

Darwin, natural selection and antibiotic resistance

Triple only

**Who developed the theory of evolution by natural selection independently of Darwin?**

Darwin, natural selection and antibiotic resistance

Triple only

**Name Darwin's book and the year it was published.**

Darwin, natural selection and antibiotic resistance

Triple only

**Give one impact of Darwin and Wallace's ideas on modern biology.**

Darwin, natural selection and antibiotic resistance

**What is natural selection?**

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**What is evolution?**

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**What causes new alleles to appear in a population?**

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**Put natural selection in order: variation, alleles passed on, survival and reproduction, proportion increases.**

Darwin, natural selection and antibiotic resistance

**How do antibiotic-resistant bacteria emerge?**

On the Origin of Species, 1859.

Alfred Wallace.

Organisms better adapted to their environment are more likely to survive and reproduce, passing on their alleles.

They explain the diversity of life and how species are related, and with genetics explain variation and the emergence of resistant organisms.

Mutation.

A change in the inherited characteristics of a population over many generations.

A mutation makes a bacterium resistant.  
The antibiotic kills the others, so the resistant ones survive, reproduce and pass on the allele.

Variation, survival and reproduction of the better adapted, alleles passed on, proportion with the advantageous allele increases.

Darwin, natural selection and antibiotic resistance

**What is the selection pressure in antibiotic resistance?**

Darwin, natural selection and antibiotic resistance

**Why does antibiotic resistance support Darwin's theory?**

Evidence for evolution and classification

**Ardi: age and key features?**

Evidence for evolution and classification

**Lucy: age and key features?**

Evidence for evolution and classification

**What did Richard Leakey's team find, and how old is it?**

Evidence for evolution and classification

**Put Ardi, Lucy and Leakey's fossils in order, oldest first.**

Evidence for evolution and classification

**Why is fossil evidence for human evolution incomplete?**

Evidence for evolution and classification

**Write 4.4 million years in standard form.**

It shows natural selection happening: variation, a selection pressure, survival of the resistant, and inheritance of resistance.

The antibiotic.

3.2 million years ago. Walked upright on two legs, with a small brain.

4.4 million years ago. Walked upright but had a grasping big toe, so could still climb trees.

Ardi (4.4 million), Lucy (3.2 million), Leakey's (1.6 million years ago).

Fossils from 1.6 million years ago, including a nearly complete skeleton with a larger brain and longer legs, much more like a modern human.

$4.4 \times 10^6$  years.

Fossils are rare and often incomplete, because most remains decay before they fossilise.

Evidence for evolution and classification

**How do stone tools change over time?**

Evidence for evolution and classification

**How can stone tools be dated from their environment?**

Evidence for evolution and classification **Triple only**

**What is a pentadactyl limb?**

Evidence for evolution and classification **Triple only**

**What does the pentadactyl limb suggest about evolution?**

Evidence for evolution and classification

**Name the five kingdoms.**

Evidence for evolution and classification

**Name the three domains.**

Evidence for evolution and classification

**What led to the suggestion of three domains?**

Selective breeding and tissue culture

**What is selective breeding?**

By the age of the rock layer or materials found with them.

They become more complex and better made, showing greater skill and intelligence.

Similar bone structure suggests a common ancestor, with limbs adapted by natural selection for different functions.

A limb with five digits, found in many vertebrates.

Archaea, Bacteria and Eukarya.

Animals, plants, fungi, protists and prokaryotes.

Humans choosing parents with desired characteristics to breed together, repeated over many generations.

Genetic analysis showed that the prokaryotes are not one closely related group.

Selective breeding and tissue culture

**Give two characteristics selected for in food plants.**

Selective breeding and tissue culture

**Give two characteristics selected for in domesticated animals.**

Selective breeding and tissue culture

**What is a disadvantage of selective breeding?**

Selective breeding and tissue culture

**Two Rr plants are crossed (R dominant). What is the probability of an rr offspring?**

Selective breeding and tissue culture **Triple only**

**What is tissue culture?**

Selective breeding and tissue culture **Triple only**

**What conditions does tissue culture need?**

Selective breeding and tissue culture **Triple only**

**Advantage of tissue culture in plant breeding programmes?**

Selective breeding and tissue culture **Triple only**

**Advantage of tissue culture in medical research?**

Any two of: more milk, more meat, more eggs, a gentle nature.

