

**PRECISE**

**SAMPLE CONTENT**



# SCIENCE AND TECHNOLOGY (PART - 2)

**BASED ON TEXTBOOK AND BOARD PAPER PATTERN**



Ms. Khushbu Bohara  
M.Sc. (Botany)

Mrs. Ketki Deshpande  
M.Sc.

**STD. X**  
(Eng. Med.)

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# Precise Science and Technology **Part - 2** STD. X

## Salient Features

- ☞ Written as per the latest textbook and Board Paper Pattern
- ☞ Marks provided to the questions as per relevant weightage wherever deemed necessary
- ☞ Solved questions from Board Activity Sheets  
**March 2019 to July 2023**
- ☞ Each chapter contains:
  - 'An Overview' of the chapter to facilitate easy comprehension
  - A surfeit of objective questions for practice
  - Various types of 'Theoretical Questions' to study the concepts in depth
  - Coverage of Intext questions which are important from the board perspective
  - 'Reading between the lines' for concept elaboration
- ☞ Includes Important Features for holistic learning:
  - **Reading Between the Lines** - **Important words** - **HOTS**
  - **Hints to Objective Questions**
- ☞ Q.R. codes provide:
  - The Video/PDF links to boost understanding of a concept or activity
- ☞ Includes Board Activity Sheet of March 2024 (Solution is provided in PDF format through Q.R. code)

Printed at: **Print to Print**, Mumbai

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## PREFACE

'Precise Science and Technology Part-2, Std. X' has been prepared as per the latest syllabus which is a compact yet complete guide designed to boost students' confidence and prepare them to face Std. X Board exam.

Each chapter commences with:

- **An Overview** section, facilitating a quick review of key points for students.
- **Objective Questions** categorized under specific headings such as:
  - *Choose the correct alternative* - *Name the following* - *True or False*
  - *Odd one out* - *Complete the analogy* - *Match the following*
- **Theoretical Questions** are diversified into categories like:
  - *Answer the following* - *Distinguish between* - *Give reasons*
  - *Questions based on diagram* - *Complete the given chart/table* - *Questions based on paragraph*
- A series of '**Intext Questions**' along with questions titled under 'Use your brain power', 'Can you tell' and various similar titles pave the way for a robust concept building.
- For the students to grasp a better understanding of the concept lying behind the answer, '**Reading between the lines**' has been provided wherever necessary.
- Questions that entail students to apply higher order thinking skills are marked [*HOTS*].
- **Important words** are underlined in long answers to enhance retention and recall.
- To enhance audio-visual learning, videos showing demonstration of activities / concept explanation are included wherever required.
- Solved questions from the **Board Activity Sheets** of March and July 2019, December 2020 and March and July 2022, March and July 2023 have been included to keep students updated about the kind of questions asked in the previous examinations. Questions are allotted with marks in accordance with the new marking scheme wherever possible. In examination, the question may be changed to reflect new marking scheme.

With absolute trust in our work, we hope our holistic efforts towards making this book an ideal knowledge hub for students pays off.

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.

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*A book affects eternity; one can never tell where its influence stops.*

Publisher

**Edition:** Fourth

### Disclaimer

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## KEY FEATURES

**An Overview:** It presents a concise summary of the main points within the chapter, providing a succinct overview of its contents.

**Question Types:** Optimum coverage of different types of questions i.e., diagram based questions, paragraph based questions.

**Latest Board Questions:** Includes questions from Board Activity Sheets till July 2023.

**Reading Between the Lines:** ‘Reading between the lines’ helps students to grasp a better understanding of the concept lying behind the answer. *(Students are not expected to write this as a part of the answer.)*

**Weightage of Marks:** Wherever possible, questions are allotted with marks in accordance with new marking scheme.

**Important words:** Important words are underlined in long answers to enhance retention and recall among students.

**Intext Questions:** For better concept-building, this section covers different types of questions like “Use your brain power”, “Can you tell”, etc.

**Q.R. Codes:** Q.R. code provides:

- i. Access to a video/PDF in order to boost understanding of a concept or activity.
- ii. Solution to Board Activity Sheet of March 2024.

## PAPER PATTERN

- There will be separate question papers for Part 1 and Part 2 of 40 marks each.
- Duration of each paper will be 2 hours.

| Question No. | Type of Questions  | Total Marks |
|--------------|--|-------------|
| 1.           | (A) 5 Questions of 1 mark each (Multiple Choice Questions) | 05          |
|              | (B) 5 Questions of 1 mark each (Objectives)                | 05          |
| 2.           | (A) 3 Questions of 2 marks each (Solve any 2)              | 04          |
|              | (B) 5 Questions of 2 marks each (Solve any 3)              | 06          |
| 3.           | 8 Questions of 3 marks each (Solve any 5)                  | 15          |
| 4.           | 2 Questions of 5 marks each (Solve any 1)                  | 05          |

### Distribution of marks according to question type and aims

| Sr. No. | Question type     | Marks     | Marks with option | % Marks    | Sr. No. | Aims          | Marks     | Marks with option | % Marks    |
|---------|-------------------|-----------|-------------------|------------|---------|---------------|-----------|-------------------|------------|
| 1.      | Objective         | 10        | 10                | 25         | 1.      | Knowledge     | 10        | 15                | 25         |
| 2.      | Very short answer | 10        | 16                | 25         | 2.      | Understanding | 10        | 15                | 25         |
| 3.      | Short answer      | 15        | 24                | 37.5       | 3.      | Application   | 16        | 24                | 40         |
| 4.      | Long answer       | 5         | 10                | 12.5       | 4.      | Skill         | 4         | 6                 | 10         |
|         | <b>Total</b>      | <b>40</b> | <b>60</b>         | <b>100</b> |         | <b>Total</b>  | <b>40</b> | <b>60</b>         | <b>100</b> |

[Maharashtra State Board of Secondary and Higher Secondary Education, Pune - 04]



## CONTENTS

| No. | Topic Name   | Marks | Marks with option | Page No. |
|-----|--|-------|-------------------|----------|
| 1.  | Heredity and Evolution   | 03    | 05                | 1        |
| 2.  | Life Processes in Living Organisms Part - 1                                      | 04    | 06                | 16       |
| 3.  | Life Processes in Living Organisms Part - 2                                      | 05    | 07                | 32       |
| 4.  | Environmental Management   | 05    | 07                | 51       |
| 5.  | Towards Green Energy   | 04    | 06                | 68       |
| 6.  | Animal Classification  | 04    | 06                | 81       |
| 7.  | Introduction to Microbiology   | 04    | 06                | 102      |
| 8.  | Cell Biology and Biotechnology   | 04    | 06                | 116      |
| 9.  | Social Health  | 04    | 06                | 129      |
| 10. | Disaster Management  | 03    | 05                | 140      |
|     | Board Activity Sheet of March 2024<br>(Solution in PDF format through Q.R. code) | -     | -                 | 158      |

*Note: Textual exercise questions are represented by \* mark.*

*Modified textual questions are represented by ♣ mark.*

This book comprises of **QR Codes** at strategic touch points. You can simply scan these Codes through your Smartphone camera and get a plethora of subject knowledge at your disposal. The QR Codes included herein would take you to videos that shall provide you a better understanding of 'Activities', 'Experiments', 'Projects' and 'Try This' section of the book. We hope students would maximize the use of this book with the aid of these videos.

## Exam Pointers

Students are expected to write the answers in their Examination as illustrated below.

**Multiple Choice Questions: Write only the correct option while answering the MCQ.**

1. Which of the following nitrogenous base is NOT present in DNA?  
(A) Thymine (B) Uracil  
(C) Adenine (D) Guanine

Ans: (B)

**Find out the correlation – Determine the correlation between two components and re-write it.**

2. *Herdmania* : Urochordata :: *Amphioxus* : \_\_\_\_\_  
Ans: *Herdmania* : Urochordata :: *Amphioxus* : Cephalochordata

## Reading between the lines

The explanation provided under ‘Reading between the lines’ is not expected to be a part of the answer. Its sole purpose is to provide a sound understanding of the concept behind the answer.

