Government of Tamil Nadu

REFRESHER COURSE MODULE

2021-2022

12

ZOOLOGY

Department of School Education

Contents

1 Reproduction and its types

Learning Outcomes

- To understand the term 'Reproduction' and its significance.
- To compare and contrast Asexual and Sexual Reproduction.
- To know the advantages and disadvantages of each type of reproduction.
- To understand how genetic information is passed from one generation to another generation.
- To know how genetic information are altered through mutations.

Teacher Activity

1. Teacher asks the student if human beings can clone themselves at will, like unicellular organism, and also ask how the organisms continue their lives on earth. After getting answer from the students, the teacher explains the term Reproduction and its two types Asexual and Sexual Reproduction.
2. Student are asked why Asexual reproduction only produces clones of parent and then explains various types of asexual reproduction such as Fission, Budding, Fragmentation and Regeneration.
3. The students are instructed to know the important terms related to reproduction.
4. The students are asked the differences in the offspring in the two types of reproduction.
5. The teacher also asks students to watch and tabulate the advantages and disadvantages of each type of reproduction.

Students Activity

1. Student will be working in pairs to better understanding of asexual and sexual reproduction. Students will be comparing 5 organisms by reading a short description of each and how they reproduce students will classify whether they reproduce sexually or asexually or even students will follow the steps and record their observations on their lab manual.
2. Students are instructed to draw chart about different types of asexual reproduction with suitable examples.
3. Students draw six quick sketches of vocabulary words related to the topic of sexual and asexual reproduction,
4. Students are instructed to describe in their own words about mitosis and meiosis cell division which are the important process of two types of reproduction.
5. Drag and drop the description below to either Asexual reproduction, sexual reproduction or both.

Asexual Reproduction	Sexual Reproduction	Both

1. Involves only one parent.
2. Transfer of DNA from parent to offspring.
3. Mutations can be avoided.
4. Fertilization occurs.
5. Does not need a mate to reproduce
6. More complex takes more time and energy
7. Produces more offspring.
8. Offspring 100% genetically identical to parent
9. Need to find to mate
10. No formation of gametes.

Evaluation

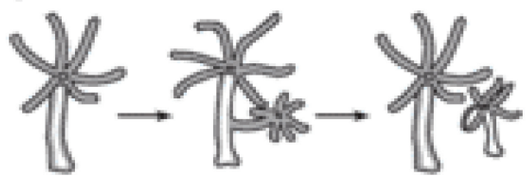
1. What is the basic difference between asexual and sexual reproduction?
2. Which type of reproduction is responsible for genetic variations? Why?
3. Describe the disadvantages of asexual reproduction.
4. Match the following :

1. Fission	-	A) Hydra
2. Fragmentation	-	B) Planaria
3. Budding	-	C) Sea anemone
4. Regeneration	-	D) Amoeba

5. Which one of the following reproduction produce genetic variation?

A)

B)



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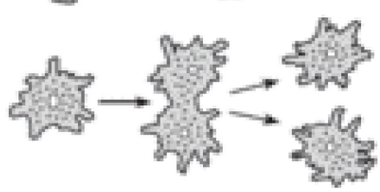

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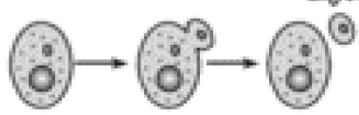


2 Parthenogenesis

Learning Outcomes

- To understand the term 'Parthenogenesis" and its significance.
- To know various types of parthenogenesis in living organisms.
- To know the advantages and disadvantages of parthenogenesis.

Teacher Activity

1. Teacher asks student whether they know about special type of reproduction apart from asexual and sexual reproduction. After getting answer from the student the student, the teacher explain the term 'Parthenogenesis'.

   "Parthenogenesis is the process of development of female gamete (ovum) into embryo without fertilization."

2. Teacher recalls the student about the process of asexual and sexual reproduction and also explains how parthenogenesis differ from the two type of reproduction. Parthenogenesis otherwise known as incomplete sexual reproduction.

3. Teacher asks the student if anybody known what type of reproduction occurs in honeybee and also asks about the social life in honeybee. i.e., queen bee, worker bee and drone bee. Teacher explaines parthenogenesis occurs in the life cycle of honeybee. The fertilized eggs develop into females (queens or infertile workers) whereas the unfertilized eggs developed into male (drone).