Any two of: disease resistance, larger fruit or grains, better taste, higher yield.

1/4 or 25%.

It reduces genetic variation, so the population is at greater risk from disease; inbreeding can cause health problems.

Aseptic technique to prevent contamination, and a nutrient medium (agar) with nutrients and growth hormones.

Growing new cells or plants from small pieces of tissue on a sterile nutrient medium.

Large numbers of identical cells can be grown to test drugs and study diseases.

Many genetically identical plants can be produced quickly from a small amount of tissue.

Genetic engineering

**What is genetic engineering?**

Genetic engineering

**Give an example of genetic engineering in medicine.**

Genetic engineering **Higher tier**

**What does a restriction enzyme do?**

Genetic engineering **Higher tier**

**What are sticky ends?**

Genetic engineering **Higher tier**

**What does ligase do?**

Genetic engineering **Higher tier**

**What is a vector in genetic engineering?**

Genetic engineering **Higher tier**

**Give the main stages of genetic engineering in order.**

Genetic engineering **Triple only**

**What does the Bt gene from *Bacillus thuringiensis* do in a crop plant?**

Bacteria given the human gene for insulin, so they make human insulin.

A process which involves modifying the genome of an organism to introduce desirable characteristics.

Short, unpaired strands of DNA left at the ends of a cut, which join with complementary sticky ends.

Cuts DNA at a specific base sequence.

A carrier, such as a plasmid or virus, used to insert a gene into another organism's cells.

Joins pieces of DNA together, for example the gene and the vector.

Codes for a toxin that kills insect pests, giving the plant insect resistance.

Cut out the gene (restriction enzyme), cut the vector (same enzyme), join with ligase, insert the vector into the target cells.

Genetic engineering **Triple only**

**Give two advantages of GM crops.**

Genetic engineering **Triple only**

**Give two disadvantages of GM crops.**

Agriculture and evaluating biotechnology **Triple only**

**How do fertilisers increase crop yield?**

Agriculture and evaluating biotechnology **Triple only**

**Give a disadvantage of using fertilisers.**

Agriculture and evaluating biotechnology **Triple only**

**What is biological control?**

Agriculture and evaluating biotechnology **Triple only**

**Advantage and disadvantage of biological control?**

Agriculture and evaluating biotechnology

**Give a benefit of selective breeding in agriculture.**

Agriculture and evaluating biotechnology

**Give a risk of genetic engineering in agriculture.**

Possible risk to human health; genes may spread to wild plants; expensive seeds; ethical concerns.

Higher yield because less is lost to pests, and less insecticide is needed. They can also have extra characteristics such as greater nutritional value.

They can be washed into rivers and lakes, causing pollution, and they cost money.

They add mineral ions, such as nitrates, that plants need for growth.

Advantage: no chemical residues.  
Disadvantage: slow, may not remove all pests, or the control organism may become a pest.

Using living organisms to control pests, for example ladybirds eating aphids.

Unknown effects on the environment or health, or genes spreading to wild species.

Higher yields and better quality food, with no special technology needed.

Agriculture and evaluating biotechnology

**Give an ethical implication of genetic engineering.**

Agriculture and evaluating biotechnology

**Give a practical implication of genetic engineering or selective breeding.**

Agriculture and evaluating biotechnology

**A yield rises from 4.0 to 5.0 tonnes per hectare. What is the percentage increase?**

Cost, time (selective breeding takes many generations), skill, and the method may not work.

Some people think it is wrong to alter the genes of organisms, especially animals.

$$(5.0 - 4.0) \div 4.0 \times 100 = 25\%.$$