

23 Variation and selection - answers

- 1 The two main causes of heritable variation are mutations and recombinations.
- 2 (i) *Entirely genetic*: eye colour, maleness, blood group, natural hair colour, sickle-cell anaemia.
(ii) *Environmental and genetic*: obesity, tallness, ability to sing, masculinity, agility.
- 3 Alleles are genes which occupy corresponding positions on *homologous* (A) chromosomes. They control the same *characteristic* (B) but not necessarily in the same way.
- 4 (a) New combinations would be tall plants with red flowers, or dwarf plants with white flowers.
(b) Tall, red-flowered plants might attract more insects for pollination.
- 5 (a) The possible genotypes in the F₂ are
AABB aabb AaBB AABb aaBb* AaBb AAbb* aaBB* Aabb*
(b) * phenotypes different from the original pair.
- 6 (a) In this model there are twelve alleles (six pairs) which could contribute to stature. An average person would be expected, therefore, to have six dominant and six recessive alleles.
(i) The shortest person will therefore, lack the dominant alleles and be 30cm (6 x 5) shorter than average, i.e. 130cm. (ii) The tallest person will have an additional six dominant alleles and therefore be 30 cm taller than average, i.e. 190cm.
(b) If stature were controlled solely by genes, the minimum difference between individuals would be 5cm.
(c) Since height is also influenced by nutrition and health, it is very unlikely that people would differ by exactly 5cm.
- 7 (a) and (b) The blood pressures seem to differ by distinct steps (discontinuous variation). But this is because the women have been arbitrarily placed in groups whose blood pressure differs by ten units. If they had been put into groups differing by only one unit, the steps would have virtually disappeared. This variation is continuous.
- 8 (a) Continuous variation: for example, weight, height, intelligence, hair colour, skin colour, physique, blood pressure (any two).
(b) Discontinuous variation: blood group, sex, eye colour (more or less), presence or absence of certain genetic diseases (e.g. albinism, haemophilia), free or attached ear lobes (any two).
- 9 The least accurate statement is (d). Continuous variation can be wholly genetic (e.g. hair colour) or result from a combination of genetic and environmental effects (e.g. skin colour).
- 10 Identical twins are derived from the same fertilised ovum (zygote) and will therefore have the same sets of chromosomes and genes.

Variation and selection - answers (continued)

11 When *Darwin* (A) and *Wallace* (B) put forward the theory of Natural Selection in 1858, they observed that there are *variations/differences* (C) between the individuals of a species. They also observed that organisms produce more offspring than can possibly *survive/live* (D) to maturity. If the *variations/differences* (E) are inherited and give the individuals an advantage over the other members of the species, they will live *longer* (F) and so leave more offspring with the beneficial *variation/difference* (G).

12 1 st generation	{ 2 parents	2
	{ 6 babies	6
2nd generation	{ When mature, they form 3 pairs	
	{ which each have 6 babies (3 x 6)	18
3rd generation	{ 18 babies; when mature they form 9	
	{ pairs which each have 6 babies (9 x 6)	54
		<u>80</u>

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<i>Type of competition</i>	<i>Favourable competition</i>
For food	Can eat a wider variety of food, more efficient digestion, better hunting or searching technique, more acute sense organs.
For mates	Brighter colouring; spectacular display; more aggressive to rivals.
For shelter	Superior burrowing or climbing skills; more sophisticated nest building; better concealment

14 For a beneficial variation to have a selective advantage in the course of evolution, it must be *inherited* (A) by the offspring.

15 Evolution is thought to come about as a result of *mutations* (A) which produce new *varieties* (B). These gradually replace the original population as a result of *natural selection* (C).

16 The most acceptable statement is (a). Statements (b) and (c) imply a direct line of evolution from existing apes to humans. Statement (d) is too vague to have much significance.

17 (i) In a cereal variety, a breeder might select for high yield; disease-, frost- or drought-resistance; early maturation; short straw (easier to harvest); reduced need for fertilisers; good quality of product (e.g. high in protein); processing qualities (e.g. good for making bread).

(ii) In a farm animal a breeder might select for high yield (wool, milk, meat); good meat/fat ratio; disease resistance; fertility (more offspring).

