Biology: Genetics, Inheritance and Populations

Monohybrid inheritance

1. Identify parent genotype → **BB x bb**
2. Identify gametes
3. Complete the Cross clearly

male / female	B	B
b	Bb	Bb
b	Bb	Bb

Genotypes of offspring

4.
5. Describe the phenotypes and give a %, ratio, fraction eg: So 100% brown

Genetic Cross terminology

F_1 generation	Are the first generation of offspring
F2 generation	When F_1 generations are cross bred
backcross	When offspring are cross bred with their parents (plants and animals not humans)
polyploidy	When an organism has 3 or more times the haploid number of chromosomes (usually in plants)

Chi– Squared test

1. $$X^2 = \sum \frac{(o-e)^2}{e}$$
2. Compares observed (O) and expected (E) results from test crosses to see if **differences** are probably due to chance
3. A **null hypothesis** would state that there is no scientific reason for a difference between O and E
4. Work out degrees of freedom by subtracting 1 from the number of phenotypes. 4 flower colours = 3 degrees of freedom.
5. Find where the X^2 calculated value falls compared to the critical p values in the probability column of 0.05.
6. X^2 values in the columns above the 0.05 p value column show that differences between O and E are NOT significant.
7. The null hypothesis would be accepted in this case.

Hardy Weinberg Equation

The frequency of the dominant and recessive allele and the phenotypes in a population can be calculated.

$p + q = 1$ and $p^2 + 2pq + q^2 = 1$

- where 1 denotes the 'whole' population
- frequency measures how common the allele or phenotype is in the population
- can be expressed as a % or a probability – read what the question asks for

Key Vocabulary

Gene	A section of DNA that codes for the production of a protein.
Locus	The position of a gene on a chromosome.
Allele	An alternative form of a gene that occurs at the same locus on homologous chromosomes.
Dominant	The allele is always expressed, even if one copy is present.
Recessive	The allele is only expressed if the individual has two copies
Codominant	**The alleles** are both equally expressed in the same phenotype
Monohybrid cross	A genetic cross involving the alleles for one characteristic
Dihybrid cross	A genetic cross involving the alleles for two characteristics
Sex linked allele	An allele carried on a sex chromosome. Usually the X and carried into the gamete with that chromosome during meiosis.
Autosomal linked allele	An allele carried on any of the other chromosomes (autosomes) and carried into the gamete with that chromosome.
Epistasis	At each locus are two alleles that dictate a phenotypes. The expression of one is dependent on the inherited form of the other

Key Vocabulary Evolution

Fundamental niche	This any place and all the interacting factors where an organism is able to live.
Realised niche	This is the place and all the interacting factors where an organism actually lives because it is best adapted to living there.
Carrying capacity	The number of organisms that an ecosystem can sustainably support.
Interspecific competition	Competition for survival between members of different species
Intraspecific competition	Competition for survival within the same species

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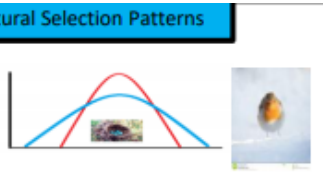
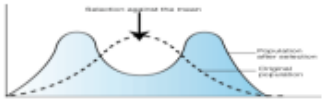
Key Descriptions

Mutation	A gene **mutation** is a permanent alteration in the DNA sequence that makes up a gene.
Natural Selection	Organisms that are better adapted to an environment will survive and reproduce*. This **means** that the advantageous alleles of their phenotype are passed on to offspring.* 'survival of the fittest'
Evolution	Evolution is change in the alleles inherited by offspring in generations spanning thousands of years.
Allopatric speciation	A physical barrier separates a group from the main population, such as a mountain range or a waterway or a freak event, making it impossible for them to get back to breed with the main population. Eg: Darwin's Finches
Sympatric speciation	Reproductive isolation occurs within a population without geographic isolation. Eg: birdsong, courtship dances, pollen release times.
Genetic Drift	**Genetic drift** is the change in allele frequencies of a population due to random chance events, such as natural disasters.
Bottleneck	A type of genetic drift, occurs when a population rapidly decreases in size. Eg: Only a few individuals survive a near extinction event.
Founder effect	When a new population has to establish from a small number of 'founding ' individuals. A bottleneck event is followed by the founder effect.

Natural Selection to Speciation

1	**Variation** naturally exists between members of a species or a random **mutation** occurs.
2	This variation may cause some individuals to be **better adapted** to survival in their habitat
3	If a **new** disease, predator or competitor comes along or there is a **new** environmental change.
4	*[This may happen because a group has become permanently separated from the main population and* ***isolated.*** *(Allopatric or Sympatric)]*
5	Those better adapted **survive** and **reproduce**
6	Passing on their **useful genes** to their offspring
7	As this happens over thousands of years … the group becomes so **genetically different** to the original species that a NEW SPECIES is formed.
8	A **species** is a is a group of organisms that can successfully reproduce with one another and produce **fertile offspring**. This is SPECIATION.

Natural Selection patterns

Stabilising Selection		In Robins the most successful egg number is 4 – less eggs and there is a risk none hatch – more than 4 means the adults cannot feed all the baby birds
Directional Selection		If seed size increases in a year birds with the biggest beaks get the most food – small beaked birds starve.
Disruptive Selection		The white rabbit is predated more in the habitat as the brown and black varieties are better camouflaged.