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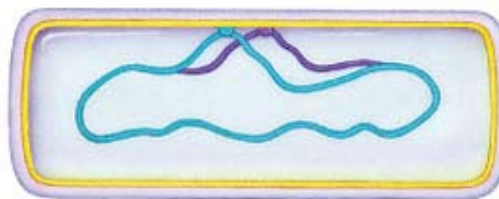


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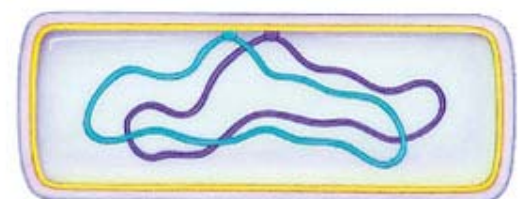




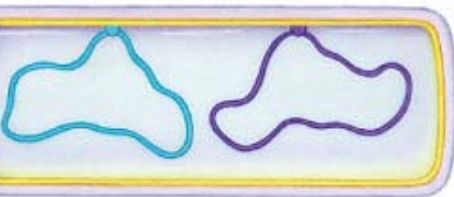
**a** A bacterial cell (cutaway view) before its DNA is copied. The DNA is attached to the plasma membrane.



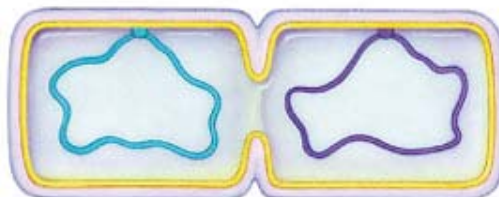
**b** Replication starts and proceeds in two directions, away from some point in the bacterial DNA molecule.



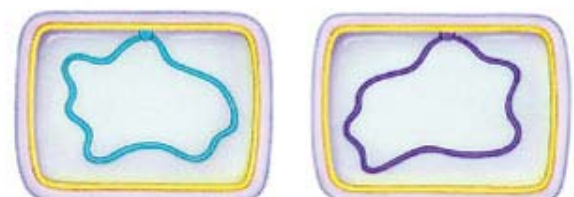
**c** The DNA copy is attached at a membrane site near the attachment site of the parent DNA molecule.



**d** Membrane growth proceeds between the two attachment sites and moves the DNA molecules apart.

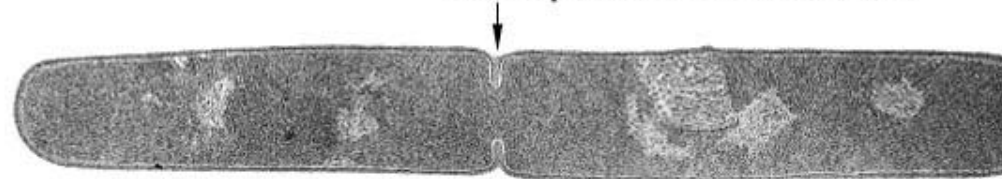


**e** New membrane and new wall material start forming through the cell midsection.



**f** The ongoing, organized deposition of membrane and wall material at the cell midsection divides the cytoplasm in two.

new deposits at cell midsection





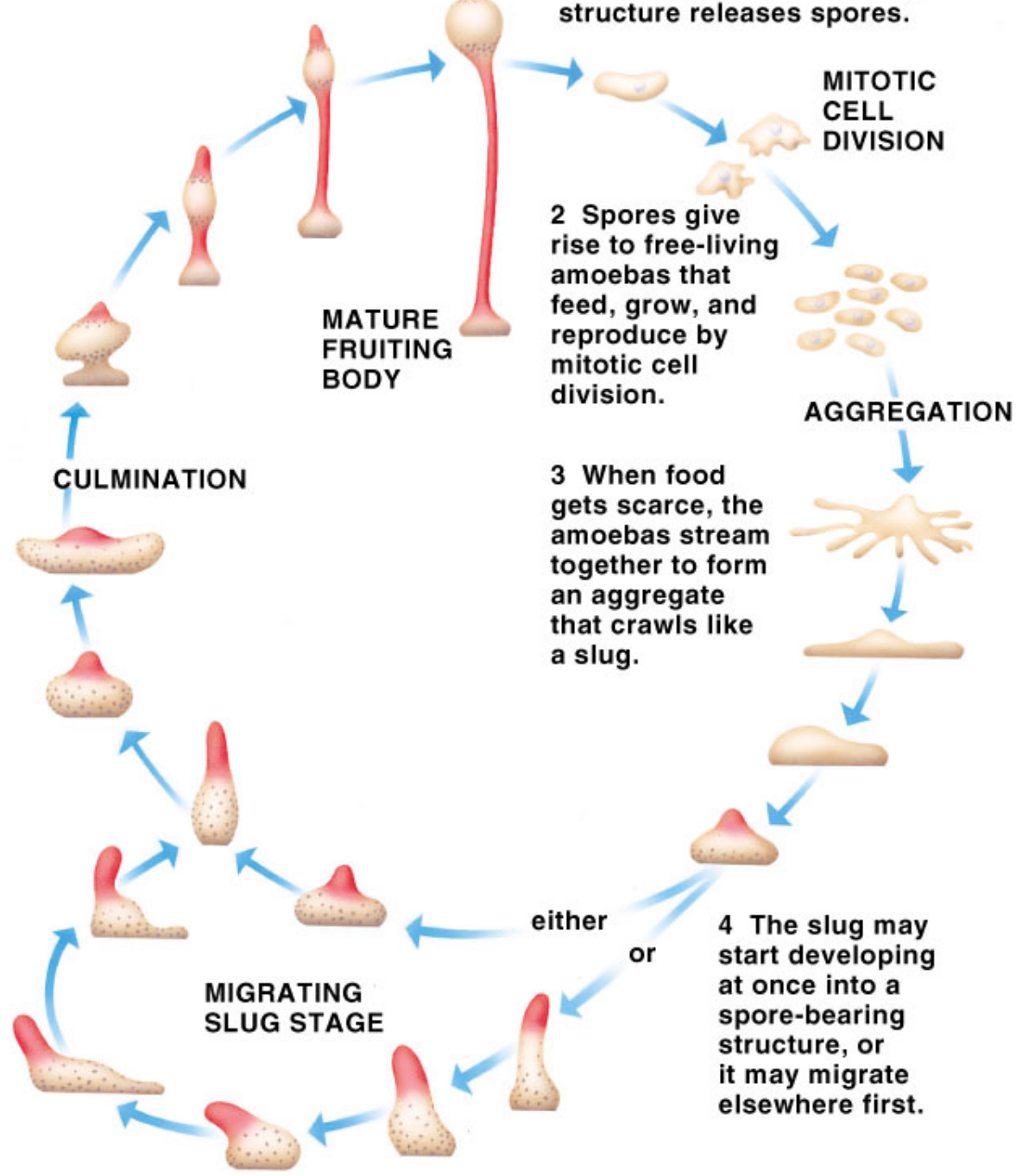




Figure 9-12a





Vu/©A.M. Siegelman/Visuals Unlimited

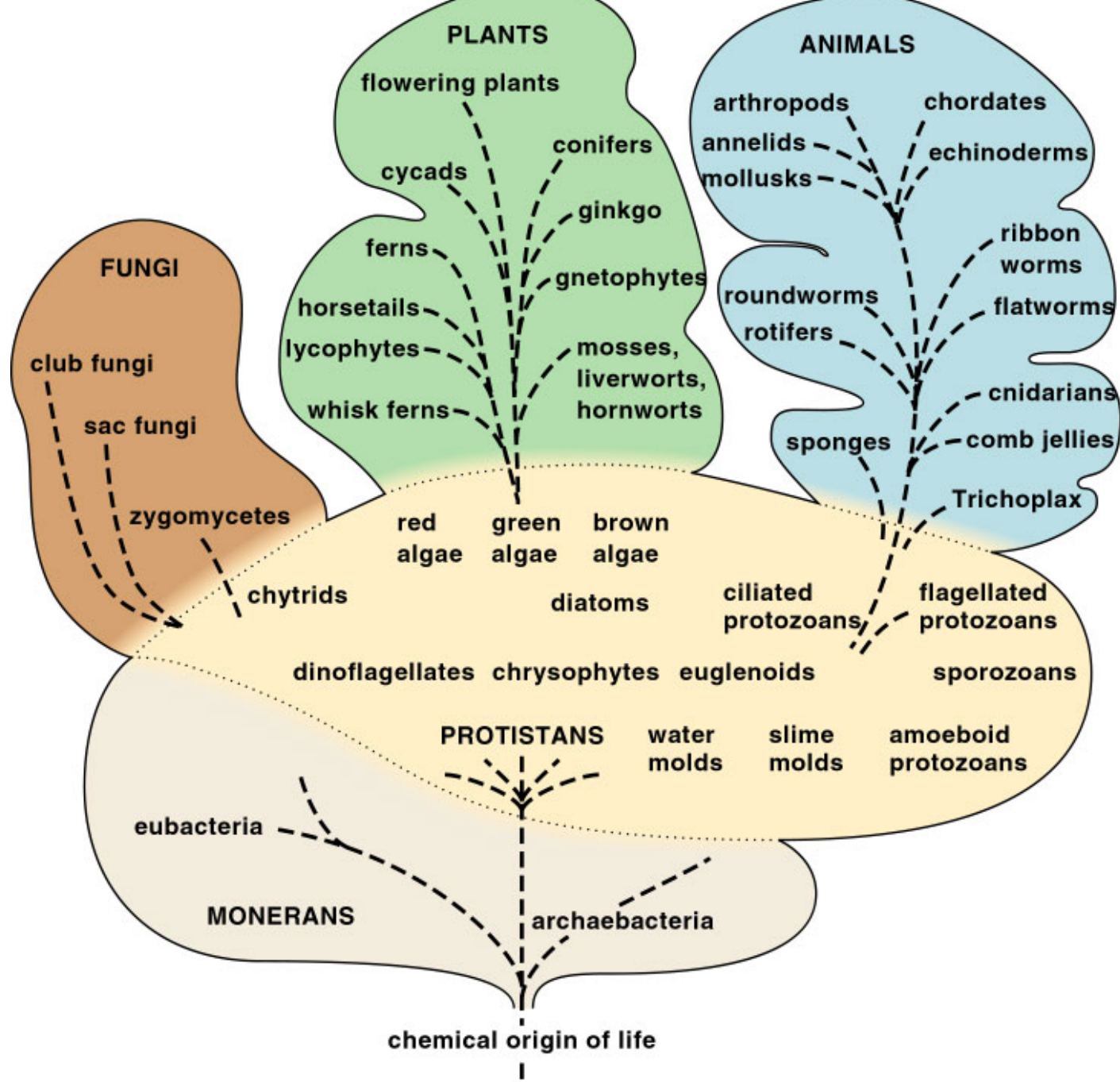
Figure 9-12c





Figure 9-12d

# 五界生物的親緣關係



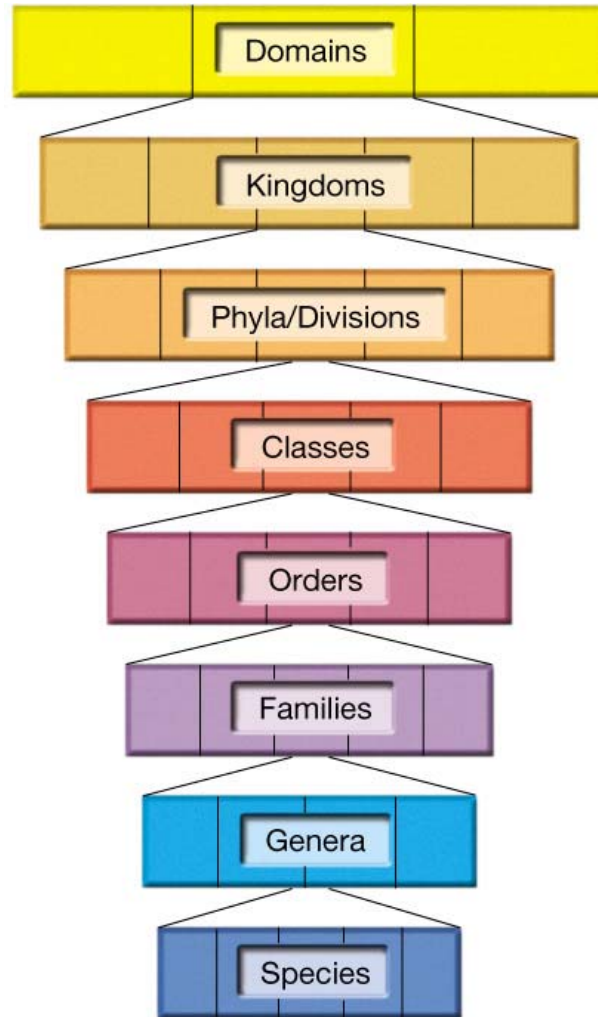


Figure 9-13



Figure 9-14a





John D. Cunningham/Visuals Unlimited

Figure 9-16



Figure 9-17f





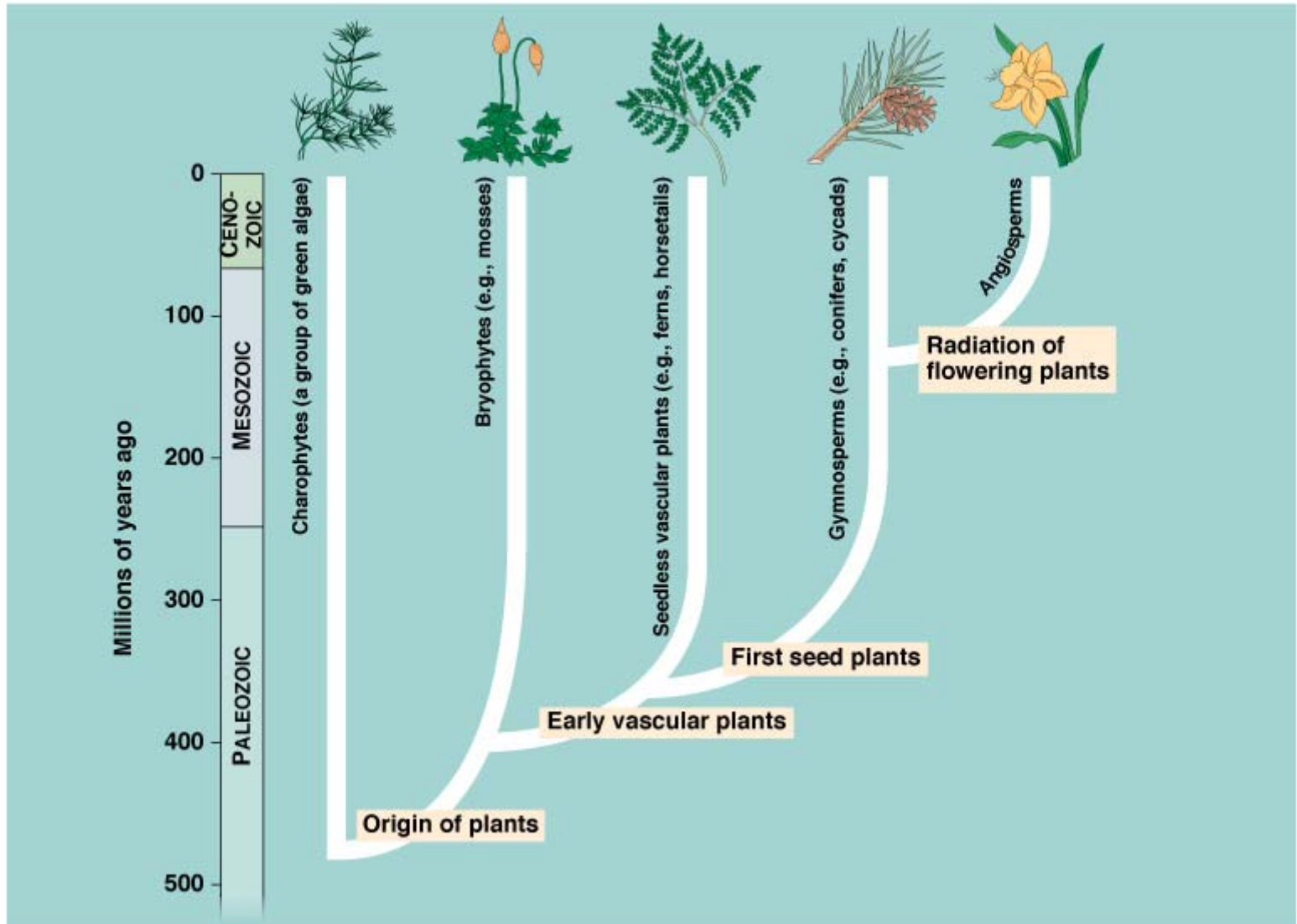
Figure 9-18b

# 植物和藻類有何不同？

- 營養來源：土壤、空氣和水
- 系統分化：根莖葉和固著器
- 支持方式：土、空氣、木質和水
- 光合作用：特定部位和全部
- 營養輸送：輸導組織
- 繁殖方式：無性→世代交替→有性繁殖
- 保護方式：蠟質、莖、細胞壁



# 植物演化上的重要事件



# How Are Fungi Classified?

- The major divisions of fungi are zygotemycetes, ascomycetes, basidiomycetes, and imperfect fungi.
- A lichen is a symbiotic association between a fungus and unicellular algae or cyanobacteria. This self-sufficient combination can colonize bare rock. Mycorrhizae are associations between fungi and the roots of most vascular plants.
- The fungus derives photosynthetic nutrients into the root from the surrounding soil.

