

CBSE Class 10 Science
NCERT Exemplar Solutions
Chapter 9
Heredity and Evolution

Exercise

Multiple Choice Questions (MCQs)

1. Exchange of genetic material takes place in

- (a) vegetative reproduction
- (b) asexual reproduction
- (c) sexual reproduction
- (d) budding

Ans. (c) Sexual reproduction

Explanation: All other options show asexual reproduction in which genes are contributed by a single parent. In sexual reproduction, genes are contributed by two parents and hence exchange of genetic material take place.

2. Two pink colored flowers on crossing resulted in 1 red, 2 pink and 1 white flower progeny. The nature of the cross will be

- (a) double fertilization
- (b) self-pollination
- (c) cross fertilization
- (d) no fertilization

Ans. (c) Cross fertilization

Explanation: The term 'cross' in the question indicate towards cross fertilization.

3. A cross between a tall plant (TT) and short pea plant (tt) resulted in progeny that were all tall plants because

- (a) tallness is the dominant trait
- (b) shortness is the dominant trait
- (c) tallness is the recessive trait
- (d) height of pea plant is not governed by gene 'T' or 't'

Ans. (a) tallness is the dominant trait

Explanation: In mono hybrid cross, dominant character is the only character expressed in the first generation of progeny.

4. Which of the following statement is incorrect?

- (a) For every hormone there is a gene.
- (b) For every protein there is a gene.
- (c) For production of every enzyme there is a gene.
- (d) For every molecule of fat there is a gene

Ans. (d) For every molecule of fat there is a gene

Explanation: Hormone and enzymes are made up of proteins and formation of any particular protein is also controlled by a particular gene. But fat formation does not depend on gene. Hence, all other options are correct.

5. If a round, green seeded pea plant (RR yy) is crossed with wrinkled, yellow seeded pea plant, (rr YY) the seeds produced in F₁ generation are

- (a) round and yellow
- (b) round and green

(c) wrinkled and green

(d) wrinkled and yellow

Ans. (a) round and yellow

Explanation: Here, roundness and yellow color, are dominant characters. These will be fully expressed in F_1 generation.

6. In human males all the chromosomes are paired perfectly except one. This/ these unpaired chromosomes is/are

(i) large chromosome

(ii) small chromosome

(iii) Y-chromosome

(iv) X-chromosome

(a) (i) and (ii)

(b) (iii) only

(c) (iii) and (iv)

(d) (ii) and (iv)

Ans. (c) (iii) and (iv)

Explanation: These are sex chromosomes determining the gender of the offspring.

7. The maleness of a child is determined by

(a) the X chromosome in the zygote

(b) the Y chromosome in zygote

(c) the cytoplasm of germ cell which determines the sex

(d) sex is determined by chance

Ans. (b) the Y chromosome in zygote

Explanation: If a sperm with Y chromosome fertilizes the egg, the resulting zygote would develop into a male child.

8. A zygote which has an X-chromosome inherited from the father will develop into a

- (a) boy
- (b) girl
- (c) X- chromosome does not determine the sex of a child
- (d) either boy or girl

Ans. (b) Girl

Explanation: As X-chromosome from the father will mate the X-chromosome of the mother resulting in XX-chromosome of the child as 23rd pair.

9. Select the incorrect statement

- (a) Frequency of certain genes in a population change over several generations resulting in evolution
- (b) Reduction in weight of the organism due to starvation is genetically controlled
- (c) Low weight parents can have heavy weight progeny
- (d) Traits which are not inherited over generations do not cause evolution

Ans. (b) Reduction in weight of the organism due to starvation is genetically controlled

Explanation: Weight loss/gain depends on external factors and are not carried genetically.

