



EXAM PAPERS PRACTICE



variation

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Variation and natural selection

Variation

Variation

Differences between individuals of the same species

Phenotypic variation

Differences between the features of different individuals

variation 变异

phenotypic variation 表型变异

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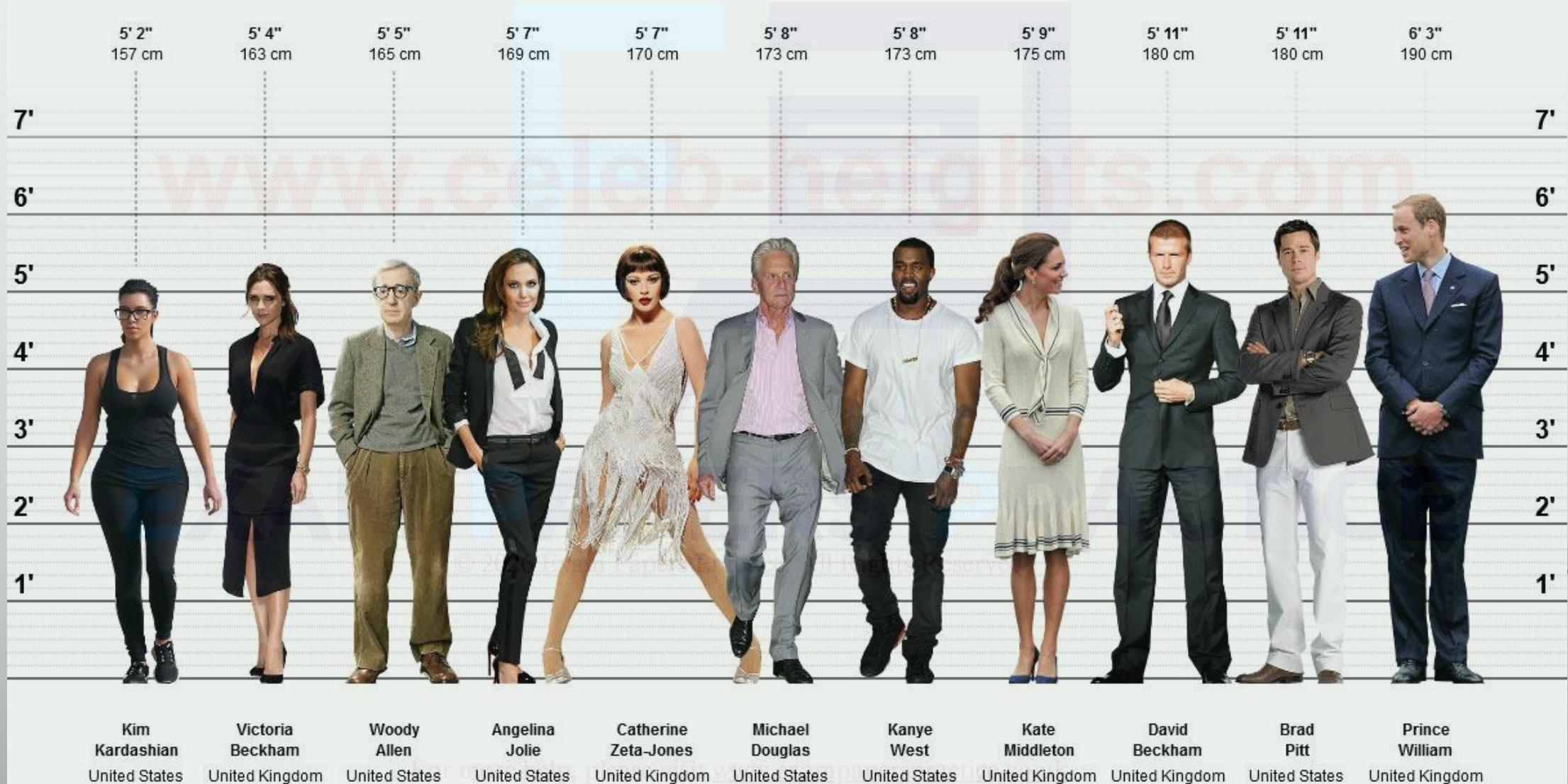
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Variation and natural

Variation

CELEB-HEIGHTS™ :: Celebrity Height Chart

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Variation and natural selection

Variation

Two basic kinds of variation

continuous variation

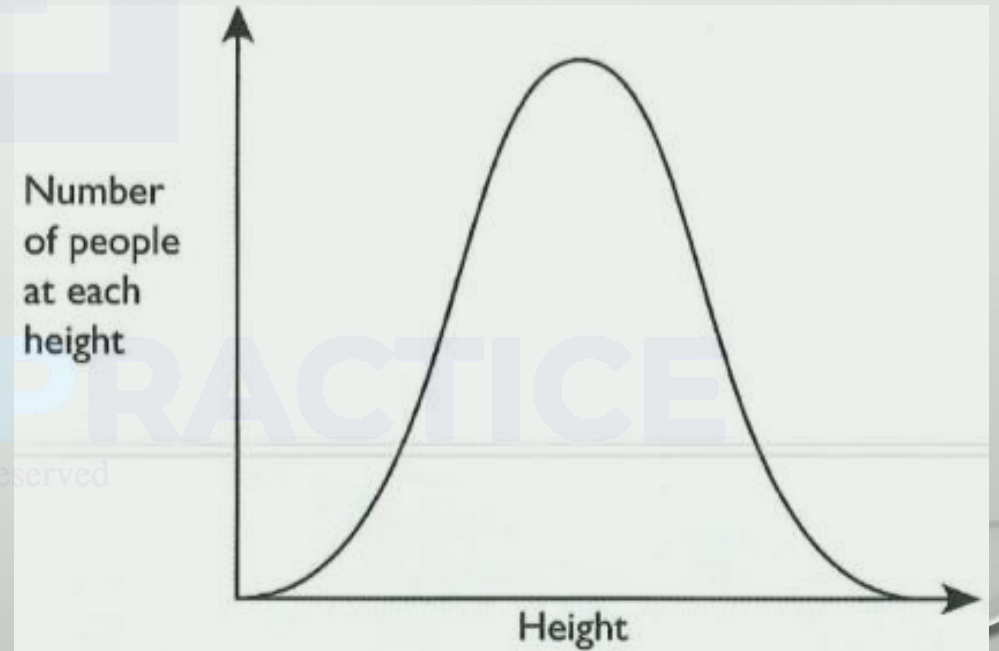
Height (there is no definite heights that a person must be)

discontinuous variation

ABO blood group

Normal distribution

Most people come in the middle of the range, with fewer at the lower or upper ends



continuous variation 连续变异
discontinuous variation 不连续变异

Variation and natural selection

Reasons of variation ?



gene

environment

Variation and natural selection

Reasons of variation ?

Genetic variation

different genotypes → different phenotypes

Environmental variation

Different environmental factors affect growth and development of organisms

genetic variation 遗传变异
environmental variation 环境变异

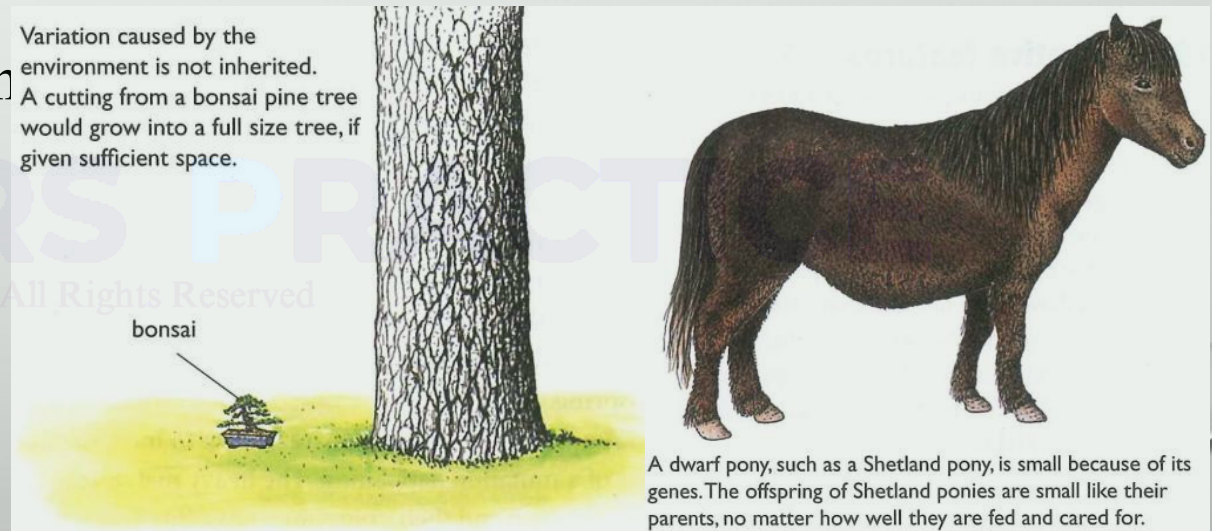
Variation

Discontinuous variation is caused by genes alone.

Continuous variation is often influenced by both genes and the environment.

Variation caused by the environment is not inherited. A cutting from a bonsai pine tree would grow into a full size tree, if given sufficient space.

bonsai



A dwarf pony, such as a Shetland pony, is small because of its genes. The offspring of Shetland ponies are small like their parents, no matter how well they are fed and cared for.