1. What will happen if number of consumers in environment goes on increasing gradually?

- Ans: i. If the number of consumers in the environment goes on increasing gradually, there would be a decline in the number of the prey they feed on.  
ii. A decline in the number of prey, would eventually result in a decline in the number of consumers due to scarcity of food.

Hence, increase in the number of consumers in the environment would cause an imbalance in the ecosystem.

Answer



### Reading between the lines

Considering there is a gradual increase in the number of herbivores;

- The number of producers will be comparatively less to fulfill the food requirements of large number of primary consumers (herbivores).
- As a result, many of the primary consumers (herbivores) will die due to the lack of availability of food.
- Eventually, secondary consumers (carnivores) depending upon these primary consumers will also die due to lack of food, thereby disrupting the entire food chain.

Not a part of the answer

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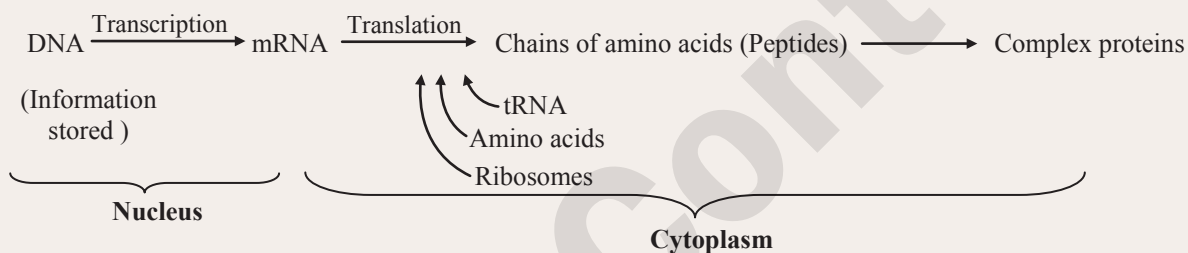
**Note:** Textual exercise questions are represented by \* mark. Textual exercise questions which are not the part of Board paper pattern are modified. These questions are represented by ♣ mark.

## An Overview

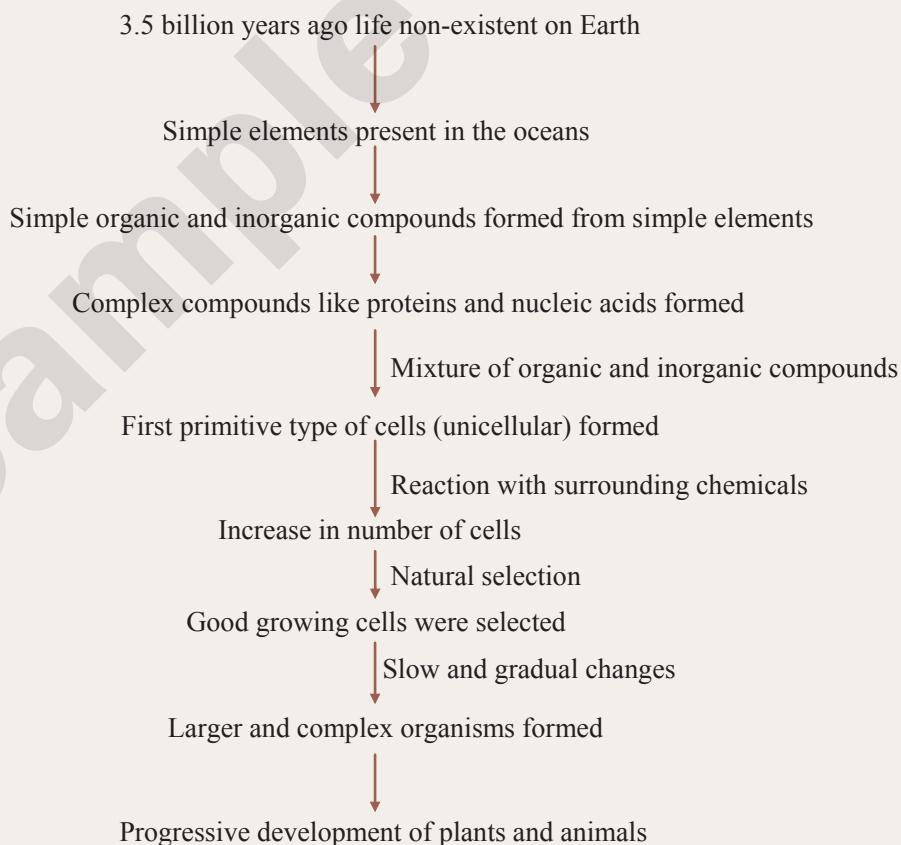
### ➤ Central Dogma:

DNA  $\xrightarrow{\text{Transcription}}$  RNA  $\xrightarrow{\text{Translation}}$  Proteins

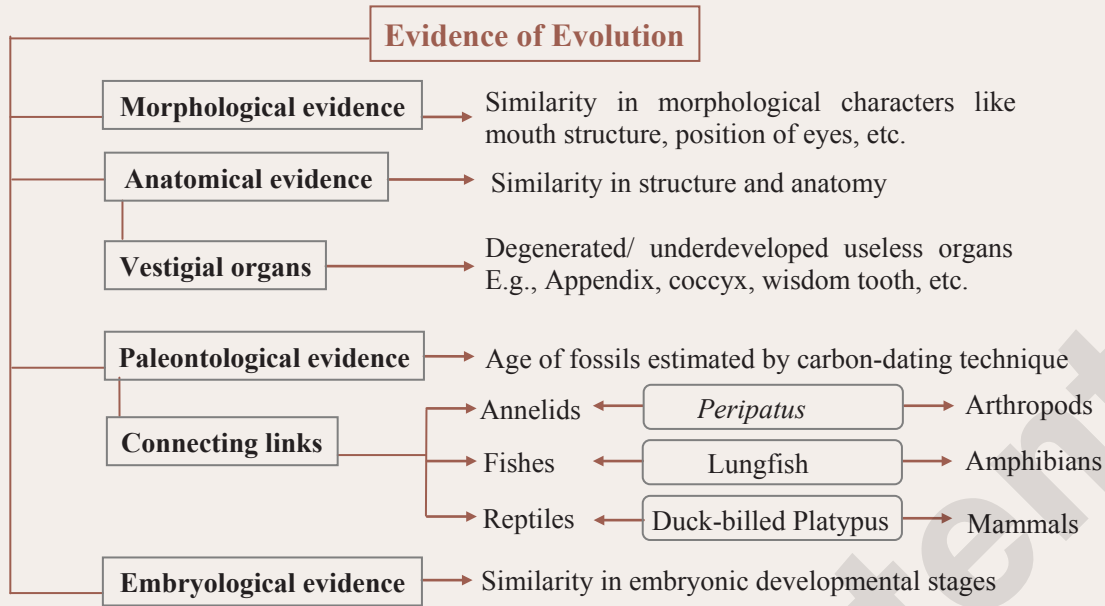
### ➤ Process of protein synthesis:



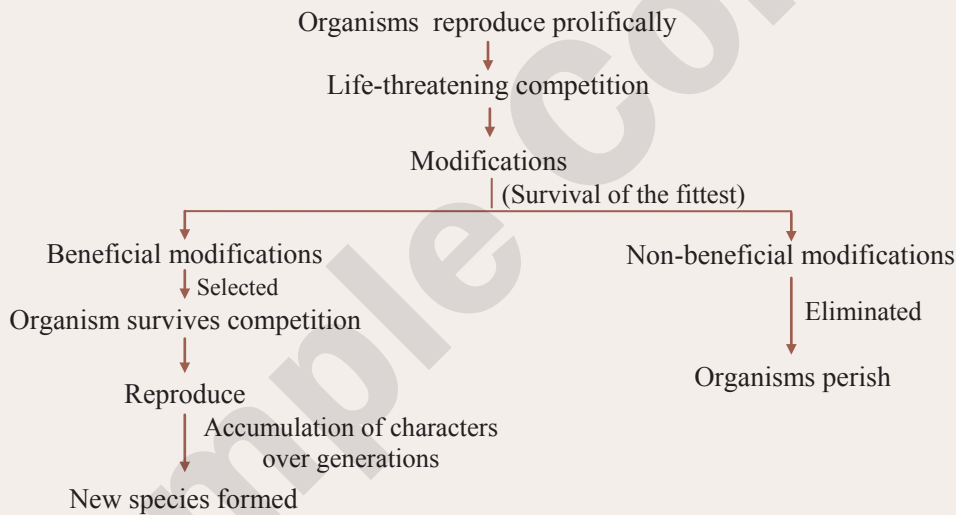
### ➤ Evolution:



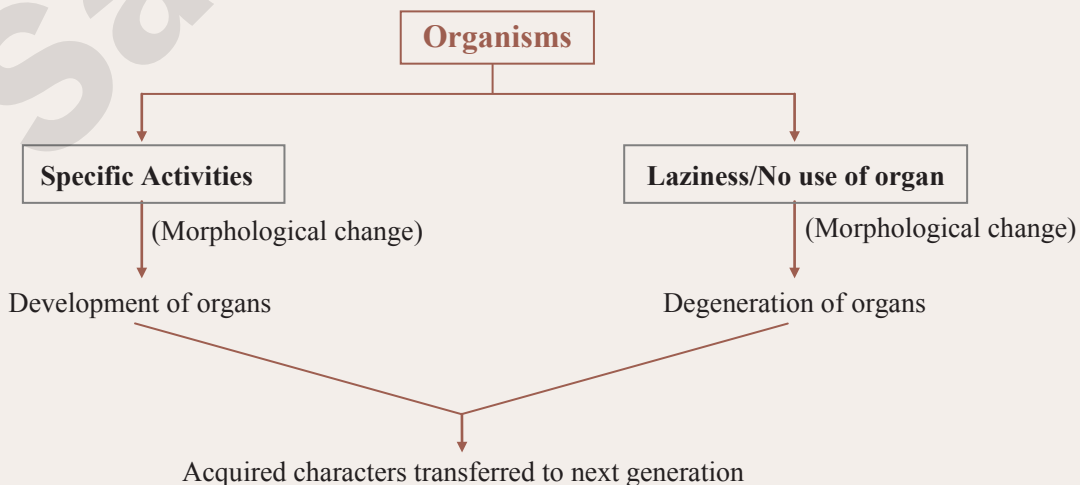


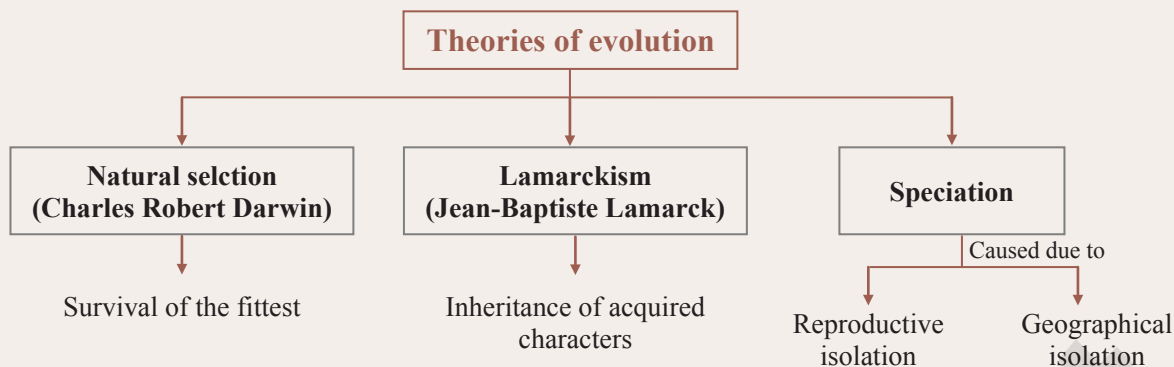


➤ **Darwin's theory of natural selection:**



➤ **Lamarckism / Theory of inheritance of acquired characters:**



**Human evolution:**

| Period                      | Event  | Evolution of Man        |
|-----------------------------|--|-------------------------|
| 7 crore years ago           | Last dinosaurs disappeared. Monkey-like animals (similar to modern lemurs) evolved.  | -                       |
| 4 crore years ago           | Ape-like animals evolved by the disappearance of the tail, enlargement of the brain and improved hand function.                        | -                       |
|                             | In South and North-East Asia, ape-like animals evolved into gibbon and orangutan.  | -                       |
| 2.5 crore years ago         | In Africa, ape-like animals evolved into gorillas and chimpanzees.   | -                       |
| 2 crore years ago           | Human-like animals, lived on land as forests declined, lumbar bones developed, erect posture, hand used for eating food and other work | <i>Ramapithecus</i>     |
| 40 lakh years ago           | Ape grew in size, became more intelligent  | <i>Australopithecus</i> |
| 20 lakh years ago           | Morphology similar to genus ' <i>Homo</i> '  | Skilled human           |
| 15 lakh years ago           | Human walking with erect posture evolved. It may have existed in China, Indonesia and Asian subcontinent.                              | -                       |
| For 1 lakh years thereafter | Evolution in developing brain. Discovery of fire.  | -                       |
| 50,000 years ago            | Brains evolved. Class-wise man. ( <i>Homo sapiens</i> )  | Cro-magnon man          |
| 10,000 years ago            | Wise man practiced agriculture, cattle-rearing and established cities. Cultural development took place.                                | Wise man                |
| 5,000 years ago             | Art of writing invented  | -                       |
| 400 years ago               | Modern sciences emerged  | -                       |
| 200 years ago               | Industrial society established   | -                       |

**Information about scientists**

| Scientist                                   | Contribution   | Year |
|---|--|------|
| Gregor Johann Mendel                        | Pioneer of Modern Genetics   | -    |
| Dr. Har Gobind Khorana                      | Indian scientist to get Nobel Prize for his contribution in the discovery of the triplet codons for 20 amino acids | 1968 |
| Walter and Sutton                           | Observed the paired chromosomes in grasshopper   | 1902 |
| Oswald Avery, Maclyn McCarty, Colin MacLeod | All living organisms have DNA as genetic material (Except viruses)   | 1944 |
| Francois Jacob and Jacques Monod            | Model for protein synthesis  | 1961 |



**Choose the correct alternative [1 Mark each]**

- Which of the following nitrogenous base is NOT present in DNA?  
(A) Thymine (B) Uracil  
(C) Adenine (D) Guanine
- Transfer of information from molecule of DNA to mRNA is called as \_\_\_\_\_ process. **[Mar 2020]**  
(A) transcription (B) translation  
(C) translocation (D) mutation  
*[Note: Above Textual Exercise Question is not a part of Board paper pattern. Hence, this question is modified.]*
- Which of the following types of RNA carries information from genes to the ribosome?  
(A) mRNA (B) tRNA  
(C) rRNA (D) All of the above
- The amino acids brought in by the tRNA are bonded together by \_\_\_\_\_ bonds.  
(A) peptide (B) hydrogen  
(C) phosphate (D) disulphide
- Genetic disorder like sickle cell anaemia may be caused due to \_\_\_\_\_. **[July 2023]**  
(A) mutation (B) translation  
(C) translocation (D) transcription
- The origin of the universe is explained by  
(A) Darwin's theory (B) Big-bang theory  
(C) Speciation (D) Lamarckism
- Which of the following is/are unicellular organism(s)?  
(A) *Amoeba* (B) *Chlorella*  
(C) *Paramecium* (D) All of the above
- Vestigial organ \_\_\_\_\_ present in human body is proof of evolution.  
(A) intestine (B) appendix  
(C) liver (D) eye lens  
*[Note: Above Textual Exercise Question is not a part of Board paper pattern. Hence, this question is modified.]*
- The appendix is fully functional in which organisms?  
(A) Humans (B) Ruminants  
(C) Fishes (D) Apes
- \_\_\_\_\_ is a connecting link between Annelida and Arthropoda. **[Mar 2019]**  
(A) Duck-billed platypus  
(B) *Peripatus*  
(C) Lungfish  
(D) Whale