# How are Fungi classified?

- The zygote fungi (Zygomycota) can reproduce by forming diploid zygospores
- The sac fungi (Ascomycota) form spores in a saclike case called an ascus
- The club fungi (Basidiomycota) produce club-shaped reproductive structures called basidia
- The imperfect fungi (Deuteromycota) seem to reproduce only by asexual means



Figure 9-20a





Figure 9-20c



Figure 9-20d





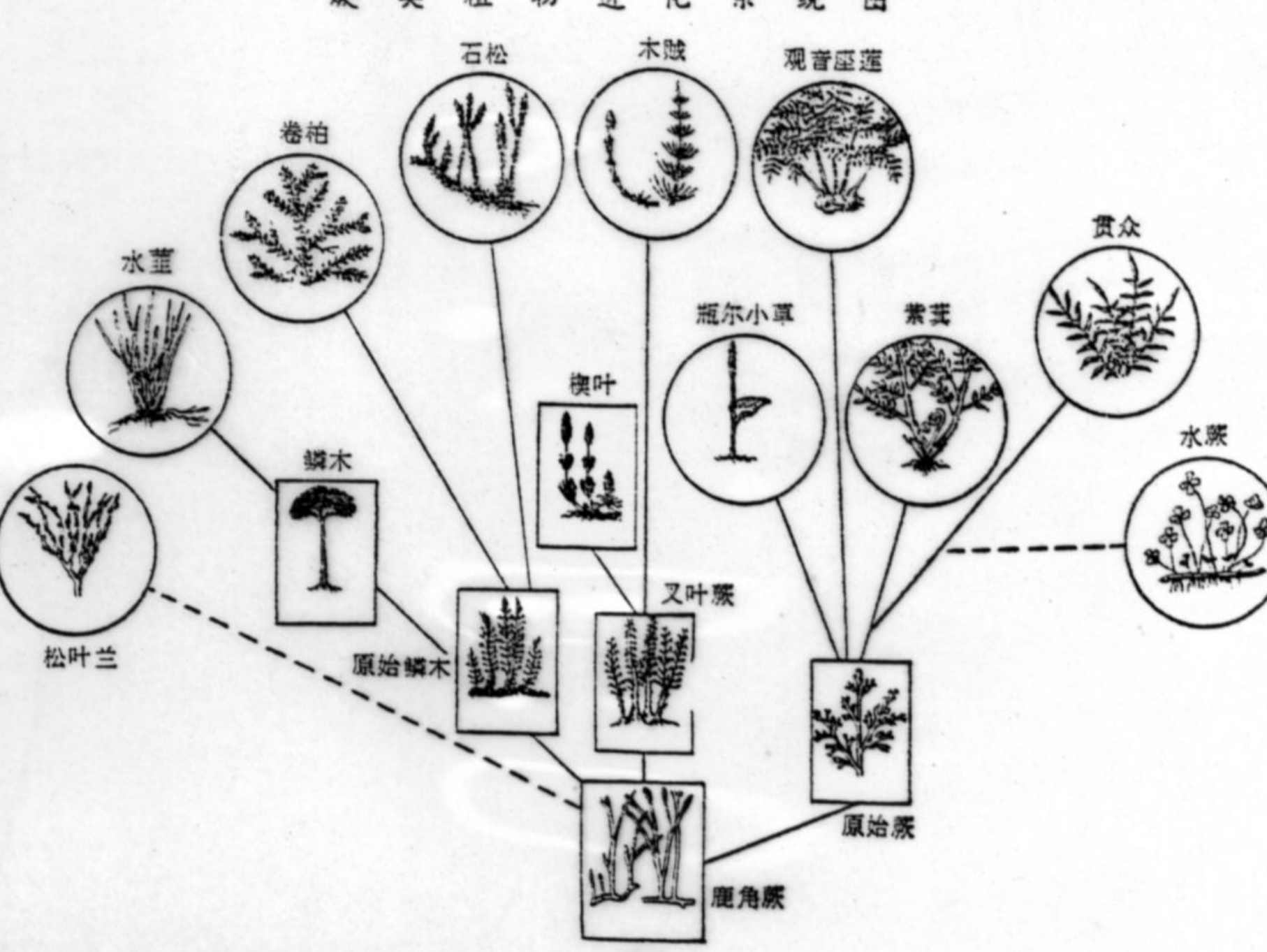
Figure 9-20f















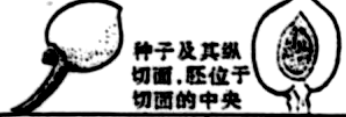



Gay Bumgarner/Stone

Figure 9-20g



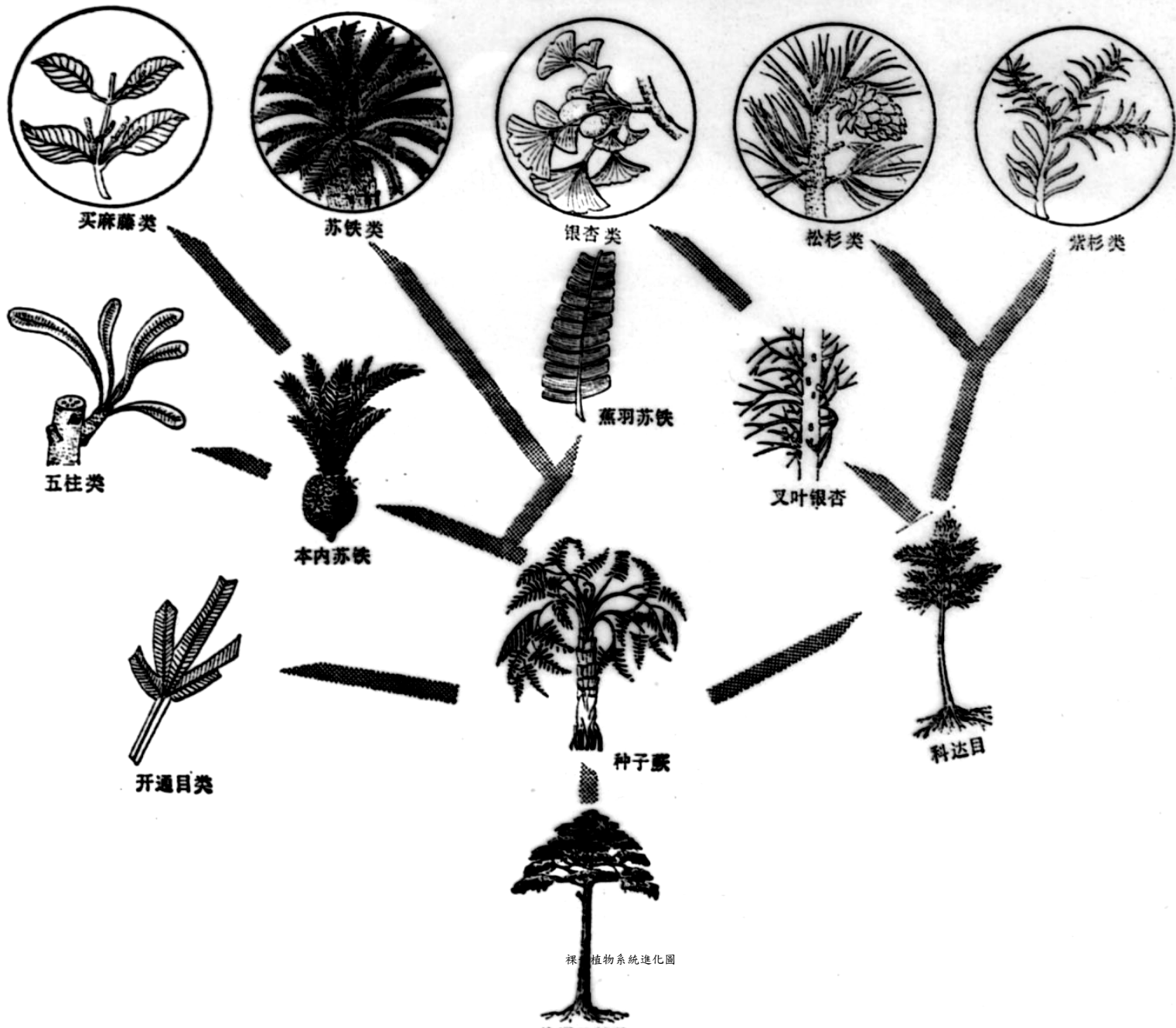


# 裸子植物和蕨类植物主要特征的比较

裸子植物	蕨类植物
 <p>银杏</p>	 <p>蕨</p>
 <p>雌花      雄蕊</p>	 <p>孢子叶的小裂片</p>
 <p>胚珠及其中的大孢子      花粉囊及花粉粒</p>	 <p>孢子囊及孢子</p>
 <p>胚珠及其中的雌配子体      花粉粒</p>	 <p>配子体的腹面具可游卵器和精子器</p>
 <p>雌配子体顶端的颈卵器      花粉管及其中的精子</p>	 <p>游动精子进入颈卵器—精子      精子</p>
 <p>雌配子体及受精卵</p>	 <p>配子体及受精卵</p>
 <p>种子及其纵切面, 胚位于切面的中央</p>	 <p>配子体及胚</p>
 <p>幼苗</p>	 <p>配子体及幼孢子体</p>



裸子植物进化系统图



# 被子植物和裸子植物主要特征的比較






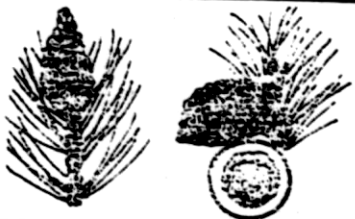




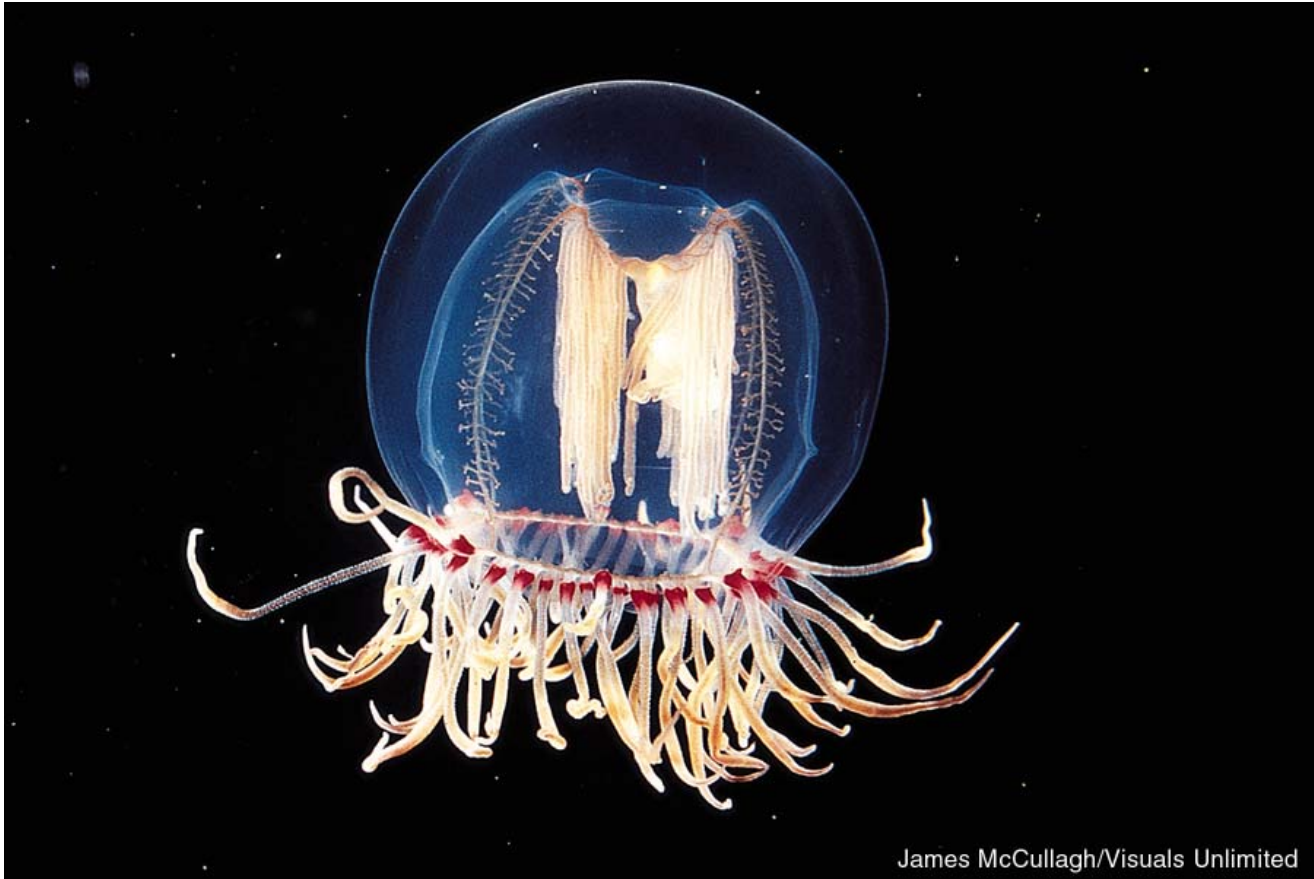
被子植物	裸子植物
 <p>有多年生木本植物如乔木、灌木和藤木还有很多草本植物</p>	 <p>裸子植物都是多年生木本植物，多数是乔木</p>
 <p>被子植物具有导管和伴胞</p>	 <p>裸子植物的木质部中一般没有导管，只有管胞，韧皮部中没有伴胞。</p>
 <p>大多数是两性花，除了雄蕊和雌蕊以外还有花冠和花萼</p>	 <p>花都是单性的，一般呈球果状</p>
 <p>胚珠生在雌蕊的子房内，花粉受精后，胚珠形成种子，子房形成果实，种子包在果皮内而</p>	 <p>胚珠是裸露的，以后发育成的种子，外面没有果皮包被</p>
 <p>花粉管中一精子与卵结合，另一精子与二极核结合，这是被子植物特有的双受精现象，被子植物的胚乳是受精的极核发育而成的</p>	 <p>在花粉管中只有一精子与卵结合，没有双受精现象，裸子植物的胚乳是由雌配子体形成的</p>





Figure 9-21a





James McCullagh/Visuals Unlimited

Figure 9-21c



Figure 9-21f





Figure 9-21g

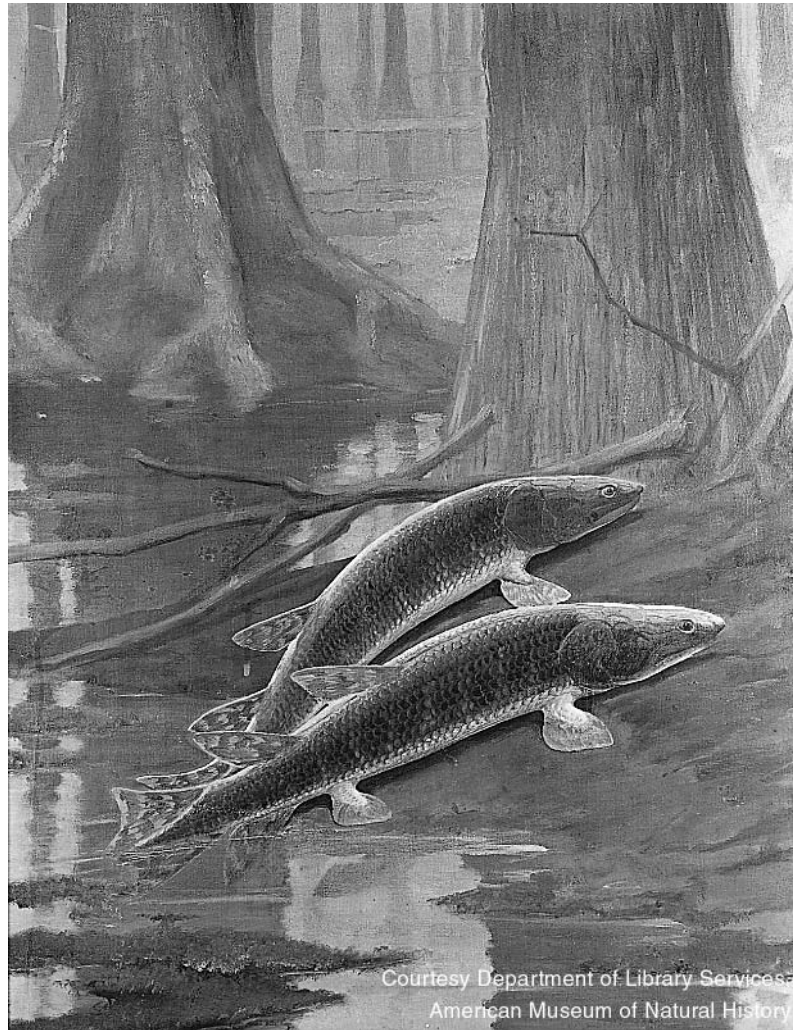


Figure 9-21i





Figure 9-8



Courtesy Department of Library Services  
American Museum of Natural History

Figure 9-9



Figure 9-7c



# 动物界系统树



動物界系統樹

# What is an animal?

- multicellular 多細胞
- Eukaryotes 真核生物
- heterotrophic 異營性
- most digest food inside their bodies 攝食性
- sexual reproduction 有性生殖
- diploid adult 成體為二倍體
- embryonic stages 胚胎發育過程