Variation and natural selection

Variation

cause of genetic variation

mutation ①——really the source of all genetic variation

- ◆ A change in the base sequence of DNA
- ◆ mutation is how new alleles are formed
- ◆ only source of brand-new characteristics in gene pool

mutation 突变

Variation and natural selection

Variation

cause of genetic variation

mutation ②——chromosomes

◆ Down's syndrome (three copies of chromosome 21)

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Down's syndrome 唐氏综合症

Variation and natural selection

Variation

Factors of mutation

- ◆ **ionizing radiation**
radiation can **damage the bases** in DNA, if this happens in ovaries or testes, then the altered DNA may be passed on to the offspring
- ◆ **chemicals — mutagens**
heavy metals e.g. lead, mercury

ionizing radiation 电离辐射
mutagen 诱变剂

Variation and natural selection

Variation

cause of genetic variation

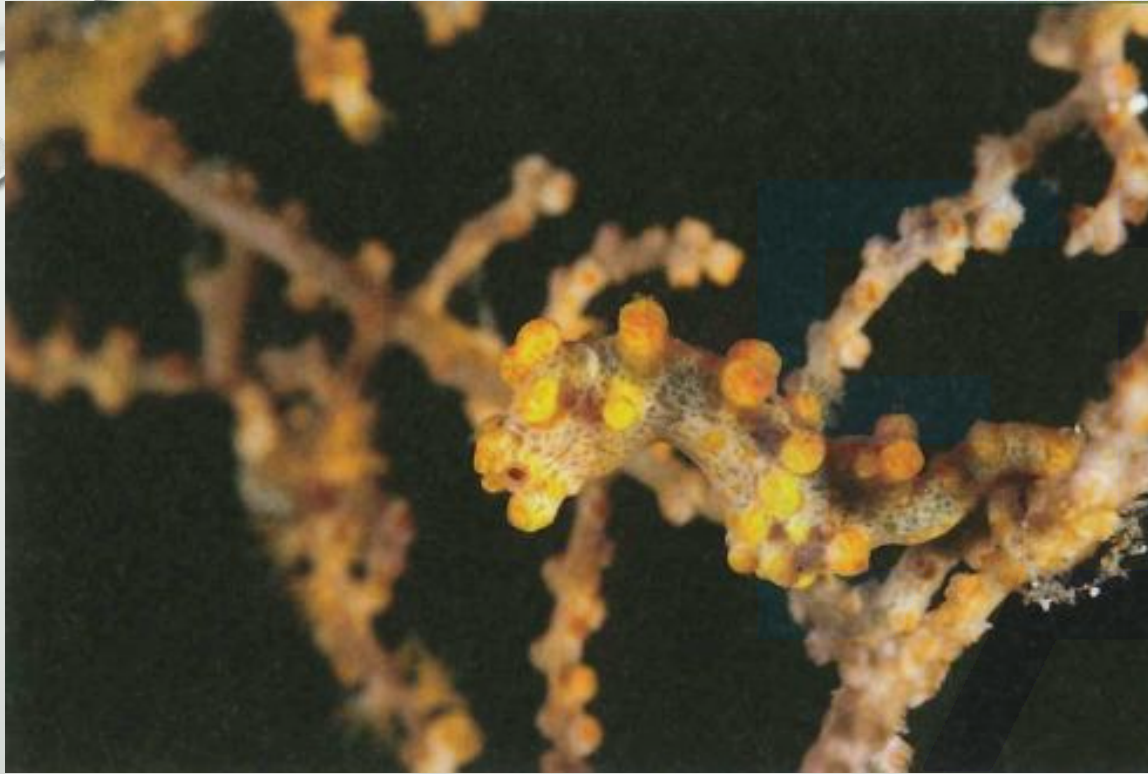
mutation ①——really the source of all genetic variation

mutation ②——chromosomes

meiosis

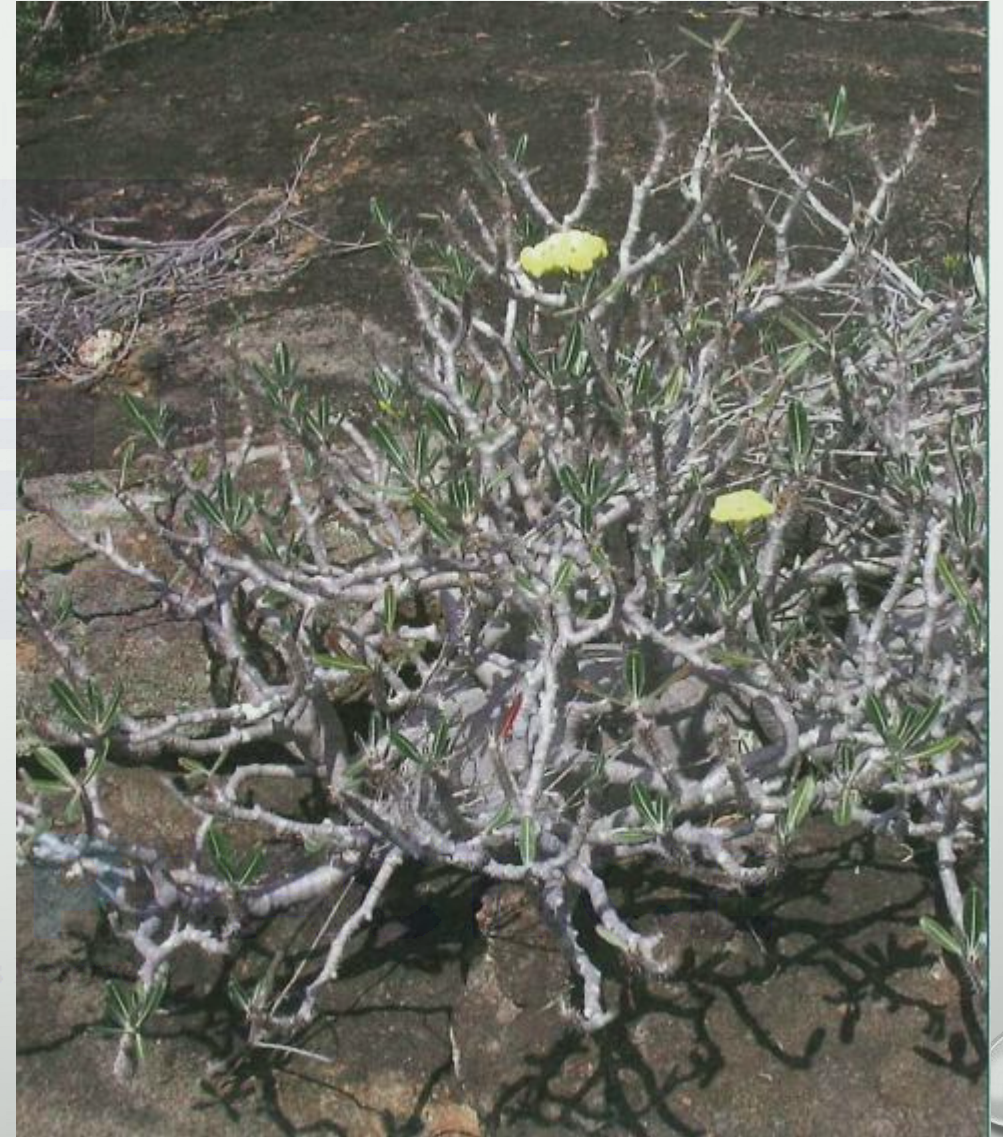
gametes not exactly the same, many possible combinations of genes when fertilization

Down's syndrome 唐氏综合症



Adaptive features

camouflage 伪装



Variation and natural selection

Adaptive features

Adaptive feature

An **inherited** feature of an organism that **increase its fitness**.

Fitness

The **probability** of an organism **surviving** and **reproducing** in the environment in which it is found.

The greater the organism's fitness, the greater its chance of surviving to adulthood and reproducing

fitness 适合度

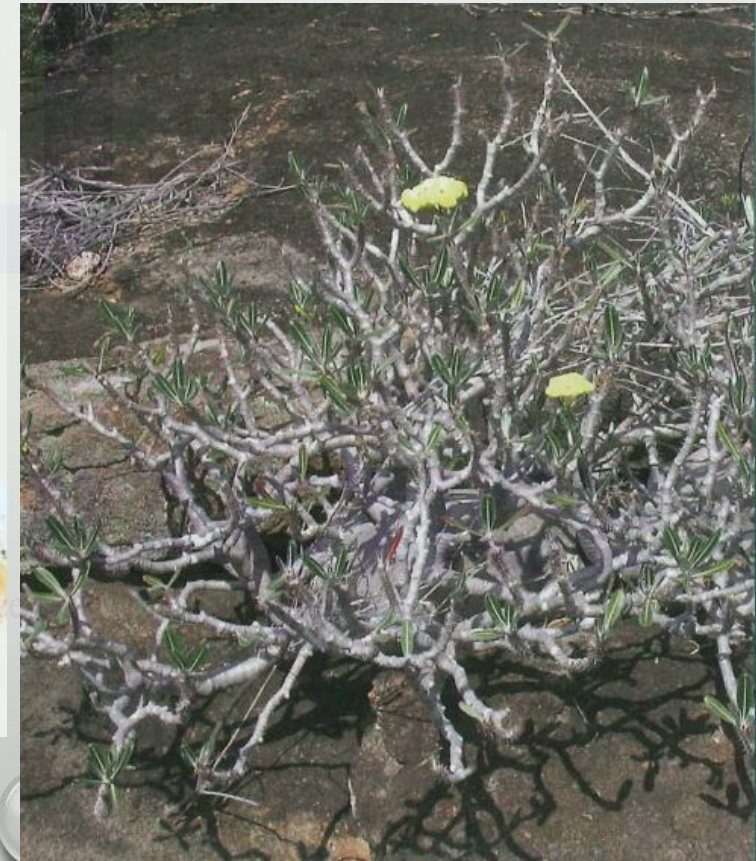
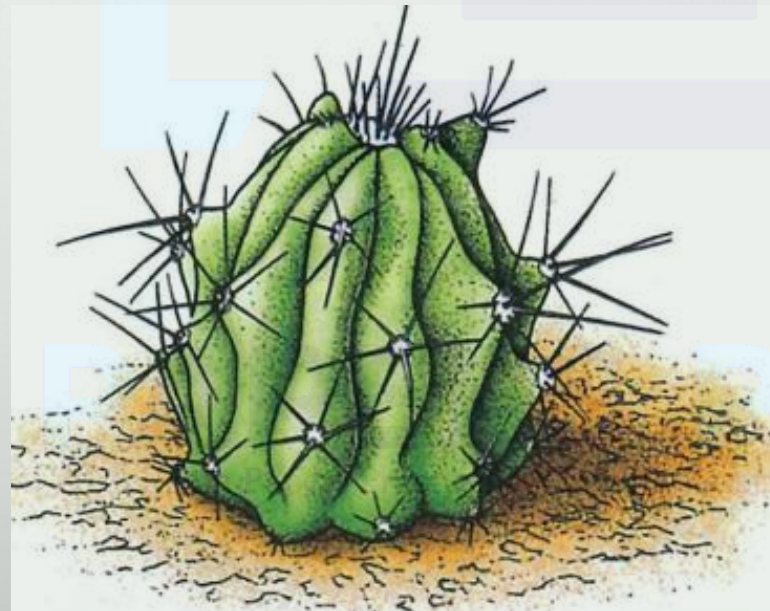
Variation and natural selection

