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Organisms and their environment

Ecology



Ecology

the study of the **interaction** between living organisms and **their environment**.

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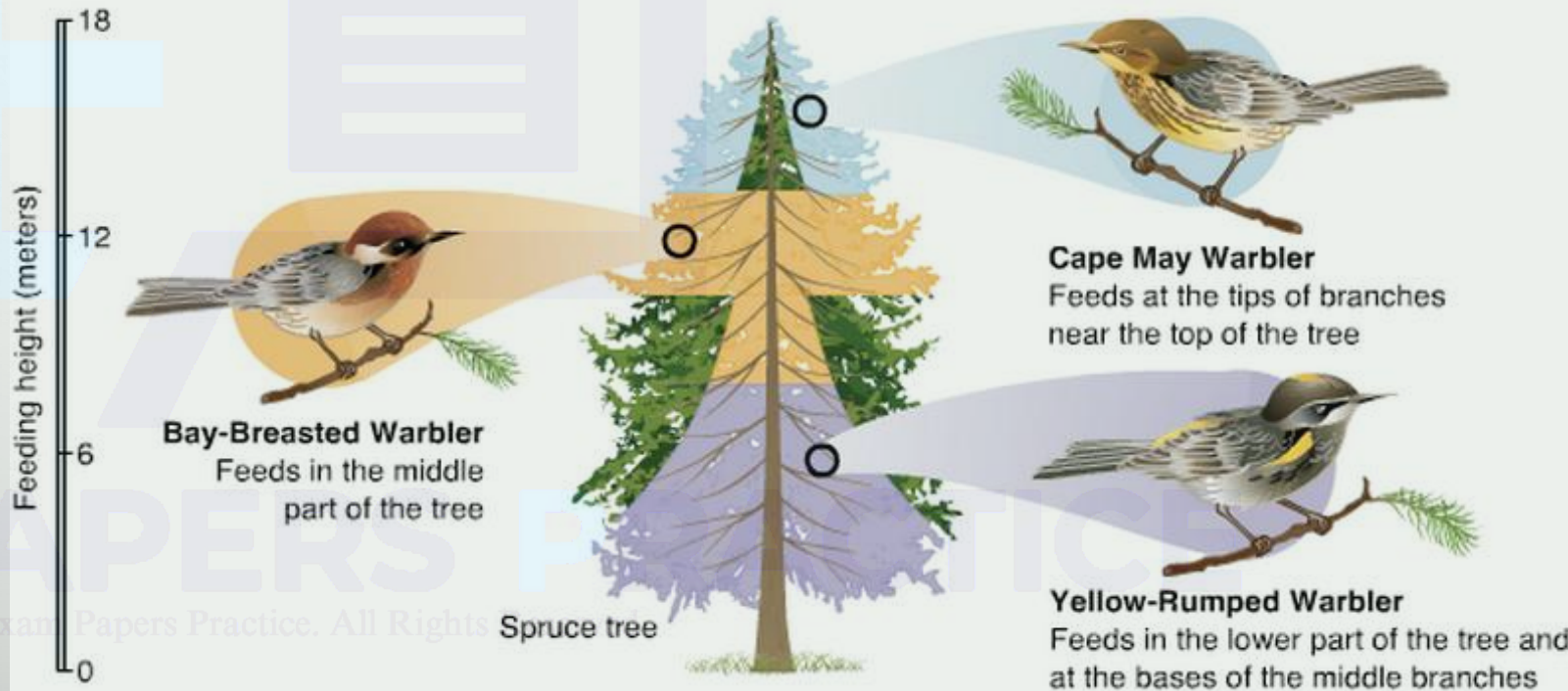
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ecology 生态

Organisms and their environment

niche

A niche is the role the species plays, and includes the type of food it eats, where it lives, where it reproduces, and its relationships with other species.



niche 生态位

Organisms and their environment

Food chain

A diagram showing the flow of energy from one organism to the next beginning with a producer

plants – primary producers



grasshopper – a primary consumer



flycatcher – a secondary consumer



producer

An organism that makes its own organic nutrients, usually using energy from sunlight, through photosynthesis.

consumer

An organism that gets its energy by feeding on other organisms.

herbivore

An animal that gets its energy by eating plants.

carnivore

An animal that gets its energy by eating animals.

producer 生产者 food chain 食物链 consumer 消费者
herbivore 食草动物 carnivore 食肉动物

Ecology—food chain

Organisms and their environment

Ecology—food chain

plants – primary producers



grasshopper – a primary consumer



flycatcher – a secondary consumer



consumer

primary consumer

secondary consumer

tertiary consumer

primary consumer 初级消费者
secondary consumer 次级消费者
tertiary consumer 三级消费者

Organisms and their environment

Ecology—food chain

plants – primary producers



grasshopper – a primary consumer



flycatcher – a secondary consumer



primary trophic level

secondary trophic level

tertiary trophic level

primary trophic level 第一营养级
secondary trophic level 第二营养级
tertiary trophic level 第三营养级

Trophic levels

The position of an organism in a food chain, food web or pyramid of biomass or numbers.

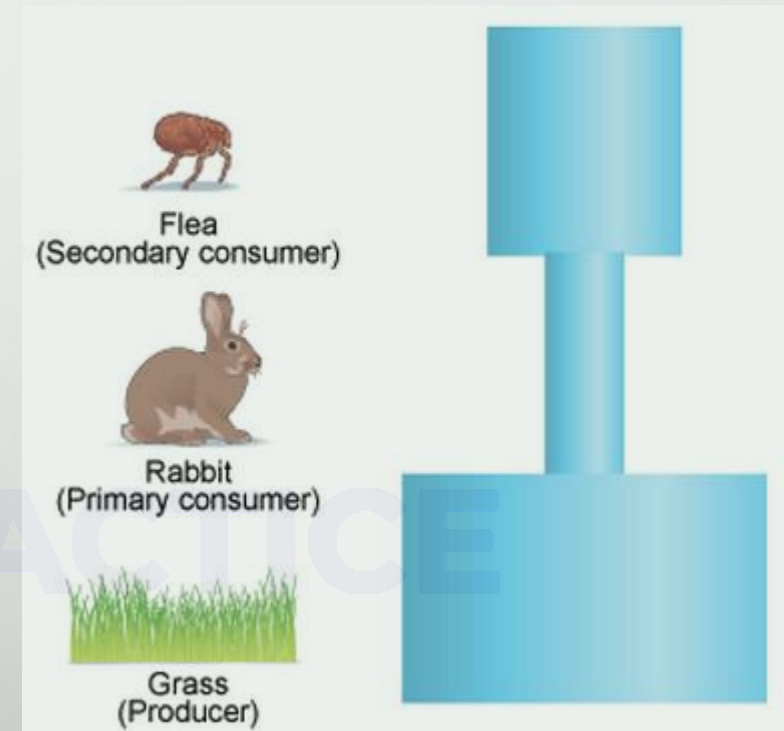
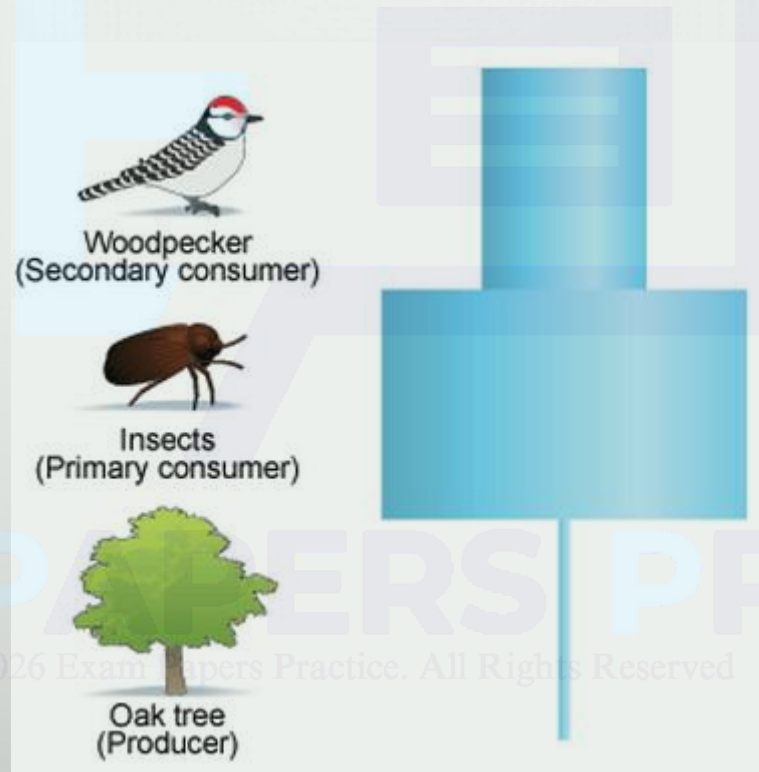
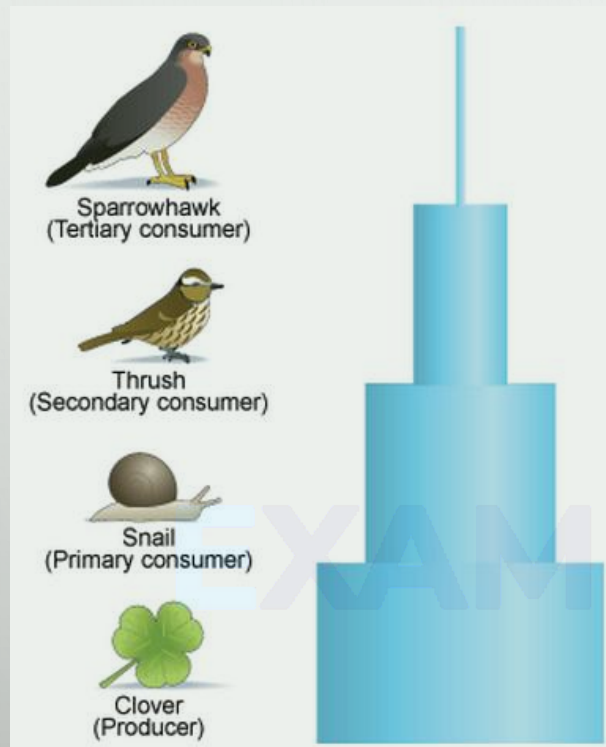
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Grass	→	Grasshopper	→	Frog	→	Hawk
						
Producer		Consumer		Consumer		Consumer
		Primary consumer		Secondary consumer		Tertiary consumer
		Herbivore		Carnivore		Carnivore

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Pyramid of numbers

In the pyramid, the size of each block represents the number of organisms at that step in the food chain.



pyramid of number 数量金字塔

Organisms and their environment

Ecology—pyramid of numbers, biomass

biomass——the mass of the organisms

pyramid biomass

The size of each block represents the biomass of each trophic levels.