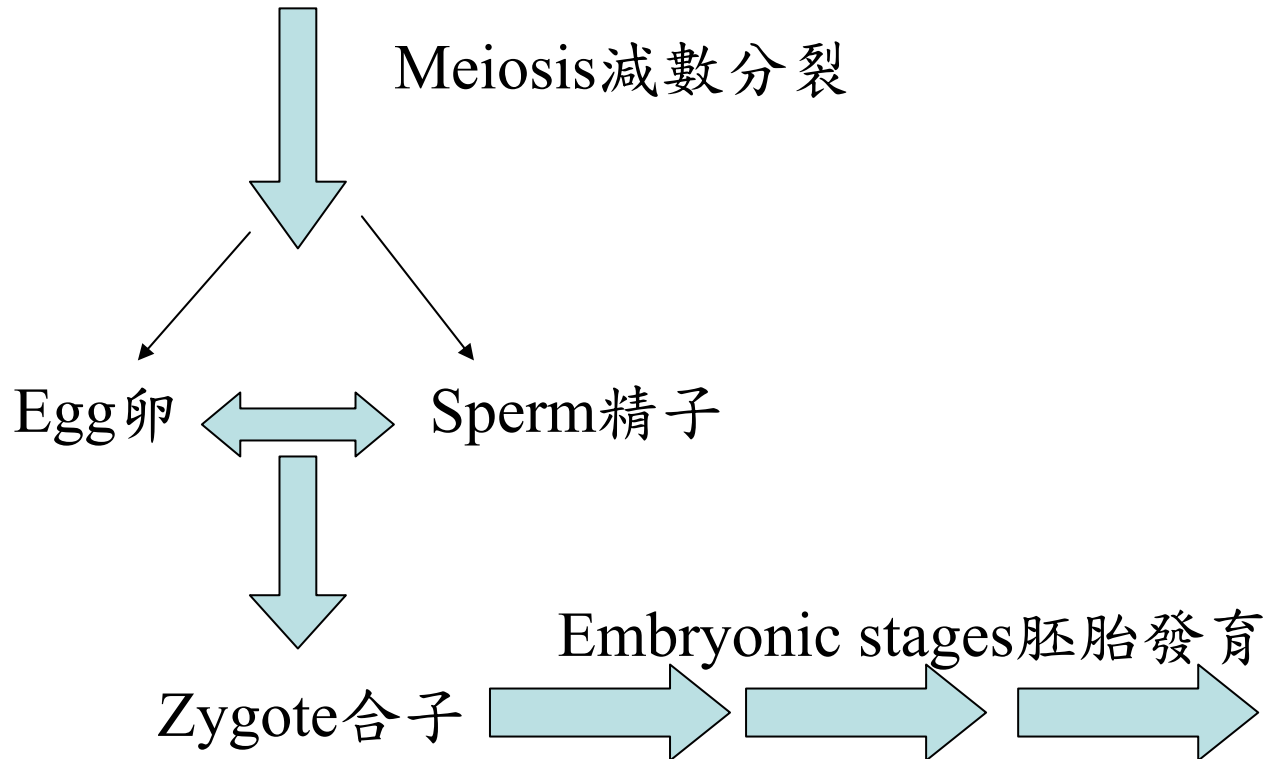
# What is an animal?

- Glycogen storage 碳水化合物以肝糖形式儲存
- lack cell walls 缺細胞壁
- cell junctions:
  - tight junctions 緊密鍵結
  - desmosomes 胞橋小體
  - gap junctions 縫隙連接
- Nervous and Muscle tissues 神經和肌肉組織



# Life cycle 生活史

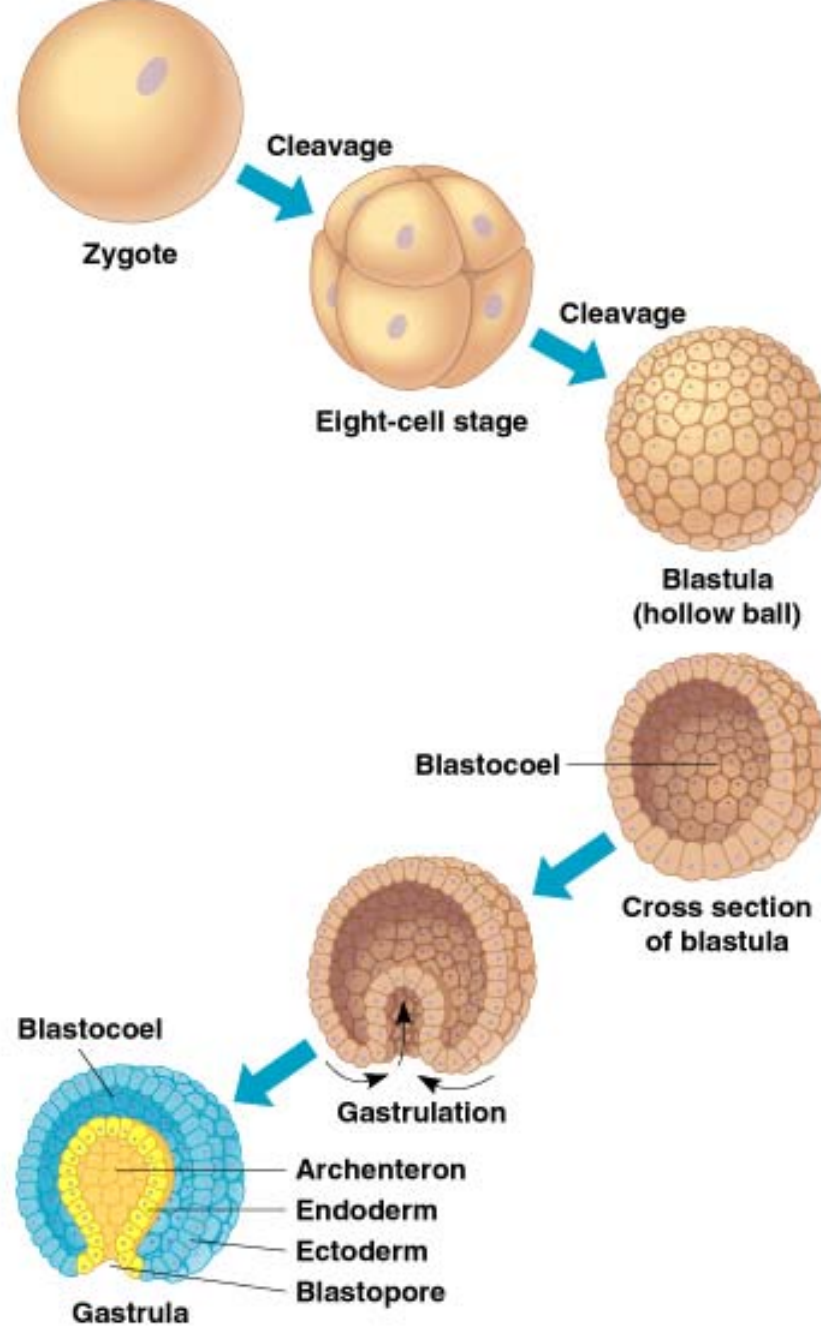
- Diploid adult 二倍體成體



# Life cycle生活史

- Zygote 合子      Cleavage (卵裂) →
- Blastula 囊胚
- Gastrula 原腸胚      Gastrulation (原腸化) →
- larva 幼蟲      Metamorphosis (變態過程) →
- adult 成體

# 早期胚胎發育的過程



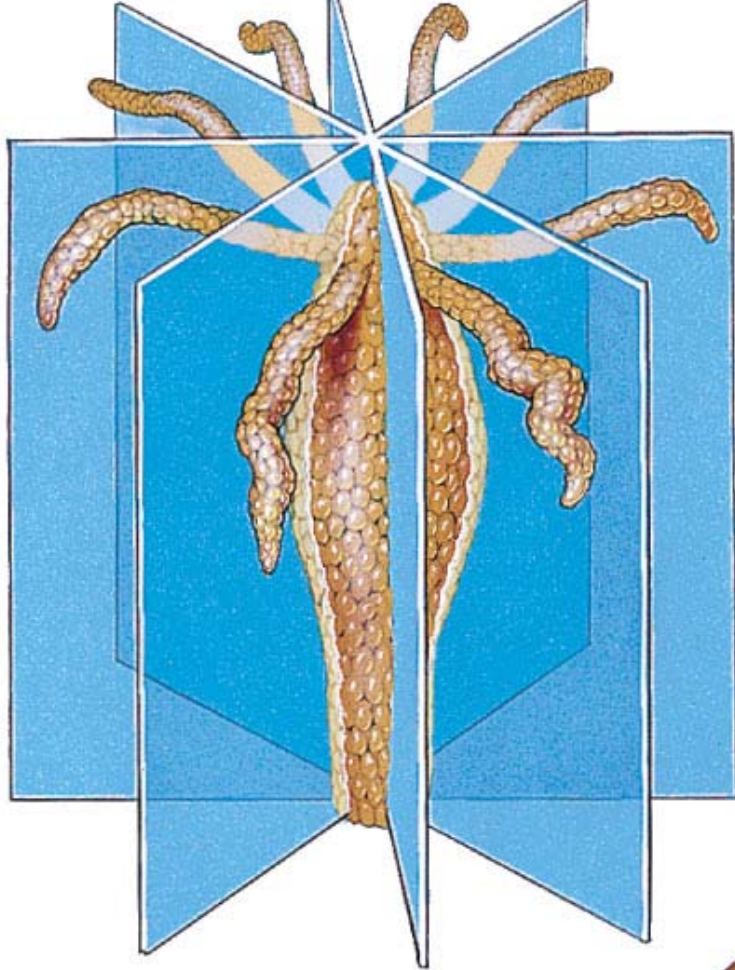


# What are the major evolutionary trends in animals?

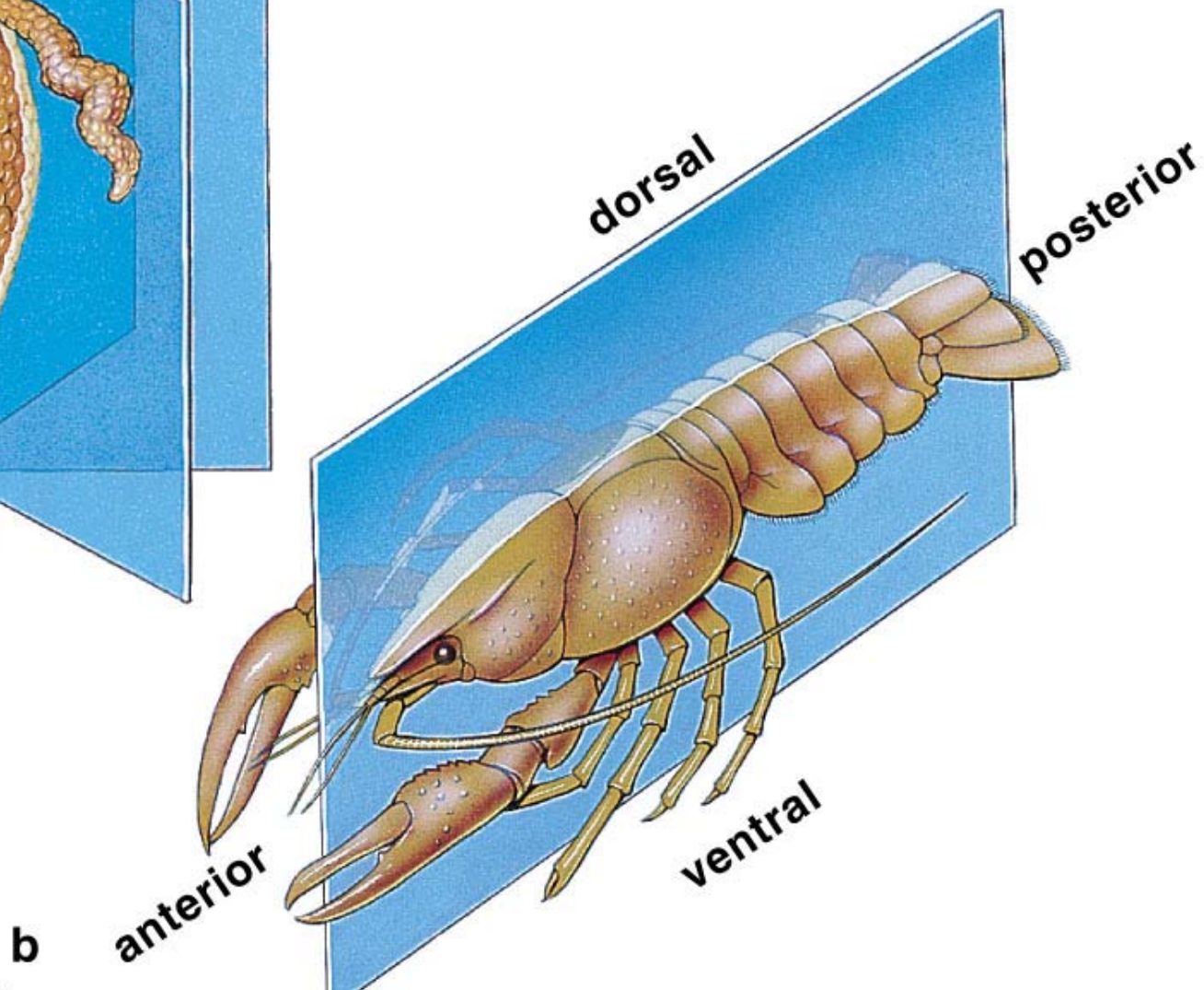
- **Over evolutionary time, animals have increased in complexity**
- **Animal phyla show trends toward increasing cellular organization**
- **Body forms became symmetrical early in the evolutionary history of animals**
- **Cephalization increased over evolutionary time**
- **Body cavities arose in more-complex animals**
- **Segmentation first arose in annelid worms**
- **Digestive systems increased in complexity**

# Trends in body symmetry

- Asymmetry: sponges
- Radial symmetry: cnidarians, some adult echinoderms
- bilateral symmetry: flatworms, mollusks, arthropods, larval echinoderms, chordates