- Connecting links suggest that amphibians have evolved from  
(A) mammals (B) reptiles  
(C) fishes (D) aves
- Theory of inheritance of acquired characters is also known as  
(A) Lamarckism (B) natural selection  
(C) speciation (D) translocation
- Modern man differs from *Australopithecus* in which of the following aspects?  
(A) Presence of tail  
(B) Use of hands for eating food  
(C) Increased brain size  
(D) All of the above
- Art of writing was invented about \_\_\_\_\_ years ago.  
(A) 400 (B) 200  
(C) 50,000 (D) 5000

**Answers:**

- (B)
- Hint:**Uracil is present in RNA instead of thymine of DNA.
- (A) 3. (A) 4. (A)
- (A) 6. (B) 7. (D)
- (B) 9. (B) 10. (B)
- (C) 12. (A) 13. (C)
- (D)

**Name the following [1 Mark each]**

- Genetic disorder that is caused by mutation.
- First living material formed in ocean.
- Remnants and impressions of organisms that remain preserved underground.
- Method used in palaeontology and anthropology for determining the age of fossils by measuring C-14 radioactivity.
- Plants and animals that show some morphological characters by which they are related to two different groups.
- Book published by Darwin explaining evolution through natural selection.
- I am connecting link between Reptilia and mammals. What is my name? **[Mar 2020]**

**Answers:**

- Sickle cell anaemia, etc.
- Protoplasm 3. Fossils
- Carbon dating 5. Connecting links
- Origin of species
- Duck-billed platypus
- Hint:**Duck-billed platypus lays eggs like reptiles but shows relationship with mammals too due to presence of mammary glands and hair.

**True or False.****If false, write the correct sentence****[1 Mark each]**

1. Francois Jacob and Jacques Monod proposed a model for the process of protein synthesis.
- ♣2. The causality behind the sudden changes was understood due to mutation principle of Hugo de Vries.  
[Note: Above Textual Exercise Question is not a part of Board paper pattern. Hence, this question is modified.]
- ♣3. The proof for the fact that protein synthesis occurs through gene was given by George Beadle and Edward Tatum.  
[Note: Above Textual Exercise Question is not a part of Board paper pattern. Hence, this question is modified.]
4. Information about protein synthesis is stored in the tRNA.
5. Proteins are synthesised by DNA through RNA.
6. During transcription, the sequence of nucleotides in mRNA is complementary to the DNA strand used for synthesis.
7. tRNA has anticodon with complementary sequence to the codon on mRNA.
8. mRNA is formed in the nucleus and transferred to the cytoplasm for translation.
9. Gradual development of plants and animals from ancestors having different structural and functional organization is called evolution.
10. Under changing environment sudden development of new tissues and organs occurs in living organisms.
11. Fossils of invertebrates indicate they originated in the Cenozoic era.
12. Appendix is a fully functional organ in ruminants.
13. Reptiles and amphibians have evolved from mammals.
14. Darwin's theory of natural selection explained evolution with respect to useful and useless modifications.
15. Based on his observations of plants and animals, Darwin suggested that only the fittest organisms survive.
16. According to Lamarck, the characters which are acquired by the organism during the life time are passed on to the next generation.
17. Long neck of the giraffe is an example of Lamarckism.
18. Genetic variation is responsible for the formation of new species from earlier ones.
19. Geographical isolation leads to speciation.

**Answers:**

1. True.
2. True.
3. True

4. False.  
Information about protein synthesis is stored in the DNA.
5. True.
6. True.
7. True.
8. True.
9. True.
10. False.  
Under changing environment, gradual changes occur in existing tissues and organs in living organisms.
11. False.  
Fossils of invertebrates indicate they originated in the Paleozoic era.
12. True.
13. False.  
Mammals have evolved from reptiles and amphibians have evolved from fishes.
14. False.  
Darwin's theory of natural selection did not explain useful and useless modifications.
15. True.
16. True.
17. True.
18. True.
19. True.

**Odd one out****[1 Mark each]**

1. Foreleg of ox, Ear pinnae of sheep, Patagium of bat, Flipper of whale
2. Coccyx, Intestine, Wisdom teeth, Appendix
3. Cro-Magnon man, *Aegyptopithecus*, *Australopithecus*, Neanderthal man

**Answers:**

1. Ear pinnae of sheep  
Foreleg of ox, patagium of bat and flipper of whale are similar in structure, indicating common ancestry (anatomical evidence). Ear pinnae of sheep is not similar to these structures.
2. Intestine  
Intestine is a fully functional organ in humans, whereas coccyx, wisdom teeth and appendix are vestigial organs.
3. *Aegyptopithecus*  
*Aegyptopithecus* walked using four limbs, whereas Cro-Magnon man, *Australopithecus* and Neanderthal man had erect posture.

**Complete the analogy****[1 Mark each]**

1. DNA: Thymine :: RNA: \_\_\_\_\_
2. RNA synthesis: \_\_\_\_\_ :: Protein synthesis: Translation
- ♣3. \_\_\_\_\_: Sudden changes in genes :: Evolution: Gradual changes in specific characters  
[Note: Above Textual Exercise Question is not a part of Board paper pattern. Hence, this question is modified.]







- b. Sometimes sudden changes occur in the genes causing mutations. These mutations can cause either a minor or a considerable alteration in the characters of an individual.
- c. If these changes occur in DNA of germ line cells then, these changes would be inherited to the next generation.

**\*2. How are the hereditary changes responsible for evolution? [5 Marks]**

**Ans:**

- Evolution is the gradual change occurring in living organisms over a long duration.
- Certain heritable mutations may occur in the genes resulting in genetic variations.
- These genetic variations are responsible for the formation of new species from the earlier ones.
- According to Darwin's theory, organisms with favourable or beneficial variations survive in competition and are selected by nature whereas the others with non-favourable variations are eliminated.
- This leads to the formation of new species as a result of accumulation of specific characters through several generations in the sustained and selected organisms.

**3. What is mutation? [1 Mark]**

**Ans:** Mutation is any sudden change that occurs in the nucleotide sequence of a gene, causing either a minor or considerable change in the characters of an individual.

**4. How are genes carried? [1 Mark]**

**Ans:** Genes are carried via chromosomes.

**5. Enlist the uses of the science of heredity. [2 Marks]**

**Ans:** The science of heredity is useful for:

- diagnosis of diseases.
- treatment and prevention of heredity disorders.
- production of hybrid varieties of animals and plants.
- industrial processes in which microbes are used.

**6. How do genes control the structure and functioning of the body? [1 Mark]**

**Ans:** Genes carry genetic information that is responsible for the development of the body structure and functioning of various organ systems of the body.

**7. What do you mean by central dogma? [Mar 2019] [1 Mark]**

**Ans:** Central dogma is the process of synthesis of proteins by DNA, through RNA.

**8. What is transcription? [Mar 2019] [1 Mark]**

**Ans:** Transcription is the process of RNA synthesis.

**OR**

Transcription is the process of synthesis of mRNA from DNA.

**9. Write a note on 'transcription'. [2 Marks]**

**Ans:**

- Transcription is the process of synthesis of mRNA from DNA. It takes place in the presence of RNA polymerase.
- During transcription, mRNA is produced as per the sequence of nucleotides present on the DNA.
- This mRNA sequence is always complementary to the DNA strand that is used for its synthesis.
- The thymine in DNA molecule is replaced by uracil in RNA, during the process of transcription.