10. New species may be formed if

- (i) DNA undergoes significant changes in germ cells
- (ii) chromosome number changes in the gamete

- (iii) there is no change in the genetic material**
- (iv) mating does not take place**

- (a) (i) and (ii)
- (b) (i) and (iii)
- (c) (ii), (iii) and (iv)
- (d) (i), (ii) and (iii)

Ans. (a) (i) and (ii)

Explanation: If there is no change in the genetic material, then no evolution would take place. Sexual reproduction cannot take place without mating. Hence, statements (iii) and (iv) are incorrect.

11. Two pea plants one with round green seeds (RRyy) and another with wrinkled yellow (rrYY) seeds produce F₁ progeny that have round, yellow (RrYy) seeds. When F₁ plants are selfed, the F₂ progeny will have new combination of characters. Choose the new combination from the following



















- (i) Round, yellow**
- (ii) Round, green**
- (iii) Wrinkled, yellow**
- (iv) Wrinkled, green**

- (a) (i) and (ii)
- (b) (i) and (iv)
- (c) (ii) and (iii)
- (d) (i) and (iii)

Ans. (c) (ii) and (iii)

Explanation: As we see in punette square, the new combination formed in F₂ progeny is

Round, green (RRyy) and Wrinkled, yellow (rrYY)

		Mother (RrYy) 			
		RY	Ry	rY	ry
Father (RrYy) 	RY	 RRYY	 RRYy	 RrYY	 RrYy
	Ry	 RRYy	 RRyy	 RrYy	 Rryy
	rY	 RrYY	 RrYy	 rrYY	 rrYy
	ry	 RrYy	 Rryy	 rrYy	 rryy

12. A basket of vegetables contains carrot, potato, radish and tomato. Which of them represent the correct homologous structures?

- (a) Carrot and potato
- (b) Carrot and tomato
- (c) Radish and carrot
- (d) Radish and potato

Ans. (c) Radish and carrot

Explanation: They have similar design and origin.

13. Select the correct statement

- (a) Tendril of a pea plant and phylloclade of Opuntia are homologous
- (b) Tendril of a pea plant and phylloclade of Opuntia are analogous
- (c) Wings of birds and limbs of lizards are analogous
- (d) Wings of birds and wings of bat are homologous

Ans. (a) Tendril of a pea plant and phylloclade of Opuntia are homologous

Explanation: They have similar design and origin, hence they are homologous.

14. If the fossil of an organism is found in the deeper layers of earth, then we can predict that

- (a) the extinction of organism has occurred recently
- (b) the extinction of organism has occurred thousands of years ago
- (c) the fossil position in the layers of earth is not related to its time of extinction
- (d) time of extinction cannot be determined

Ans. (b) the extinction of organism has occurred thousands of years ago

Explanation: Older fossils are found in deeper layers.

15. Which of the following statements is not true with respect to variation?

- (a) All variations in a species have equal chance of survival
- (b) Change in genetic composition results in variation
- (c) Selection of variants by environmental factors forms the basis of evolutionary processes.
- (d) Variation is minimum in asexual reproduction

Ans. (a) All variations in a species have equal chance of survival.

Explanation: Only useful variations stand a chance of survival.

The nature selects the fittest variation among all.

16. A trait in an organism is influenced by

- (a) paternal DNA only
- (b) maternal DNA only
- (c) both maternal and paternal DNA

(d) neither by paternal nor by maternal DNA

Ans. (c) both maternal and paternal DNA

Explanation: Since DNA in an organism is contributed by two parents, hence traits are influenced by both maternal and paternal DNA.

17. Select the group which shares maximum number of common characters

(a) two individuals of a species

(b) two species of a genus

(c) two genera of a family

(d) two genera of two families

Ans. (a) two individuals of a species

Explanation: Species is the lowest taxon and hence members of same species share the maximum number of common characters.

18. According to the evolutionary theory, formation of a new species is generally due to

(a) sudden creation by nature

(b) accumulation of variations over several generations

(c) clones formed during asexual reproduction

(d) movement of individuals from one habitat to another

Ans. (b) accumulation of variations over several generations

Explanation: Whenever there is a variation in DNA a new species is formed. But making of clones and movement from one habitat to another does not results in DNA variation.