**a**



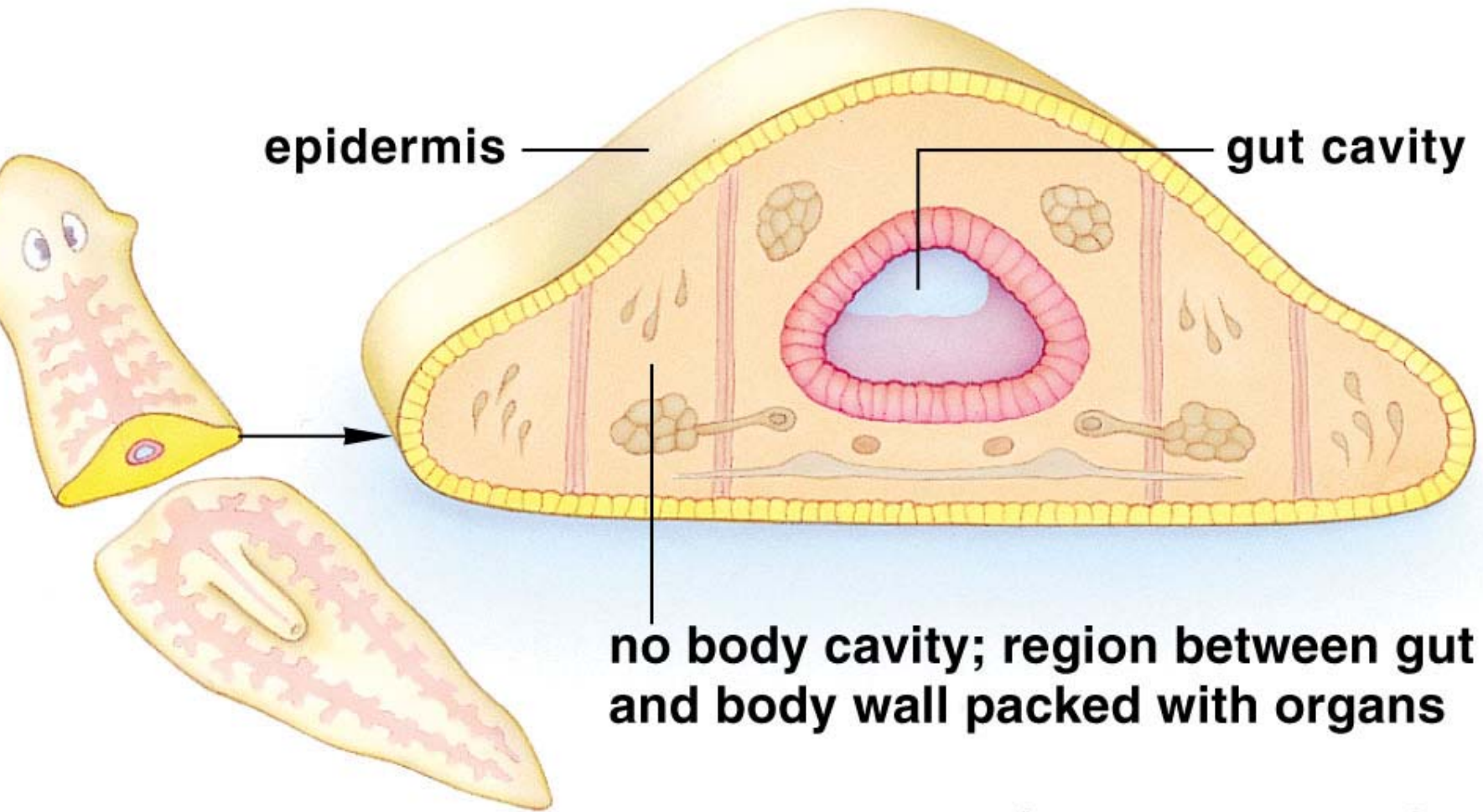
**b**

**anterior**

**dorsal**

**posterior**

**ventral**



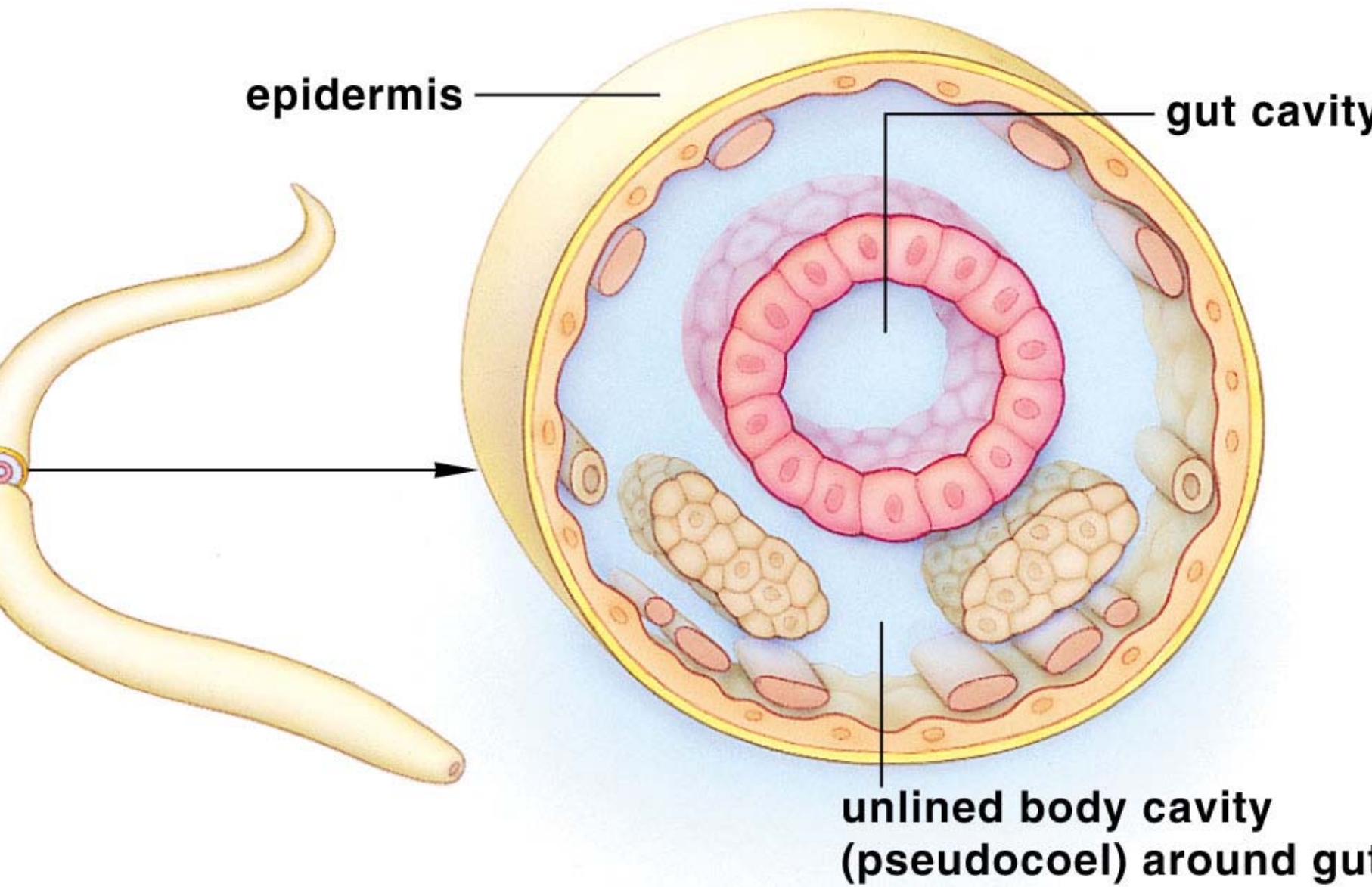
**epidermis**

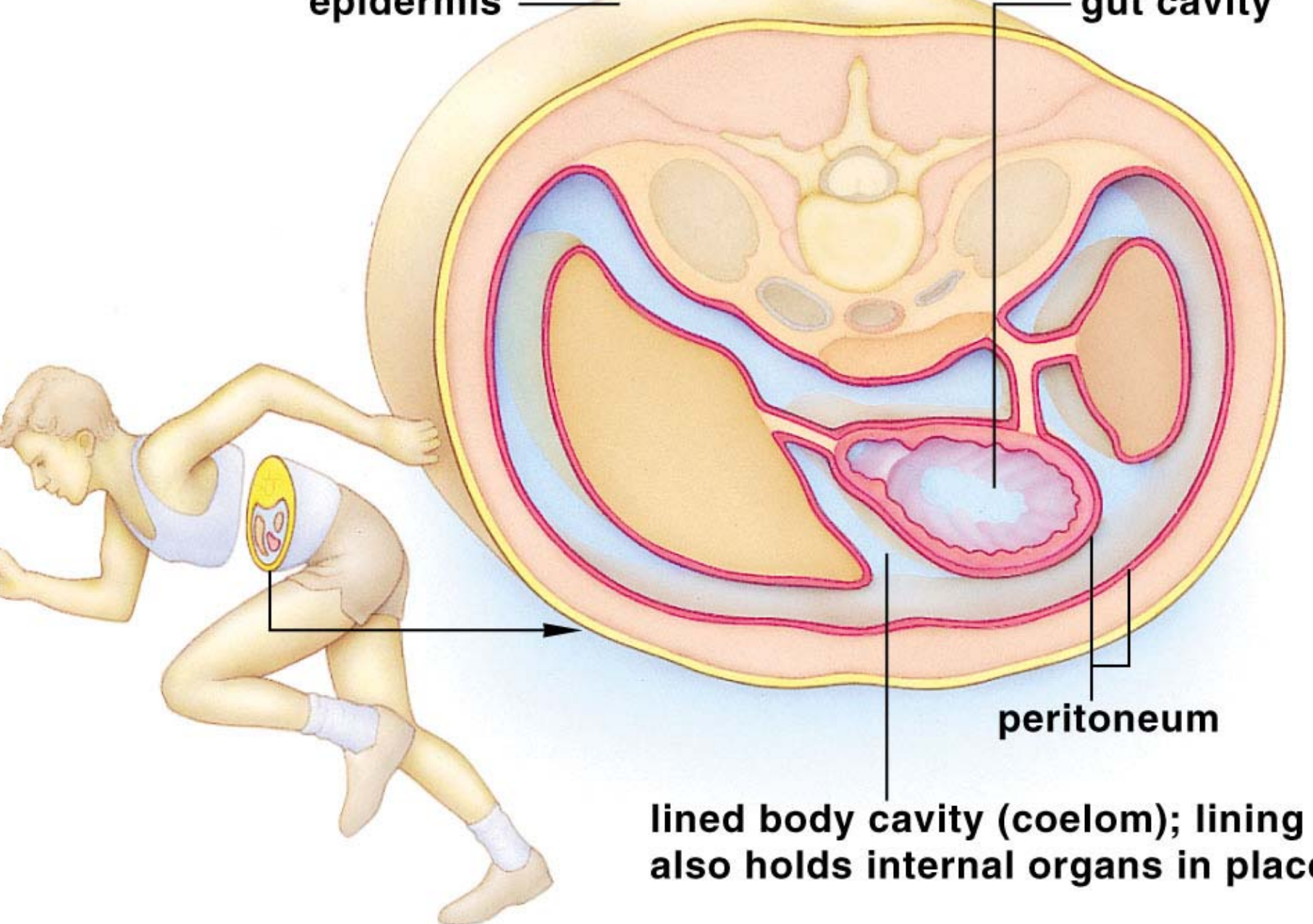
**gut cavity**

**no body cavity; region between gut and body wall packed with organs**

**a No coelom (acoelomate animal)**

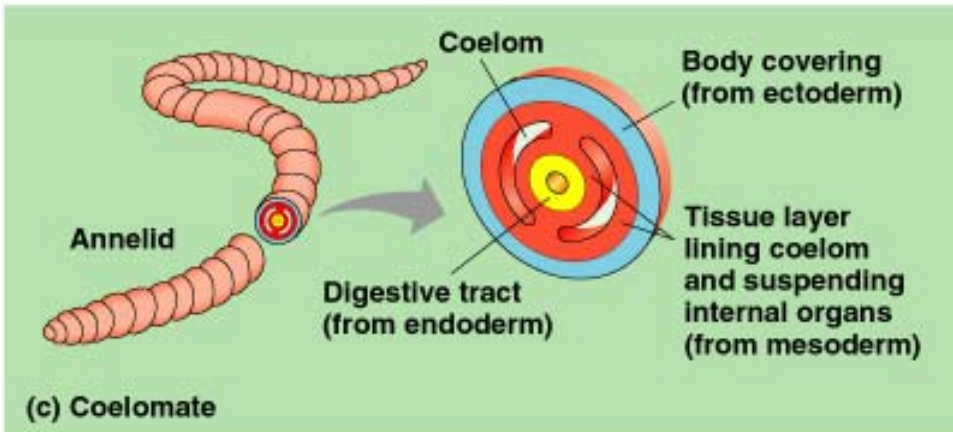
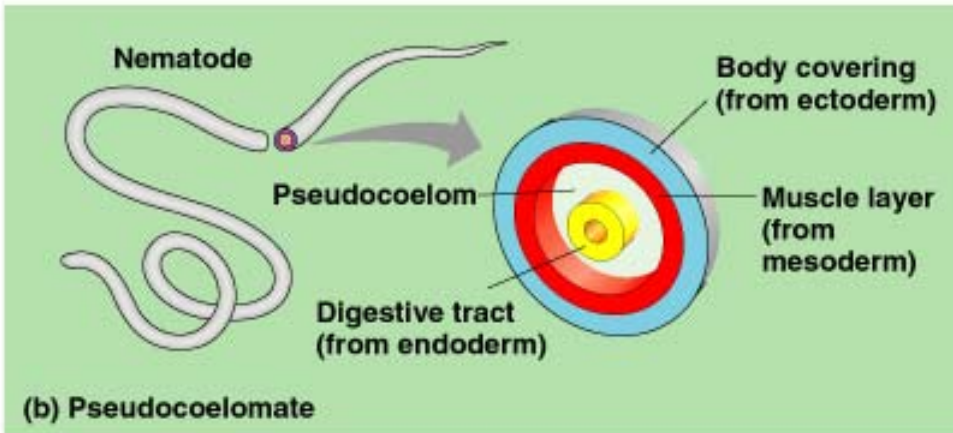
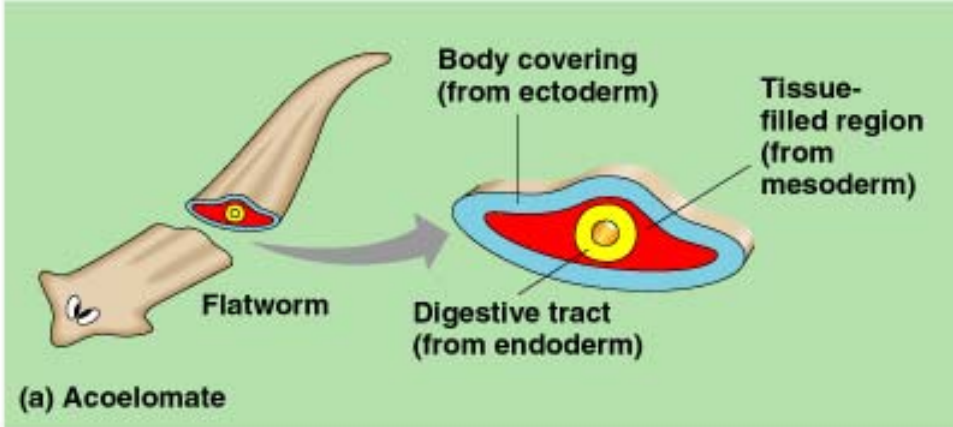








# 兩側對稱動物的體制

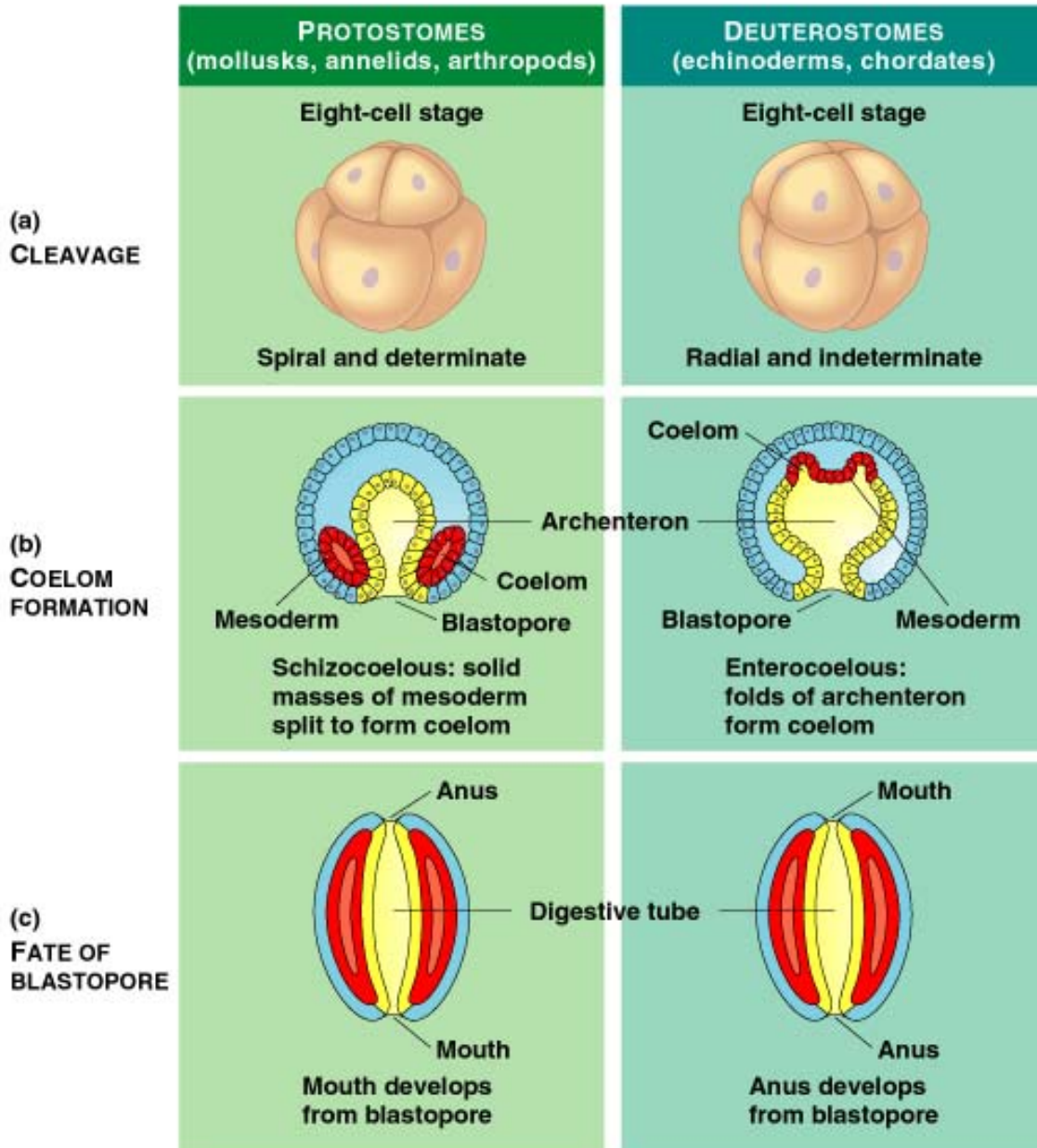


# Trends in digestive system

- Intracellular: Porifera (Sponges)
- Gastrovascular cavity: Cnidaria (Hydra, Anemones, Jellyfish), Platyhelminthes (flatworms),
- Separate mouth and anus: Nematoda (roundworms), most more complex animals