4. Teacher explains the types of parthenogenesis namely natural parthenogenesis and artificial parthenogenesis. The types of natural parthenogenesis such as Arrhenotoky (only males are produced), Thelytoky (only females are produced) and Amphiboly (any sex).

Students Activity

1. Students are asked to make a model for the social life of honeybees and describe the type of reproduction occurs.
2. Students are asked to draw a chart that denotes the number of chromosome present in the gametes and the development of gamete into male or female honeybees (Haplodiploid parthenogenesis).
3. Students are asked to induce artificial parthenogenesis (experimental activation of the egg). Student perform this experiment in the eggs of frog. Certain compounds called Calcium ionophores cause parthenogenesis development in frog's egg.

Evaluation

1. What is parthenogenesis? Explain its various types.
2. Differentiate between the following:
   i) Sexual Reproduction and Parthenogenesis
   ii) Natural and indirect parthenogenesis.
3. **Match the following:**

i) Arrhenotoky	a) Sea urchin
ii) Thelytoky	b) Aphis
iii) Amphitoky	c) Solenobia
iv) Artificial parthenogenesis	d) Honeybee

4. Describe the advantages and disadvantages of parthenogenesis.
5. Give an account of artificial agents which induce artificial parthenogenesis.

3 Reproductive system of various animals

Learning Outcomes

- To understand the structure of Reproductive System in various animals.
- Knows the Primary and Accessory Reproductive Organs.
- Understands the structure and function of male and female reproductive cell.
- To know about the role of hormone in reproduction of male and female reproductive cells.

Teacher Activity

1. The students are asked how a new organism is produced and which organ system in our body is responsible for it. Then the teacher explains the importance of reproductive system in various animals.

2. Students are asked to say about the differences they have been seen in the reproductive system of Invertebrate animals and Chordate animals. The Earthworms are called as hermaphrodite because both male and female reproductive organs present in the same animal. But in chordates the reproductive organs are present in separate animals, i.e., male and female.

3. Teacher asks the students how many of them know about the structure of reproductive system and formation of male and female reproductive cells. Then, teacher explains the formation of male reproductive cells [sperm] (Spermatogenesis) and female reproductive cells [ovum] (oogenesis).

4. Teacher explains the process of fertilization (fusion of male and female gametes) and two types of fertilization namely internal fertilization and external fertilization. Students are also asked about the types of fertilization that occurs in aquatic animals and terrestrial animals.

5. Students are asked how many of them know about the human reproductive system. Then teacher explains various organs present in the human reproductive system. The male reproductive system consists of testes, vas deferens, seminal vesicle, prostate gland, urethra and penis and the female reproductive system consists ovaries, fallopian tube, uterus and vagina.

Students Activity

1. Students are asked to make clay model of human male and female reproductive system.

2. Students are asked to draw a neat diagrams of reproductive system of earthworm and cockroach and write down the differences between them in a chart paper.

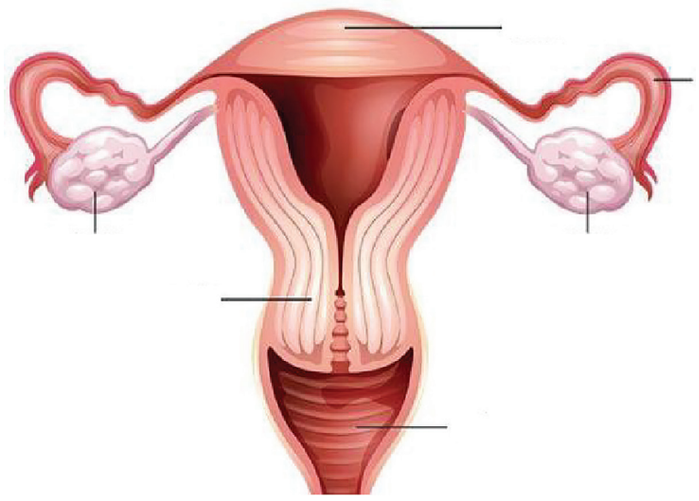
3. Students are divided into two groups, i.e., A and B. Each group of students are instructed to make a chart about different hormones involved in the production of male and female reproductive cells.