Adaptive features

Xerophytes

Plants that are **adapted** to live in places where **water is in short supply**.

e.g. **succulents**, **cacti**



xerophyte 旱生植物
hydrophyte 水生植物
succulent 多汁的; 肉质植物
cacti 旱生植物

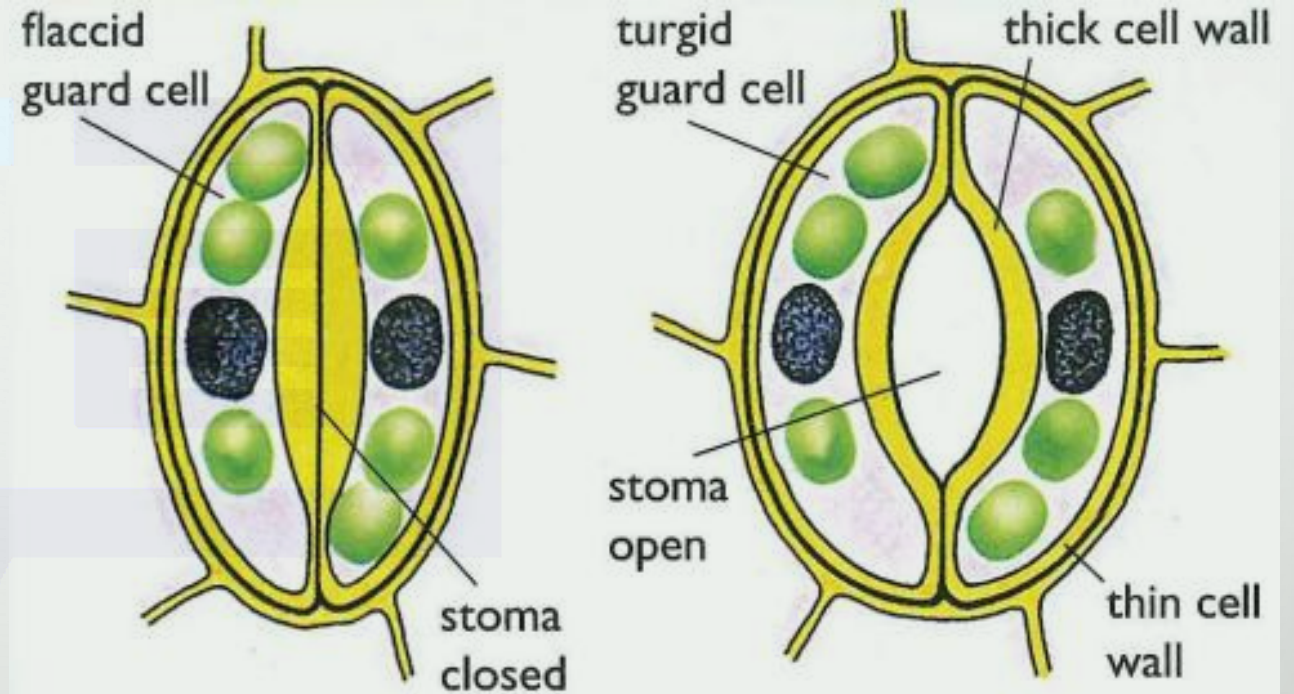
Variation and natural selection

Xerophytes' Adaptive features

◆ closing stomata

xerophyte 旱生植物

Adaptive features— xerophytes



When a plant is short of water, the guard cells become flaccid, closing the stomata.

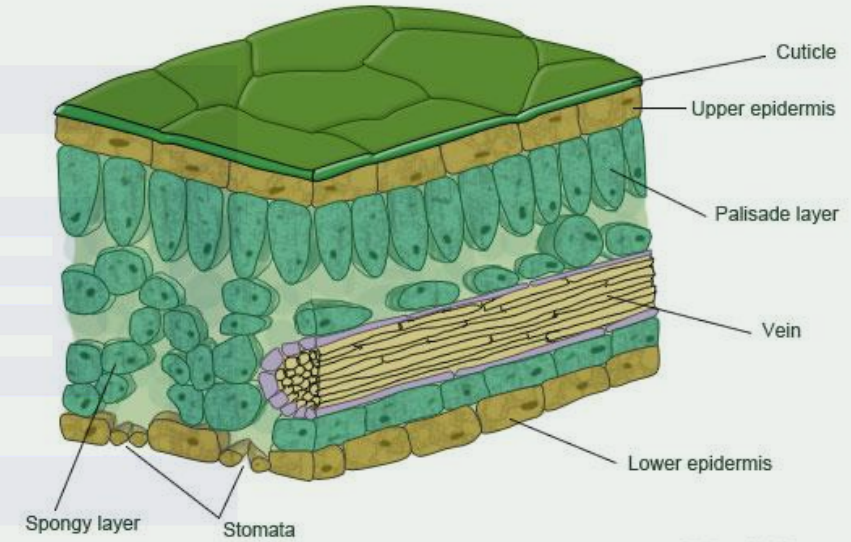
When a plant has plenty of water, the guard cells become turgid. The cell wall on the inner surface is very thick, so it cannot stretch as much as the outer surface. So as the guard cells swell up, they curve away from each other, opening the stoma.

Variation and natural selection

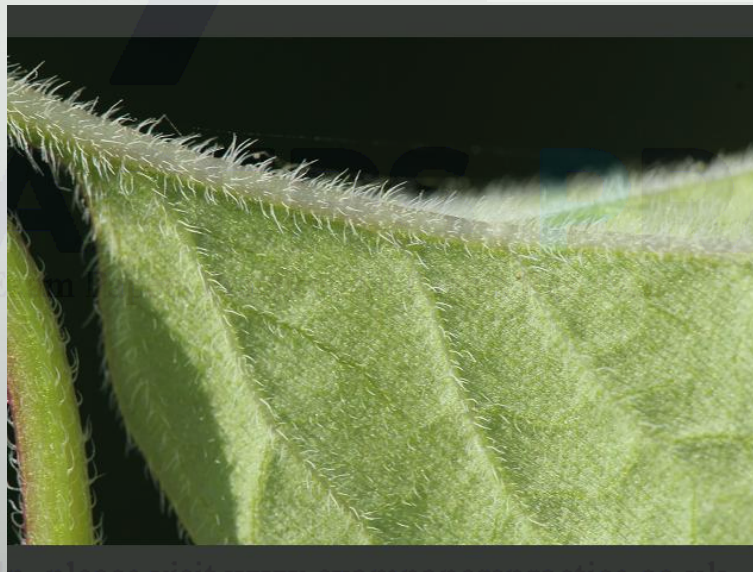
Adaptive features

Xerophytes' Adaptive features

- ◆ closing stomata
- ◆ waxy cuticle
make leaf waterproof
- ◆ hairy leaves
trap a layer of moist air



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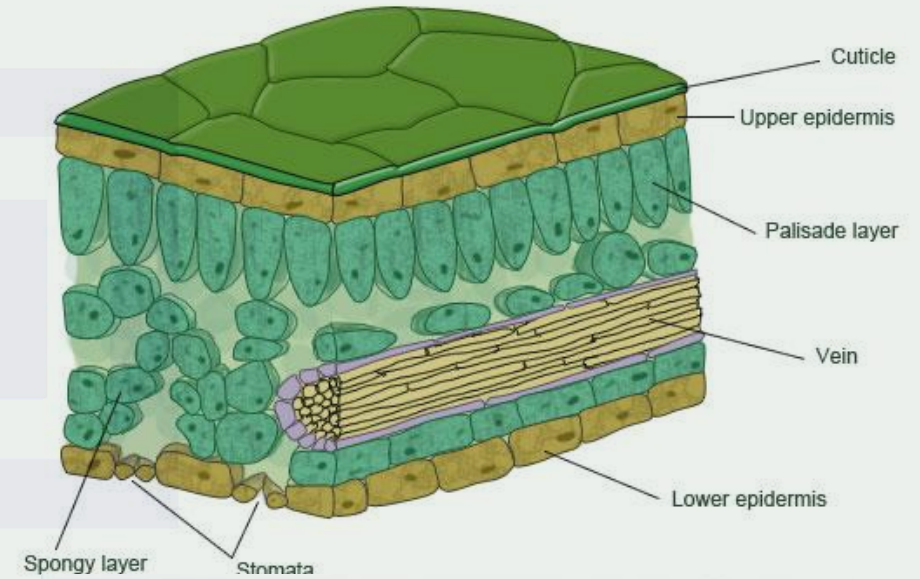
waxy cuticle 蜡质层
cuticle 角质层, 护膜

Variation and natural selection

Adaptive features

Xerophytes' Adaptive features

- ◆ closing stomata
- ◆ waxy cuticle
make leaf waterproof
- ◆ hairy leaves
trap a layer of moist air
- ◆ stomata on underside of leaves (some be sunk into deep pits in the leaf)
less water will evaporate

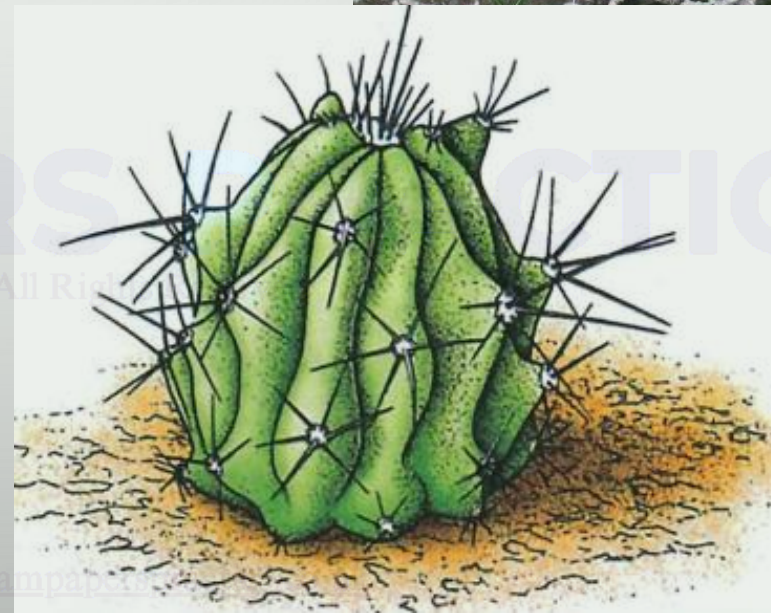


Variation and natural selection

Adaptive features—— xerophytes

Xerophytes' Adaptive features

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- ◆ waxy cuticle
make leaf waterproof
- ◆ hairy leaves
trap a layer of moist air
- ◆ stomata on underside of leaves(some be sunk into deep pits in the leaf)
- ◆ less water will evaporate
cutting down on the surface area
conserve water