# 原口動物與後口動物胚胎早期發育的比較



# Trends in Nervous system

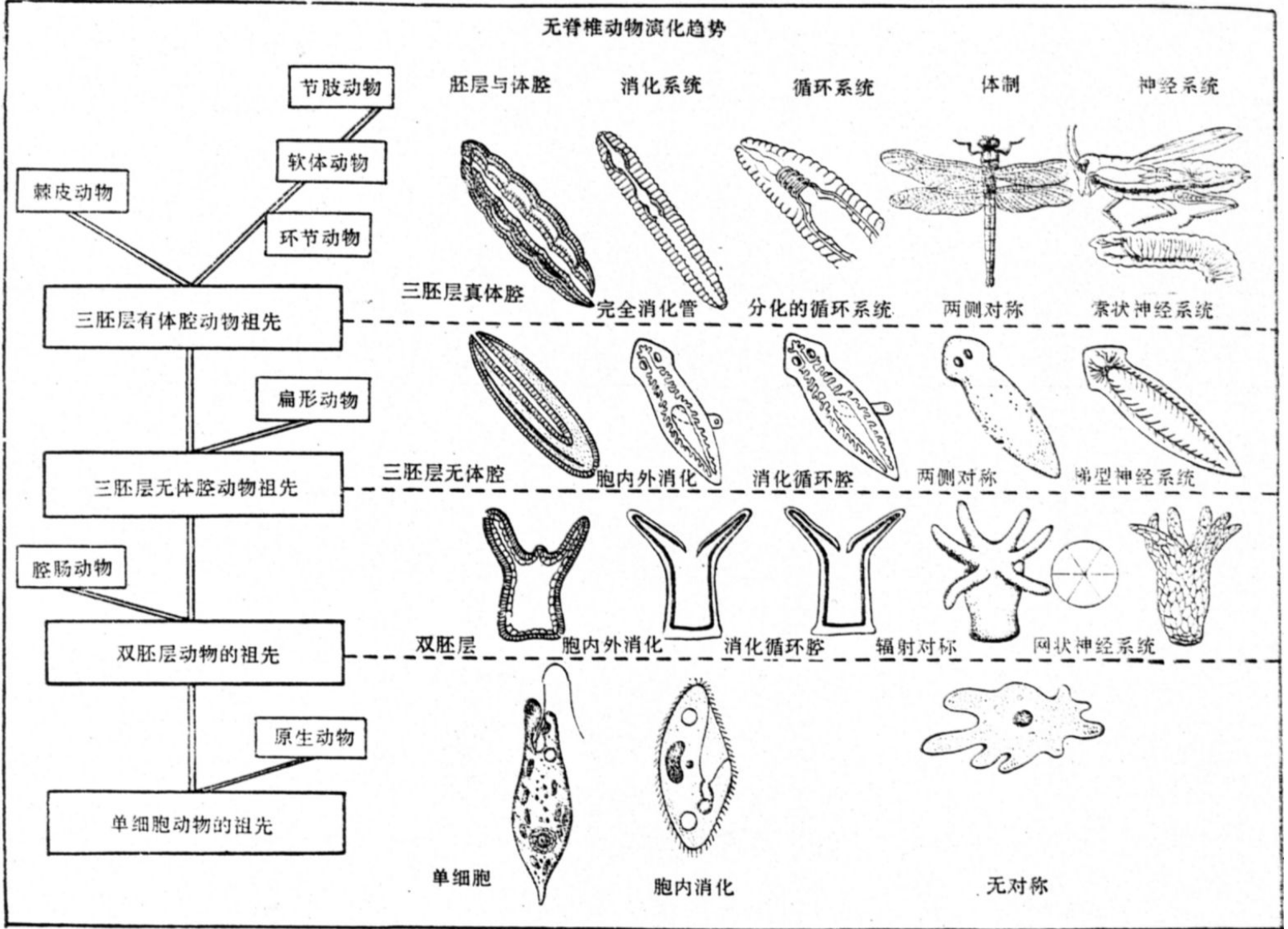
- **Absent: Porifera (Sponges)**
- **Nerve net: Cnidaria (Hydra, Anemones, Jellyfish),**
- **Head ganglia with longitudinal nerve cords: Platyhelminthes (flatworms),**
- **Head ganglia with dorsal and ventral nerve cords: roundworms,**
- **Head ganglia with paired ventral cords; ganglia in each segment: segmented worms, Arthropoda (insects, Arachnids, crustaceans)**
- **Well-developed brain in some cephalopods; several paired ganglia, nerve network in body wall: Mollusca (snail, clams, squid)**
- **Nerve ring and radial nerves; nerve network in skin: Echinodermata (sea stars, sea urchins)**
- **Well-developed brain; dorsal nerve cord: Chordata (vertebrates)**

# Trends in support

- **Absent: Platyhelminthes (flatworms)**
- **Hydrostatic skeleton: Cnidaria (Hydra, Anemones, Jellyfish), Nematoda (roundworms), Annelida (segmented worms), Mollusca (snail, clams, squid)**
- **Endoskeleton of spicules: Porifera (Sponges)**
- **Endoskeleton of plates beneath outer skin: Echinodermata (sea stars, sea urchins)**
- **Exoskeleton: Arthropoda (insects, Arachnids, crustaceans)**
- **Endoskeleton of cartilage or bone: Chordata (vertebrates)**