4. Students are given diagrams of 20 animals and find out which type of fertilization (Internal and External) occur in those animals and give their report in a lab sheet.

5. Students are asked to draw a neat labelled diagram of sperm and ovum and also make a model of them.

Evaluation

1. Describe the structure of reproductive system of earthworm.
2. List out the differences between spermatogenesis and oogenesis.
3. Write about female reproductive system of pigeon.
4. In the diagram below:



   a) Identify the name
   b) Label the parts.

5. Sperms are produced in the –
   a) Scrotum
   b) Seminal vesicle
   c) Seminiferous tubules
   d) Prostate gland

6. **Mach it:**

1) Earthworm	A) Single ovary
2) Cockroach	B) External fertilization
3) Frog	C) Collaterial gland
4) Pigeon	D) Hermaphrodite

4 Fertilization and Foetal Development

Learning Outcomes

- To understand the process of fertilization, steps involved in fertilization and embryo development.
- To understand the different modes of fertilization.

Teacher Activity-1

Define and explain the key terms that involved in fertilization process about fusion of male and female gamete, zygote undergo mitotic division to form blastula, transformation of blastula into gastrula etc.,

Teacher Activity-2

Explains the two types of fertilization using the pictorial chart.

Internal: Fusion of Gamets occurs within the body of an animals.
Externa: Fusion of Gamets occurs out of the body of an animals i.e. water.

Teacher Activity-3

By showing PPT, video clips and also use microscopic presentation of Fertilization process and explaining of its stages among the students.

Students Activity

Activity-1:

Writing Activity

This writing activity should be completed after learning about fertilization process.

Materials:

Notes, Texts, Graphic Organizer, Notebook, Paper, Pencils and Writing Paper.

Activity-2

- Students may request to arrange the various developmental stages of zygote in correct order by providing index cards with diagrammatic representation.
- Award the student one who arranged in correct order.

Evaluation

1. What is fertilization?
2. Gestation period of human is

   a) 500 days b) 300 days c) 280 days d) 10 months
3. What will happen, if fertilization does not occur?
4. The implantation of the embryo occurs at about _____ days of fertilization.
5. Describe the various developmental stages of fertilization.
6. **Match the following:**

   a) Parturition - Release of egg from graafian follicle

   b) Gestation - Delivery of baby from uterus

   c) Ovulation - Duration between pregnancy and birth

5 Menstrual Cycle and Stages of Foetal Development

Learning Outcomes

- Understanding the basic idea of menstrual cycle.
- Knowing the basic concept of fertilization process.
- Understanding the foetal developmental stages.
- Gain knowledge on Gestation.
- Gain awareness on parturition and lactation.

Teacher Activity-1

Teacher explains the menstrual cycle and the foetal development stages by using pictures with the following headings:

1. Menstrual cycle - Definition
2. Menarche (Onset of puberty) - 11-13 years
3. Menopause (Ceases of menstrual cycle) - 48-50 years
4. Menstrual cycle doesn't occur during pregnancy.
5. Menstrual cycle - stages:
   a) Menstrual phase (4-5 days)
   b) Follicular phase (6-13 days)
   c) Ovulatary phase (14^{th} day)
   d) Luteal phase (15-28 days)

Teacher Activity-2

Teacher explains the fertilization process and foetal development stages by using pictures with the following headings:

1. Fertilization (fusion of sperm and egg and Zygote formation)
2. Blastula formation (by cleavage)
3. Implantation (Attachment of Zygote to the uterine wall)
4. Gastrulation (Formation of primary germ layers, Ectoderm, endoderm and mesoderm)
5. Organogenesis (Foetal organs are formed from different germ layers)

6. Placenta formation - function and significance.
7. Pregnancy (Gestation) - Human gestation period = 280 days
8. Parturition (Child birth)
   * Oxytocin → uterine contraction
9. Lactation
   * Prolactin → Milk secretion
   * Oxytocin → Ejection of milk

Students Activity

1. Draw the menstrual cycle diagram with proper headings.
2. Differentiate between corpus Lutium and Corpus albicans
3. List out the hormonal changes during menstrual cycle.
4. Tabulate the importance of placenta.
5. Find out the gestation period of dog, cat, elephant, deer and monkey.

Evaluation

1) Oestrogen is produced by

   a) Primary follicle, b) Graafian follicle, c) Corpus luteum, d) Corpus albicans

2) _____ fertilization occurs in human.

