Markscheme

① James Hutton (1726-1797)
- proposed uniformitarianism - changes in the Earth's crust occur at predictable continuous rates, i.e. same today as the past
- founded modern geology - deduced the age of Earth was <u>far</u> older than predicted biblically due to slow processes of erosion, upwelling, sedimentation, etc.
- first to suggest the notion that better adapted species to new environments survive & those poorly adapted die - leading to changes and variation Known later as natural selection

Charles Lyell (1797-1875)
- expanded upon and popularized Hutton's work on geology.
- inspired Darwin which led to him applying Lyells work to biology where species gradually evolve and like geology, constant forces cause species to become variable and adapt.
- did not agree with Darwin but was his close friend, colleague and helped him in his publications

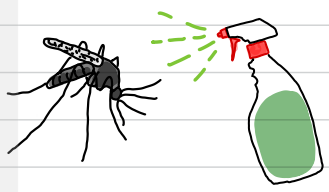
Jean Baptiste Lamarck (1744-1829)
- by comparing modern species with fossils he interpreted a 'line of descent' → older to most recent
- believed species increased in complexity over time until 'perfection'
- hypothesized that the path of progression followed by a species is determined by their interaction with environment
  ↳ as environment changes, so do the needs of species
- inheritance of acquired characteristics: characteristics acquired during individuals lifetime can be passed onto offspring
  ↳ wrong <u>but</u> species can change without limit

Alfred Russel Wallace (1823-1913)
- independently developed the idea of evolution via natural selection (before Darwin)
- shared his findings with Darwin, who had come to the same conclusion
- rejected 'Lamarckism'
- devised first modern definition of species and thought most occured via allopatry (whereas Darwin thought sympatry)
- developed ideas on sexual selection and dimorphism

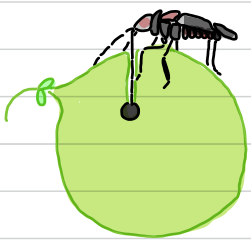
② Many possible examples.

<u>DDT resistance in mosquitoes</u>
↳ <u>D</u>ichloro<u>d</u>iphenyl<u>t</u>richloroethane is an insecticide which causes spontaneous neuron firing, leading to death

1. Mutation in mosquito affecting ion channel (making DDT inactive at causing spasms) or enzymes which break down DDT
2. Variation in mosquito population in terms of DDT resistance
3. Selection pressure: DDT sprayed which kills mosquitoes
4. Those mosquitoes with DDT resistance, more likely to survive → more likely to reproduce
5. More genes for DDT resistance passed on to next generation
6. more mosquitoes resistant to DDT in population



<u>Soapberry bug mouthpart evolution</u>
↳ soapberry bugs use their mouthparts to eat inside of fruit - native in FL is balloon fruit
1. Variation in the length of the mouthpart in soapberry bugs: some longer/shorter than others
2. selection pressure: flat pod fruit introduced to one area, favouring smaller mouthparts
3. those bugs with smaller mouthparts were more successful at feeding → more likely to reproduce
4. more genes for smaller mouthparts passed onto next generation
5. increase in small mouthparts allele frequency in population → mean mouthparts size decreases