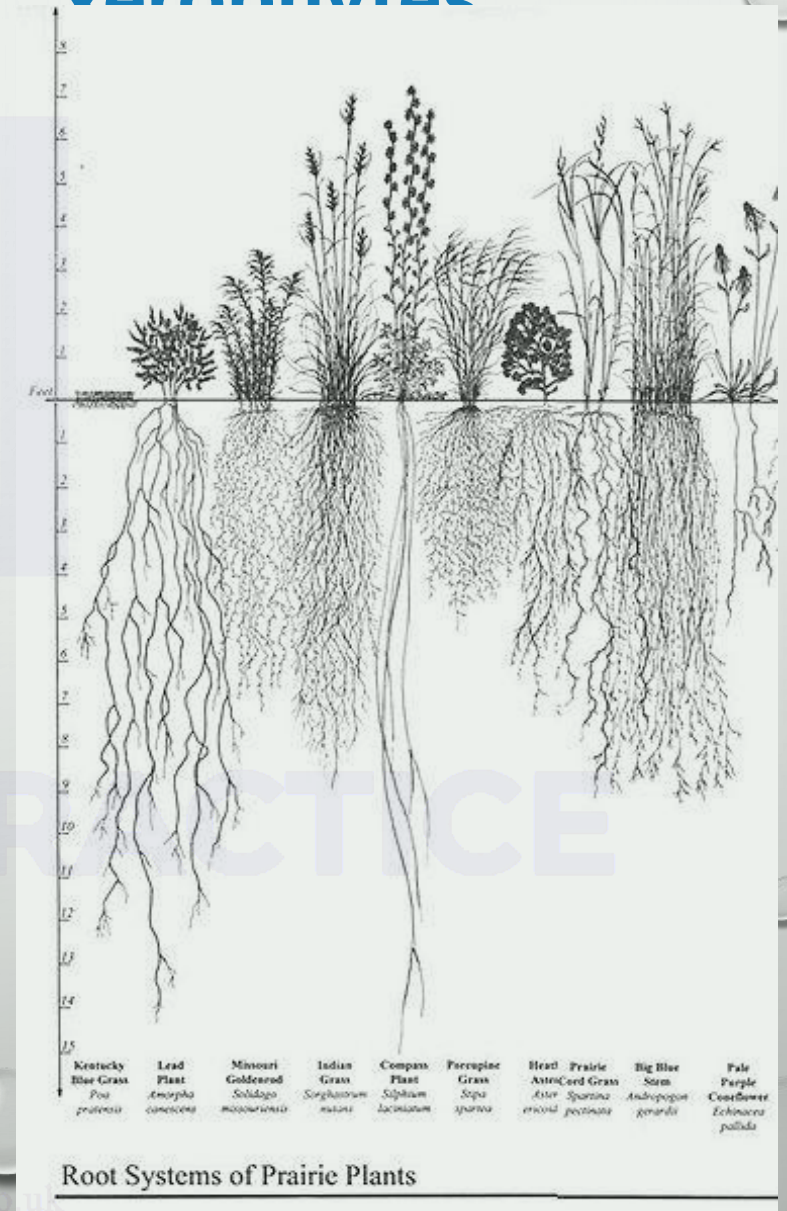


Variation and natural selection

Adaptive features—— xerophytes

Xerophytes' Adaptive features

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- ◆ stomata on underside of leaves(some be sunk into deep pits in the leaf)
- ◆ less water will evaporate
cutting down on the surface area
conserve water
- ◆ having deep or spreading roots



Variation and natural selection

Adaptive features

hydrophytes

Plants that live in very wet places, including those that live in water.

No problem of water shortage, no need to adaptations to conserve water.

hydrophyte 水生植物



Variation and natural selection

Adaptive features

hydrophytes

Plants that live in very wet places, including those that live in water.

e.g. Water hyacinth



Water hyacinth
Eichhornia crassipes
Photo by Karen Brown
© 2006 University of Florida

Water hyacinth 水葫芦

Variation and natural selection

Adaptive features

hydrophytes

Plants that live in very wet places, including those that live in water.