Moreover, Theory of Sudden Creation was disapproved by the scientists.

19. From the list given below, select the character which can be acquired but not inherited

- (a) color of eye
- (b) color of skin
- (c) size of body
- (d) nature of hair

Ans. (c) size of body

Explanation: A person can become fat or thin because of diet. A person can develop muscular body through regular exercise. But these characters cannot be inherited in the next generation.

20. The two versions of a trait (character) which are brought in by the male and female gametes are situated on

- (a) copies of the same chromosome
- (b) two different chromosomes
- (c) sex chromosomes
- (d) any chromosome

Ans. (b) Two different chromosomes

Explanation: This is the reason; one version is expressed in some progenies, while another version is expressed in some other progenies.

21. Select the statements that describe characteristics of genes

- (i) genes are specific sequence of bases in a DNA molecule
- (ii) a gene does not code for proteins
- (iii) in individuals of a given species, a specific gene is located on a particular

chromosome

(iv) each chromosome has only one gene

(a) (i) and (ii)

(b) (i) and (iii)

(c) (i) and (iv)

(d) (ii) and (iv)

Ans. (b) (i) and (iii)

Explanation: A gene codes for proteins and hence statement (ii) is incorrect. A chromosome can have many genes and hence statement (iv) is incorrect.

22. In peas, a pure tall plant (TT) is crossed with a short plant (tt). The ratio of pure tall plants to short plants in F₂ is

(a) 1: 3

(b) 3: 1

(c) 1: 1

(d) 2: 1

Ans. (c) 1:1

Explanation: A cross between (TT) and (tt) would produce progenies with following genotypes: Pure tall (TT), Mixed tall (Tt) and Short (tt). The ratio of pure tall and pure short plant is 1 : 1. Their ratio can be given by following Punette Square:

	T	t
T	TT	Tt
t	Tt	tt

1 TT : 2Tt : 1tt
3 Tall : 1 Short

23. The number of pair (s) of sex chromosomes in the zygote of humans is

- (a) one
- (b) two
- (c) three
- (d) four

Ans. (a) One

Explanation: 23rd pair contains sex chromosomes.

24. The theory of evolution of species by natural selection was given by

- (a) Mendel
- (b) Darwin
- (c) Morgan
- (d) Lamarck

Ans. (b) Darwin

25. Some dinosaurs had feathers although they could not fly but birds have feathers that help them to fly. In the context of evolution this means that

- (a) reptiles have evolved from birds
- (b) there is no evolutionary connection between reptiles and birds
- (c) feathers are homologous structures in both the organisms
- (d) birds have evolved from reptiles

Ans. (d) Birds have evolved from reptiles

Short Answer Questions

26. How is the sex of a newborn determined in humans?

Ans. Somatic cell of human beings has 23 pairs of chromosomes. Out of them the 23rd pair contains sex chromosomes. In a male, the somatic cell has X and Y chromosomes in 23rd pair. In female, the somatic cell has XX chromosomes in 23rd pair. So, a sperm can have either X or Y chromosome as the 23rd chromosome. On the other hand, an egg has X chromosome as the 23rd chromosome. When a sperm with X chromosome fertilizes the egg, the resulting zygote develops into a girl child. When a sperm with Y chromosome fertilizes the egg, the resulting zygote develops into a male child.

27. Do genetic combination of mothers play a significant role in determining the sex of a new born?

Ans. No, because mothers have a pair of X-chromosomes. All children will inherit an 'X' chromosome from their mother regardless of whether they are boys or girls. The sex of a new born is determined by the 23rd pair of chromosome of the father.

28. Mention three important features of fossils which help in the study of evolution.

Ans. (a) Fossils represent modes of preservation of ancient species.

(b) Fossils help in establishing evolutionary traits among organisms and their ancestors.

(c) The age of the fossil helps in determining the time period in which that species lived.

