Chp 14: Inheritance

Learning Outcomes

Candidates should be able to:

- ☐ (a) distinguish between the terms gene and allele
- ☐ (b) explain the terms dominant, recessive, codominant, homozygous, heterozygous, phenotype and genotype
- ☐ (c) predict the results of simple crosses with expected ratios of 3:1 and 1:1, using the terms homozygous, heterozygous, F1 generation and F2 generation
- ☐ (d) explain why observed ratios often differ from expected ratios, especially when there are small numbers of progeny
- ☐ (e) use genetic diagrams to solve problems involving monohybrid inheritance
- ☐ (f) explain co-dominance and multiple alleles with reference to the inheritance of the ABO blood group phenotypes (A, B, AB, O) and the gene alleles (IA, IB and IO)
- ☐ (g) describe the determination of sex in humans – XX and XY chromosomes
- ☐ (h) describe mutation as a change in the sequence of a gene such as in sickle cell anaemia, or in the chromosome number, such as the 47 chromosomes in the condition known as Down syndrome
- ☐ (i) name ionising radiation (e.g. X-ray) and chemical mutagens as factors which may increase the rate of mutation
- ☐ (j) distinguish between continuous and discontinuous variation and give examples of each.

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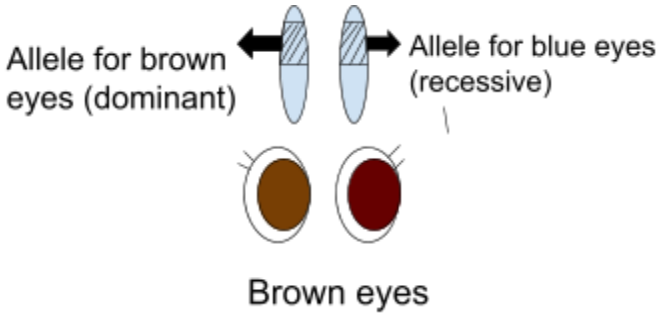
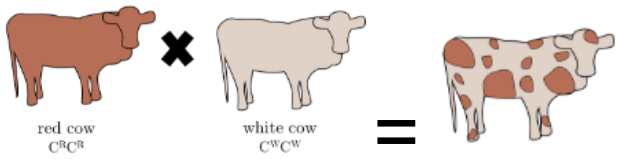
… VS …	
Gene: a sequence of DNA nucleotides that control the formation of a single polypeptide. A unit of inheritance.	**Allele**: Different forms of the same gene. They occupy the same relative position on a pair of homologous chromosomes.
Homozygous: having 2 identical alleles of a particular gene (eg DD/ dd)	**Heterozygous**: having 2 different alleles of a particular gene (eg Dd)
Dominant allele: the allele that is expressed (the outward appearance) - Can be represented by a uncapitalised letter (D**d**)	**Recessive allele**: the allele that is unexpressed (not seen on the outward appearance) - Can be represented by a capitalised letter (**D**d)
	
Genotype: the combination of alleles for a particular gene (how your **g**enes look)	**P**henotype: The expressed trait (the outward appearance / **P**hysical trait)

Codominance: both alleles express themselves in the heterozygote, which has a phenotype intermediate between that of its purebred parents.



eg : Red cow + white cow = red and white cow

Q: Why do observed ratios often differ from expected ratios, especially when there are small numbers of progeny?
ANS: Statistically, ratios are inaccurate when sample numbers are small.
Also, during fertilisation, the fusion of gametes is random, hence the actual number of offspring will be unlikely to match the expected ratio precisely. (TB Pg 388)

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Determining Blood Types

- The alleles for blood groups A, B and O are designated I^A , I^B , I^O respectively.
- **IA and IB** are dominant over IO (eg people with alleles IO and IA will have blood group B, people with IO and IB will have blood group B
- I^A , I^B express codominance and will have the blood group AB.

Determining Sex

- Females have XX chromosomes, males have XY

Mutation: a change in the sequence of a gene (eg in sickle cell anemia), or in the chromosome number eg people with Down syndrome have an extra chromosome, 47 in total)

Factors increasing rate of mutation:

- Ionising radiation
- Chemical mutagens

Continuous vs Discontinuous Variation

Figure 18.19 Graph showing discontinuous variation

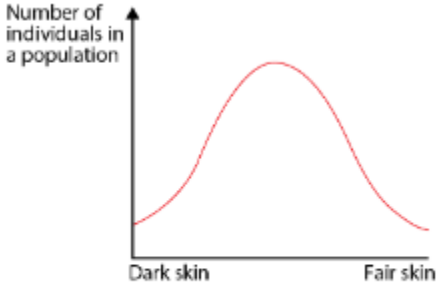

Figure 18.20 Graph showing continuous variation

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Table 18.7 Distinguishing discontinuous variation from continuous variation

Discontinuous Variation	Continuous Variation
Involves a few clear-cut phenotypes (e.g. green or yellow seeds in pea plants)	Involves a range of phenotypes (e.g. human skin colour)
Controlled by one or a few genes	Controlled by many genes
Genes do not show additive effect	Genes show additive effect
Relatively unaffected by environmental conditions	Greatly affected by environmental conditions

(additive effect- the combined effect of many genes)

(TB Pg 400)

Sources of Genetic variation: Meiosis, Random Fertilisation, Mutation

- Variation and competition lead to differential survival of, and reproduction by, those organisms best fitted to the environment. 💪
- Natural selection is a possible mechanism for evolution, which is a gradual change in the inheritable characteristics of a population over time.

An example of environmental factors that act as forces of natural selection:

- In 1848, England experienced industrialisation and many trees that surrounded factories producing smoke were covered in black dust. After this, the number of moths with dark coloured wings increased in the area. This was because they could camouflage better on the blackened tree trunks and could avoid getting eaten, and had more time to reproduce.