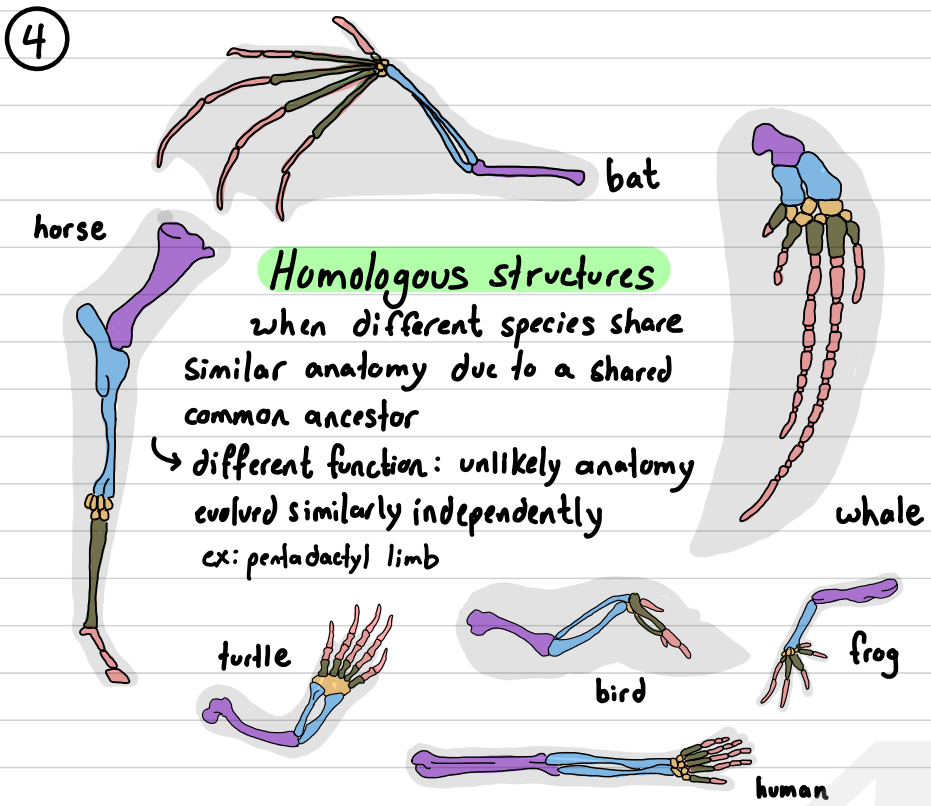
*reverse happened in LA where balloon plants introduced

③ Many possible answers.

Ex for animals: polar bears (fur, fat, paws for cold), camels (nostrils, eyelashes, feet, hump, stomach for desert), etc.
Ex for plants: venus fly traps (eat insects for nitrates), pine trees (cold climate), cacti (deserts), etc.

Markscheme

④



Homologous structures

when different species share similar anatomy due to a shared common ancestor

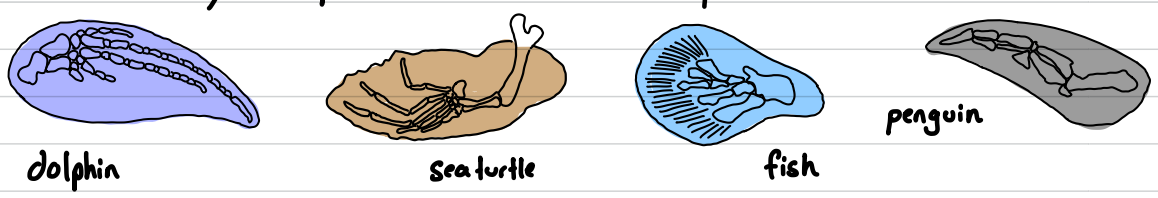
↳ different function: unlikely anatomy evolved similarly independently

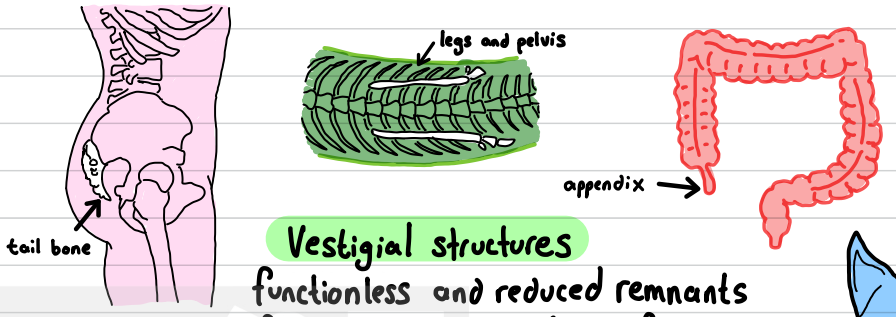
ex: pentadactyl limb

Analogous structures

adaptations that possess similar function but different origin (and anatomy)