29. Why do all the gametes formed in human females have an X chromosome?

Ans. Human females have the two X chromosomes called sex chromosomes as 23rd pair of chromosome. During meiosis at the time of gamete formation, one X chromosome enters each gamete. Hence all the female gametes possess an X chromosome.

30. In human beings, the statistical probability of getting either a male or female child is 50: 50. Give a suitable explanation.

Ans. The sex of an infant is determined by the type of sex chromosome contributed by the male gamete. Since the ratio of male gametes containing X chromosome and those containing Y chromosome is 50: 50, the statistical probability of male or a female infant is also 50: 50.

31. A very small population of a species faces a greater threat of extinction than a larger population. Provide a suitable genetic explanation.

Ans. A small population of a species faces a greater threat of extinction than a larger population. Following are some genetic explanation for this:

(a) Inbreeding: A small population promotes inbreeding. This results in least number of variations being incorporated in subsequent generations.

(b) Genetic drift: A small population is more exposed to sudden changes in the environment. The genetic drift because of sudden changes has the potential to wipe off the entire population.

(c) Inbreeding depression: It results in negative population growth which is further detrimental to the survival of the species.

32. What are homologous structures? Give an example. Is it necessary that homologous structures always have a common ancestor?

Ans. Structures which have a common basic structure but perform different functions are called homologous structures. e.g... fore limbs of reptiles, amphibians and mammals. For example: the forelimbs of frog and dog are homologous structure, as they are comprised of similar bones which are humerus, radio-ulna, carpal and metacarpals. The forelimbs of frog

are adapted for jumping movement, while the forelimbs of dog are adapted for walking and running. Yes, they have common ancestor but variously modified to carry out different activities. It is necessary that homologous structures always have a common ancestor.

33. Does the occurrence of diversity of animals on earth suggest their diverse ancestry also? Discuss this point in the light of evolution.

Ans. Though animals have a vast diversity in structures they probably do not have a common ancestry, because common ancestry may greatly limit the extent of diversity. But we can group the animals into different groups and subgroups; on the basis of certain common characters. As many of these diverse animals are inhabiting the same habitat, their evolution by geographical isolation and speciation is also not likely. Thus, a common ancestry for all the animal is not the likely theory.

34. Give the pair of contrasting traits of the following characters in pea plant and mention which is dominant and recessive (i) yellow seed (ii) round seed.

Ans. (a) yellow — dominant

green — recessive

(b) round — dominant

wrinkled — recessive

35. Why did Mendel choose pea plant for his experiments?

Ans. (a) Easy to grow

(b) Short life span

(c) Easily distinguishable characters

(d) Larger size of flower

(e) Self pollinated

(f) Cross-Pollination can be done easily

36. A woman has only daughters. Analyze the situation genetically and provide a suitable explanation.

Ans. (a) The woman produces ova with 'X' chromosome

(b) The man produces sperms with X and Y chromosome which actually determines the sex of the baby.

Here, the X-chromosome of father's sperm combines with the X-chromosome of mother's egg resulting in daughters. The statistical probability of birth of a boy or girl is 50:50, which depends on the father.

WWW.PHYSICSGURUKUL.COM

Long Answer Questions

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

Ans. 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.

38. Bacteria have a simpler body plan when compared with human beings. Does it mean that human beings are more evolved than bacteria? Provide a suitable explanation.

Ans. It depends on our perspective through which we try to evaluate evolution. If complexity in body design is the parameter to define evolution, then human beings are more evolved than bacteria. Bacteria are unicellular while human beings are multicellular. Bacteria show cellular level of organization, while human beings show organ system level of organization. In terms of complexity human beings are definitely highly evolved compared to bacteria.

But when we compare the ability of survival, then situation is quite opposite. Human beings are living in almost every part of the earth but they can live only on land. Moreover, in extreme environmental conditions, human beings make artificial facilities to counter the adverse conditions. This means their body is not adapted to withstand extreme climatic conditions. Bacteria, on the other hand, are known to be present almost everywhere on earth. They are known to live even in some of the harshest conditions; like Sulphur spring, crater of volcano, etc. Bacteria can survive in highly acidic environment and they can survive extreme temperatures. From this angle, bacteria can be considered as more evolved than human beings.

