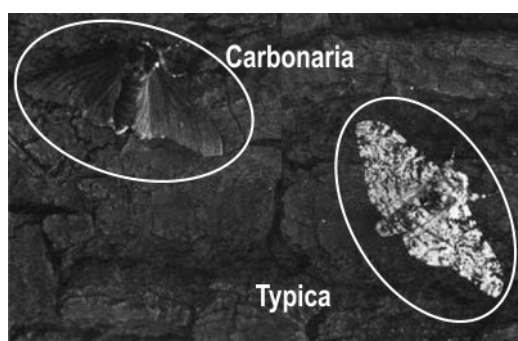


Heredity and Evolution

“In the early part of the nineteenth century, the common form of *Biston betularia*, called *typica*, had a peppered appearance. Its wings were flecked with black and white, and it was well camouflaged in its favourite resting place, the pale and lichen-covered barks of trees in rural England. A dark, or melanistic, form of the moth, called *carbonaria*, was first recorded in about 1848, and presumably had existed in very small numbers before then. But by the middle of the twentieth century, the melanistic form of the moth had come to represent over 95 percent of the *Biston betularia* population, especially in such industrial centers as Manchester and Liverpool. This is among the most rapid of all recorded evolutionary changes. Why was there such a dramatic change in fortunes of the peppered *typica* and the melanistic *carbonaria*? With rapid industrialisation, soot came to cover the barks of trees, making them black instead of pale, and also killed the lichens. Now the melanistic form was better camouflaged on the darkened bark, while the peppered form became increasingly less camouflaged and hence more easily detected and eaten by birds. The birds, which had kept the melanistic form at a very low frequency before industrialisation, now concentrated their attention on the peppered form. Natural selection, in the form of bird predation, favoured the peppered form earlier and the melanistic form later.”

-Excerpt from Survival Strategies, by Raghavendra Gadagkar.



Q: 1 Where did the variations seen in the appearance of the moth most likely come from?

- 1** The moths changed their appearance based on what was good for their survival.
- 2** The environment caused genetic changes in the moths, making them look different.
- 3** Random genetic changes and different combinations of genes arising at the time of reproduction led to the differing appearances.
- 4** Selective breeding between the most adapted moths and rapidly changing environment created a variety of moth appearances.

Q: 2 Which of the following correctly describes what is most likely to be passed on from a moth to its offspring?

- 1** the strategy the parent moth learns to escape from the predator bird
- 2** the newer patterns produced on the wings due to genetic changes
- 3** the tactics used to gather more food
- 4** (None of the above can be passed on from a moth to its offspring.)



Q: 3 In 1956, strict anti-pollution laws were enacted in England, which led to the countryside becoming relatively less polluted and free of smoke. One of the following was observed in 20 years from this event and is believed to be linked to this event. Which one could it be?

- 1** The number of the melanistic form dropped significantly.
- 2** The number of the melanistic form increased significantly.
- 3** The melanistic and peppered forms evolved into a single new form.
- 4** The melanistic and peppered forms became extinct from the countryside.

Q: 4 Select the option that correctly summarises the given observations in the passage.

- 1** Majority of the peppered moths changed their appearances to become melanistic moths so that they could survive.
- 2** The predator birds help in controlling the number of any given type of moth so that neither one gets an undue advantage of survival.
- 3** Different types of moths had to continuously make efforts to adapt themselves in order to survive in the changing environmental conditions.
- 4** It is by chance that different types of moths were present at any given point of time and the environmental factors determined which type got a survival benefit.

Q: 5 Attached earlobes in humans is an inherited condition. The allele for attached earlobes is recessive.

What are the chances of parents, both having attached earlobes, to have a child with attached earlobes?

- 1** 0%
- 2** 25%
- 3** 75%
- 4** 100%

Q: 6 A monohybrid cross is conducted between one variety of pea plants having pods that are full (FF) and another having pods that are constricted (ff).