e.g. Water hyacinth

- ♦ roots do not attach to the bed of river or pond

- ♦ the stems and leaf stalks have hollow spaces filled with air

Help them to float on the top of the water for get sunlight

- ♦ leaves have stomata on both surfaces

Absorb carbon dioxide

- ♦ the cuticle is much thinner than xerophytes

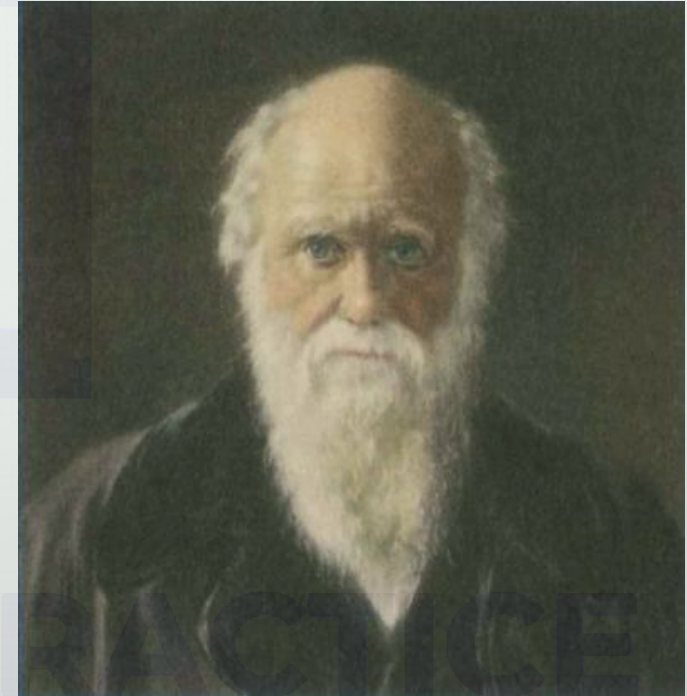




**Why do they like
this ?**

Variation and natural selection

Natural selection

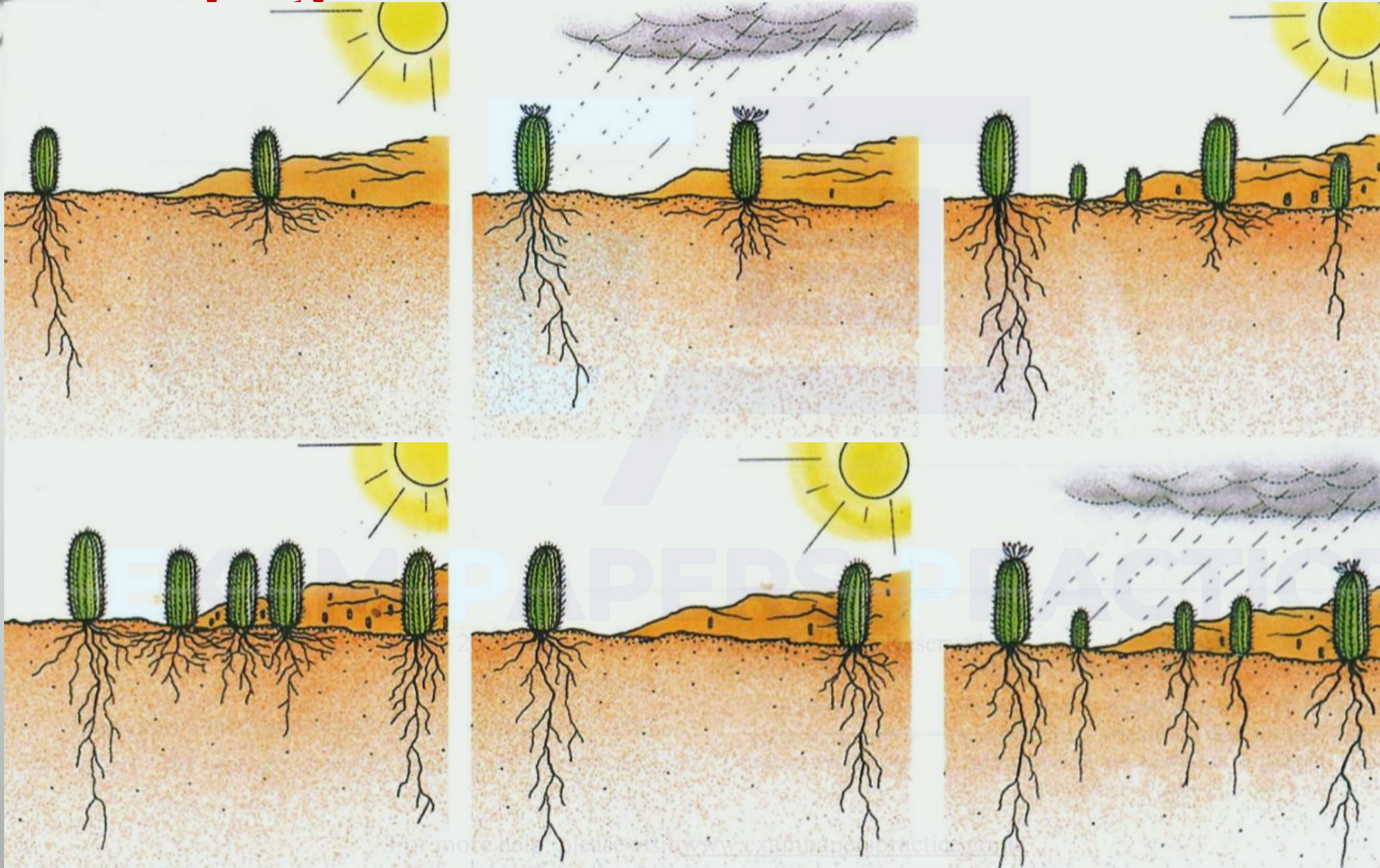


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Variation and natural

Natural selection



Variation and natural selection

Natural selection

Natural selection

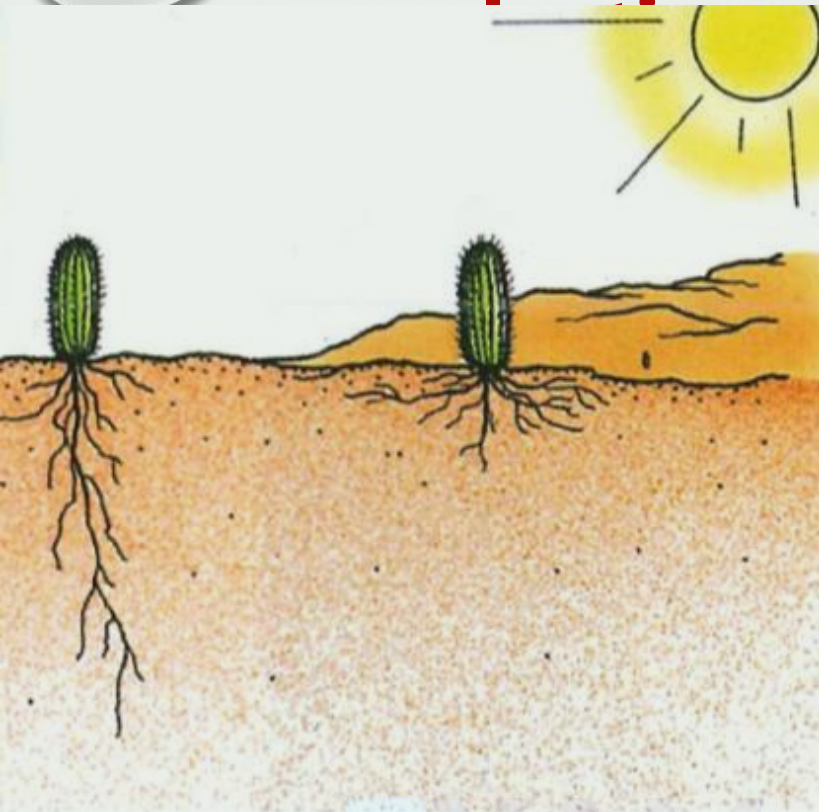
- ↓ Variation
- ↓ over-production — more young than will survive to adulthood
- ↓ struggle for existence — considerable competition for survival between the organisms
- ↓ survival of the fittest
- ↓ advantageous characteristics passed on to offspring — alleles
- ↓ gradual change — the population will lose all the poorly adapted individuals.

Process of adaptations

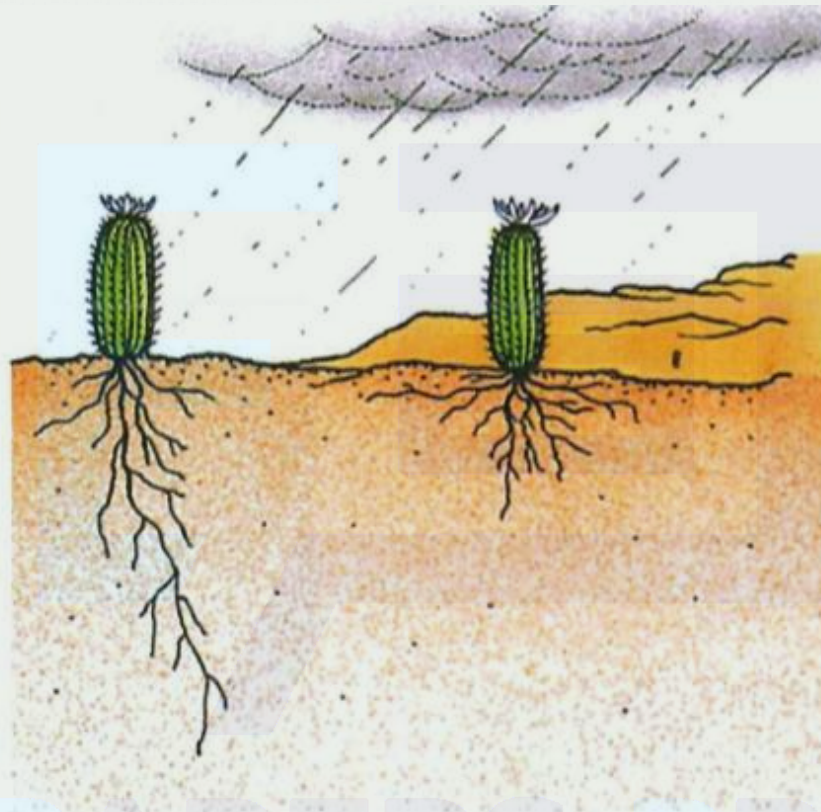
The process resulting from natural selection, by which populations become more suited to their environment over many generations.

Variation and natural

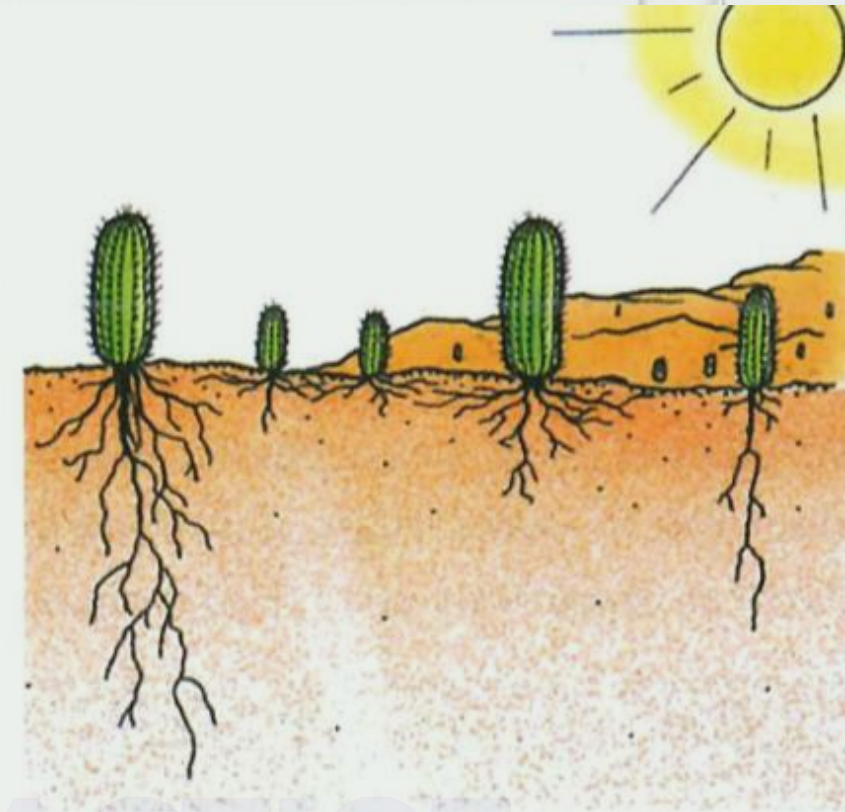
Natural selection



Genetic variation. In a population of cacti, some have longer roots than others.



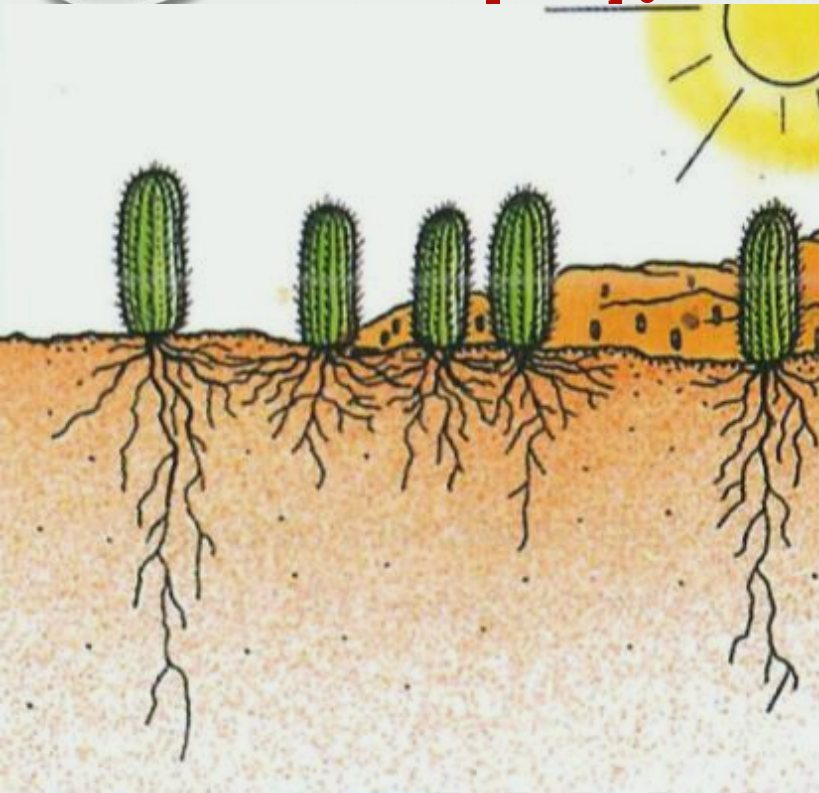
In the wet season they flower.