39. All the human races like Africans, Asians, Europeans, Americans and others might have evolved from a common ancestor. Provide a few evidences in support of this view.

Ans. All the human races appear to be different but they have a large number of common characters. The list of common characters can be very long but we can make a shorter list:

- Similar size of brain.
- Bipedal locomotion
- Hair of body.
- Ability to handle tools.
- Ability to communicate using language.
- Highly complex social behavior.
- Same body design.

All these characters show a common ancestry for all human races. Moreover, the fact that all human beings are able to interbreed keeps them under the same species.

40. Differentiate between inherited and acquired characters. Give one example for each type.

Ans.

Inherited characters	Acquired characters
Alters the genotype and phenotype.	Alters phenotype only.
Is transmitted to the next generation.	Is not transmitted to the next generation.
Is a result of genetic recombination.	It is a result of organisms' response to environmental challenges.
Example: hair colour, eye colour, etc.	Example: muscular body, ability to excel in certain field, etc.

41. Give reasons why acquired characters are not inherited.

Ans. Acquired characters are acquired due to individual's response to external stimuli. These traits develop because of constant exposure to a certain stimulus and the resultant response by the individual. Let us take the example of a certain cricketer who is an excellent batsman. He could become an excellent batsman because of several reasons. Some of them

could be; his keen interest in the game, timely support from his family and friends, proper coaching at the right age and timely selection in the cricket team. All the cricketing ability could be acquired by him because of the way he responded to all the challenges and opportunity. But this does not mean that the son of this cricketer would become an excellent cricketer; because cricketing ability is not an inheritable character.

In fact, acquired characters just alter the phenotype of an individual. It has no effect on genotype. A character can only be inheritable when it changes the genotype of individual. Hence, acquired characters are not inherited.

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

Ans. The apparent structures in an organism, are termed morphological structures. Morphological structures can be easily seen by all us. Molecular structure is about the structure of biomolecules which are the integral components of organisms.

We see lot of diversity all around us. This diversity is possible because of diversity in morphological structures. This shows that morphological structures are least stable. Life which began as simple forms on the earth in now composed of many complex forms.

But despite all the evolution which have taken place through millions of years, the structure biomolecules remains the same. A DNA is same in a human and in a mouse. A protein has same structure in a bird and in a fungi. So, the molecular basis of life has not changed through all these years. This shows that evolution has exhibited a greater stability of molecular structure when compared with morphological structure.

43. In the following crosses write the characteristics of the progeny

	Cross	Progeny
(a)	RR YY × RR YY Round, Yellow Round, Yellow
(b)	Rr Yy × Rr Yy Round, Yellow Round, Yellow
(c)	rr yy × rr yy Wrinkled, green wrinkled, green
(d)	RR YY × rr yy Round, yellow wrinkled, green

Ans. (a) Round yellow (RRYY)

(b) Round yellow (RRYY), Round yellow (RrYy), Round green (RRyy), Round green (Rryy), wrinkled yellow (rrYY), wrinkled yellow (rrYy), wrinkled green (rryy).

		Mother (RrYy)			
		RY	Ry	rY	ry
Father (RrYy)	RY	RRYY	RRYy	RrYY	RrYy
	Ry	RRYy	RRyy	RrYy	Rryy
	rY	RrYY	RrYy	rrYY	rrYy
	ry	RrYy	Rryy	rrYy	rryy

(c) Wrinkled green (rryy)

(d) Round yellow (RrYy)

		rryy			
		ry	ry	ry	ry
RRYY	RY	RrYy	RrYy	RrYy	RrYy
	RY	RrYy	RrYy	RrYy	RrYy
	RY	RrYy	RrYy	RrYy	RrYy
	RY	RrYy	RrYy	RrYy	RrYy



