**10. What is meant by triplet codon? [Mar 2019] [1 Mark]**

**Ans:** Three nucleotides which code for each amino acid is known as triplet codon.

**11. What is translation? [1 Mark]**

**Ans:** Translation is the process by which tRNA supplies amino acids as per the message on mRNA. tRNA has anticodon complementary to the codon on the mRNA.

**\*12. Explain the process of formation of complex proteins. [3 Marks]**

**Ans:**

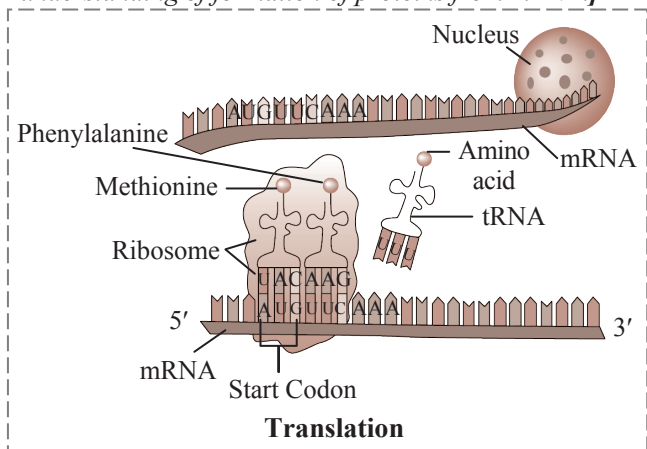
- Information about protein synthesis is stored in DNA. mRNA is synthesised from this DNA by the process of transcription. The process of synthesis of proteins from DNA through RNA is called central dogma.
- Translation occurs in the following manner:
  - mRNA formed in the nucleus during transcription moves in the cytoplasm, carrying the coded message from DNA.
  - Each mRNA contains codes for amino acids in the form of triplet codons.
  - As per the message on mRNA, amino acids are supplied by the tRNA, which has an anticodon (complementary sequence) to the codon on mRNA.
  - The amino acids supplied by tRNA are bound together by peptide bonds with the help of rRNA.
  - The process continues as the ribosome moves along the entire length of the mRNA by a distance of one triplet codon, also known as translocation.

In this way, many such chains of amino acids (peptides) come together to form complex proteins.





[Note: Students can refer the given diagram for better understanding of formation of proteins from mRNA.]



13. What is translocation? [1 Mark]

Ans: Translocation is the movement of ribosomes from one end of the mRNA to the other end by the distance of one triplet codon during translation.

\*14. Write a short note on evolution. [2 Marks]

Ans:

- Evolution is defined as the gradual changes occurring in living organisms over a long duration.
- It is a slow-going process through which the development of organisms is achieved.
- Evolution is thus the formation of new species due to changes in specific characters of living organisms.
- Changes in these specific characters get accumulated over several generations of living organisms in response to natural selection.

15. Explain the process of formation of complex compounds from simple elements. [5 Marks]

Ans:

- Around 3.5 billion years ago, it is speculated that life was non-existent on Earth.
- In the beginning, only simple elements may have been present in the oceans.
- Simple organic and inorganic compounds may have been formed by these simple elements.
- These simple compounds may have eventually resulted in the formation of complex compounds like proteins and nucleic acids.
- The process of formation of complex compounds may have occurred over a long period of several years.

\*16. Explain the theory of evolution and mention the proof supporting it.

Ans:

- According to the theory of evolution, the first living material (protoplasm) was formed in the ocean.
- Unicellular organisms formed over the course of time.
- Larger and more complex organisms were formed after the slow and gradual changes that occurred in unicellular organisms.

iv. Through evolution, plants and animals developed progressively from their ancestors that had different structural and functional organization.

v. The proofs/evidences supporting the theory of evolution include morphological evidences, anatomical evidences, vestigial organs, palaeontological evidences, connecting links and embryological evidences.

17. What is morphological evidence of evolution? [1 Mark]

Ans: Morphological evidence is based on the similarity of size, shape or structure of organs among a group of organisms proving that they evolved from the same ancestor.

18. Define anatomical evidence. [1 Mark]

Ans: Anatomical evidence is the evidence of evolution based on the similarities in the anatomical structure of bones and joints in the organs of animals.

\*19. Explain with suitable examples importance of anatomical evidences in evolution. [July 2019, Mar 2020] [3 Marks]

Ans:

- Anatomical evidences are the similarities in structures and anatomy between different organisms.
- The hand of a human, the foreleg of an ox, the flipper of a whale and the patagium of a bat appear different superficially or morphologically.
- Also, the functions of these structures vary in different animals.
- However, there is a similarity in the structure of bones and joints in the organs of these animals.
- These similarities indicate that the animals evolved from a common ancestor thus providing proof of evolution.



**Reading between the lines**

Comparative anatomy is the study of similarities and differences in the anatomy (body structures or organs) of different species.

It includes;

- **Homologous organs:**  
These organs perform different functions but have similar anatomical structures and indicate common ancestry.  
For e.g., Forelimb of whale, bats, humans, etc.
- **Analogous organs:**  
These organs have similar function but appear structurally dissimilar.  
For e.g., Eye of octopus and eye of mammals, etc.
- **Vestigial organs:**  
These structures are non-functional in certain organisms, while they are functional in others, indicating common ancestry. For e.g., Appendix, etc.



20. What are vestigial organs? [1 Mark]

Ans: Vestigial organs are degenerated or underdeveloped useless organs of organisms.

21. \*Define vestigial organs. Write names of some vestigial organs in human body and write the names of those animals in whom same organs are functional.

OR

- Define vestigial organs.
- Write name of any two vestigial organs in human body.
- Explain how one human vestigial organ is functional in another animal.

[Dec 2020] [3 Marks]

Ans:

- Refer Answer the following: Q.20.
- Other vestigial organs in human body include the tail-bone (coccyx), body hair, wisdom tooth, etc.
- Some vestigial organs in humans that are functional in other animals are as follows:
  - Appendix: It is useful and fully functional in ruminants.
  - Muscle of the ear pinna: It is useful in monkeys and for the movement of the ear pinna.



### Reading between the lines

The function of some vestigial organs (in humans) in other animals is as follows:

- Tail-bone (coccyx)**: It is useful in other mammals for balance.
- Body hair**: They are useful in other mammals for insulation against the cold.
- Nictitating membrane (third eyelid)**: It is useful in animals like frog, pigeon, etc., for the purpose of protection of eye.
- Wisdom tooth**: They are present in mammals with large jaws for chewing raw food.

22. Define vestigial organs. Write any two names of vestigial organs in human body.

[July 2019] [2 Marks]

Ans: Refer Answer the following: Q.21(i, ii)

23. What is palaeontological evidence of evolution based on? [1 Mark]

Ans: Palaeontological evidence of evolution is based on the study of remnants and impressions of organisms that remain preserved underground as fossils.

\*24. Define fossil. Explain importance of fossils as proof of evolution.

Ans:

- Fossils are remnants and impressions of organisms that remain preserved underground.
- Studying fossils help the scientists learn about the features of the organisms that lived in the past.
- The oldest fossils are buried deep in the Earth's crust, while the younger ones occupy the upper surfaces. Hence, fossils of invertebrates are found buried deep as they are very old and belong to the Palaeozoic era. The fossils of Pisces, Amphibians and Reptiles were obtained from the consecutive layers. The Mesozoic era was dominated by reptiles, while the Cenozoic era showed presence of mammals and birds.
- Thus, study of fossils is an important aspect of evolution since it can be used in palaeontology and anthropology for determining age of the fossils and deducing information about their ancestors.