3) The implantation of the embryo occurs at about _____ day of fertilization.

4) True or False:

   Menstrual cycle does not occur during pregnancy

5) **Match the following:**

a) Parturition	-	Duration between pregnancy and birth
b) Gestation	-	Attachment of zygote to endometrium
c) Ovulation	-	Delivery of baby from uterus
d) Implantation	-	Release of egg from Graafian follicle.

6 Genetics

Learning Outcomes

- Understands the basic concepts in genetics.
- Knows how genes play a vital role in living organisms.
- Interest in knowing different terms of genetics.

Teacher Activities

Dear students, have you ever wondered, how you look like your parents and tried to know the reasons. The teacher encourages them, works with them to bring the reasons.

Activity-1

Teacher presents a Power Point Presentation and provides one copy of Question paper per group (4-5), a note to write their answers.

Activity-2

Teacher provides 3 sets of cards for each group, one set with terms (Gene, DNA, Chromosome, Nucleus, Cell, Organisms) 2nd with pictures, 3rd with definitions and asking them to put the structures in place.

Activity-3

Students, I am tall like my father, Tell me whom you resemble, your father, mother or both?

Activity-4

Few students are asked to pickup 2 beads from a box full of two different colour beads labelled with alphabets for a particular trait.

(Same colour in alphabet - Homozygous TT

Different colour in alphabet - Heterozygous Tt)

Activity-5

Listen students if father is with HH and mother hh. Find whether curly hair or straight hair is dominant and which will be expressed in first generation.

Students Activities

1. **Individual Activity**
   Know yourself. Find the reason why you are Tall, Short, Cleft Lip, Sharp nose, etc. (Mendelian traits)

2. **Group Activity**
   Picture of a Cell, Nucleus, Chromosome, DNA, are given to each group and they have a locate them in proper place.

3. **Group Discussion**
   Do genes have a specific locus?

4. **If father has brown eyes, mother blue eyes, what will be the genotypic ratio of their offspring?**

5. **Fill the Punned Square**

♀ / ♂	B	b
B	?	?
b	Bb	?

Evaluation

1. Differentiate a gene and allele.
2. The world's cutest baby Anahita has Green eyes. Is it dominant character?
3. _____ forms the physical basis of inheritance.
4. Find who I am?
   1. I am alternative forms of the same gene.
   2. I am study of heredity.
   3. I am the raw material for Evolution.
5. Without variation, heredity and its branches of science is possible. Explain.

7 Chromosome

Learning Outcomes

- Recognise the location of chromosomes.
- Understand the structure of chromosomes.
- Knows the difference between gene and chromosomes.
- Learn to admire how variation plays a vital role even in Twins.
- Understands how the traits are transferred to different generation.

Teacher Activities

Teacher conducts a slip test regarding previous day portions.

Activity-1

In order to check the level of students understanding, she quotes, it 'Light' is a gene, what will be its allele. The students answer is Day and Night.

Activity-2

Teacher show a string of beads and then she explains that the thread is chromosome and beads are genes.

Activity-3

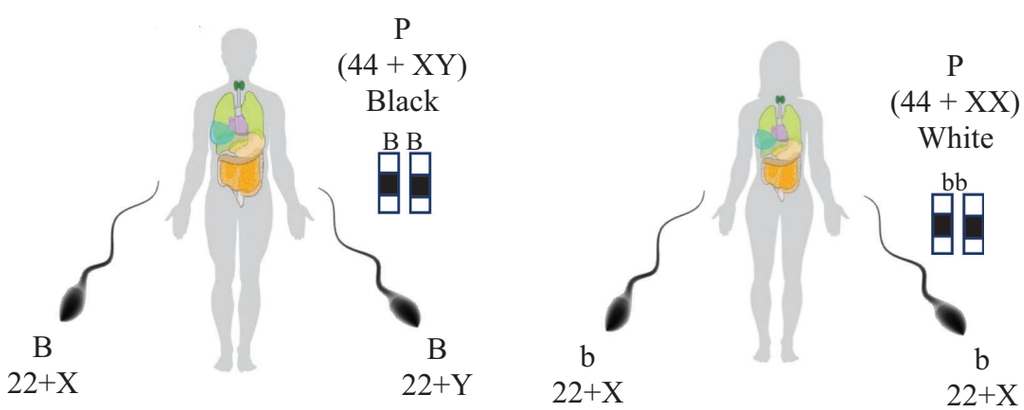
Students are asked whether they can cross their right thumbs over left, when they clap their hands and tries to work with them to come up with the correct answer.