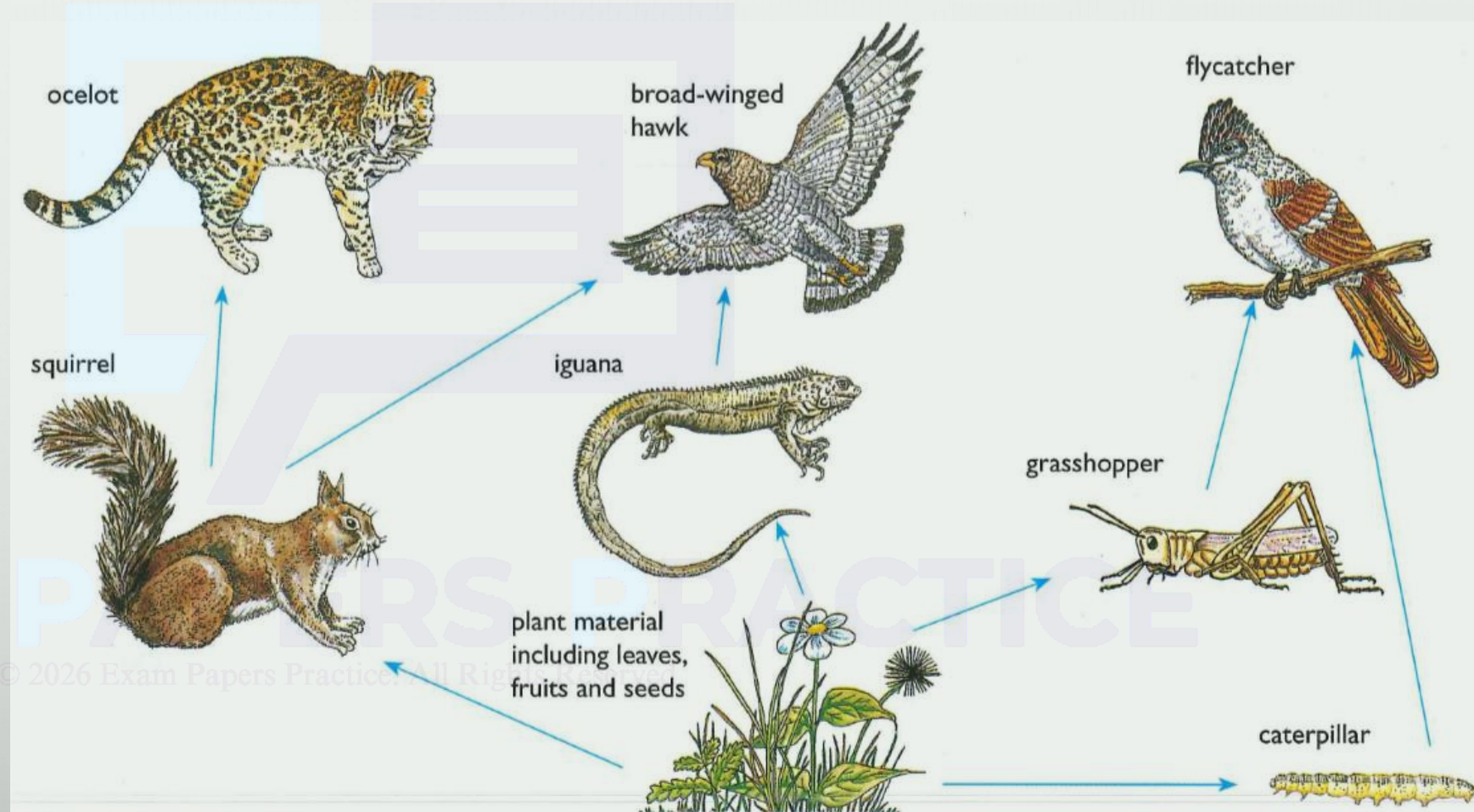
pyramid of biomass 生物量金字塔

Organisms and their environment

Ecology

Food web

A network of interconnected food chains



food web 食物网

Organisms and their environment

Ecology—energy flow

All living organisms need energy. They get energy from food, by respiration.

All the energy in living organisms originate from sun!



plants – primary producers

grasshopper – a primary consumer

flycatcher – a secondary consumer



Energy flow

energy flow 能量流动
ingest 摄取

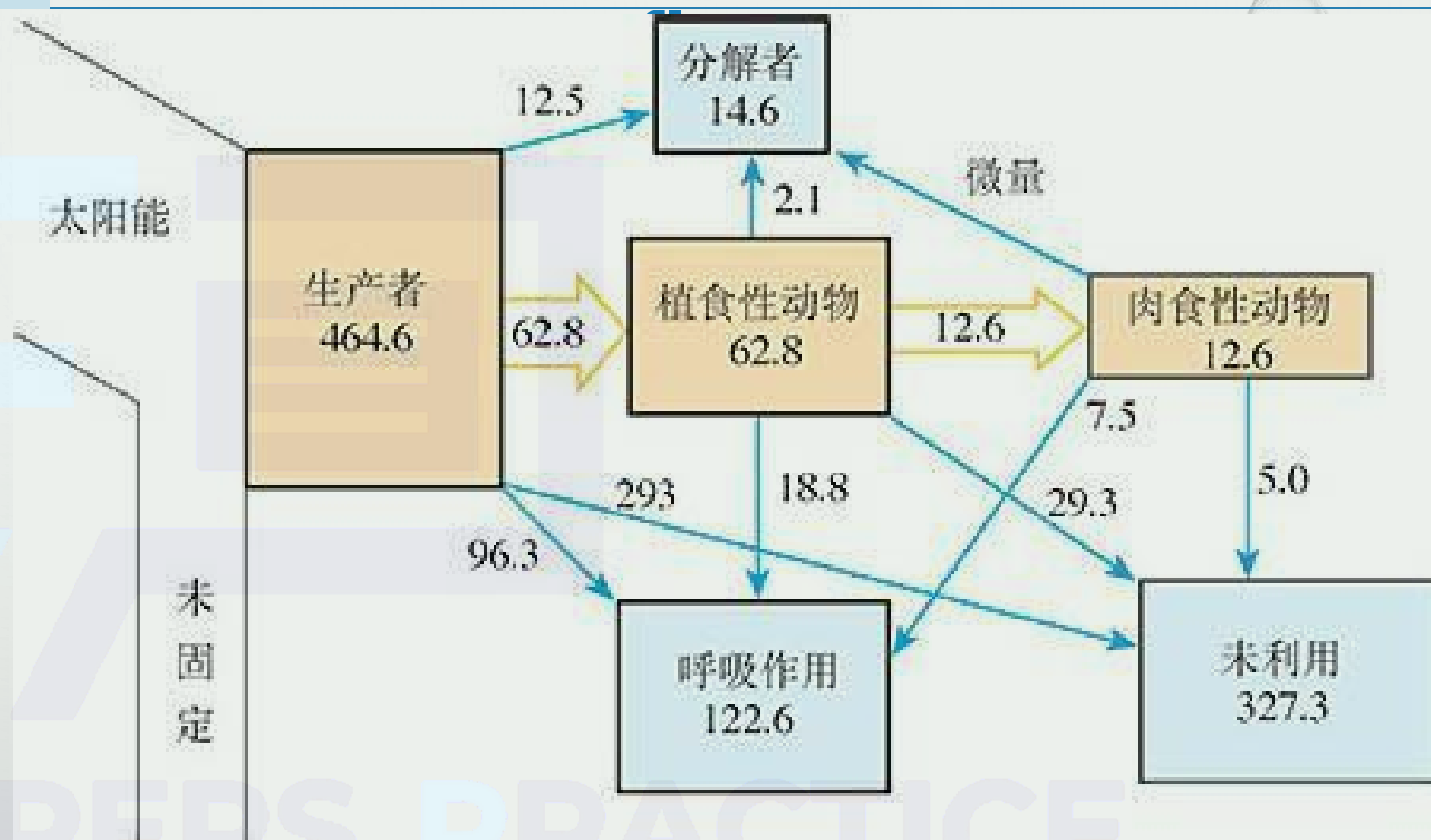
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All energy in an ecosystem originates from the sun. as energy is passed along a food chain, some of it is lost to the environment.

- ◆ Some energy is lost as heat energy when respiration.
- ◆ When one organism eats food, it rarely eats absolutely all of it.
- ◆ Not all of the food molecules are digested and absorbed.

energy efficiency 能量效率
energy flow 能量流动

Ecology—energy



The nearer to the beginning of the food chain we feed, the more energy there is available for us.