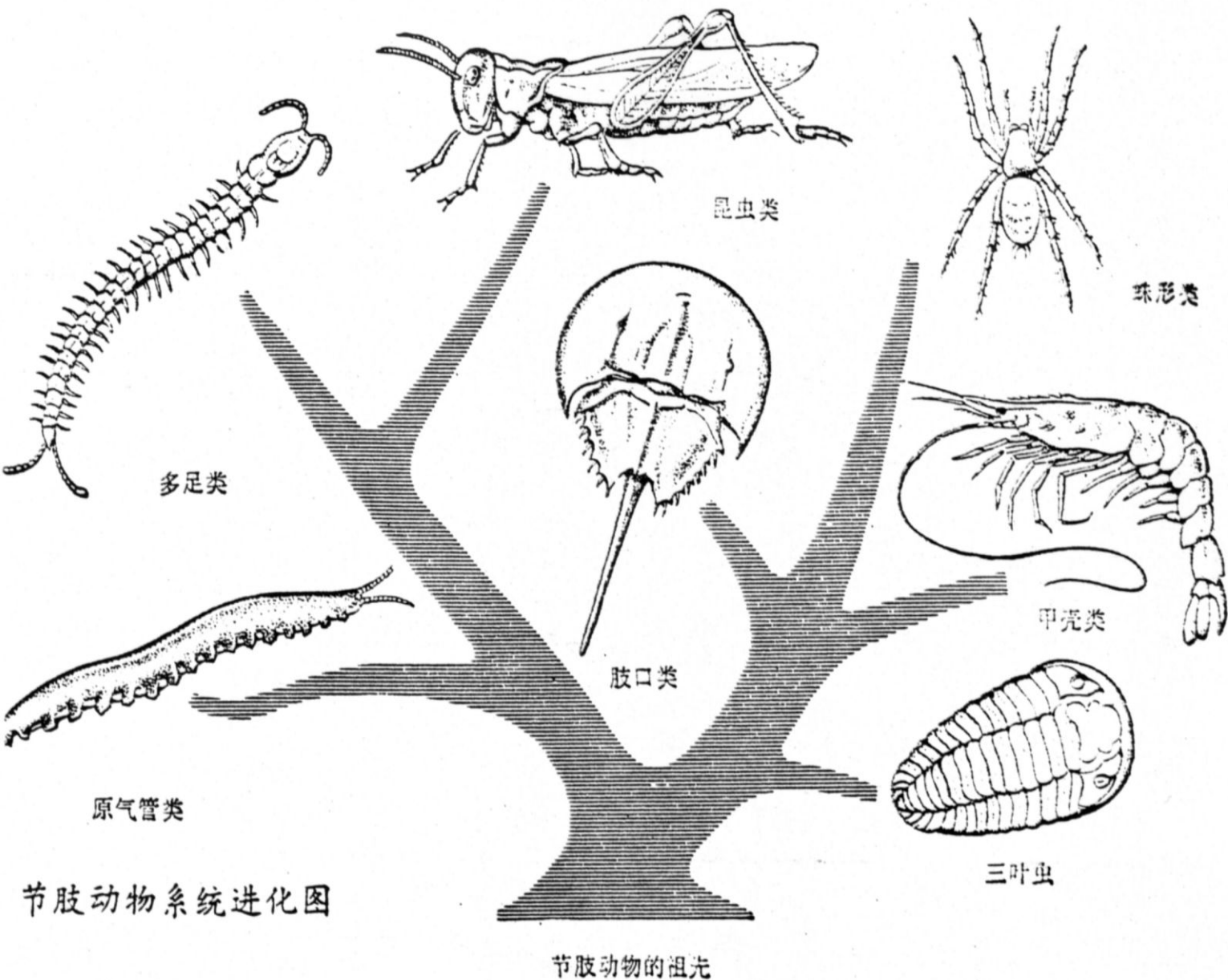
# 無脊椎動物的進化趨勢

无脊椎动物演化趋势





節肢動物系統進化圖



節肢動物系統進化圖



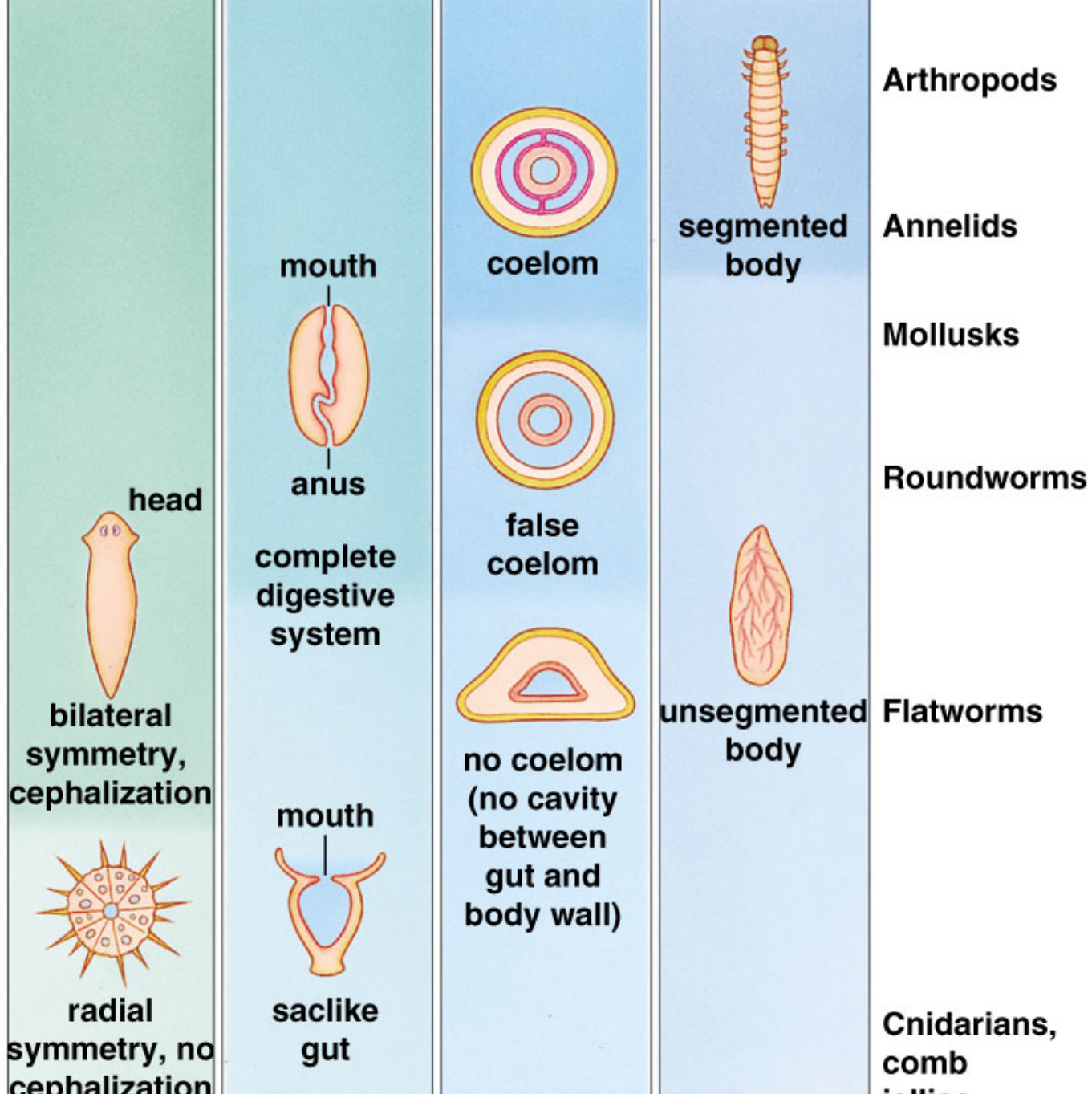




Figure 9-21j



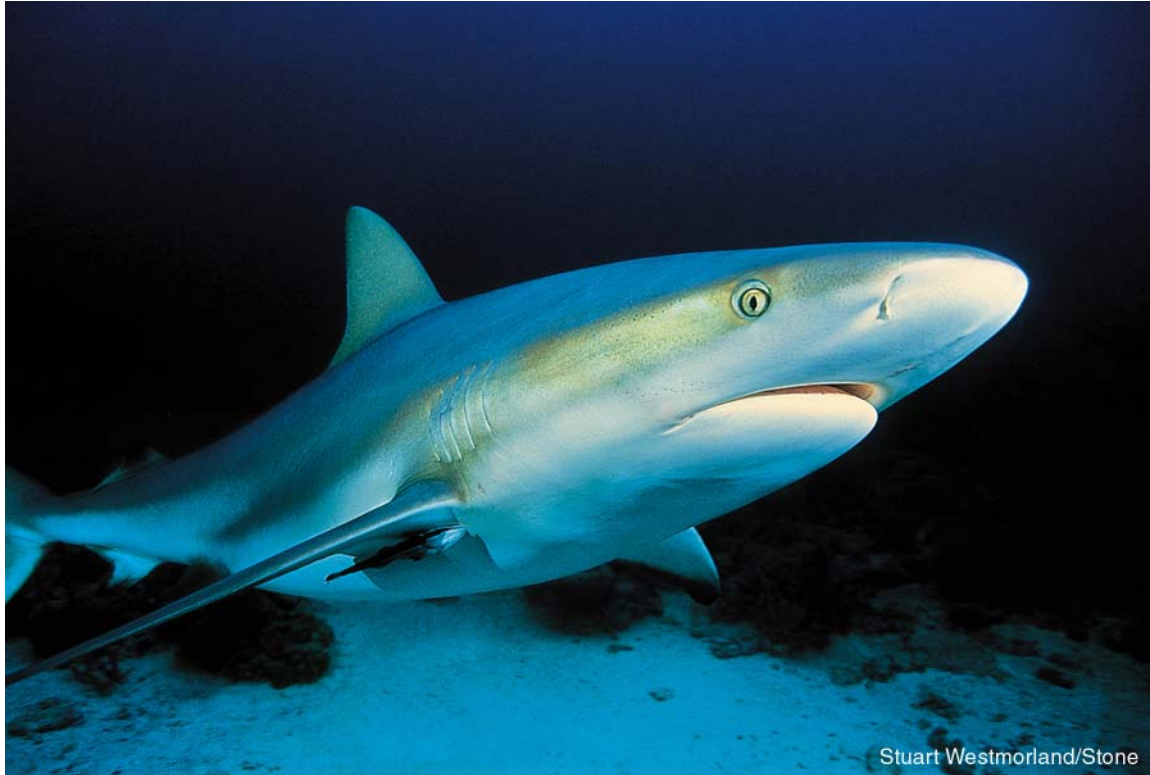


Figure 9-22a



Figure 9-22b



Joe McDonald/Visuals Unlimited

Figure 9-22d



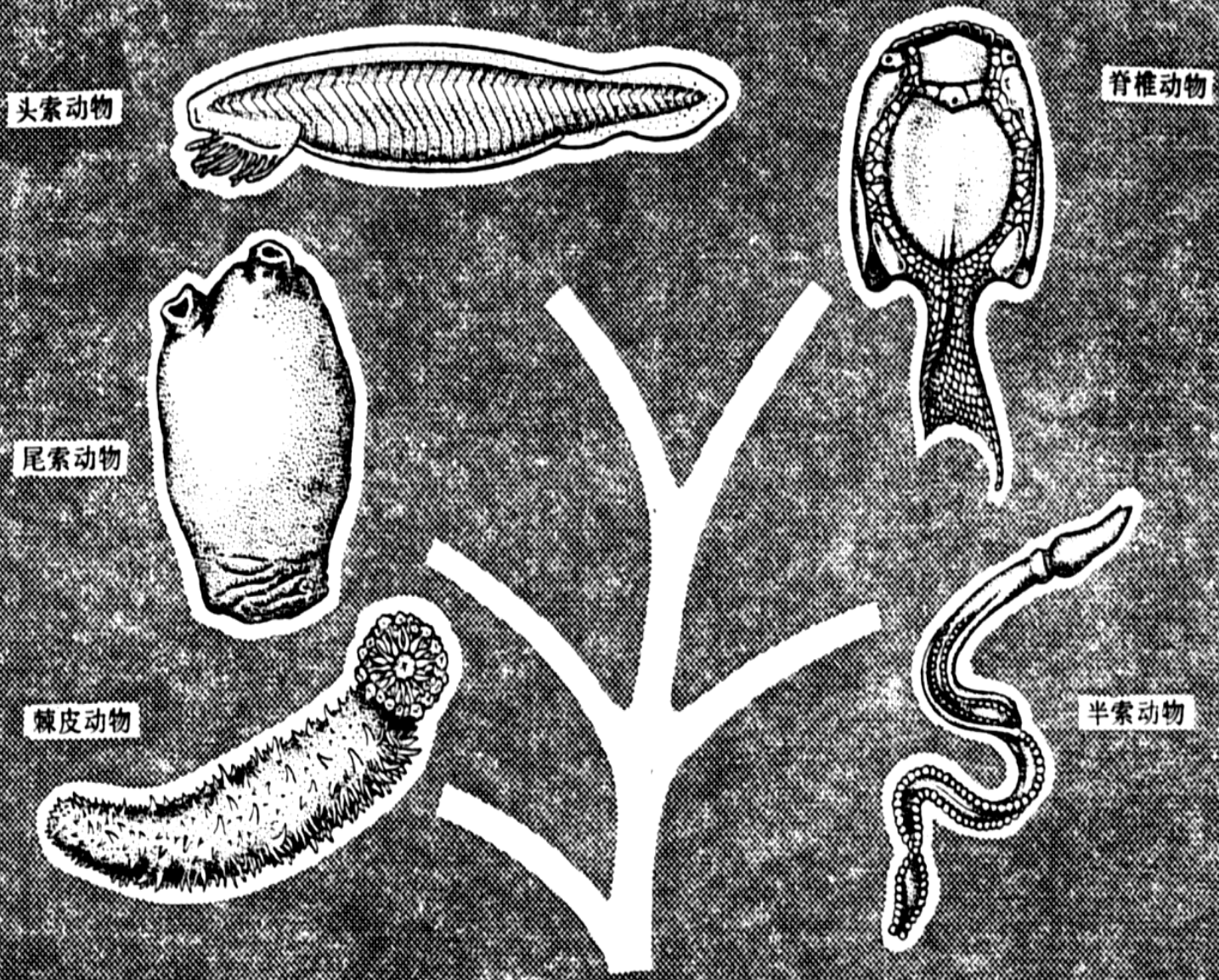
Figure 9-22e





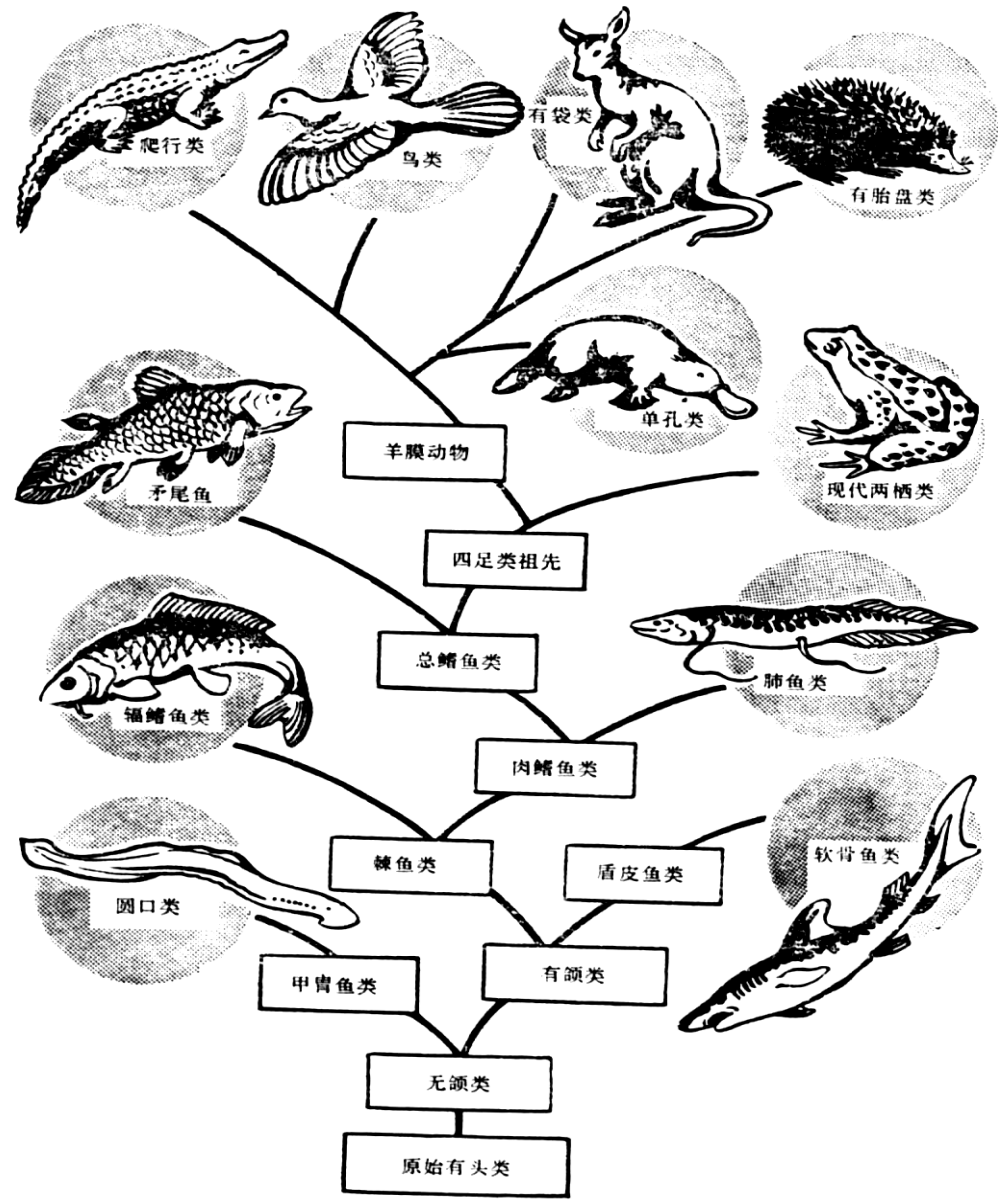
Figure 9-22f

脊索動物的系統發生圖



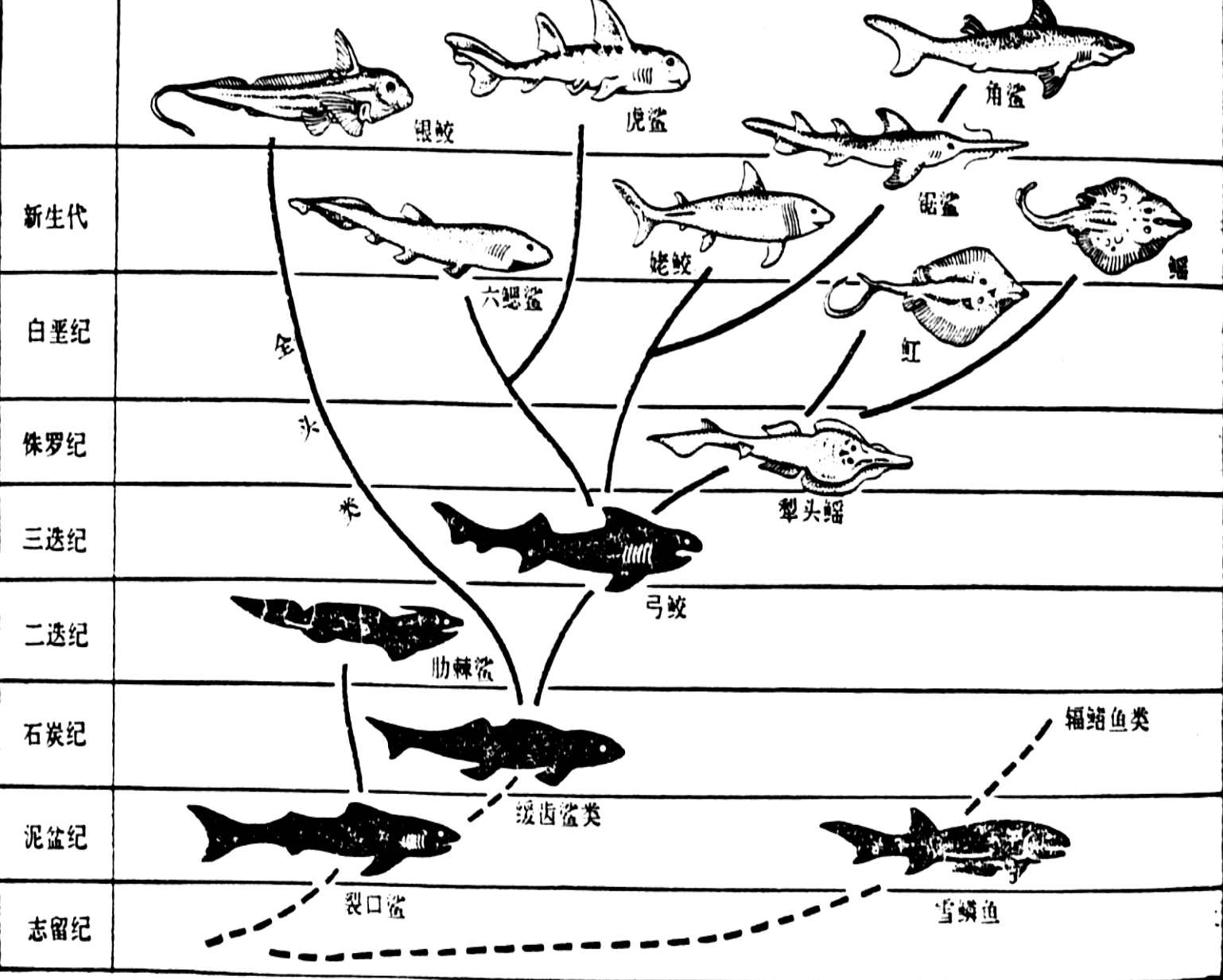
脊索动物的系统发生图

# 脊椎動物的系統發生圖



脊椎动物的系统发生图

# 軟骨魚類的進化圖

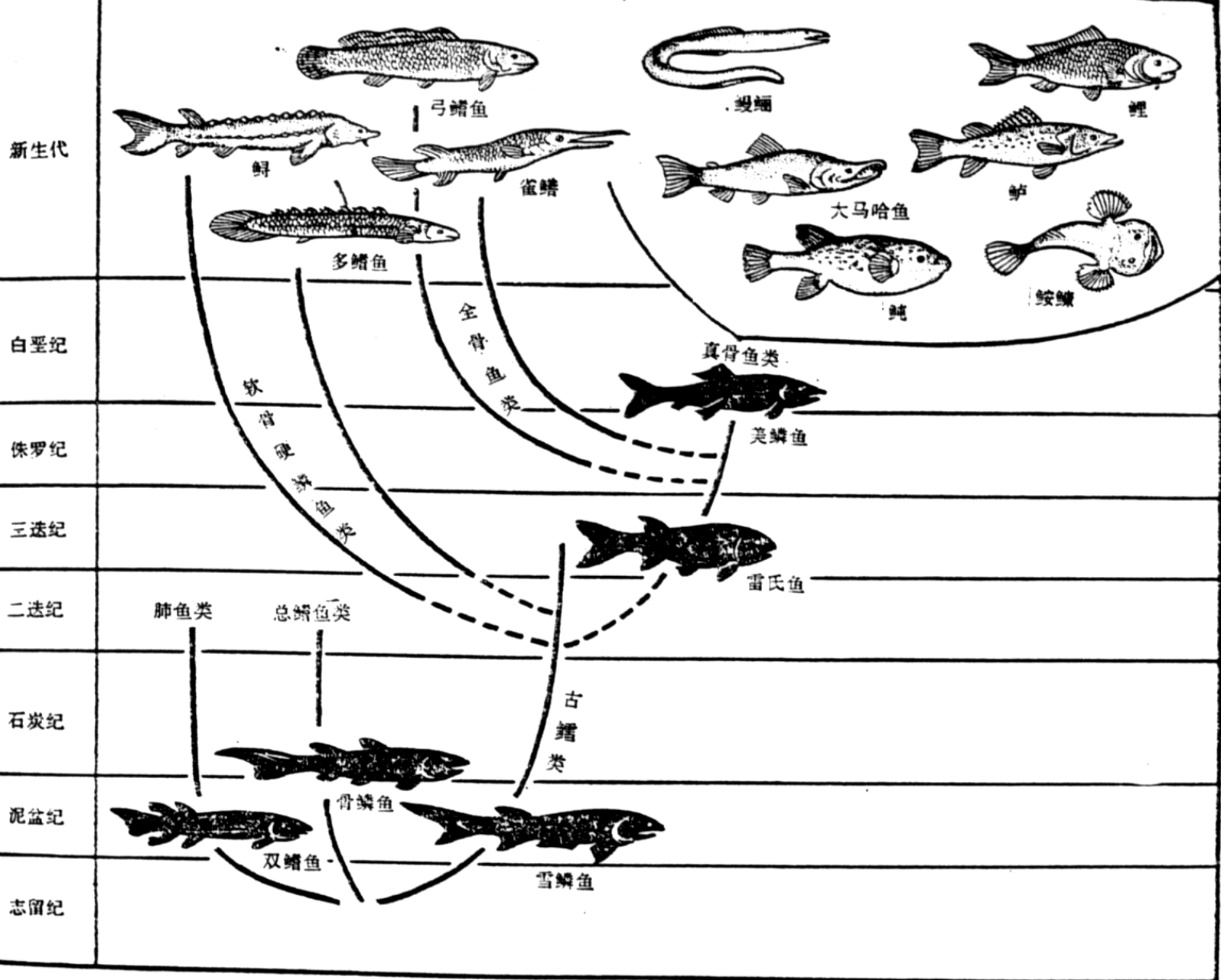


