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NCERT Class 10 Chapter 9 Heredity and Evolution CBSE Board Sample Problems Long Answer (For CBSE, ICSE, IAS, NET, NRA 2022)

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Question

Mention the function of cellular DNA. Taking tallness as a characteristic for a plant, explain how proteins control the characteristic.

Solution

- Cellular DNA is the information source for making proteins in the cell. A section of DNA that provides information for one protein is called the gene for that protein. How do proteins control the characteristics that we are discussing here? Let us take the example of tallness as a characteristic.
- We know that plants have hormones that can trigger growth. Plant height can thus depend on the amount of a particular plant hormone. The amount of the plant hormone made will depend on the efficiency of the process for making it.
- Consider now an enzyme that is important for this process. If this enzyme works efficiently, a lot of hormone will be made, and the plant will be tall. If the gene for that enzyme has an alteration that makes the enzyme less efficient, the amount of hormone will be less, and the plant will be short.
- Thus, genes control characteristics, or traits.

Question

A group of grass hoppers - some green and some brown lived in grassland having dry bushes and dry grass.

- (a) Which one would normally be picked up by predatory birds and why?
- (b) Population of which grasshopper will increase?
- (c) Name this phenomenon

Solution

- (a) Green as they can be easily identified

(b) Brown as they can easily hide themselves in dry bushes.

(c) Natural selection

Question

List the steps involved in the formation of new species

Solution

- The population is first of all separated by geographical barrier into two sub population so that there is no exchange of genes between them. Such kind of population is known as geographically isolated population.
- Natural selection and genetic drift will occur either in both sub population or only in one due to which variation will keep on increasing.
- After thousands of years both the population will become so different from each other that they fail to reproduce so it can be said that the new species has emerged from the existing species.

Question

Explain giving examples how artificial selection has helped in the formation of newer varieties of cauli flower

Solution

- Humans have far more than 2000 years cultivated wild cabbage as a food plant and generated different vegetables from it by selection. This process since it was done artificially is called artificial selection.
- Ex- some farmers wanted to select the plant for short distances b/w the leaves and thus have artificially bred cabbage we eat. Some have wanted to select for arrested flower development, and have bred broccoli, or for sterile flowers, and have made the cauliflower.
- Some have selected for swollen parts, and come up with kohlrabi. Some have simply looked for slightly larger leaves, and come up with a leafy vegetable called kale.

Question

How is the sex of child determined in human beings?

Solution

- The explanation lies in the fact that all human chromosomes are not paired. Most human chromosomes have a maternal and a paternal copy, and we have 22 such pairs. But one pair, called the sex chromosomes, is odd in not always being a perfect pair. Women have a perfect pair of sex chromosomes, both called X.

- But men have a mismatched pair in which one is a normal-sized X while the other is a short one called Y. So women are XX, while men are XY. All children will inherit an X chromosome from their mother regardless of whether they are boys or girls.
- Thus, the sex of the children will be determined by what they inherit from their father. A child who inherits an X chromosome from her father will be a girl, and one who inherits a Y chromosome from him will be a boy.

Question

Give reasons why acquired characters are not inherited,

Solution

- Every character is influenced by genes and environment. But genetic traits are inherited as their information is stored in DNA. Acquired characters do not produce change in the DNA of germ cells, so they cannot be inherited.
- Only those characters which have a gene for them can be inherited. Example: Tanning of complexion due to extended exposure to sunlight will not be a permanent change and will not bring any change in DNA.
- Hence such changes will not be inherited. However, our skin color is a genetically controlled trait and will be transferred from one generation to other.

Question

Evolution has exhibited a greater stability of molecular structure when compared with morphological structures. Comment on the statement and justify your opinion.

Solution

- We see immense diversity in size, form, structure and morphological features in the living world. But at the molecular level these, diverse types of organism's exhibit unbelievable similarity. For instance, the basic biomolecules like DNA,
- RNA, carbohydrates, proteins etc. exhibit remarkable similarity in all organisms.
- The nucleotides, sugar-phosphate backbone and the fundamental way in which the three base codon, code for 20 amino acids (including start and stop codons) are very similar in diverse living forms 20 primary amino acids in life have not be replaced by some of the very large number of alternatives that exist in nature, such as in meteorites (> 60 amino acids have been found in certain carbonaceous meteorites) .
- Hence, evolution has exhibited a greater stability of molecular structure when compared with morphological structures.

Question

Caucasoid (white) , Mongoloid (yellow) , Negroid (black) and Australoid might have evolved from a common ancestor. Provide a few evidences in support of this view.

Solution

- Caucasoid (white) , Mongoloid (yellow) , Negroid (black) and Australoid might have evolved from a common ancestor because of Common body plan, structure, physiology and metabolism.
 - Constant chromosome number
 - Common genetic blue print
 - Freely inter-breeding

Question

How sexual reproduction creates genetic variation which is needed for better adaptation to changing environment? Provide a suitable explanation.

Solution

Sexual reproduction increases genetic variation in offspring, which in turn increases the genetic variability in species.

INDEPENDENT ASSORTMENT OF CHROMOSOMES

- Independent assortment occurs when homologous chromosomes separate during anaphase I of meiosis. The way the pairs are oriented during metaphase I, in one cell is different from the way they're oriented in another cell.
- When the homologous chromosomes separate, many different combinations of homologous chromosomes can travel together toward the same side of the cell. (2^{23} that's 8,388, 608) to be exact.

RANDOM COMBINATION OF GENES DURING FERTILIZATION

- Fertilization produces random combinations of genetically diverse sperm and eggs, creating virtually unlimited possibilities for variation. Millions of genetically different sperm swimming toward an egg.
- Fertilization is random, so the sperm that wins the race in one fertilization event is going to be different than the sperm that wins the next race.
- And, of course, each egg is genetically different too.

NEW GENETIC COMBINATION DURING CROSSING-OVER

- When homologous chromosomes come together during prophase I of meiosis, they exchange small segment of DNA with each other.
- This crossing-over results in new gene combinations and new chances for variety.

NONDISJUNCTION OF HOMOLOGOUS CHROMOSOMES

When chromosomes don't separate the way they're supposed to, that's called nondisjunction. Occasionally, a pair of chromosomes don't separate, and both members of the pair end up in the same gamete.

Question

Does geographical isolation of individuals of a species lead to formation of a new species? Provide a suitable explanation.

Solution

- Yes, geographical isolation gradually leads to genetic drift. This may impose limitations to sexual reproduction of the separated population.
- Slowly the separated individuals will reproduce among themselves and generate new variations.
- Continuous accumulation of those variations through a few generations may ultimately lead to the formation of a new species.

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