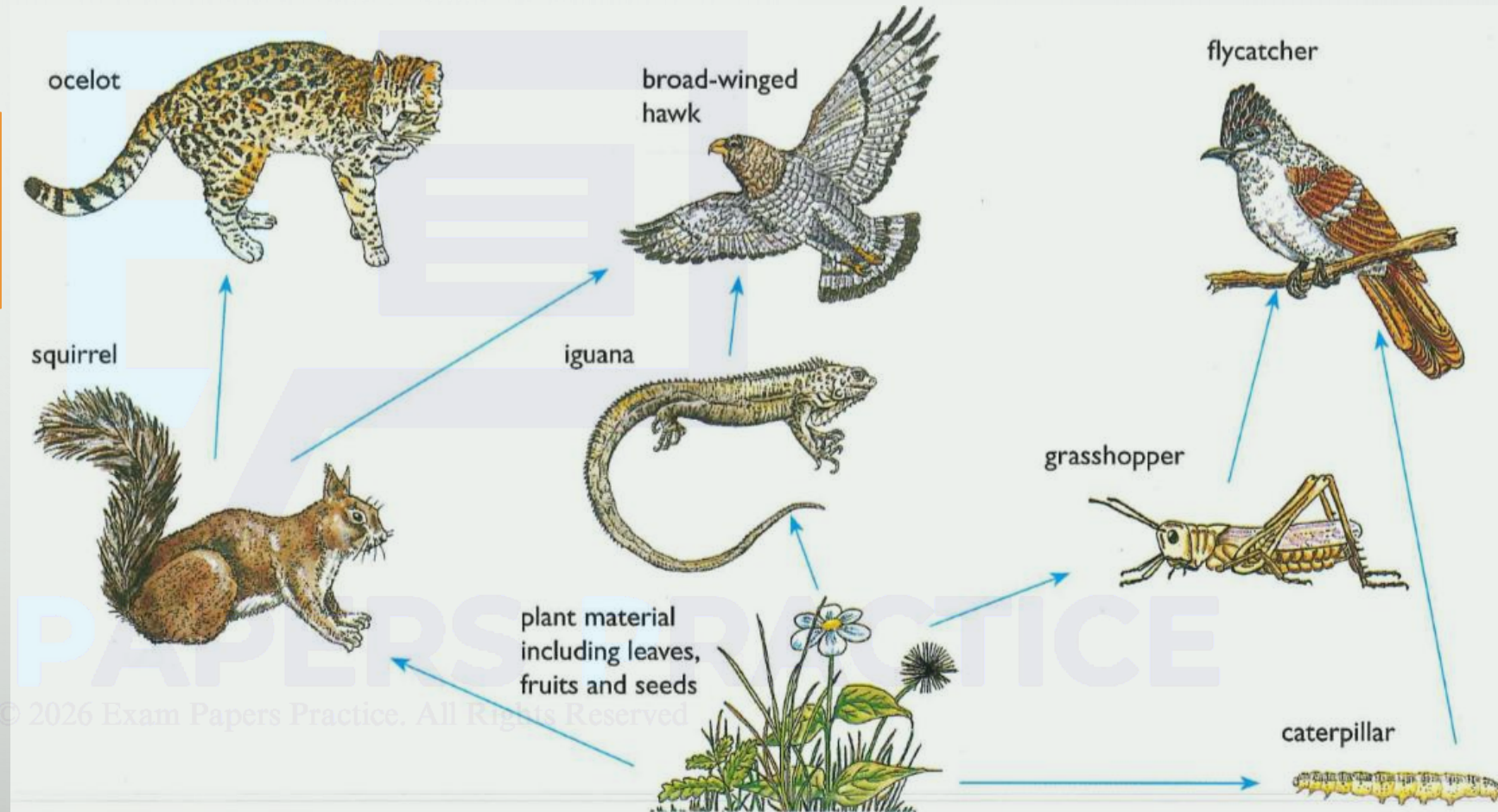
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Ecology— decomposer

decomposer

An organism that gets its energy from dead or waste organic matter.

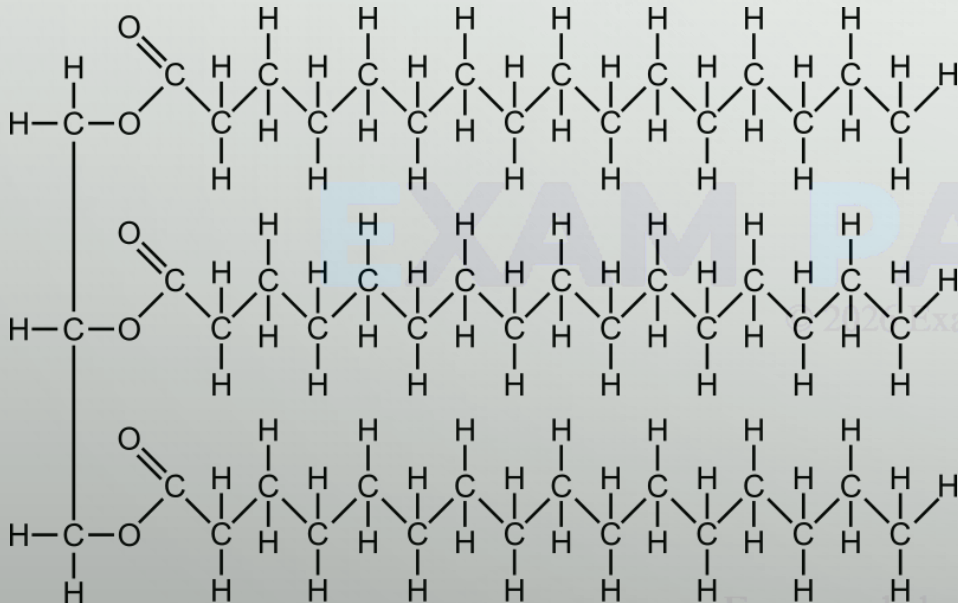
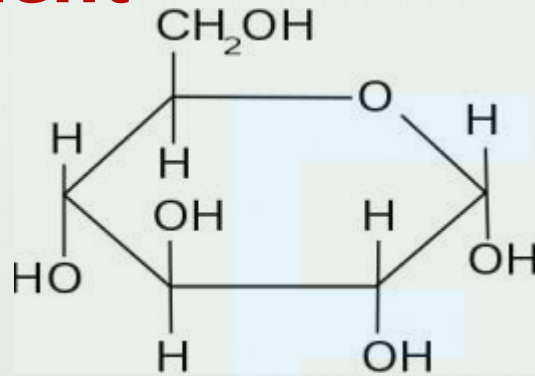
Decomposers help to release substances from dead organisms, so that they can be used again by living ones.



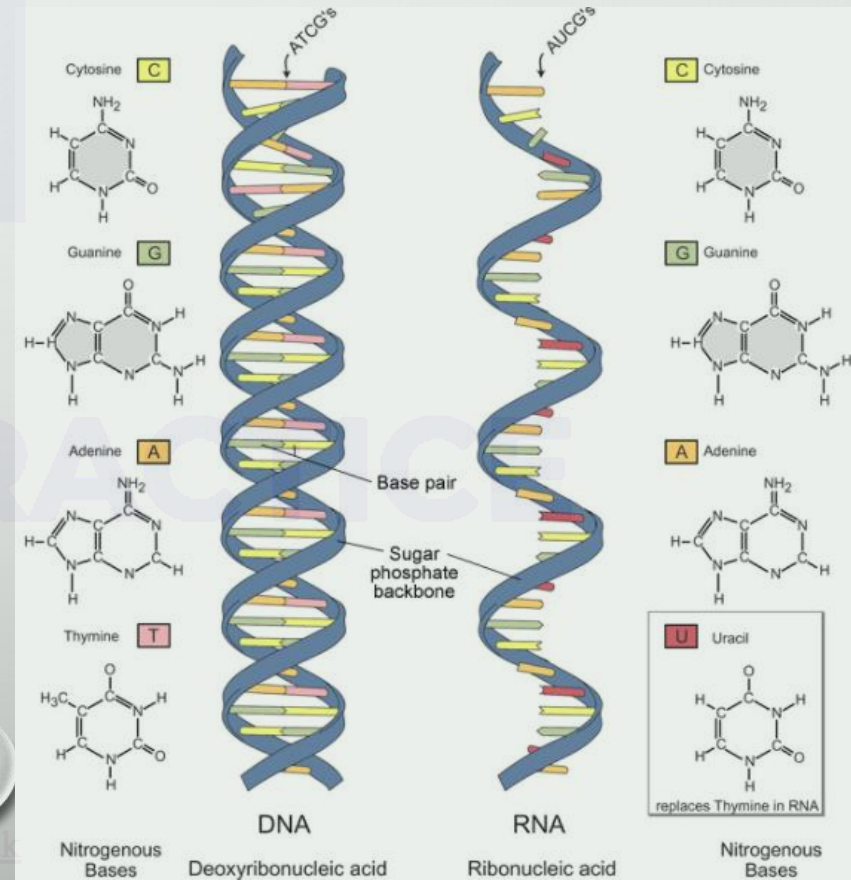
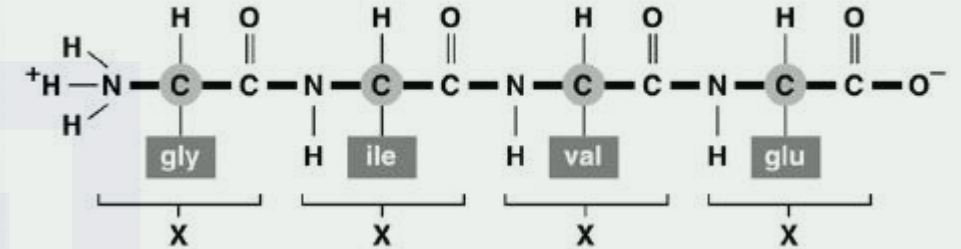
decomposer 分解者