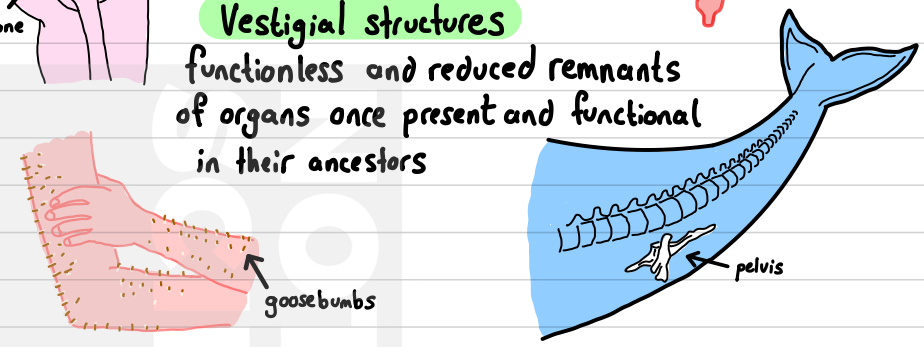
→ occurs when they are exposed to common selection pressure

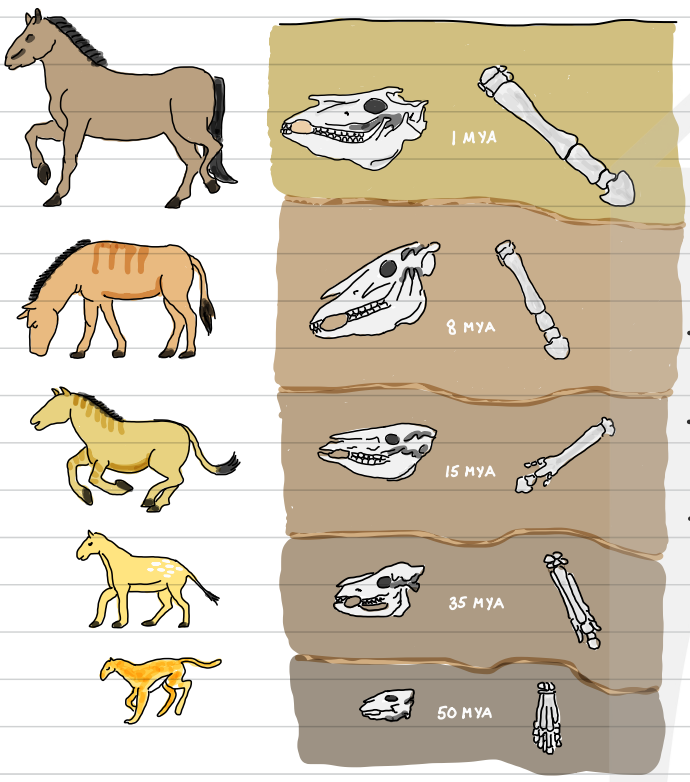




Vestigial structures

functionless and reduced remnants of organs once present and functional in their ancestors





Fossil record

The preserved remains or traces of an organism from the past and their relative placement in rock

→ layers provide a timeline
deeper = older

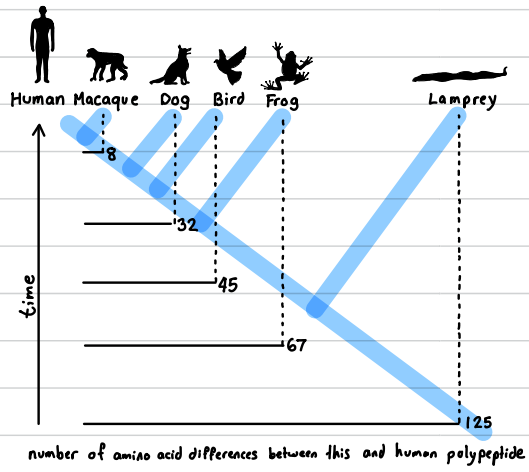
→ age of layers and fossils can be determined

→ fossils show chronological sequence in which characteristics appear and develop/change