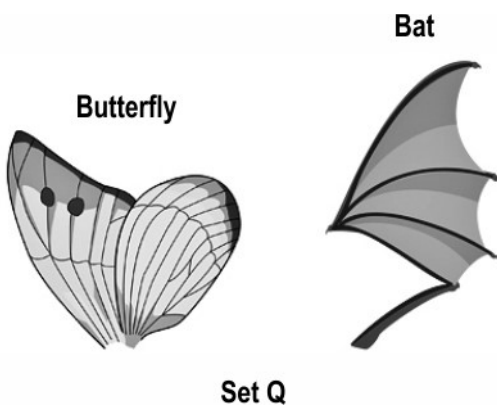
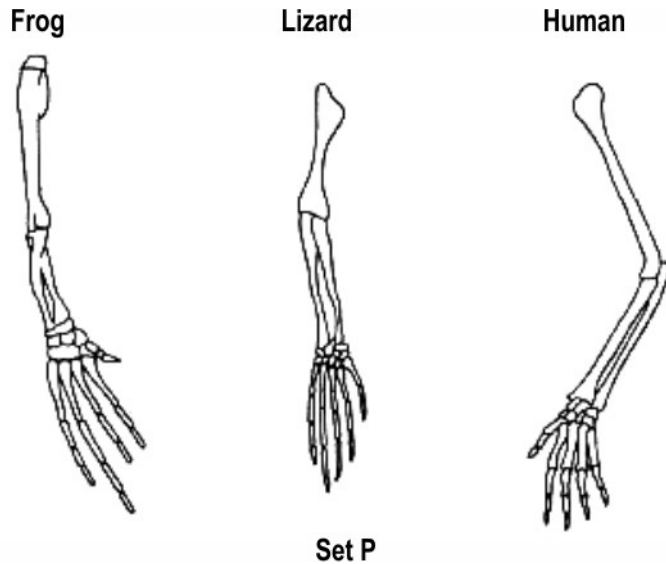
What is the percentage of heterozygous offsprings in F1 generation?

- 1** 100%
- 2** 75%
- 3** 50%
- 4** 25%



Q: 7 Evolution in living organisms can be understood by studying the characteristics of different species. These characteristics can be different or similar based on their ancestors. [3]

Given below are pictures of two sets P and Q, of organs of different species. Each set is grouped based on the evolution of these organs in different species.



- (a) Name the scientific terms that describe the evolutionary relationship of the organs in sets P and Q.
- (b) What are the differences between the two sets of organs?

Q: 8 As part of a theatrical presentation on tracing evolutionary evidences, two teams of class 10 dressed up as the following: [3]

Team P: One person each dressed as a cat and a dolphin to show the cat's leg and a dolphin's flippers as homologous organs.

Team R: One person each dressed as an insect and a bird to show the insect's wings and the bird's wings as homologous organs.

- (a) Define homologous organs.
- (b) Which of the two teams should win the presentation for correct depiction?
- (c) What is incorrect about the losing team's presentation?
- (d) Apart from such anatomical connections, name TWO other sources of evidence of evolution used by us.

Q: 9 "*Sex determination is an important developmental event in the life cycle of all sexually reproducing plants. Recent studies of sex determination in many plant species, from ferns to maize, have been fruitful in identifying the diversity of genetic and epigenetic factors that are involved in determining the sex of the flower or individual.*" [5]

The above is an excerpt from an article by two scientists Cristina Juarez and Jo Ann Banks.

- (a) What is the most likely genetic factor for sex determination in unisexual plants?
- (b) Epigenetic factors refer to factors external to the genetic component of an individual. Name evidence of ONE epigenetic condition that determines sexuality in animals.
- (c) State Mendel's law of segregation and explain how sex determination violates the law.
- (d) Which parent determines the sex of the offspring in human beings? Why?

Q: 10 Consider a pea plant that is recessive for plant height. Its 'genotype' is tt and 'phenotype' is dwarf. [5]

- (a) Assuming that the gene for plant height obeys the Mendel's laws of inheritance, indicate the genotypes and phenotypes of ALL the possible parent pairs that could have dwarf offspring.
- (b) Using any of the parent pairs mentioned by you in (a), perform a cross to show the genotypes of the offspring that might arise in the next generation.

Q: 11 Two tall pea plants are used to produce a progeny of 20 pea plants. The two parent plants have a genotype of TT and Tt respectively. [1]

How many short pea plants will be found in the progeny in the F1 generation?

Answer the following questions based on the given information.



Coelacanth is a deep sea dwelling fish that was believed to be extinct 66 million years ago, around the same time the dinosaurs went extinct. However, in 1938 a specimen of the fish was discovered near the shores of South Africa. Scientists also believe that this fish may be the member of species of fish that crawled onto land to evolve into animals with legs. Upon investigation of the specimen by marine biologists certain features of the fish was discovered.

Some of them are listed below:

(i) It has paired lobe-shaped fins that move in an alternating pattern similar to the limbs of a four-legged animal. (ii) It has a lung in its body but carries out exchange of gases through gills.



Q: 12 The lobed fin of the fish and limbs of a terrestrial animal have similar structure but different function. What are such organs called? [1]

Q: 13 A vestigial organ is an organ that is carried forward to progeny by evolution but serves no specific purpose in the body of the individual. What organ in the fish can be called a vestigial organ? [1]

Q: 14 How can scientists so accurately determine the apparent time of extinction of the fish? [1]

Q: 15 Plants that reproduce through asexual reproduction give rise to similar and not identical offsprings. [1]

What could be the most likely reason for the above statement to be true?

Pea plants can have green or yellow seeds. One of the phenotypes shows dominance over the other. A farmer decides to pollinate a flower of a plant with green seeds using pollen from a flower of a plant with yellow seeds. The resulting pod has all green seeds.