Organisms and their environment

Carbon



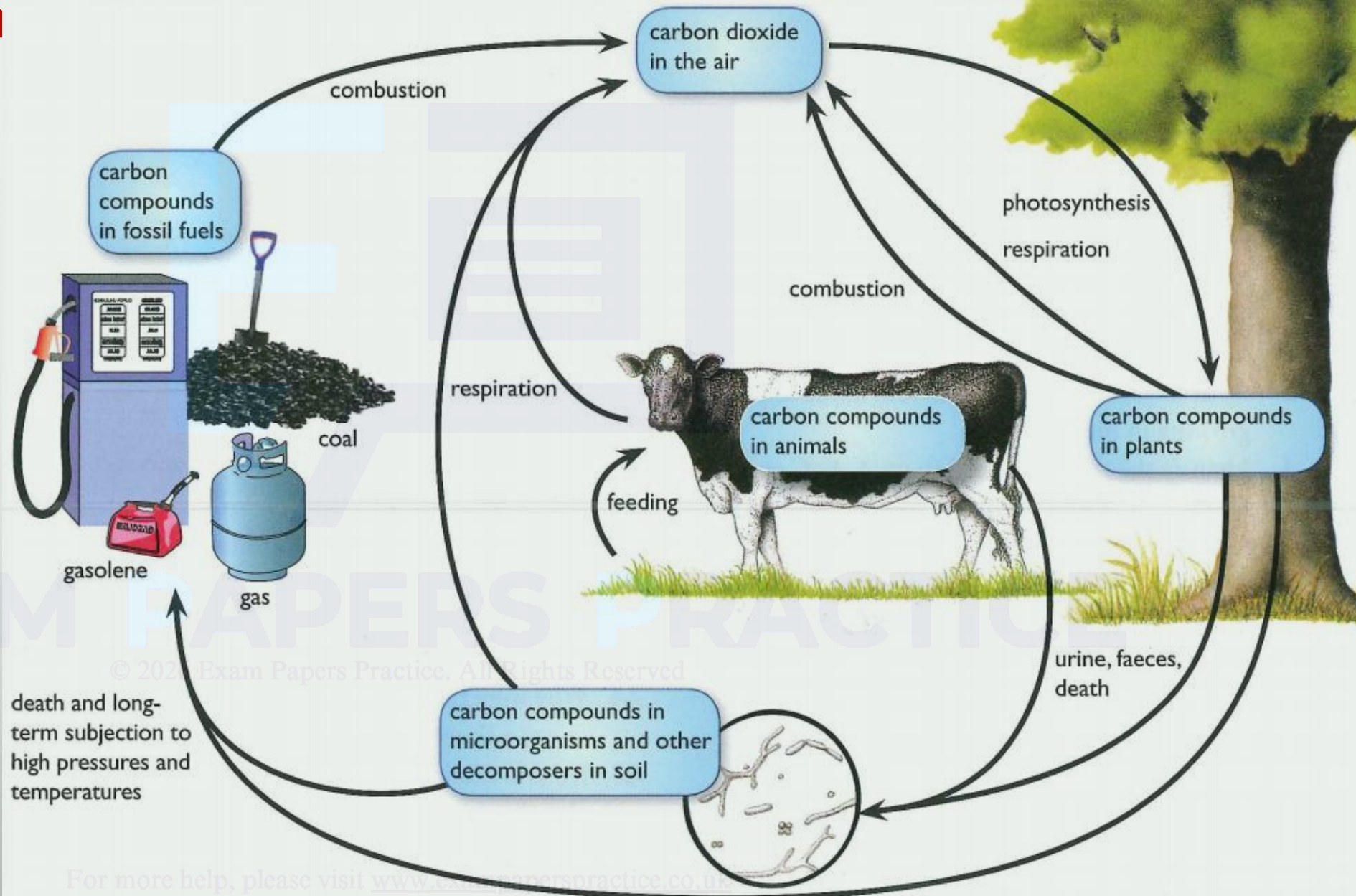
Ecology—nutrient cycles



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Ecology—nutrient

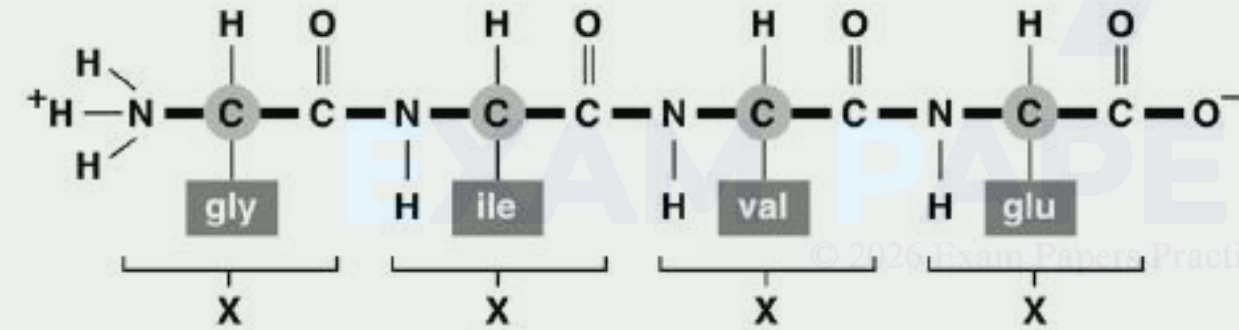
Carbon cycle



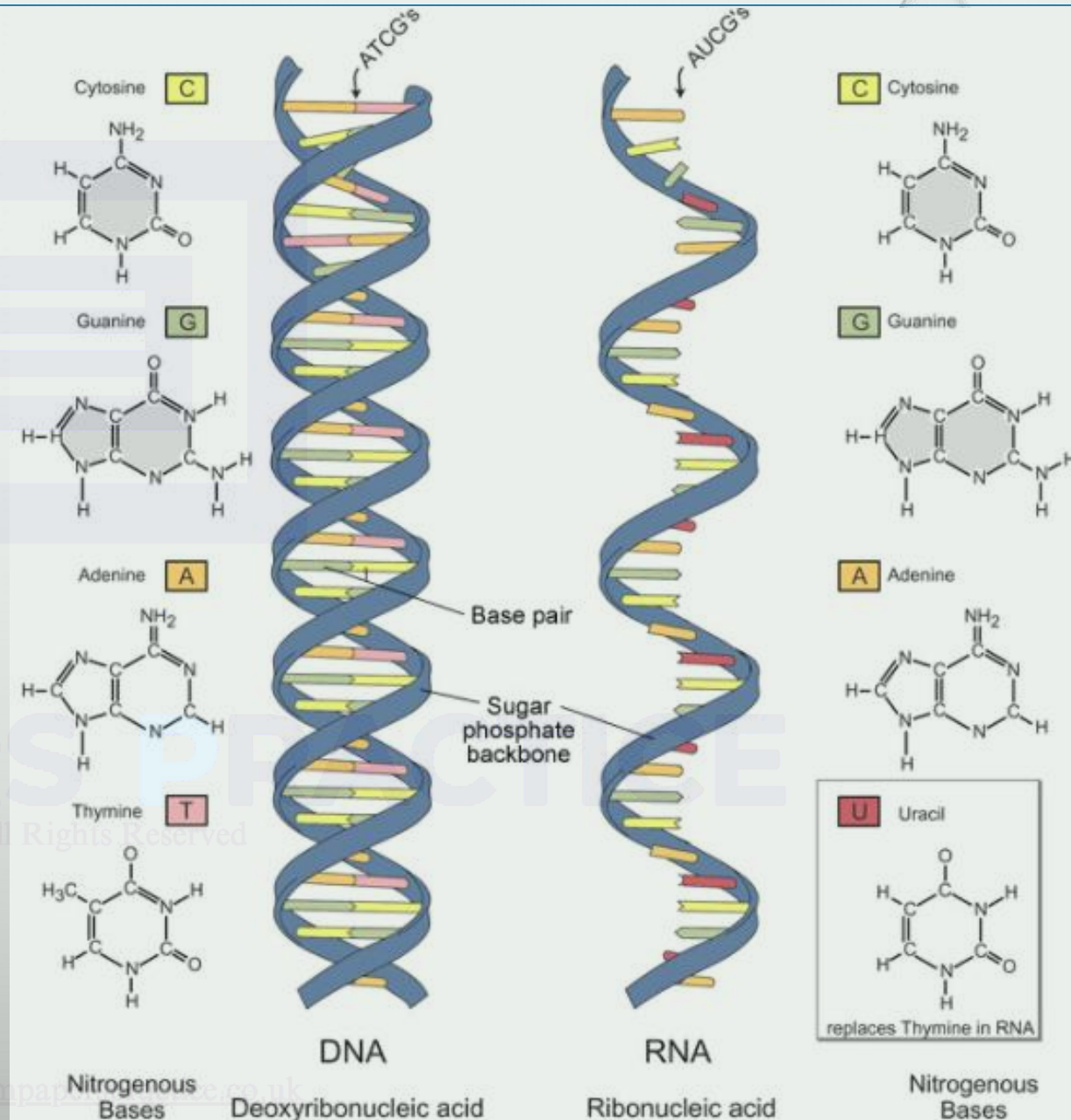
Carbon cycle 碳循环
deforestation 森林采伐
fossil fuel 化石燃料

Organisms and their environment

Nitrogen



Ecology—nutrient



Organisms and their environ

nitrogen cycle



Nitrogen fixation

inert 惰性的
ammonia / ammonium 氨
nitrate 硝酸盐
nitrogen fixation 氮固定
nitrogen oxide 臭氧
nitrate 硝酸盐



Ecology—nutrient cycles

Very **inert**.

