Essay One- Why are offspring from the same parent different in Appearance?

DNA is made up of monomers called Nucleic acids formed from a sugar phosphate backbone, a pentose sugar called deoxyribose and nitrogen containing base. DNA is stored in the nucleus of a cell and is used to store genetic information, it is the genetic information stored in our cells that leads to individuals being genetically unique and expressing different characteristics. In Eukaryotic cells DNA is linear and associated with proteins called histones, which help to support the DNA. A gene is made up of DNA bases coding for a specific polypeptide or functional RNA. It is the sequence of amino acids in a polypeptide that forms the specific primary structure of a protein. Each amino acid is coded for by a sequence of three bases in a gene called a triplet. It is the specific arrangement of amino acids coded for that result in difference of appearance.

However, mutations can occur and cause changes to the base sequence of DNA. An example of a mutation is substitution, this means that one base is substituted for another, similarly, deletion can occur, in which a base is deleted. This causes a mutation as the amino acid coded for could be altered meaning the protein that is coded for could differ. Mutations that do alter the amino acids that are coded for change certain characteristics that are expressed leading to difference in appearance between offspring. Mutations do no always cause a change in the amino acid coded for as the DNA code is degenerate, some amino acids are coded for by more than one DNA triplet.

One of the main reasons for offspring having a difference is appearance is Meiosis. Meiosis causes genetic variation between the four haploid cells that are produced at the end of the stage two. Meiosis occurs in the gametes of organisms and is in control of the genetic information that is passed on to offspring. During Meiosis one chromatids cross over, resulting in the four daughter cells formed contain chromatids with different alleles. During crossing over, the chromosomes of homologous pairs come together, chromatids cross over, one chromosome from each homologous pair ends up in each cell resulting in each cell having a different chromatid and therefore a different set of alleles, increasing genetic variation. The other way meiosis leads to genetic variation is through independent segregation. When homologous pairs are separated in Meiosis one, it is completely random what chromosome from each pair ends up in each daughter cell, so the four daughter cells produced have completely different combinations of maternal and paternal chromosomes. The fact that independent segregation random means that offspring have different chromosomes, containing different genetic information, leading to a difference in appearance between offspring.

As previously stated, allele combinations lead to genetic variation. Humans have two alleles for each gene, however gametes contain one allele for each gene and when fertilisation occurs, the two gametes fuse together and form the genotype and the phenotype of the offspring. Alleles can be dominant or recessive, if the dominant allele is passed on, the offspring will express the trait, however, two recessive alleles need to be inherited for the recessive trait to be expressed, for example eye colour, the allele for Brown eyes is dominant and the allele for blue eyes is recessive, if the allele for brown eyes and blue eyes is inherited, then the offspring will have brown eyes, however if two alleles for blue eyes are inherited, the offspring will express blue eyes. Punnet squares can be used to predict the genotype and phenotype of an organism. Some genes have codominant alleles, both alleles are expressed in the phenotype, neither one being recessive. Furthermore, some characteristics are sex linked – the allele that codes for a characteristic is located on the sex chromosome. This explains how offspring with the same parents can be different in appearance, as if one is male and one female, the male is more likely to show recessive phenotypes of genes that are sex linked. This is because, in mammals, females have two X chromosomes, whereas males have one X chromosome and one Y chromosome. The Y chromosome is smaller that the X chromosome so carries fewer genes, as males only have one X chromosome, they often only have one allele for the sex-linked genes, meaning even if the allele is recessive it will still be expressed.

Epigenetics can also control gene expression. Increased methylation of DNA can switch a gene off, increased methylation changes the DNA structure, so the transcriptional machinery can not interact with the gene, so the gene is not expressed. Decreased acetylation also switches a gene off, when acetyl groups are added the

chromatin is less condensed, so the transcriptional machinery can access the DNA and the gene can be transcribed. When, acetyl groups are removed the chromatin becomes highly condensed and the genes can't be transcribed so the gene is switched off. An offspring can inherit epigenetic changes. Most epigenetic markers are removed before they are passed on, however those that aren't removed can be passed onto the offspring, resulting in changes in and between offspring.

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