25. Explain carbon dating method. [2 Marks]

Ans:

- Carbon consumption of animals and plants stops after death and only the decaying processes of C-14 takes place continuously.
- The ratio of C-14 to C-12 changes constantly in dead plants and animals with time, as C-12 is non-radioactive.
- The time passed since the death of a plant or animal can be calculated by carbon dating i.e., by measuring the radioactivity of C-14 and ratio of C-14 to C-12 present in the remains of the dead organism.
- This is known as carbon dating method. It is used for determining the age of fossils.

\*26. Write a short note on connecting link.

[2 Marks]

Ans:

- Connecting links are some plants or animals that show morphological characters by which they can be related to two different groups of organisms.
- Peripatus is the connecting link between two different groups - annelida and arthropoda. It shows annelid-like characters such as segmented body, thin cuticle and parapodia-like organs. It also shows arthropod-like characters such as tracheal respiration and open circulatory system.



- iii. The duck-billed platypus is a connecting link between mammals and reptiles. It shows similarity with mammals due to the presence of mammary glands and hair. It lays eggs like reptiles.
- iv. Lungfishes are connecting links between fishes and amphibians. The lungfish performs respiration with lungs even though it is a fish.

**\*27. Write a short note on embryology. [2 Marks]**

**Ans:**

- Embryology is a branch of biology that deals with the study of development of an embryo.
- It enables us to compare the developmental stages of various animals.
- Embryos of different vertebrates appear similar during the initial stages indicating common origin of these animals.
- Similarities decrease gradually as the embryos develop.

**28. Embryological evidences provide proof of evolution. Explain. [3 Marks]**

**Ans:**

- Embryological evidences arise from comparative study of embryonic developmental stages of various vertebrates.
- Embryos of different vertebrates appear similar during the initial stages of development and these similarities gradually decrease as the embryo develops.
- Embryology can be used as evidence of evolution as similarities in the initial stages of development indicate the common origin of the animals.

**29. How is embryological evidence of evolution studied? [1 Mark]**

**Ans:** Refer Answer the following: Q.28 (i).

**30. \*Write a short note on Darwin's theory of natural selection.**

**OR**

**Darwin's theory of natural selection.**

**[Mar 2023] [3 Marks]**

**OR**

**Explain Darwin's theory of natural selection.**

**[Dec 2020] [2 Marks]**

**Ans:**

- Darwin's theory of natural selection is based on the concept of survival of the fittest.
- Organisms can reproduce prolifically.
- Under limited resources, organisms compete with each other in a life-threatening manner for their survival.
- According to this theory, only those organisms survive which show modifications for winning the competition. The selected organisms then give rise to new species with their specific set of characters.

- v. Objections raised against Darwin's theory of natural selection:

- Natural selection is not the only factor responsible for evolution.
- In his theory, Darwin did not explain the inheritance of useful and useless modifications.
- No explanation regarding slow and abrupt changes was provided in this theory.

*[Note: The same question is also asked for 2 Marks wherein the students are expected to write the first four points as the answer.]*

**31. Write the objections raised against Darwin's theory of natural selection?**

**[Mar 2022] [3 Marks]**

**OR**

**Write any two objections that were raised against Darwin's Theory of Natural Selection.**

**[July 2023] [2 Marks]**

**Ans:** Refer Answer the following: Q.30(v)

*[Note: The same question is also asked for 2 Marks wherein the students are expected to write any two points under Q.30(v) as the answer.]*

**\*32. Write a short note on Lamarckism.**

**Ans:**

- Lamarckism or the theory of inheritance of acquired characters was given by Jean-Baptiste Lamarck.
- It states that the morphological changes occurring in living organisms are responsible for evolution. This concept was based on the principle of use and disuse of organs.
- Morphological changes may occur gradually, either due to specific activities or laziness of that organism.
- For e.g., browsing on leaves of tall plants caused the neck of the giraffe to become long; frequent hammering movements cause the shoulders of ironsmith to become strong; inactivity caused weakening of the wings of birds like emu; legs of swans and ducks became useful for swimming due to their inhabitation in water; snakes lost their legs due to burrowing habits; etc.
- Such 'acquired characters' are transferred from one generation to another. This is called as the theory of inheritance of acquired characters.

**33. Why was Lamarck's theory disproved?**

**[1 Mark]**

**Ans:** Lamarck's theory of inheritance of acquired traits was disproved because modifications brought about in an individual are not always transferred to the next generation.



**34. What is meant by ancestry of acquired characters?** [1 Mark]

**Ans:** The ability of living organisms to transfer the characters which they have acquired, to the next generation is called ancestry of acquired characters.

**35. Define evolution.** [1 Mark]

**Ans:** Evolution is the formation of new species due to changes in specific characters over several generations of living organisms as a response to natural selection.

**36. What is speciation?** [1 Mark]

**Ans:** Speciation is the formation of new species from the existing species.

**37. What is species?** [1 Mark]

**Ans:** Species is a group of organisms that can produce fertile individuals through natural reproduction.

**\*38. Write evolutionary history of modern man.**

**Ans:** Human evolution began approximately 7 crore years ago.

The sequence of evolutionary history of modern man is as follows:

- i. The last dinosaurs disappeared 7 crore years ago.
- ii. Monkey-like animals are said to have evolved from ancestors that were similar to modern lemurs around the same time.
- iii. Ape-like animals evolved around 4 crore years ago, by the disappearance of tail, enlargement of brain and improvement in the functioning of hands.
- iv. In Africa, these ape-like animals evolved into gorillas and chimpanzees around 2.5 crore years ago.
- v. Human-like animals who used their hands for eating and doing other work evolved around 2 crore years ago.
- vi. These animals lived on land, as the forests declined due to dry environments.
- vii. Their pelvic girdle developed enabling them to stand in an erect posture in grasslands, thus leaving their hands free for use.
- viii. The first record of this human-like ape from North India and East Africa, was Ramapithecus (around 1 crore years ago).
- ix. Around 40 lakh years ago, these apes grew larger in size and became more intelligent (Australopithecus).
- x. Around 20 lakh years ago, human-like animals shared morphological similarities with the members of genus Homo, and thus skilled human developed.
- xi. Around 15 lakh years ago, human walking with an erect posture evolved and may have existed in China and Indonesia of the Asian subcontinent.
- xii. Neanderthal man evolved around 1.5 lakh years ago.

xiii. For around 1 lakh years from then, man evolved by developing his brain (improving their cranial capacity) and also discovered fire during this period.

xiv. The brain of 50,000 year old man evolved in such a way that it could be considered as member of class-wise man (*Homo sapiens*).

xv. Cro-Magnon man evolved around 50,000 years ago after which evolution became faster.

xvi. 10,000 years ago, present day modern man started practising agriculture, rearing cattle and establishing cities. Also, cultural development took place around this time period.

**39. Write the scientific name of human being.**

[July 2022] [1 Mark]

**Ans:** The scientific name of human being is *Homo sapiens*.

**Give reasons**

**1. Forelimb of bat and flipper of whale have different functions but indicate common ancestry.**

**Ans:**

- i. Forelimb of bat and flipper of whale appear different superficially and also have different functions.
- ii. However, they show similarities in the structure of bones and joints in organs which indicate a common ancestry.

**2. The vestigial organ appendix is still existent in human beings.**

**Ans:**

- i. Sudden development of new tissues or organs is not possible for the purpose of living in changing environment.
- ii. The existing organs of an organism undergo gradual changes and may become useless or harmful under certain conditions.
- iii. Such structures begin to degenerate, as per the principle of natural selection.
- iv. These organs take thousands of years to disappear. Hence, they may appear in different phases of disappearance in different animals. Hence, even though appendix is a vestigial organ, it is still existent in human beings.

**3. Duck billed platypus is a connecting link.**

[July 2023] [2 Marks]

**Ans:**

- i. Connecting links are some plants or animals that show morphological characters by which they can be related to two different groups of organisms.
- ii. The duck-billed platypus is a connecting link between mammals and reptiles as it shows similarity with mammals due to the presence of mammary glands and hairs. It lays eggs indicating similarity with the reptiles.