Plants and animals cannot use it at all. It must first be changed into a more reactive form. Such as **ammonia**(NH_3) or **nitrates**(NO_3^-)

Lightning

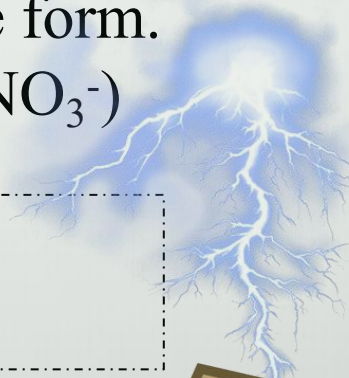
nitrogen $\rightarrow$ nitrogen oxide $\rightarrow$ nitrate

Artificial fertilisers

nitrogen + hydrogen $\rightarrow$ ammonia
 $\rightarrow$ ammonia compounds and nitrates

Nitrogen-fixing bacteria

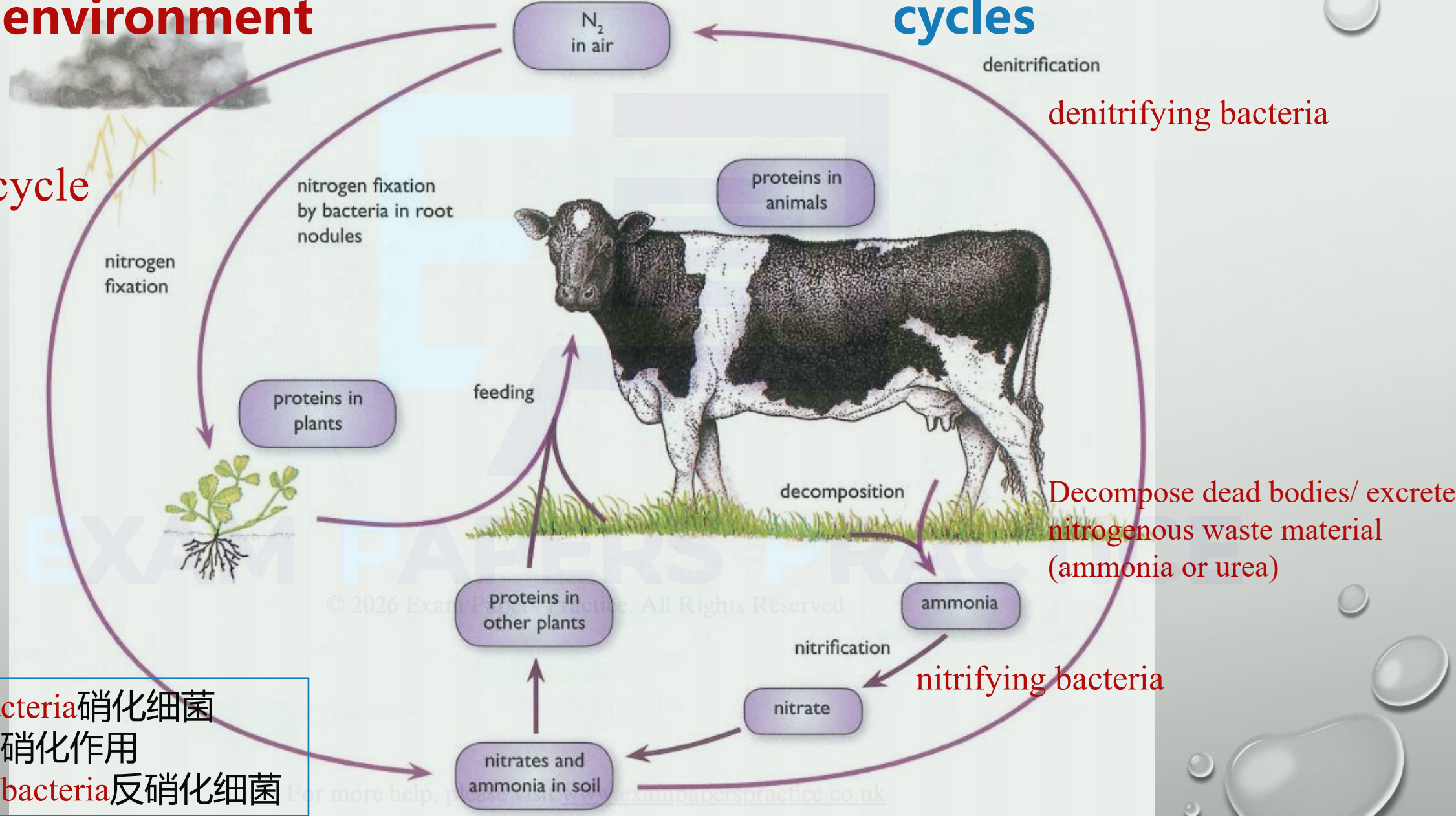
bacteria (in soil, or in root nodules on plants like peas, beans, and clover.)
Nitrogen $\rightarrow$ ammonium)



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Ecology—nutrient cycles

nitrogen cycle



nitrifying bacteria 硝化细菌
nitrification 硝化作用
denitrifying bacteria 反硝化细菌

Organisms and their environment

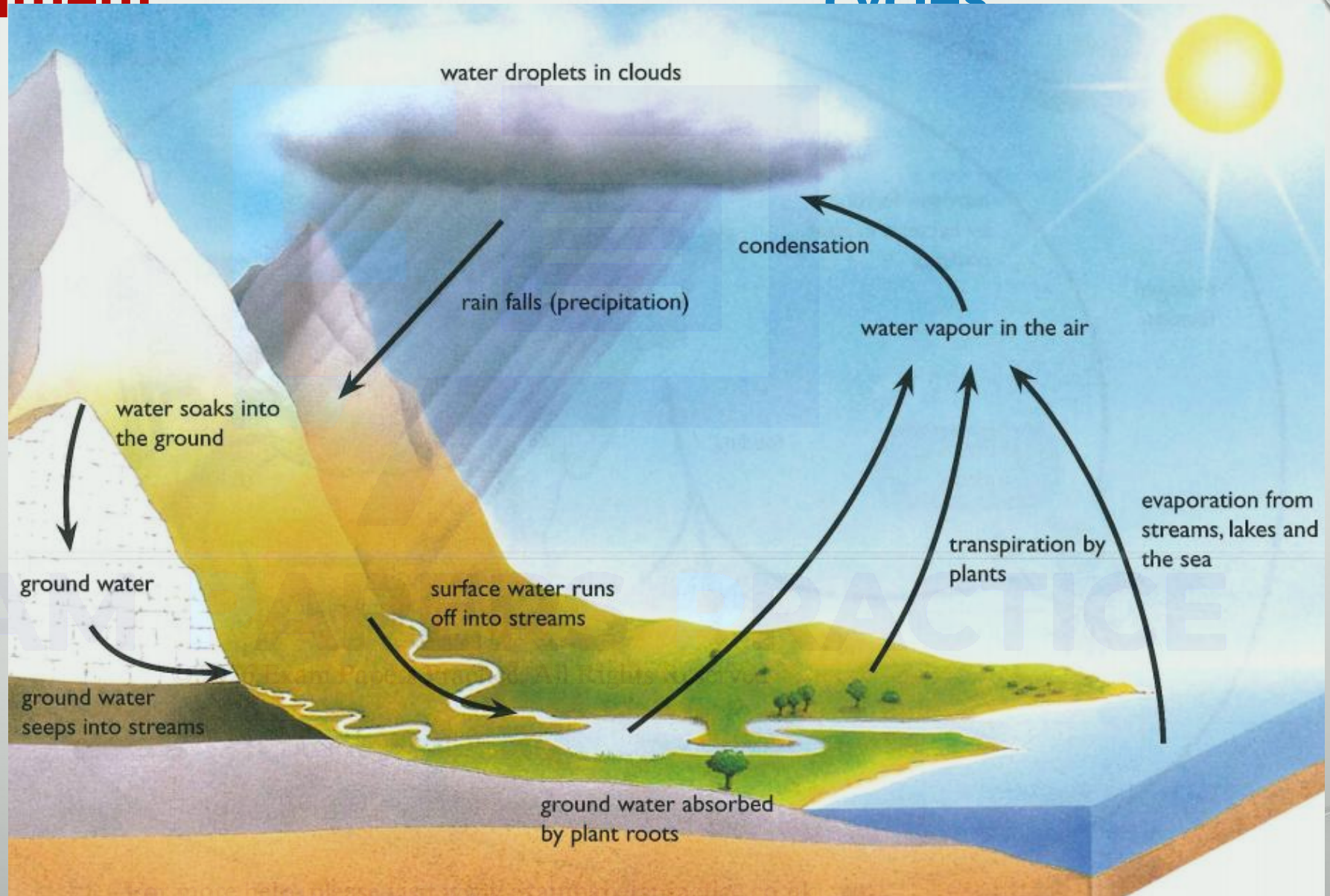
Ecology—nutrient cycles

Types of bacteria (nitrogen cycle)	
Nitrogen-fixing bacteria	nitrogen → ammonium/ammonia
Nitrifying bacteria	ammonia / urea → nitrate
Denitrifying bacteria	ammonia / nitrate → nitrogen gas

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Organisms and their environment