軟骨魚類的進化圖





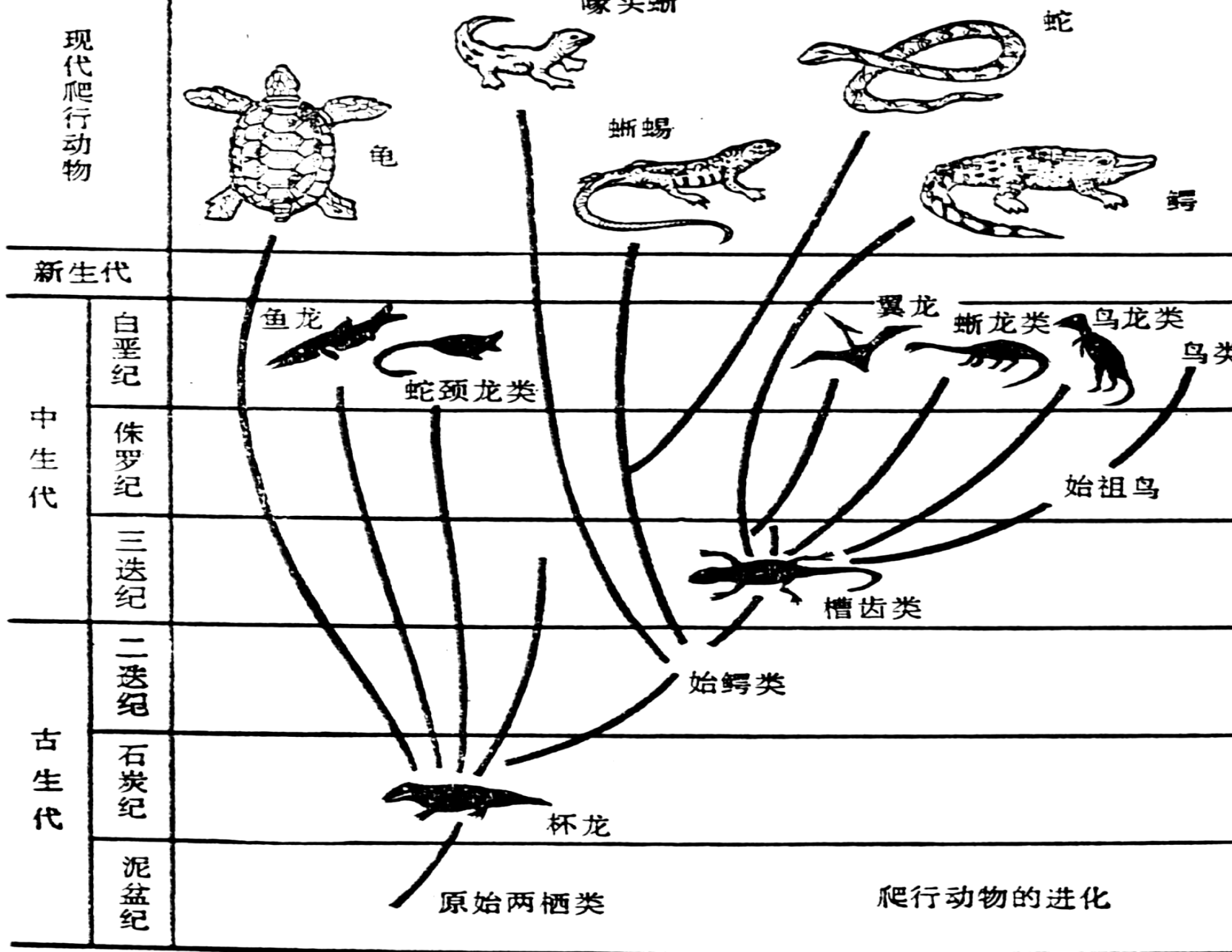
# 硬骨魚類的進化圖



硬骨魚類的進化圖

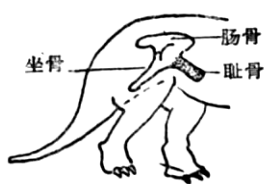


爬行动物进化图



爬行动物进化图

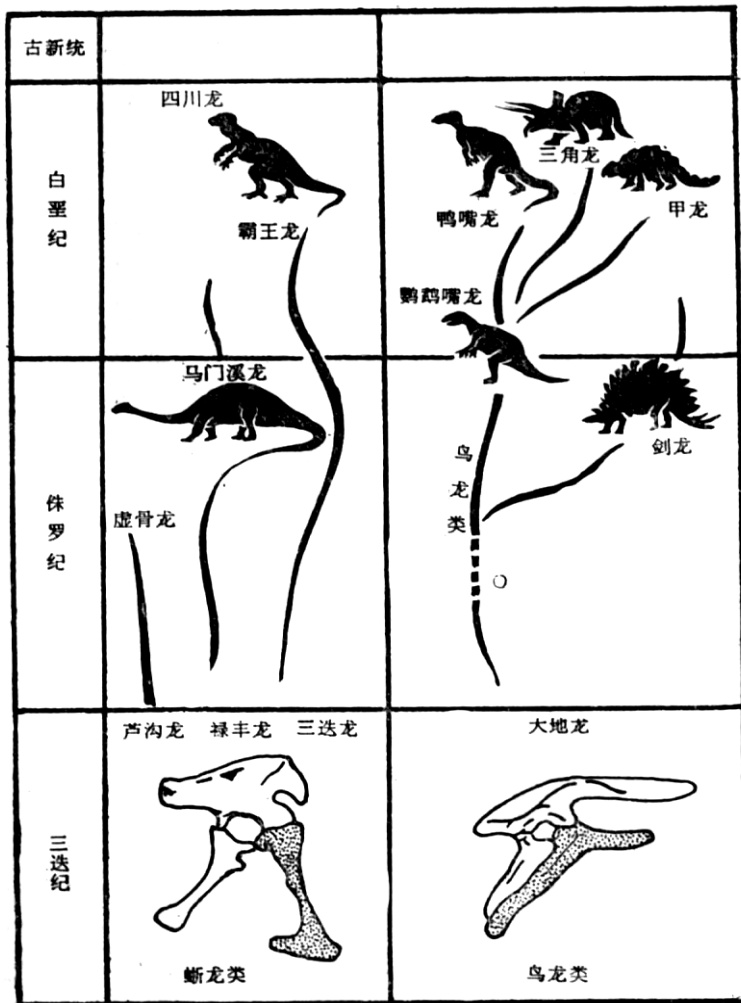




蜥龙类

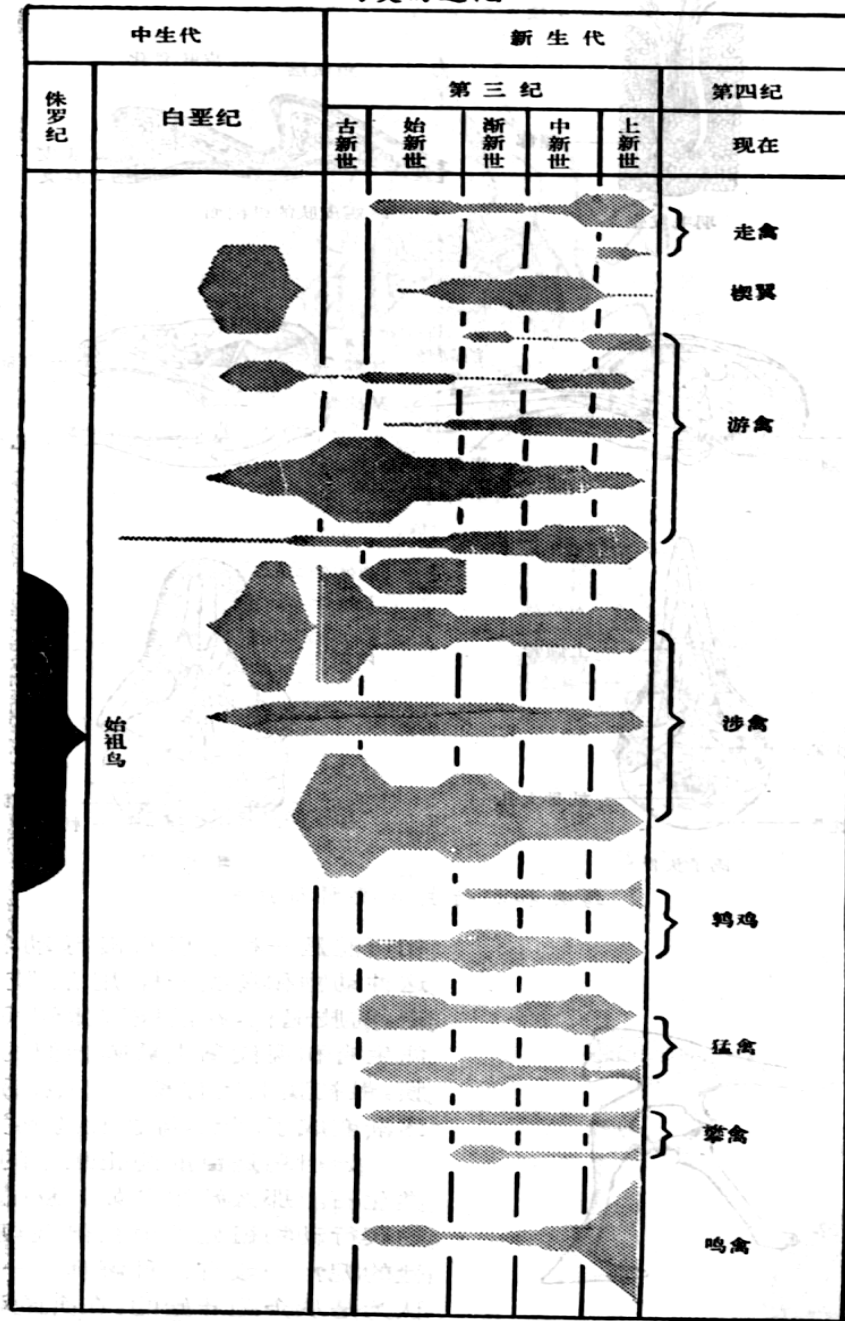


鸟龙类



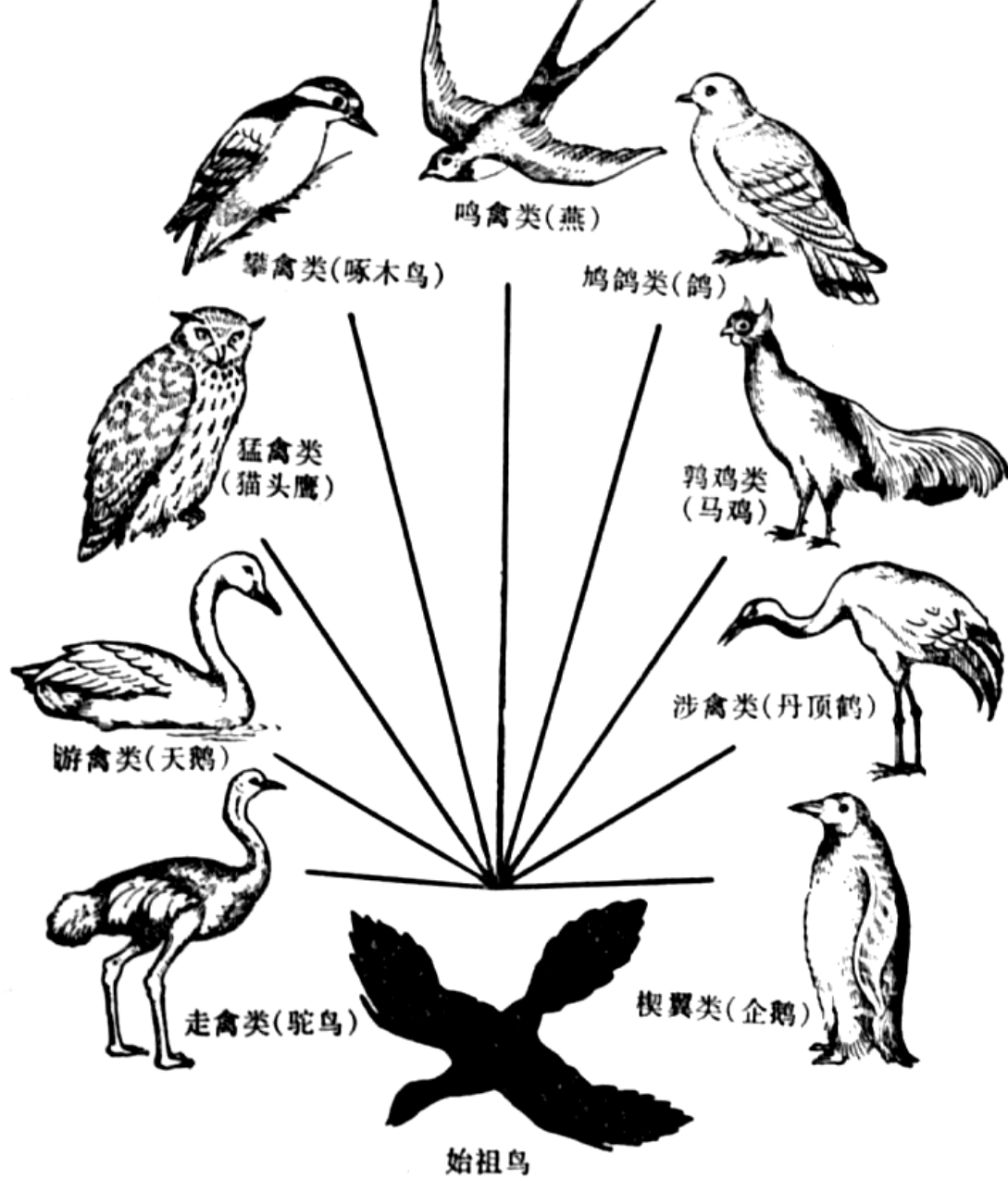
# 恐龍的進化圖

# 鸟类的进化



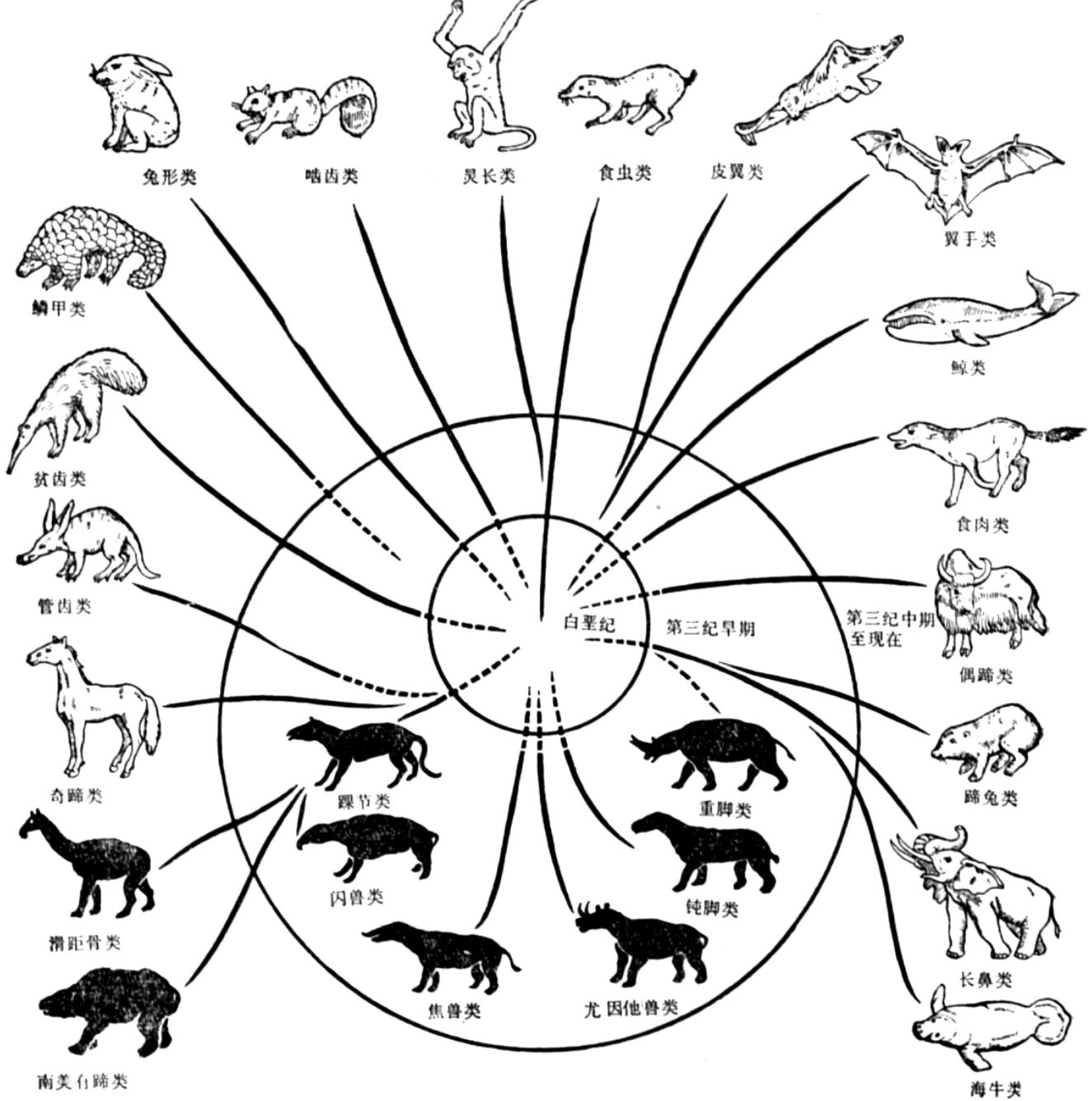
## 鳥類的進化圖

# 鳥類對環境的輻射適應圖



鳥類對環境輻射適應圖

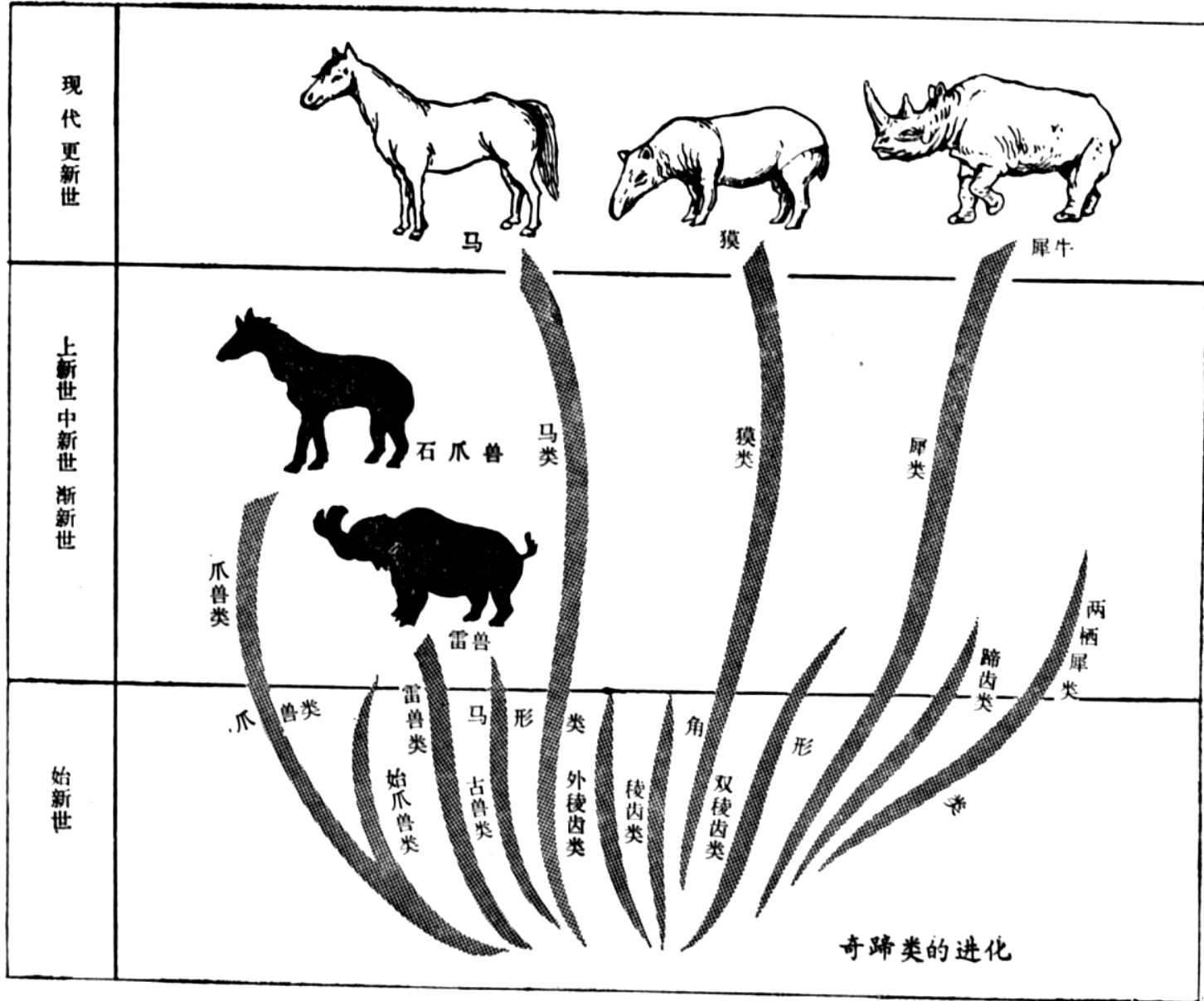
# 有胎盤哺乳動物各主要目的關係



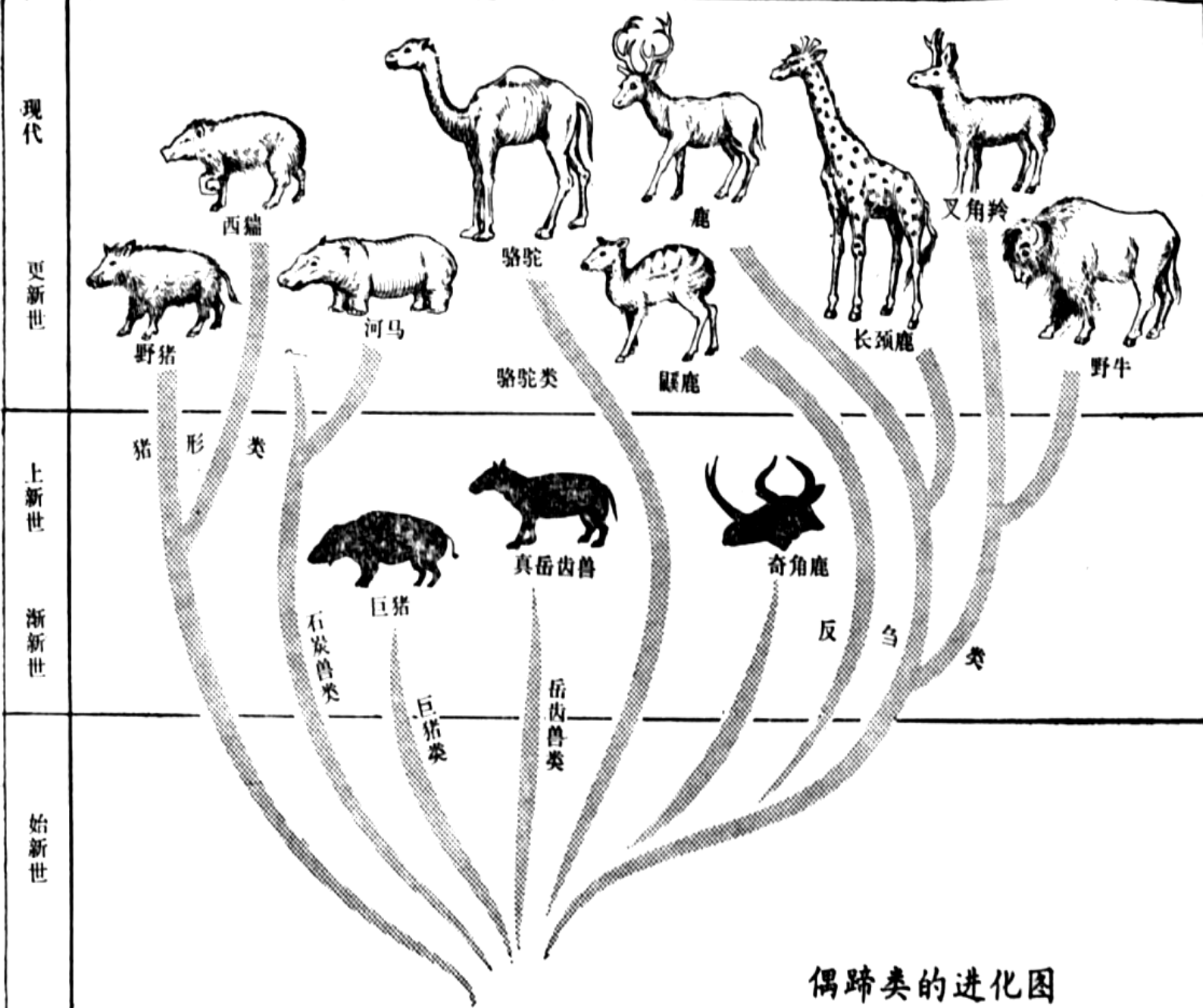
有胎盤哺乳動物各主要目的關係



# 奇蹄類的進化圖

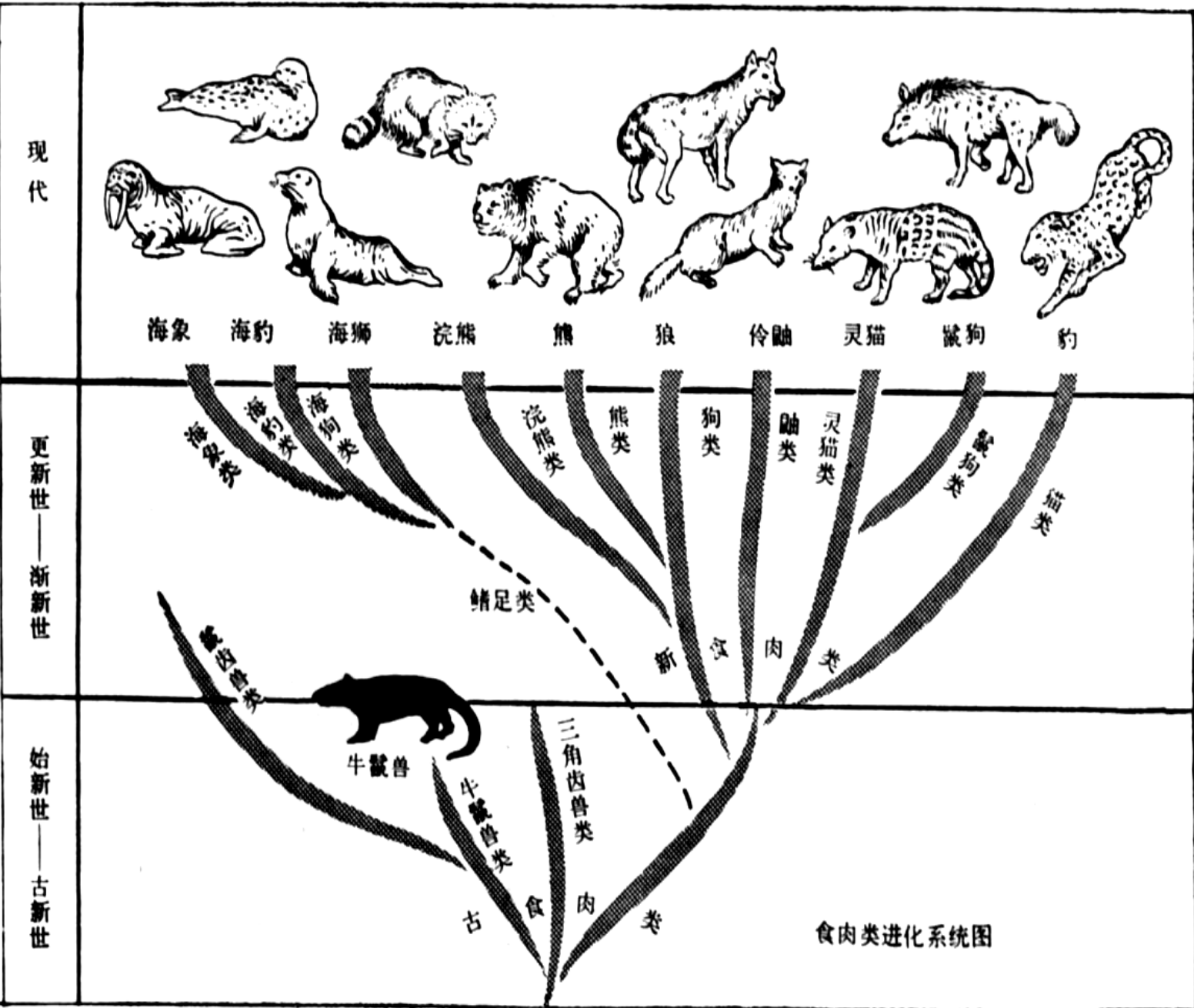