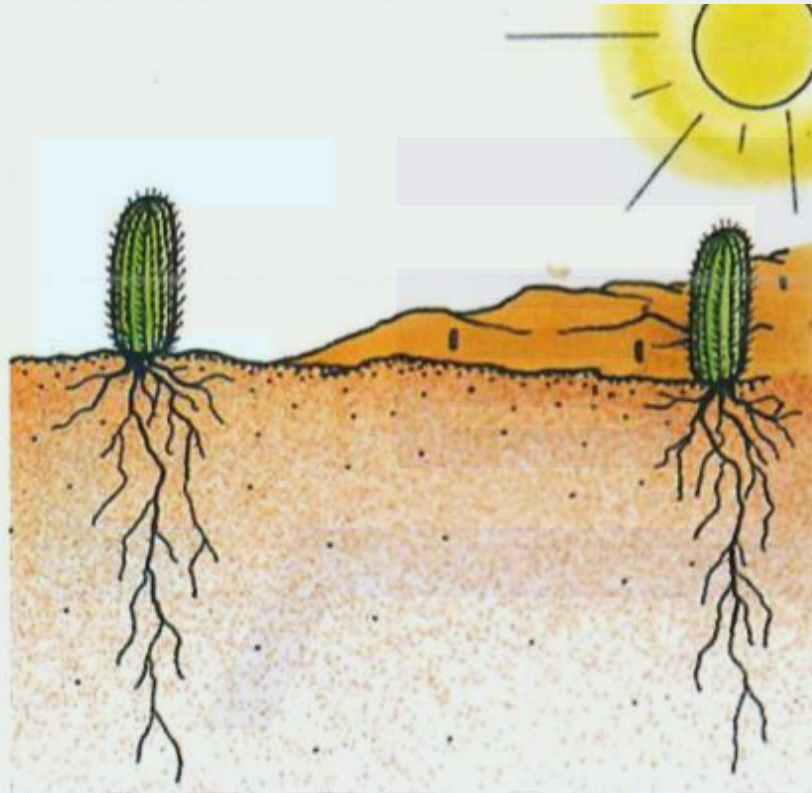
Over-production. The cacti produce large numbers of offspring.

Variation and natural

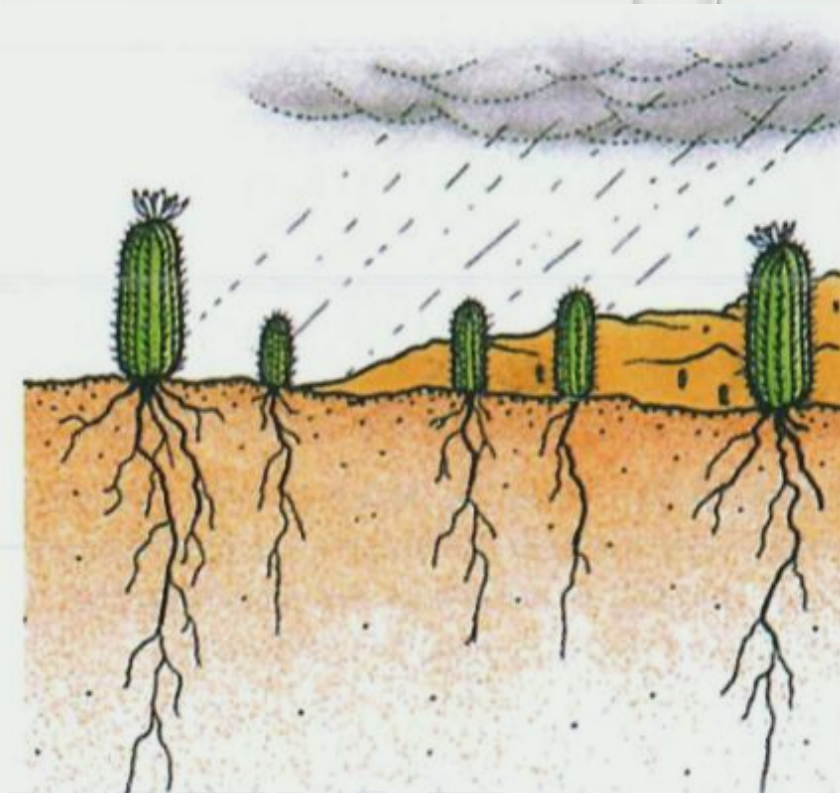
Natural selection



Struggle for existence. During the dry season, there is competition for water.



Survival of the fittest. The cacti with the longest roots are able to obtain water, while the others die of dehydration.



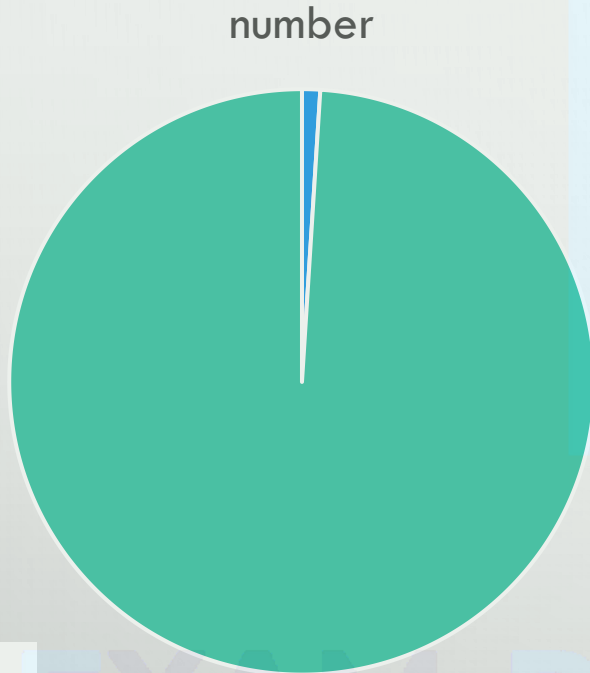
Advantageous characteristics passed on to offspring. The long-rooted cacti reproduce, producing offspring more likely to be long-rooted themselves.

dehydration 脱水

Variation and natural selection

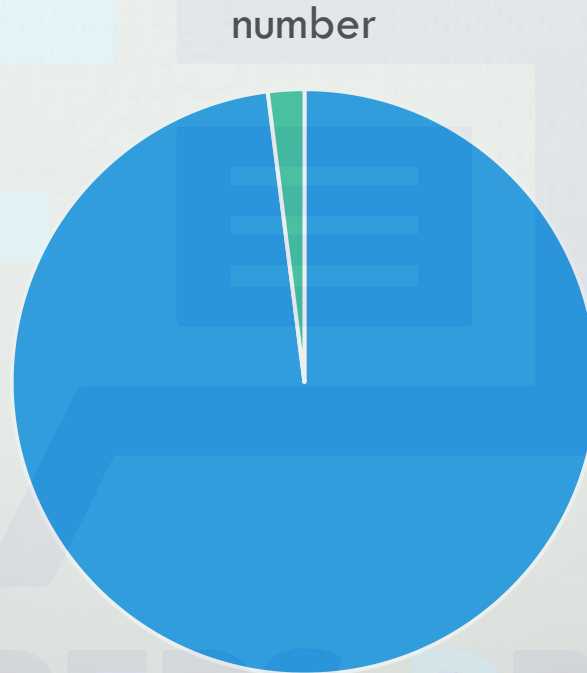
Natural selection

An example of natural selection — moth



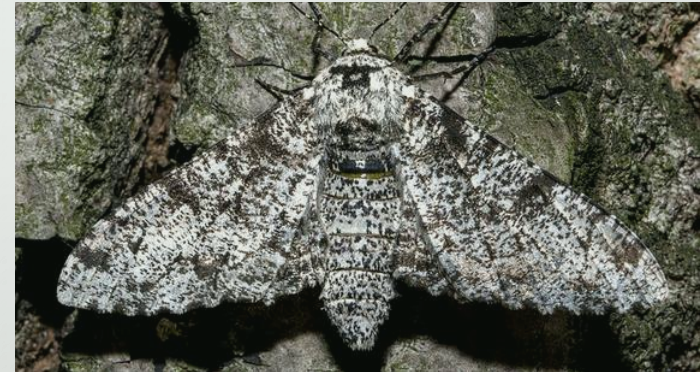
1849

■ black/melanic ■ speckled



1900

■ black/melanic ■ speckled



peppered moth 英国灰蛾
speckled 有斑点的
black/ melanic 黑色的

Variation and natural selection

An example of natural selection ——— moth

Natural selection



a Lichen-covered bark hides a speckled moth perfectly.



Dark moths are better camouflaged on lichen-free trees

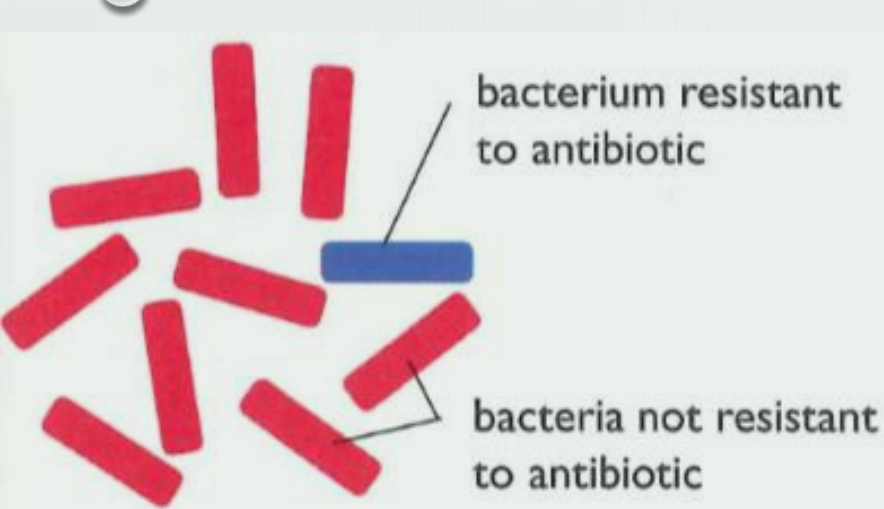
camouflage 伪装
lichen 地衣

The factor which confers an advantage on the dark moths, and a disadvantage on the pale moths in polluted areas, is **predation by birds**. This is called a **selection pressure**.