Ecology—nutrient cycles



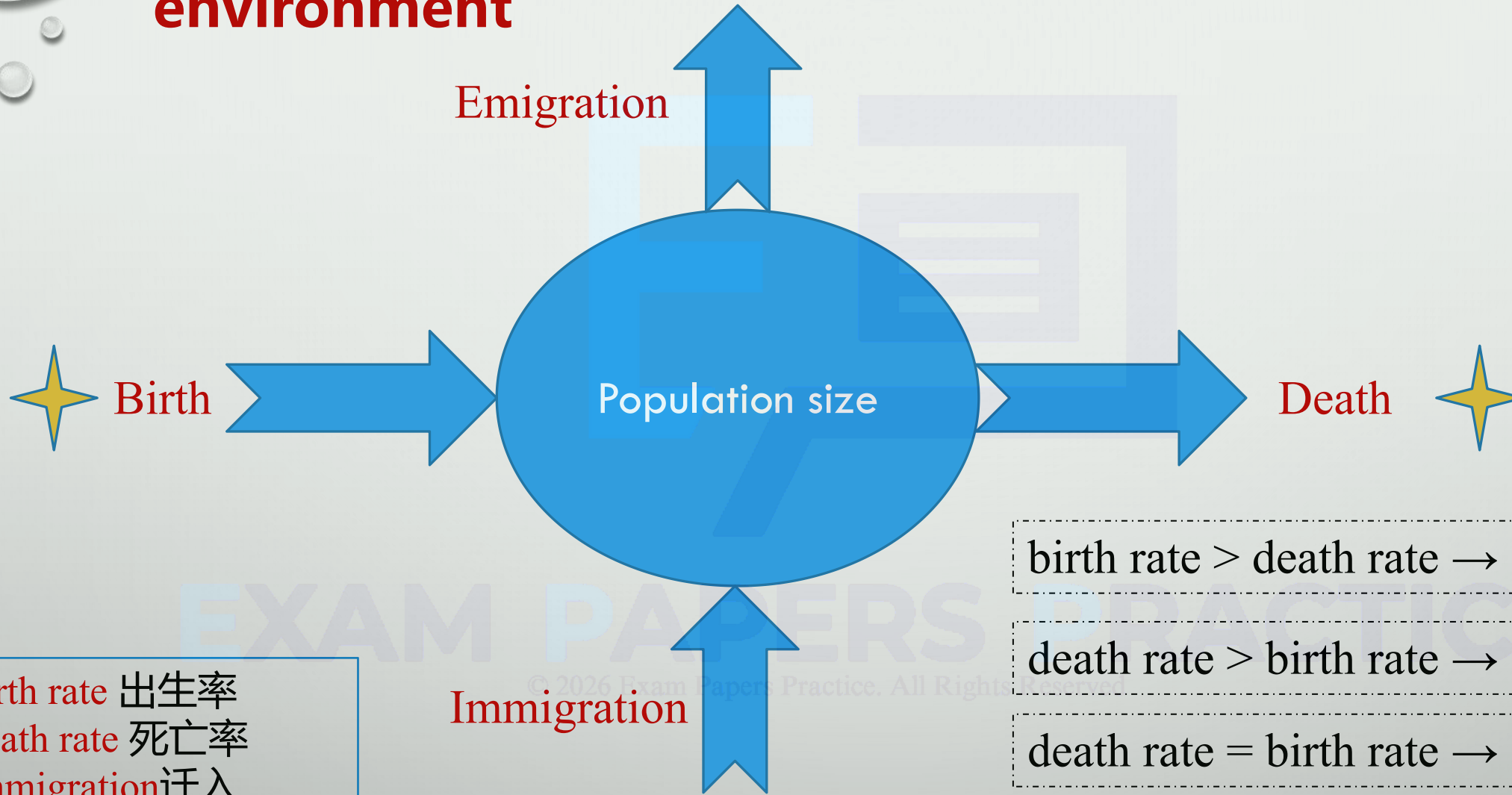
precipitation 降雨
evaporation 蒸发
transpiration 蒸腾
vapour 水汽
condensation 凝结

Population size



Organisms and their environment

Population size



birth rate 出生率
death rate 死亡率
immigration 迁入
emigration 迁出

birth rate > death rate → **increase**

death rate > birth rate → **decrease**

death rate = birth rate → **stablize**

Organisms and their environment

Population size

Factors affecting population growth



yeast 酵母菌
broth 肉汤

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population growth model

Lag phase

There are not many cells to reproduce.
They also need time to adjust to the new conditions.

log phase / exponential phase

The growth of the population is very rapid.

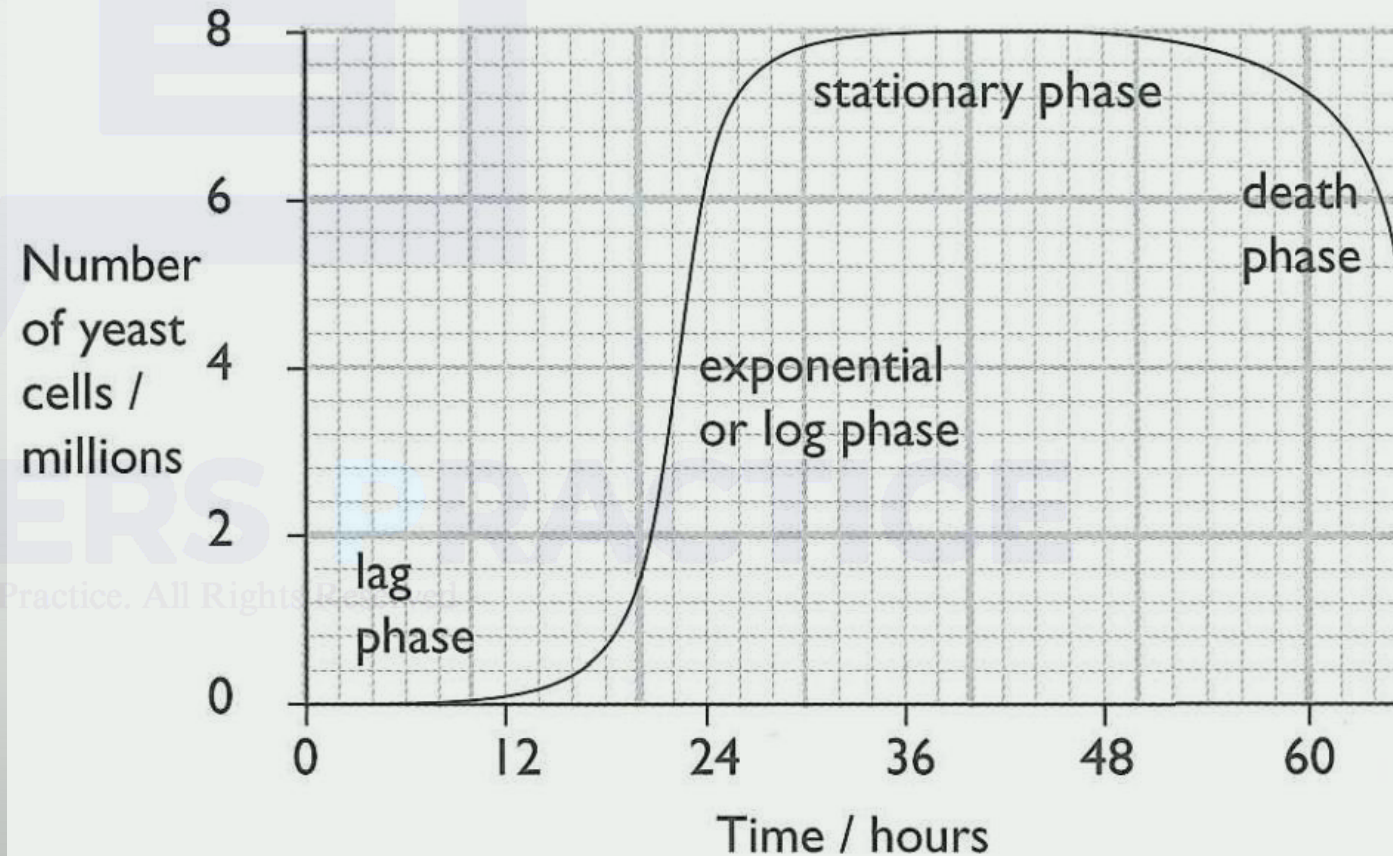
growth model 生长模型

lag phase 迟滞期

log phase / exponential phase 对数期

Population size

The growth of a population of yeast



Organisms and their environment

population growth model

stationary phase

Not enough food and much alcohol.