\*4. Read the following statements and justify same in your own words with the help of suitable examples.

i. Human evolution began approximately 7 crore years ago. [2 Marks]

Ans:

- The last dinosaurs disappeared approximately 7 crore years ago, during which monkey-like animals were said to have evolved from ancestors similar to modern lemurs.
- The tails of these monkey-like animals in Africa were speculated to have disappeared around 4 crore years ago, along with enlargement of brain and that improved hands, that resulted in evolution of ape-like animals.
- Gorillas and chimpanzees evolved 2.5 crore years ago, from which apes that used their hands for eating food and other work evolved around 2 crore years ago.
- The pelvic girdle of these apes developed in such a way that they started to stand in an erect posture and their hands became free for use, giving rise to the first human-like animals.

Thus, it is justified that human evolution began approximately 7 crore years ago.

ii. Geographical and reproductive isolation of organisms gradually leads to speciation. [2 Marks]

Ans:

- Speciation is the formation of new species from the existing species.
- Each species survives in a specific geographical condition and hence, they have a specific habitat, type of food, reproductive ability and period.
- Geographical isolation occurs when a population is separated into two or more groups by geographical barriers such as rivers, etc., thus exposing the organisms to different geographical conditions, leading to speciation.
- Reproductive isolation is brought about when the individuals from the population cannot reproduce gradually resulting in speciation. Therefore, geographical and reproductive isolation of organisms gradually leads to speciation.

iii. Study of fossils is an important aspect of study of evolution.

Ans: Refer Answer the following: Q.24

iv. There are evidences of foetal science among chordates.

Ans: Evidence of foetal science deals with the study of embryology as a proof of evolution.

Refer Answer the following: Q.28

**Distinguish between**

[2 Marks]

**1. Transcription and Translation**

Ans:

|      | Transcription   | Translation  |
|------|---|--|
| i.   | Transcription is the process of synthesis of mRNA from DNA. | Translation is the process by which tRNA supplies amino acids as per the message on mRNA. tRNA has anticodon complementary to the codon on the mRNA. |
| ii.  | It occurs in the nucleus.                                   | It occurs in the cytoplasm.  |
| iii. | It is the process of RNA synthesis.                         | It is the process of protein synthesis.  |
| iv.  | RNA polymerase catalyses this process.                      | The ribosome catalyses this process.   |

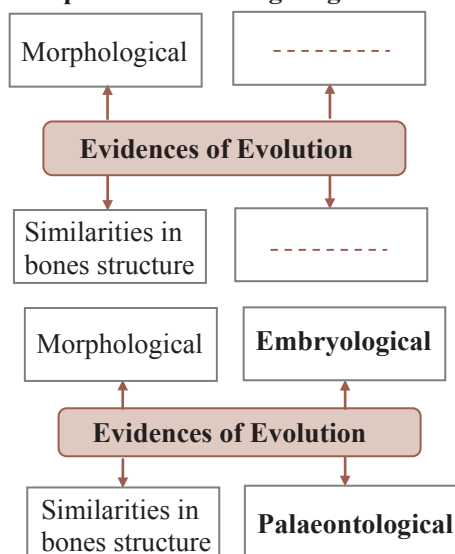
**2. Lamarckism and Natural selection**

Ans:

|      | Lamarckism  | Natural selection   |
|------|---|---|
| i.   | All acquired characters are transferred to the next generation. | Only useful modifications/ variations are transferred to next generation. |
| ii.  | It is not based on survival of the fittest.                     | It is based on survival of the fittest.                                   |
| iii. | It occurs due to morphological changes.                         | It occurs due to modifications.   |
| iv.  | It occurs due to continued activity or laziness of an organism. | It occurs due to life-threatening competition.                            |

**Complete the given chart/table**

\*1. Complete the following diagram.

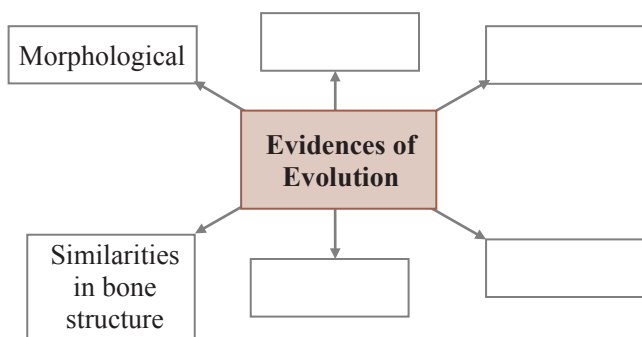


Ans:

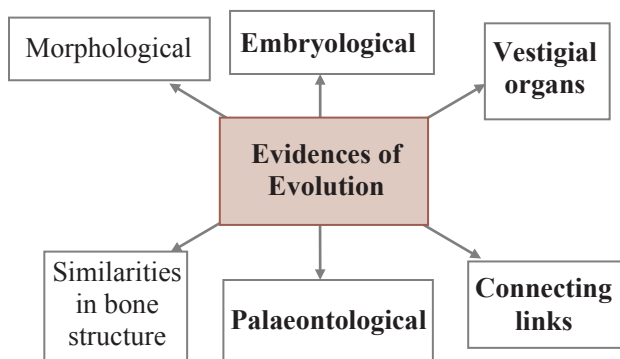
Vestigial organs and connecting links are the other evidences of evolution.



2. Complete the following diagram. [Mar 2022] [2 Marks]

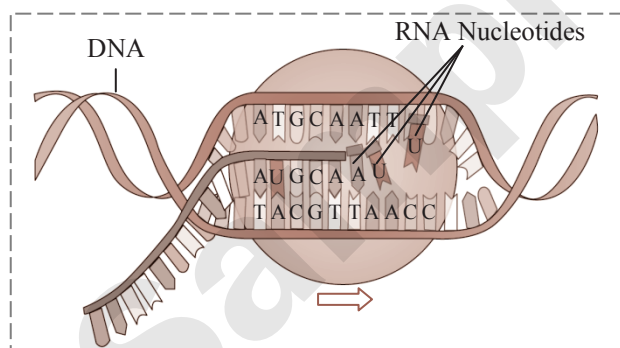


Ans:



**Questions based on diagram**

1. Observe the diagram and answer the questions given below it. [3 Marks]



i. Identify the cellular process depicted in the diagram.

Ans: The cellular process depicted in the diagram is transcription.

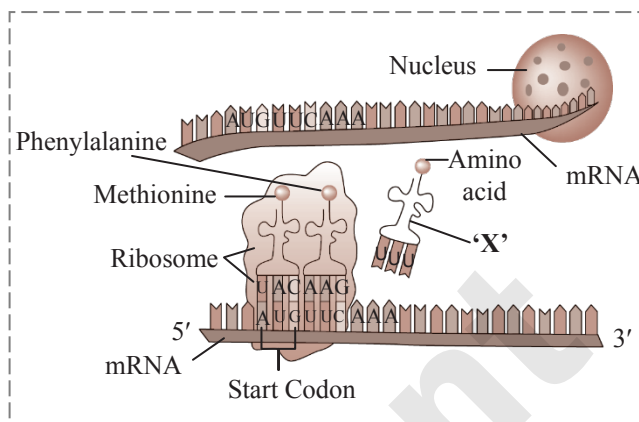
ii. Which enzyme is required for this process?

Ans: The enzyme required for this process is RNA polymerase.

iii. In which part of the cell does this process occur?

Ans: This process occurs in the nucleus of a cell.

2. Observe the given diagram and answer the questions given below it. [3 Marks]



i. Identify the molecule labelled as 'X' in the given diagram.

Ans: The molecule labelled as 'X' is tRNA.