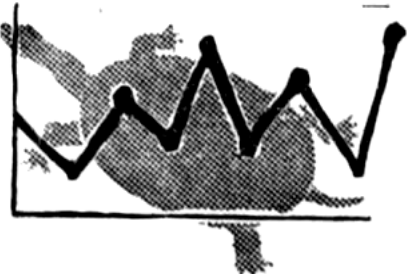
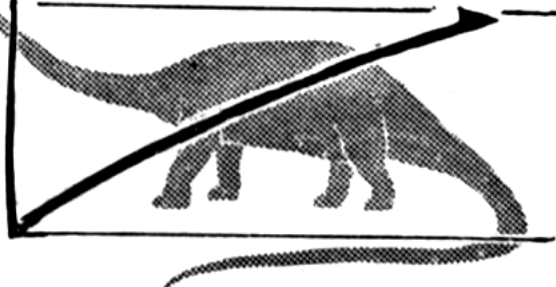
# 偶蹄類的進化圖



偶蹄类的进化图

# 食肉類動物進化系統圖



	生殖	脑	体被
哺乳类	 <p>胎生</p>		 <p>披毛</p>
爬行类	 <p>卵生</p>		 <p>鳞甲</p>
哺乳类	<p>体温</p>  <p>恒温</p>		<p>生长</p> 
爬行类	 <p>不定温</p>		

哺乳动物与爬行动物的比较

哺乳动物与爬行动物比较





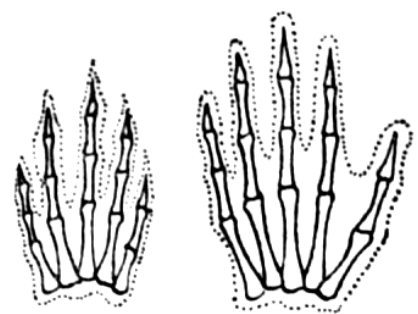
树鼩

- 狐猴
- 懒猴
- 眼镜猴
- 新大陆猴
- 旧大陆猴
- 长臂猿
- 猩猩
- 黑猩猩
- 大猩猩



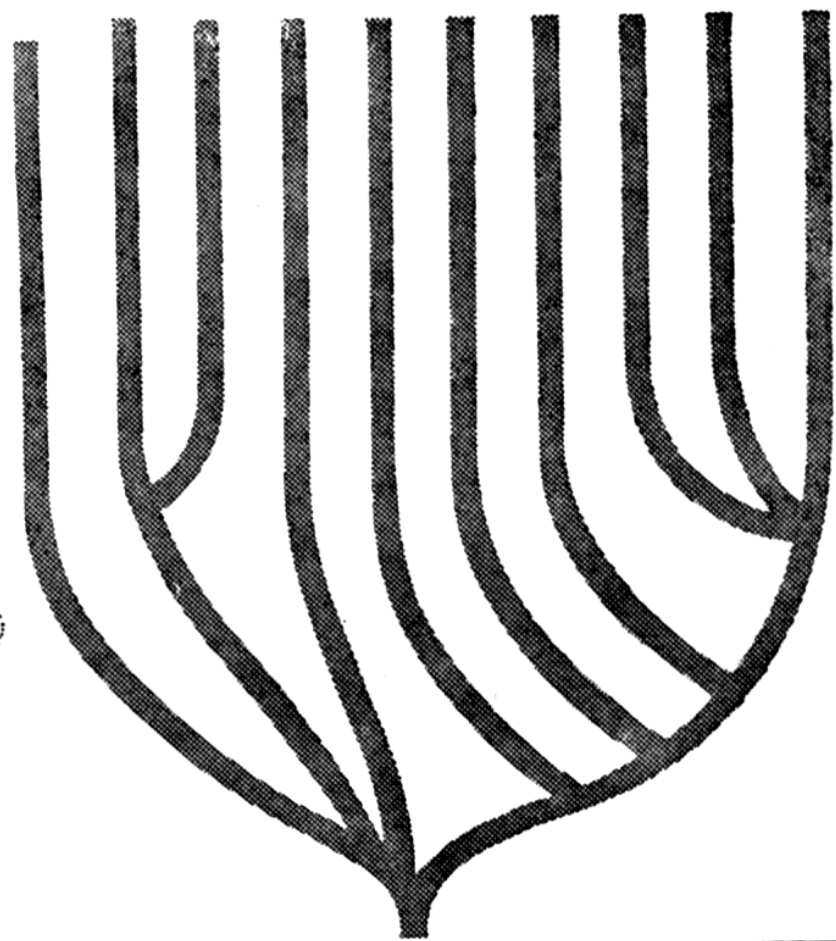
树鼩的脑

猴猴的脑



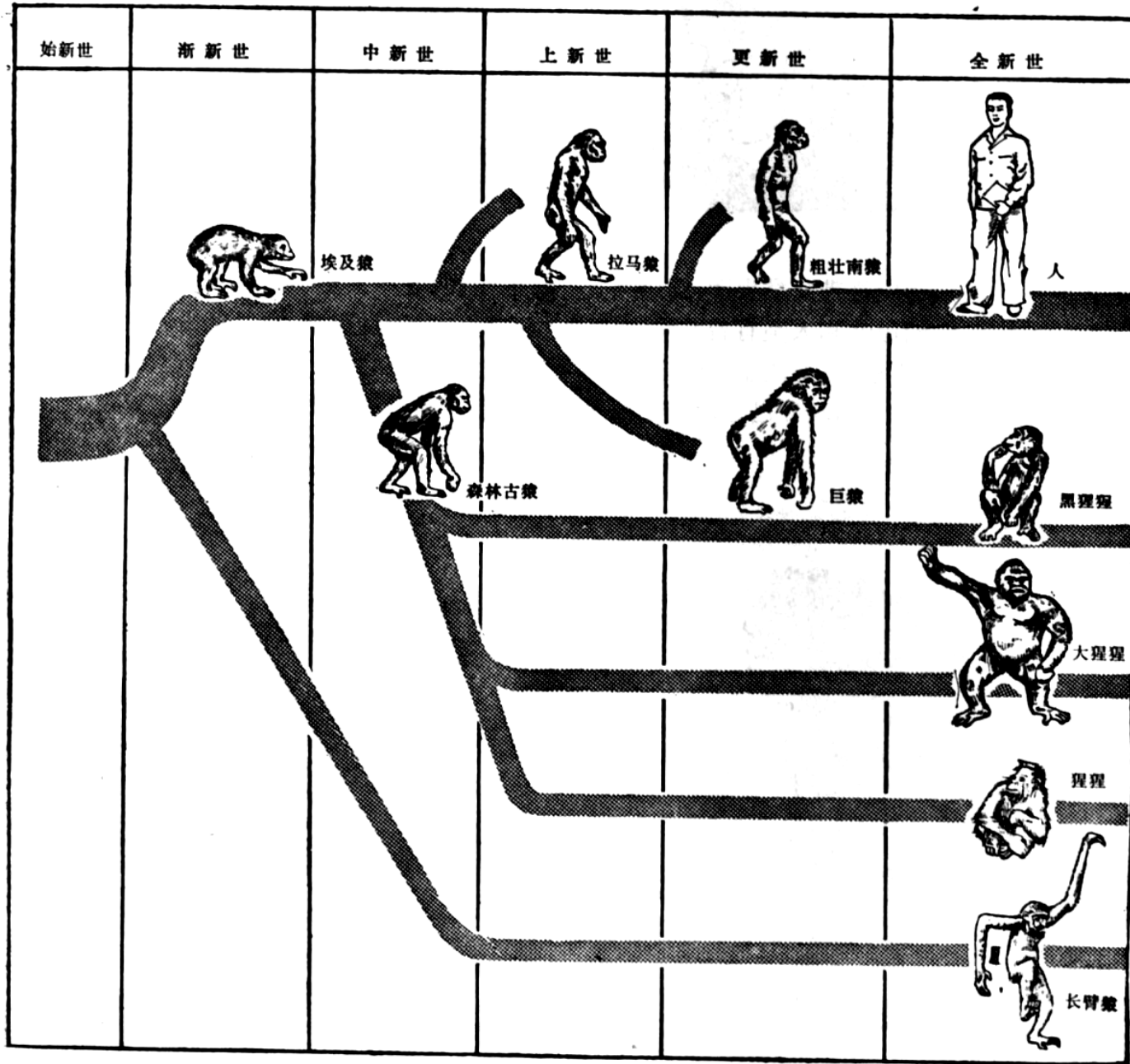
树鼩的手

猴猴的手



靈長的進化圖

灵长类的进化图



猿和人類的親緣關係

猿和人的親緣關係