Death rate $\uparrow$ birth rate $\downarrow$

The population increase **levels off**

death phase

death rate $>$ birth rate

Sigmoid growth curve

stationary phase 稳定期

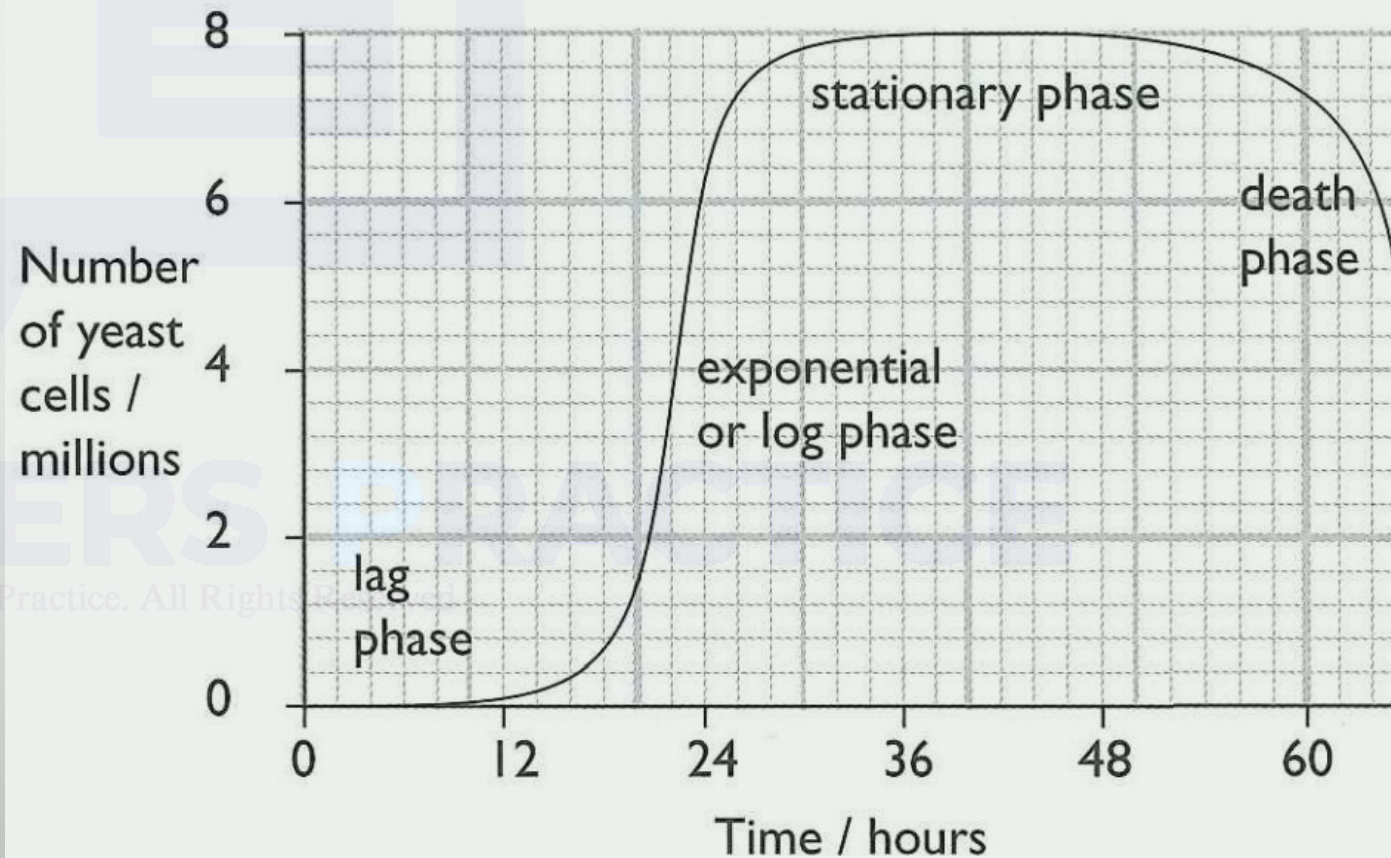
death phase 死亡期

sigmoid growth curve s型生长曲线

level off 趋平，呈平稳状态

Population size

The growth of a population of yeast



Organisms and their environment

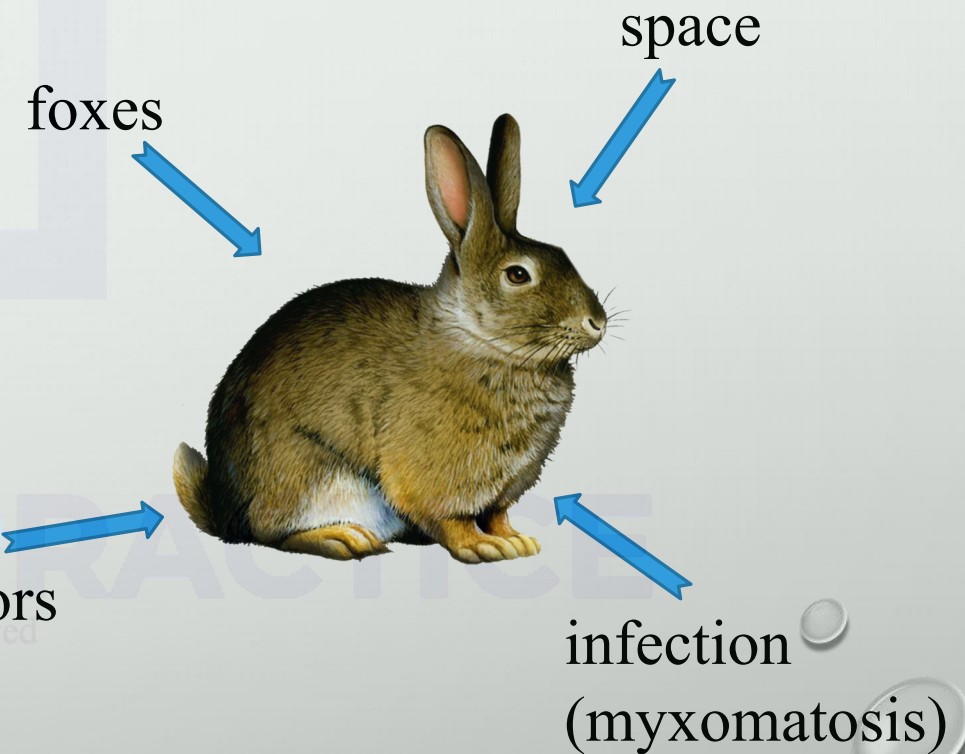
Population size

Limiting factors affecting population growth

- ♣ food supply
- ♣ disease
- ♣ living space
- ♣ predator

... ..

Interact



limiting factor 限制因素

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Population size

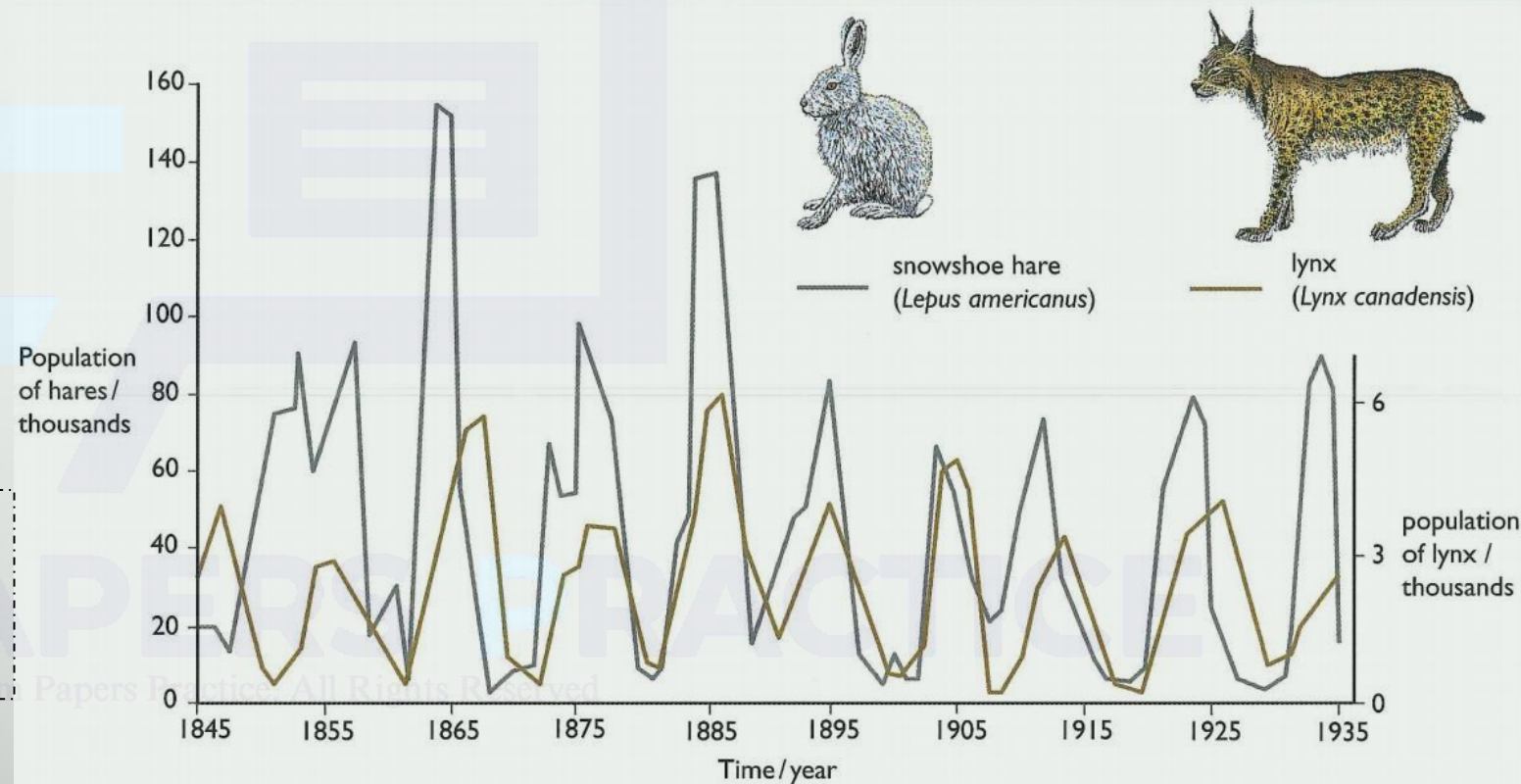
Limiting factors affecting population growth

- ♣ food supply
- ♣ disease
- ♣ living space
- ♣ **predator**

... ..

The numbers of lynx and snowshoe hares go up and down, or **oscillate**, but **average population size** stay roughly the same.

lynx 猞猁
snowshoe hare 北美野兔
oscillate 振荡, 摆动



Whenever the snowshoe hare population rises, the lynx population also rises shortly afterwards, as the lynxes now have more food. A drop in the snowshoe hare population is rapidly followed by a drop in the lynx population.

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Population size

Age pyramids—— predict change of population size

The area of each box represents the numbers of individuals in that age group.