23 Variation and selection

1 What are the two main causes of heritable variation?

2 Classify the following variations as either (i) caused entirely by genetic effects or (ii) caused by a combination of genetic and environmental effects.

obesity, eye colour, tallness, ability to sing, maleness, masculinity, blood group, natural hair colour; sickle-cell anaemia, agility

3 Alleles are genes which occupy corresponding positions on..... A chromosomes. They control the same B but not necessarily in the same way.

4 (a) What new combinations of characteristics might arise in the offspring when a tall plant with white flowers is crossed with a dwarf plant (of the same species) with red flowers?
(b) What selective advantage might either of the new varieties have?

5 The genotypes of two guinea pigs, for two characteristics are represented as **AABB** and **aabb**. These guinea pigs are mated, and their offspring eventually mate with each other.

(a) What genotypes could emerge in the second generation?

(b) Which of these would be phenotypically different (i.e. be different in appearance) from the original pair?

6 Suppose that there are six pairs of alleles which control height and that each dominant allele adds 5cm to the stature. Suppose also that the average height of an adult (with equal numbers of recessive and dominant alleles) is 160cm

(a) What is (i) the tallest, (ii) the shortest person you would expect from this pattern?

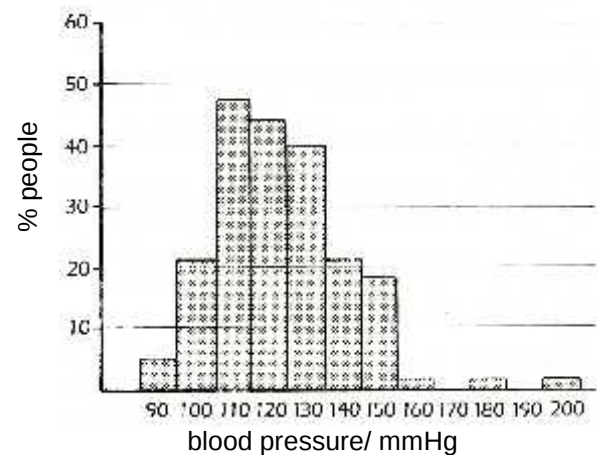
(b) On this basis, what would be the minimum difference in height between any two people?

(c) Why is this minimum difference unlikely to be observed in reality?

7 The histogram shows the range and frequency of occurrence of particular blood pressures (systolic) in a group of women in the 30-39 age group.

(a) On this evidence, could you say that blood pressure is a discontinuous variable?

(b) Justify your answer.



8 Give two examples in each case of (a) continuous, (b) discontinuous variation in human populations.

9 Which one of the following statements is the least accurate?

(a) Discontinuous variation results entirely from genetic differences.

(b) Continuous variation can result from genetic differences.

(c) Discontinuous variation cannot be altered by environmental effects.

(d) Continuous variation results from environmental effects.

Variation and selection (continued)

10 Explain why identical twins will have the same genotype.

11 When A and B put forward the theory of Natural Selection in 1858 they observed that there are C between the individuals of a species. They also observed that organisms produce more offspring than can possibly Dto maturity. If the E are inherited and give the individuals an advantage over the other members of the species, they will live F and so leave more offspring with the same beneficial G

12 A pair of mice has, on average, a litter of six babies. Assuming (i) that there are equal numbers of males and females in the litters, (ii) that the offspring breed freely amongst themselves, how many mice will there be after three generations?

13 (a) Give three examples of types of competition between members of an animal species in the same population.

(b) In each case suggest a variation that might help an individual to compete more effectively.

14 For a beneficial variation to have a selective advantage in the course of evolution, it must be A by the offspring.

15 Evolution is thought to come about as a result of A which produce new B These gradually replace the original population as a result ofC

16 Which of the following statements is most acceptable from an evolutionary point of view?

- (a) Apes and humans have evolved from a common ancestor.
- (b) Humans have evolved from apes.
- (c) Certain apes have gradually evolved into humans.
- (d) Apes and humans are related.

17 What characteristics might a breeder select for in (i) a cereal crop, (ii) a farm animal?