Molecular evidence

As mutations build-up in DNA over time, compare different species in terms of similarities in:

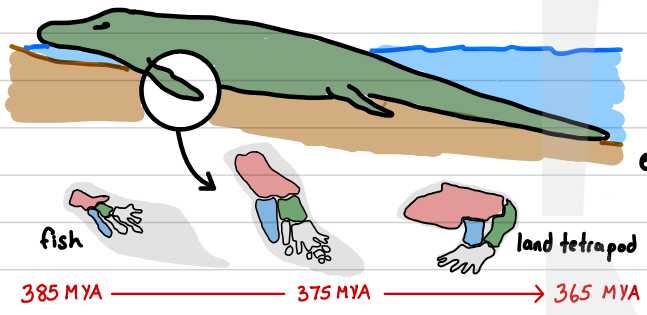
→ non-coding sequences
→ gene sequences
→ polypeptide sequences



Transitional fossil

fossil which shows links between groups by exhibiting traits common to both

ex: Tiktaalik is a fossil which has features of both fish and terrestrial tetrapods



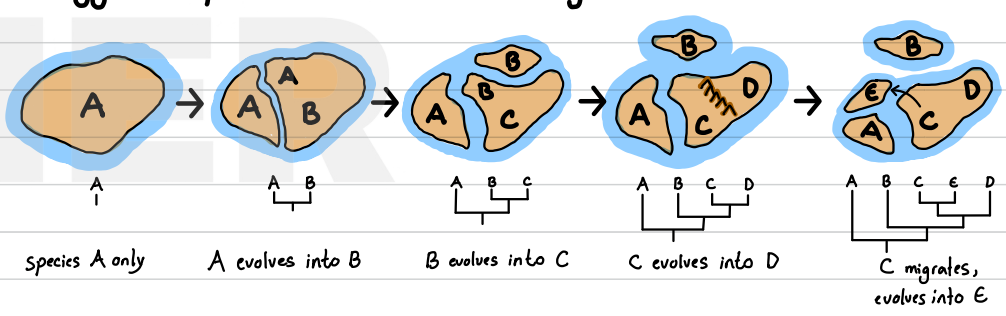
Biogeography: the study of where organisms live and how they came to live there.

→ geographically close environments are more likely to be populated by related species than those separated but environmentally similar

→ suggests species share common lineage - distribution nonrandom

Direct observation: in organisms that reproduce quickly and in large numbers, evolution can be observed directly

→ if selection pressure is known, this change can be predicted



⑤ Many possible examples

⑥ Causes:

1. Antibiotics were over-used: antibiotics were over-prescribed and taken when it was not necessary or even effective (viral infections)
   ↳ this lead to more exposure and selection for antibiotic resistance in bacteria.
2. Antibiotics were not taken to completion: if people stop taking antibiotics before prescribed time, some bacteria may survive and spread
3. Antibiotics given to livestock. This created more opportunity for resistance to be selected and spread via food.
4. Hospitals provide environments with a lot of visitors, sickness and open wounds, providing opportunity for spread.

Solutions:

1. Limit use of antibiotics to serious bacterial infections - consult doctor
2. Disinfect hands and surfaces regularly using ethanol-based agents or soap. Disinfect and cover open wounds
3. Get vaccinated and stay clean after animal handling

Markscheme

(7)
1. Smaller seeds more abundant
2. Finches with smaller beaks more successful at acquiring food
3. more likely to survive and reproduce
4. more alleles for small beak passed onto offspring
5. population evolved: mean beak size decreased

(8) Organisms that reproduce sexually have more genetic variation as unlike bacteria who only rely on mutations, they also have meiosis and random fertilization. Therefore, they have a larger gene pool (variety) and the chance of an individual having an adaptive feature is higher. This is a danger of monocultures (like in agriculture and livestock) as they have less variation and more susceptible to changes (like disease)

(9) Without variation, there is nothing to select as all individuals are the same with same features - nobody better or worse
Without struggle, there is no selection as all individuals equally likely to survive and reproduce.