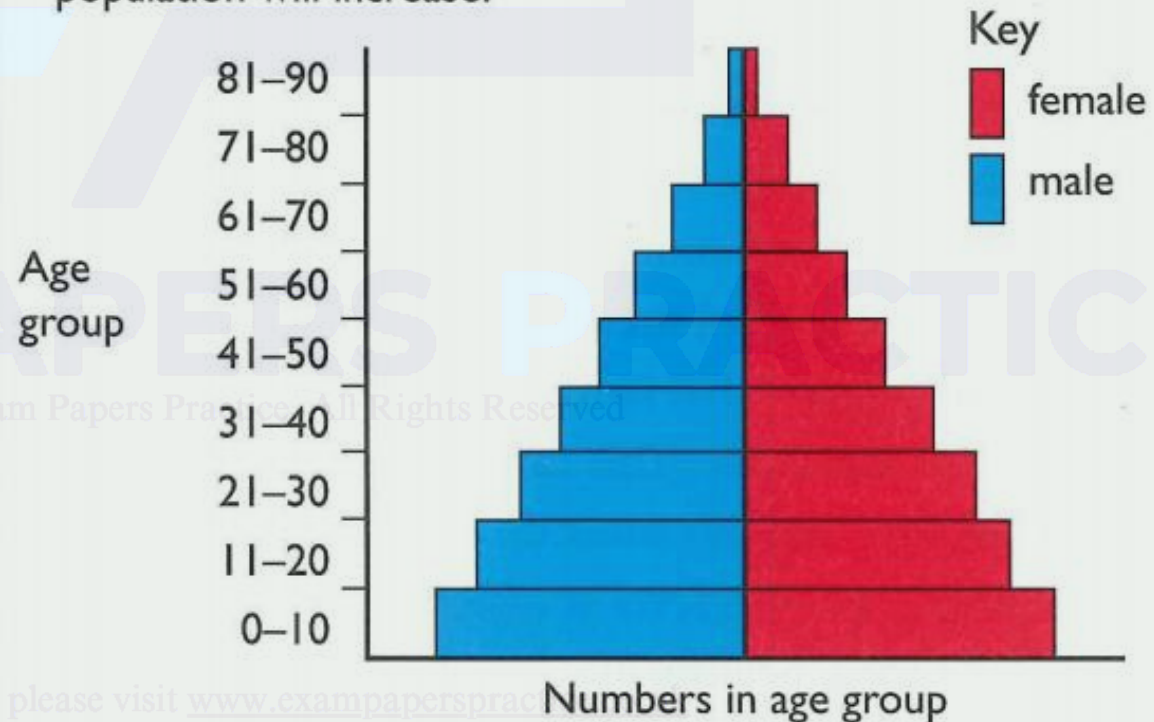
bottom-heavy pyramid

More young individuals than old ones.

birth rate > death rate

e.g. developing countries

a An increasing population. If all the organisms in the younger age groups grow up and reproduce, the population will increase.



Organisms and their environment

Population size

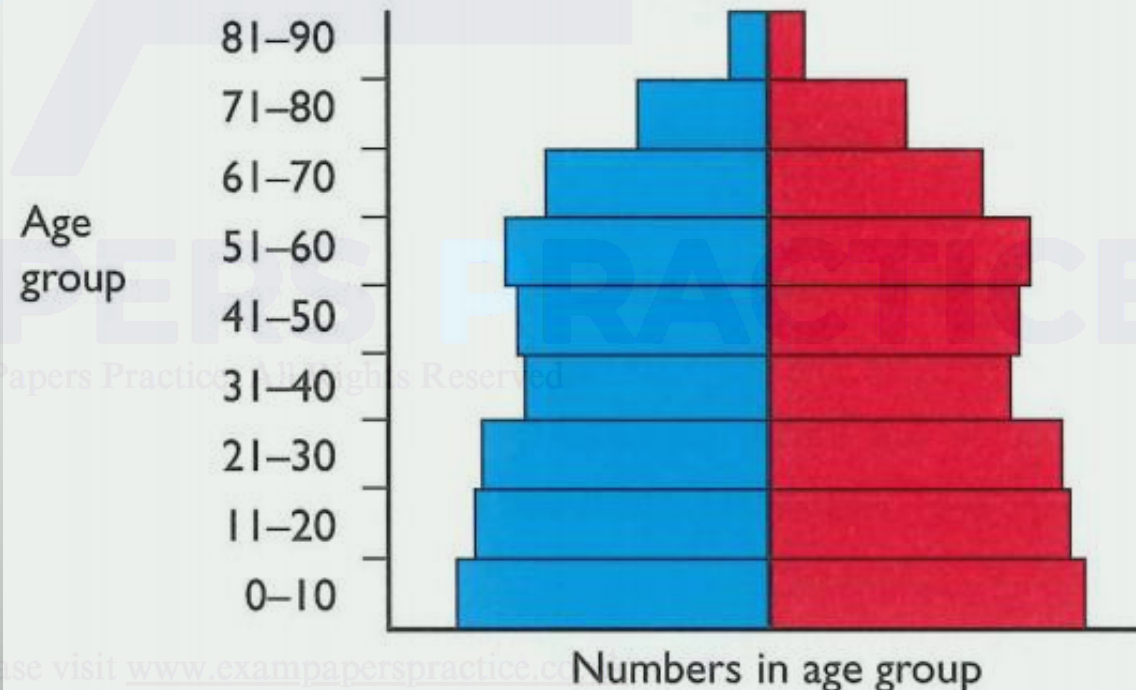
Age pyramids—— predict change of population size

even spread of ages

birth rate = death rate

e.g. developed countries

A stable population The sizes of the younger age groups are only a little larger than the older ones, so this population should not change much in size.



Organisms and their environment

Population size

The human population

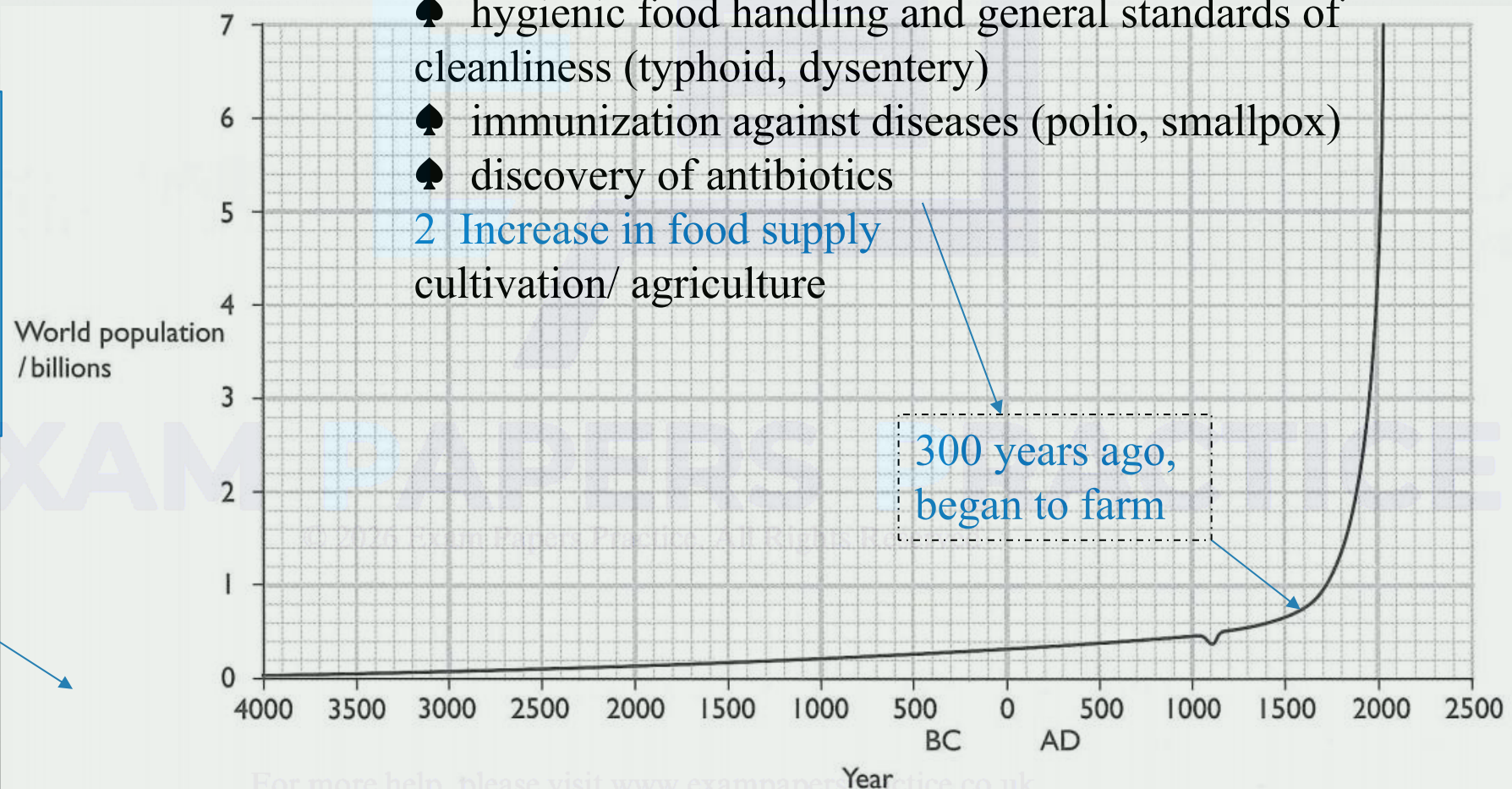
sewage 污水
hygienic 卫生的
typhoid 伤寒
dysentery 痢疾
polio 小儿麻痹症
smallpox 天花

Reasons for this recent growth

1 reduction of disease

- ♠ improvements in water supply
- ♠ sewage treatment
- ♠ hygienic food handling and general standards of cleanliness (typhoid, dysentery)
- ♠ immunization against diseases (polio, smallpox)
- ♠ discovery of antibiotics

2 Increase in food supply cultivation/ agriculture



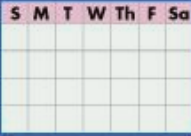
Organisms and their environment

Population size

Ways of control human population

Contraceptive techniques

contraceptive 避孕的

Most Effective ↑ Less Effective	 Sterilization	 Implant	 IUD	Effectiveness: 99% 91-94% depending on the method 76-88% depending on the method 76-88% depending on the method
	 Shot	 Pill	 Ring	
	 Diaphragm	 Condoms (Internal/external)	 Sponge	
	 Spermicide	 Fertility awareness	Withdrawal	