44. Study the following cross and showing self-pollination in F_1 , fill in the blank and answer the question that follows

Parents RRYY × rryy
 Round, Yellow × wrinkled, green
 F_1 RrYy × ?
 Round, yellow

Ans. RrYy (refer to the above Punette Square)

45. In question 44, what are the combinations of character in the F_2 progeny? What are their ratios?

Ans. Round yellow (RRYY), Round yellow (RrYy), Round green (RRyy), Round green (Rryy), wrinkled yellow (rrYY), wrinkled yellow (rrYy), wrinkled green (rryy). This can be shown by following Punette Square:

		Mother (RrYy) 			
		RY	Ry	rY	ry
Father (RrYy) 	RY	 RRYY	 RRYy	 RrYY	 RrYy
	Ry	 RRYy	 RRyy	 RrYy	 Rryy
	rY	 RrYY	 RrYy	 rrYY	 rrYy
	ry	 RrYy	 Rryy	 rrYy	 rryy

46. Give the basic features of the mechanism of inheritance.

Ans. (i) Characters are controlled by genes.

(ii) Each gene controls one character

(iii) There may be two or more forms of the gene

(iv) One form may be dominant over the other

(v) Genes are present on chromosomes

(vi) An individual has two forms of the gene whether similar or dissimilar

(vii) The two forms separate at the time of gamete formation

(viii) The two forms are brought together in the zygote.

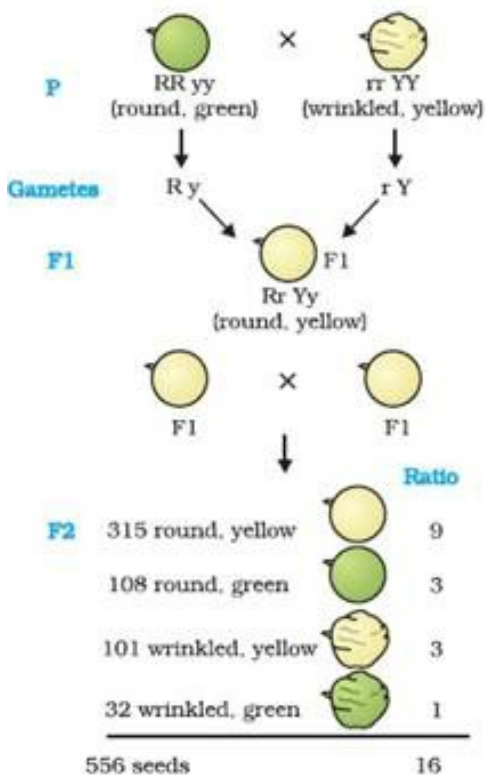
47. Give reasons for the appearance of new combinations of characters in the F₂ progeny.

Ans. During Mendel's experiment with dihybrid cross, it was seen that all the plants in F₁ generation produced round and yellow seeds. However, in F₂ generation, phenotypes of

different seeds were different. This shows new combination of characters in F₂ generation.

Out of round and wrinkled texture, round texture is the dominant character. Similarly, out of yellow and green colors, yellow color is the dominant character.

In F₁ generation, all the plants produced round yellow seeds because of dominance of characters. But genotype of all plants was of mixed characters, i.e.. RrYy. This happened because of Law of Independent Assortment. The gene for seed texture behaved independently of the gene for seed color.



Due to this, the F₂ generation showed different combination of genotype, viz. RRYy, RRYy, RrYY, RrYy, rrYY, rrYy, rryy. This can be shown by following punette square:

		mother (RrYy)			
		RY	Ry	rY	ry
father (RrYy)	RY	RRYY	RRYy	RrYY	RrYy
	Ry	RRYy	RRyy	RrYy	Rryy
	rY	RrYY	RrYy	rrYY	rrYy
	ry	RrYy	Rryy	rrYy	rryy