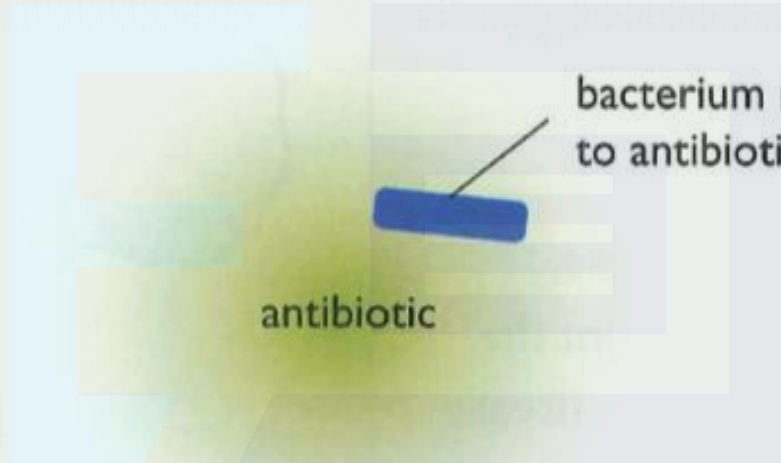
Variation and natural selection

Natural selection

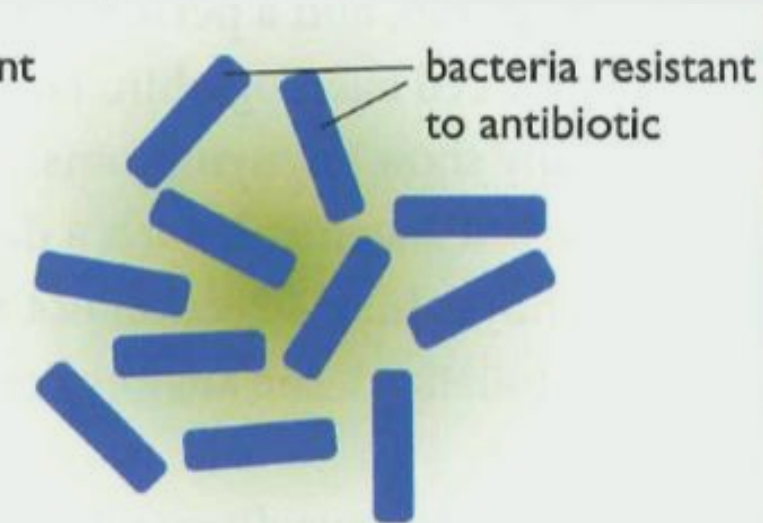
An example of natural selection ——— antibiotic resistance in bacteria



In a population of bacteria, not every one is alike. By chance, one may have a gene that makes it resistant to an antibiotic.



Antibiotic is added, which kills the bacteria that are not resistant.



The resistant one multiplies and forms a population of resistant bacteria just like itself.

antibiotics 抗生素
penicillin 青霉素

selection pressure: antibiotics

Variation and natural selection

Stabilising selection

Natural selection

Change will only occur if the environment changes, or if a new mutation appears which adapts the organism better to the existing environment.

If an organism is well adapted to its environment, and the environment stays the same, so ...

Natural selection tends to keep populations very much the same from generation to generation. ——— **stabilizing selection**
→ not evolve

Most of the time

stabilise 使... 稳定

Variation and natural selection

Natural selection

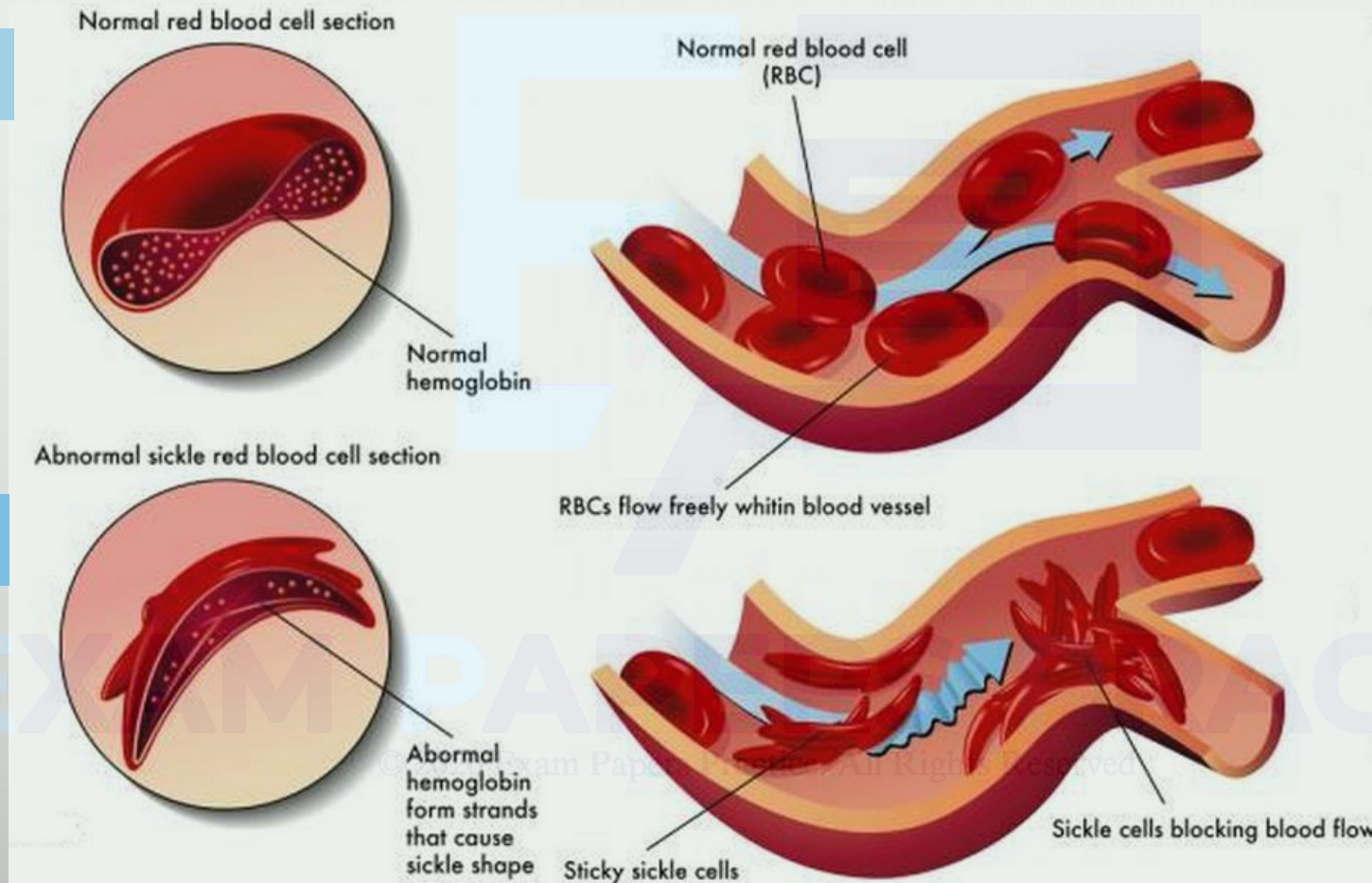
An example of natural selection — sickle cell anaemia

Hb^A

mutation

Hb^S

Produce fibres inside red blood cell when oxygen concentration is low



Sickle cell crisis

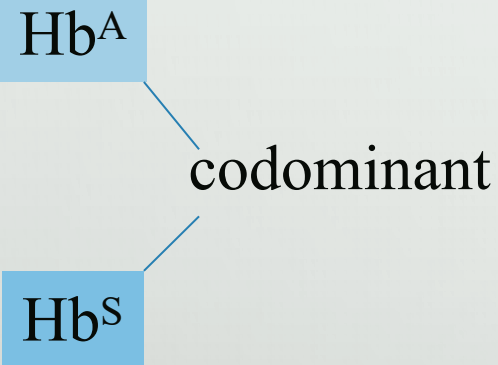
- ◆ pain (because blockages of blood)
- ◆ feel tired and short of breath (because faulty haemoglobin does not deliver oxygen efficiently)

sickle cell anaemia 镰刀型细胞贫血症

Variation and natural selection

Natural selection

An example of natural selection — sickle cell anaemia



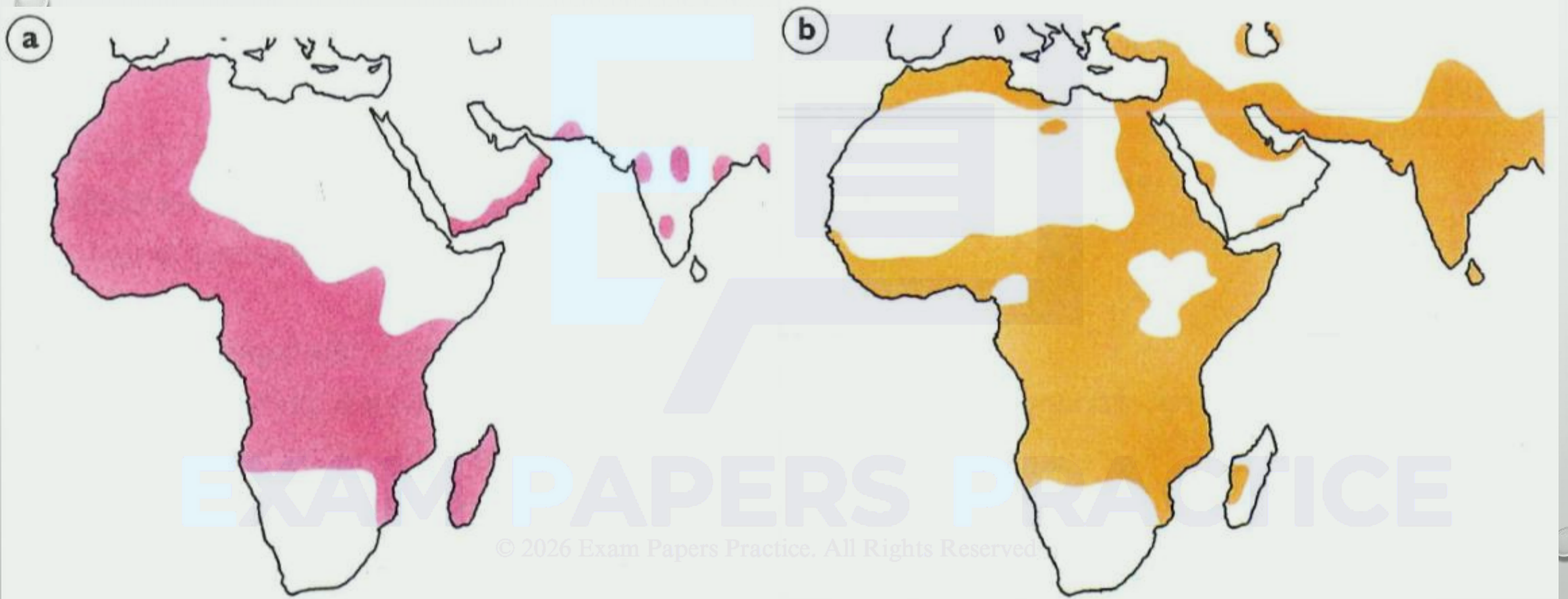
$Hb^A Hb^A$ homozygous Normal cell haemoglobin No symptoms	$Hb^A Hb^S$ heterozygous Mix normal and sickle cell haemoglobin Usually no symptoms	$Hb^S Hb^S$ homozygous Sickle cell haemoglobin have symptoms
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symptom 症状