Q: 16 What should be the genotype of the parent plants to give green and yellow seeds in equal proportions? [1]

Q: 17 The farmer crosses two heterozygous green seeded plants and obtains 100 plants in the F1 generation. [1]

What would be the number of green and yellow seeds respectively in the F1 generation?

Q: 18 Sex determination in humans happens through sex chromosomes. Along with other parameters, such processes often help in forensic studies in crime investigation and / or identification of accidents and natural calamities, In order to determine whether an accident victim is male or female, which cells can be used and why? [2]

Before the Industrial Revolution, the black peppered moth was rare. During the early decades of the Industrial Revolution in England, the countryside between London and Manchester became blanketed with soot from the new coal-burning factories. Many of the light-bodied lichens died from sulphur dioxide emissions, and the trees became darkened.

This led to an increase in bird predation for light-coloured moths, as they no longer blended in as well in their polluted ecosystem.

(Source: Wikipedia:- https://en.wikipedia.org/wiki/Peppered_moth_evolution)

Q: 19 What would have happened to the population of light-coloured moth over time and why? [1]

Q: 20 What could be an external factor that determines the return of the light-coloured moths? [1]



The table below gives the correct answer for each multiple-choice question in this test.

Q.No	Correct Answers
1	3
2	2
3	1
4	4
5	4
6	1



Q.No	Teacher should award marks if students have done the following:	Marks
7	<p>(a) 0.5 marks for each:</p> <ul style="list-style-type: none"> - P: homologous - Q: analogous 	1
	<p>(a) 1 mark for each point:</p> <ul style="list-style-type: none"> - Homologous organs have the same anatomy/structure but different functions. - Analogous organs have the same function but are different in anatomy. 	2
8	(a) organs in different animals having similar structure and origin but different function	1
	(b) team P	0.5
	(c) Wings of insects and wings of birds are analogous organs.	0.5
	<p>(d) 0.5 marks each for any two correct answers such as:</p> <ul style="list-style-type: none"> - changes in DNA - geographical distribution of species - fossil records 	1
9	(a) sex chromosomes	1
	(b) Temperature of the fertilised egg determines sex of the embryo in some reptiles.	1
	<p>(c) The law of segregation states that a diploid organism passes a randomly selected allele for a trait to its offspring, such that the offspring receives one allele from each parent. [1 mark]</p> <ul style="list-style-type: none"> - If sex determination in plants is governed by genetic factors, the offspring will get one copy of a gene from each parent. - Sex determination violates the law of segregation as the human female does not have any copy of the Y-chromosomal genes. <p>[0.5 marks for each correct point]</p>	2



Q.No	Teacher should award marks if students have done the following:	Marks								
	<p>(d) 0.5 marks for each correct answer:</p> <ul style="list-style-type: none"> - the father - because the father can pass either X or Y chromosome to the offspring 	1								
10	<p>(a) (i) 0.5 marks for indicating the genotypes for each of the pairs correctly:</p> <ul style="list-style-type: none"> - Tt X Tt - Tt X tt - tt X tt <p>(a) (ii) 0.5 marks for indicating the correct phenotypes for each of the genotypes:</p> <ul style="list-style-type: none"> - Tt (tall) X Tt (tall) - Tt (tall) X tt (dwarf) - tt(dwarf) X tt (dwarf) 	3								
	<p>(b) (i) 0.25 marks for writing the four gametes correctly</p> <p>(b) (ii) 0.25 marks for writing the four genotypes correctly</p> <p>An example is shown below:</p> <table border="1"> <tr> <td></td><td>T</td><td>t</td></tr> <tr> <td>T</td><td>TT</td><td>Tt</td></tr> <tr> <td>t</td><td>Tt</td><td>tt</td></tr> </table>		T	t	T	TT	Tt	t	Tt	tt
	T	t								
T	TT	Tt								
t	Tt	tt								
11	Zero	1								
12	(a) homologous organs	1								
13	the lung	1								
14	<p>any one answer from:</p> <ul style="list-style-type: none"> - by studying the depth of the fossils in the rocks they were found in - by radioactive isotope dating 	1								



Q.No	Teacher should award marks if students have done the following:	Marks
15	inaccuracies in copying of DNA from parent to offspring / mutations	1
16	0.5 marks each for both parents' genotype: 1st parent - Gg 2nd parent - gg	1
17	0.5 marks each for numbers mentioned: green seeds : 75 yellow seeds : 25	1
18	1 mark for each correct answer: - any cell of the body - every cell has the sex chromosomes as the 23rd pair	2
19	0.5 marks for each correct answer: -Their numbers would have reduced drastically. - Predation by birds due to increased visibility of the moths.	1
20	removal of soot cover from the trees	1