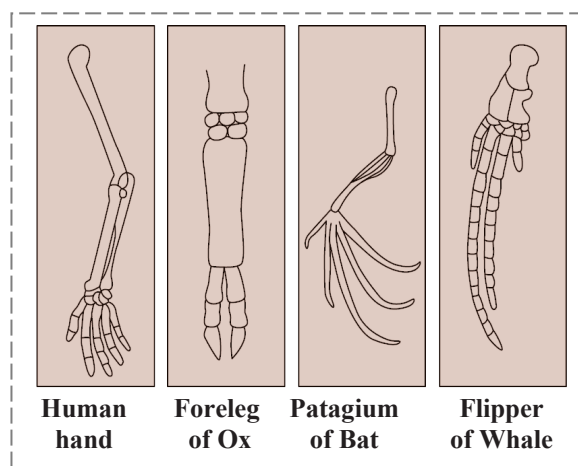
ii. What would be the sequence on the anticodon, if the corresponding codon sequence on the mRNA is GAU?

Ans: The sequence on the anticodon would be CUA.

iii. During the process of translation, the amino acids are bound by which bond?

Ans: During translation, the amino acids are bound by peptide bonds.

3. Observe the following diagrams and explain the anatomical evidences with the help of the given diagram.



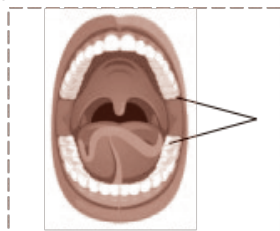
Ans: The given diagrams depict anatomical similarities between the human hand, foreleg of an ox, patagium of a bat and flipper of a whale.

Refer Answer the following: Q.19.





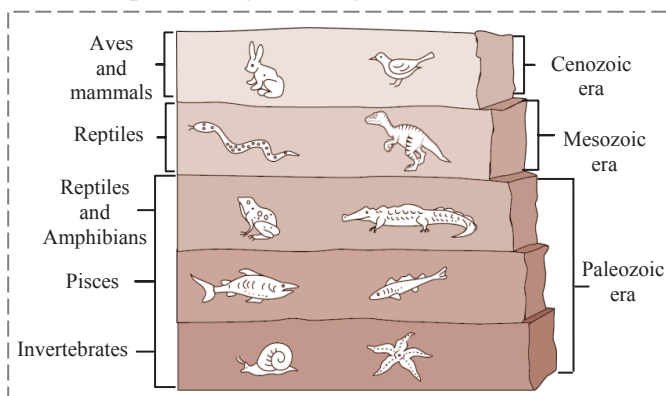
4. Write the name of indicated part in diagram:  
Human jaw



[Mar 2023] [1 Mark]

Ans: Wisdom teeth is the name of the indicated part in the diagram.

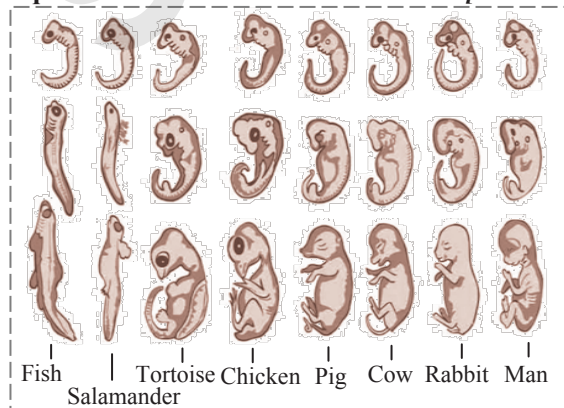
5. Explain the given diagram.



Ans:

- i. The given diagram represents the structure of ground level and fossils i.e., the remnants and impressions of organisms that remain preserved underground.
- ii. Fossils of invertebrates, pisces, amphibians and some reptiles are found in the lowermost levels of ground indicating that they evolved around the paleozoic era.
- iii. Fossils of reptiles were also found in the middle layers of the ground indicating that these fossils date back to the mesozoic era.
- iv. The top-most layer on the ground has fossils of aves and mammals indicating that they evolved in the cenozoic era.
- v. The presence of fossils of animals in different layers of soil indicate that progressive development took place in animals.

6. Observe the given figure and answer the questions. [3 Marks]



i. Identify the evidence of evolution shown in the given diagram.

Ans: Embryological evidence of evolution is shown in the given diagram.

ii. How is this evidence used as a proof of evolution?

Ans: Embryological evidence is used as proof of evolution as a similarity in initial stages of development (embryos) amongst different animals indicates a common origin (ancestor) of these organisms.

iii. Mention any two other evidence of evolution.

Ans: Morphological evidences, anatomical evidences, vestigial organs, palaeontological evidences, connecting links. [Any two examples]

**Questions based on paragraph [5 Marks]**

1. Information about protein synthesis is stored in the DNA. Proteins are synthesized by DNA through RNA. This is also known as the central dogma of life. The nucleotide sequences of the mRNA produced are complementary to the DNA strand that is used as the template for synthesis. This process of synthesis of RNA from DNA is known as 'transcription'. The code for each amino acid consists of three nucleotides (triplet codon) that are present on the mRNA. The tRNA has an anticodon sequence complementary to the codon on the mRNA. During translation, the code on mRNA is read and respective amino acids brought by tRNA are joined together by peptide bonds.

Based on the given paragraph, answer the following questions:

- i. If 3'-AACGT-5' is a sequence of the template DNA strand, what would be the nucleotide sequence of the corresponding mRNA synthesized from it?
- ii. What is the difference in nitrogenous bases of DNA and RNA?
- iii. Which enzyme would be required for the synthesis of RNA from DNA during transcription?
- iv. How many amino acids can the following mRNA sequence code for?  
5'- UUCAGCCGUGUCAUU-3'
- v. What is the function of mRNA in translation?

Ans:

- i. The corresponding mRNA synthesized from the given template DNA strand would be 5'-UUGCA-3'.
- ii. In DNA, thymine is present whereas in RNA uracil is present instead of thymine.
- iii. RNA polymerase is required for the synthesis of RNA from DNA during transcription.



- iv. The code for each amino acid consists of three nucleotides (triplet codon). The given mRNA sequence can code for five amino acids as it is made up of five triplet codons.
- v. mRNA carries information for protein synthesis from DNA (present in the nucleus) to ribosome (present in the cell cytoplasm).



### Intext Questions

1. **Can you recall? (Textbook page no. 1)**
- i. Which component of the cellular nucleus of living organisms carries hereditary characters?

**Ans:** The DNA carries the hereditary characters.

- ii. What do we call the process of transfer of physical and mental characters from parents to the progeny?

**Ans:** The process of transfer of physical and mental characters from parents to the progeny is called heredity.

- iii. Which are the components of the DNA molecule?

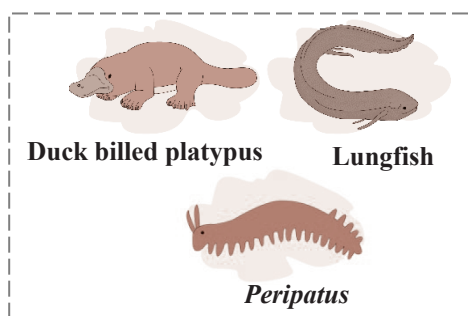
**Ans:** The components of the DNA molecule are deoxyribose sugar, nitrogenous bases and phosphoric acid.

2. **Can you recall? (Textbook page no. 3)**
- Why are many species of animals and birds getting extinct?

**Ans:** Many species of animals and birds are getting extinct due to following reasons:

- a. Over exploitation of resources
- b. Loss of habitat due to deforestation
- c. Lack of food
- d. Pollution
- e. Poaching / Hunting
- f. Climate change
- g. Human activities like construction of expressways, dams, etc.

3. **Observe and discuss. (Textbook page no. 6)**
- Observe the following pictures and discuss the characters observed.



**Ans:**

- i. **Duck-billed platypus:** Refer Answer the following : Q. 26 (iii)
- ii. **Lungfish:** Refer Answer the following : Q. 26 (iv)
- iii. **Peripatus:** Refer Answer the following : Q. 26 (ii)



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