Variation and natural selection

Natural selection

An example of natural selection — **sickle cell anaemia**



a. The distribution of the **sickle cell allele** in africa

b. The distribution of the **malaria** in africa

malaria 疟疾

Variation and natural selection

Natural selection

An example of natural selection — sickle cell anaemia

Hb^A

codominant

Hb^S

Hb^A Hb^A

homozygous

Normal cell
haemoglobin

No symptoms

die early from
malaria

Hb^A Hb^S

heterozygous

Mix normal
and sickle cell
haemoglobin

Usually no
symptoms

More resistant
to malaria

Hb^S Hb^S

homozygous

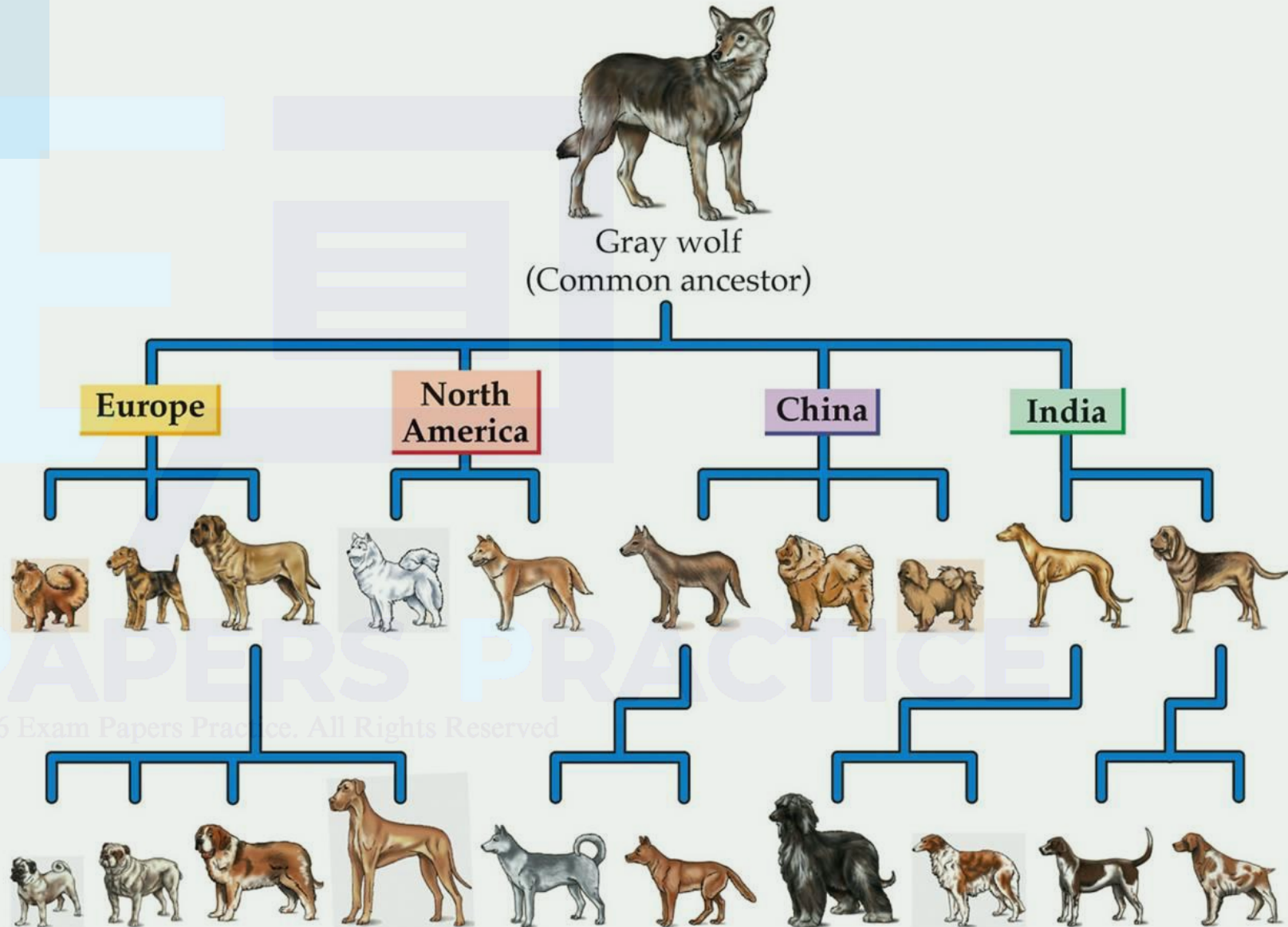
Sickle cell
haemoglobin

have symptoms

die early from
sickle cell
disease

symptom 症状

Artificial selection Selective breeding

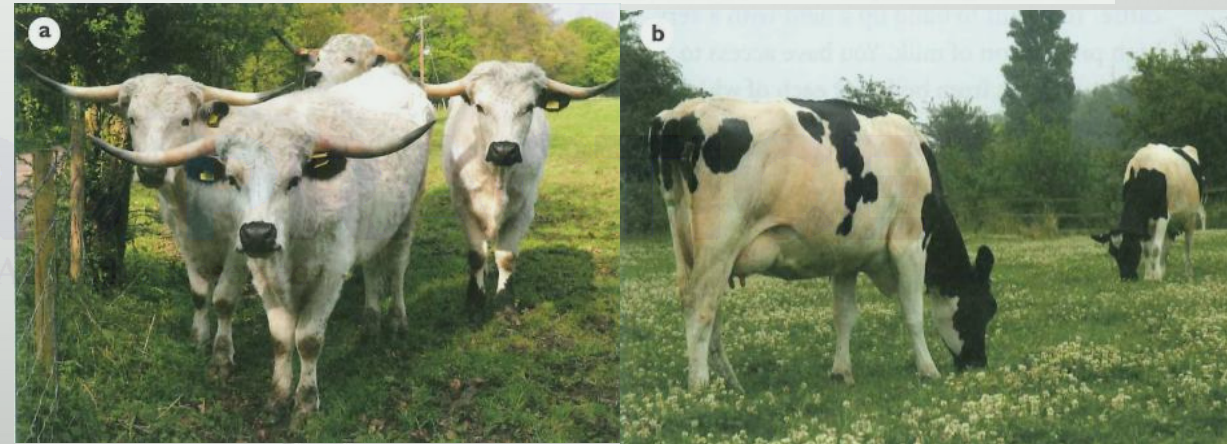
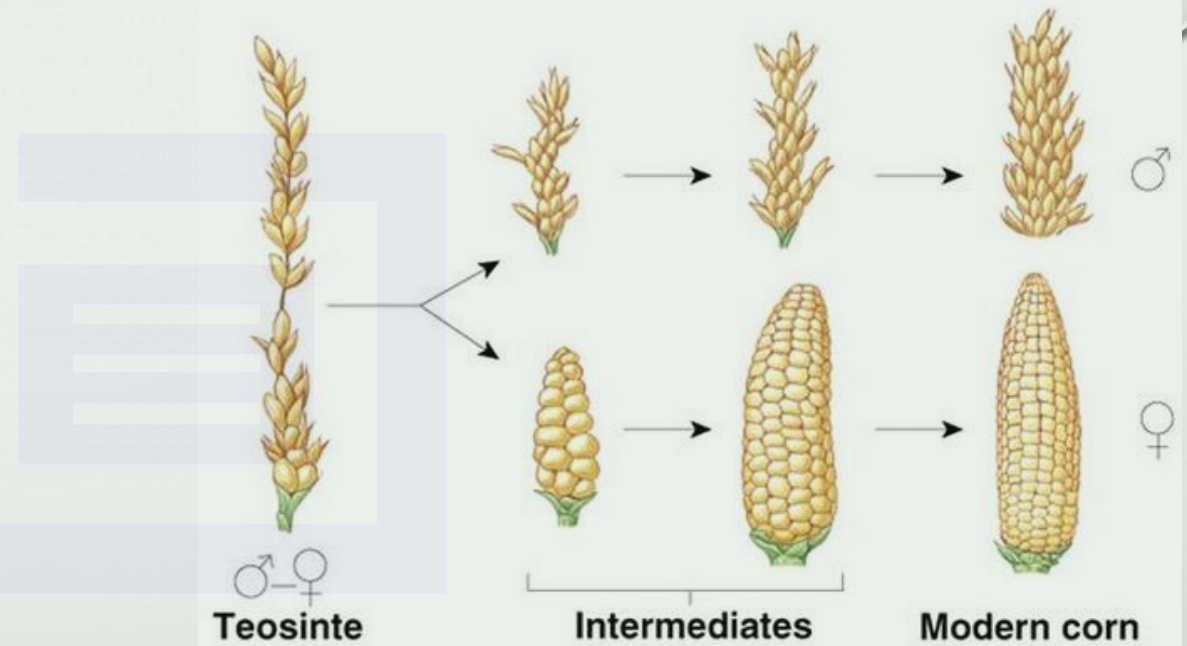


Variation and selection

artificial selection & selective

Process of artificial selection

- Selection by humans of individuals with 'advantageous' characteristics (desirable features of humans)
- crossing these individuals to produce the next generation
- selection of offspring showing the desirable features



cultivate 培育
domesticate 驯化

Cultivate plants / domesticate animals

Variation and selection

artificial selection & selective breeding

The **difference** between natural and artificial selection

	Natural selection	Artificial selection
Source of selection pressure	nature	Humans (breeder)
Object of selection	Natural populations	Domestic population
results	Individuals best suited to their environment survive	Individuals have desirable features (determined by humans) can breed
Speed of selection	slow	rapid

Artificial selection and natural selection are different forms of the same process.

Variation and selection

artificial selection & selective breeding

Do these desirable features in terms of humans would be advantageous for plant or animal if it was living in the wild?