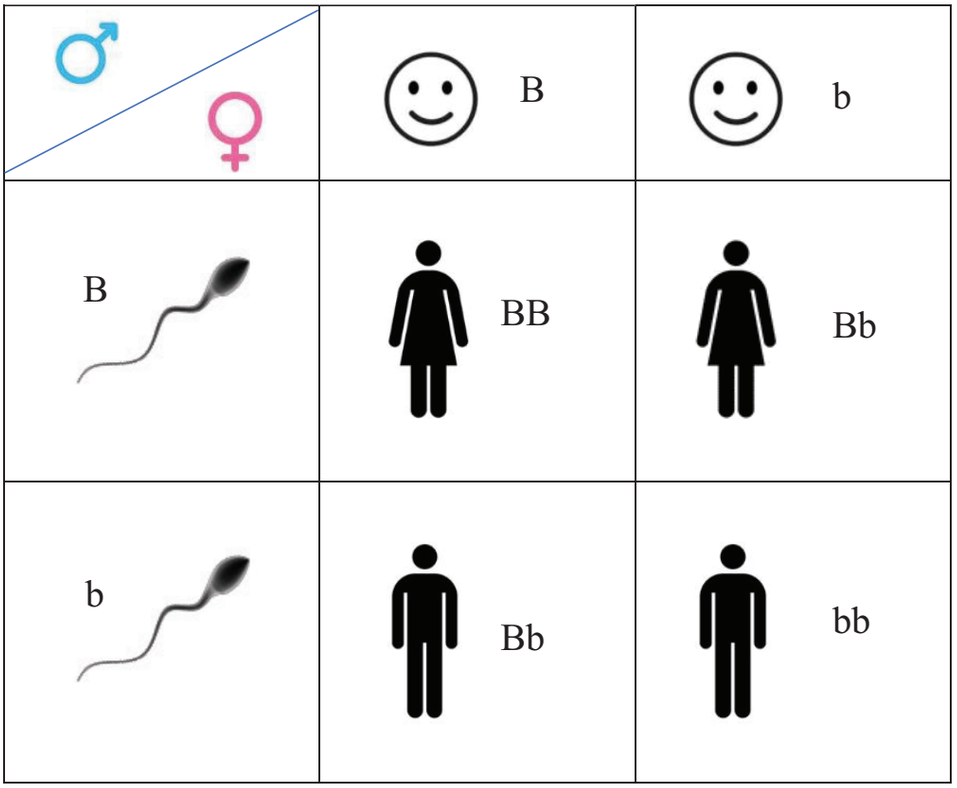
Activity-4

Twin sisters in the classification are made to stand as a model and students have to find the similarities and difference between them.

Activity-5

Inheritance from frame work:





3 - Black
1 - White

Student Activities

1 Individual Activity

Students are asked to find the variation among their blood groups .

2. Group Activity

Genetic predisposition, taste buds. Students are given broccoli to eat and a Thinking file is provided to each group (4-5), they have to file their ideas, whether they love or hate to eat it.

3. Group Activity

"Our genes might prevent us from living for more than 125 years" - Justify the reasons.

4. Group Activity

Ask your classmates to role their tongues. Observe how many are able to roll and how many not able to record your findings.

5. Individual Activity

Each student is provided with a recipe and they are asked to find a rich one.

Evaluation

1. Asking all the students to touch their tip of their nose with the tongue and can be asked to tabulate with those who can and can't.

2. Punnett square: Freckle case. Mom has freckles and dad has none. Each parent has a homozygous genotype. Their genotypes are:

   Mom = _____

   Dad = _____

3. Match the terms with their definitions:

A	Allele	i)	Traits expressed in first generation itself.
B	Gene	ii)	Alternative form of a gene.
C	Dominant	iii)	Expressed in subsequent generation.
D	Recessive	iv)	Physical factors for inheritance.

4. How many chromosomes in a cell:

Organism	Number of Chromosomes
Human	
Aedes Mosquito	
Potato	

5. A child who can roll the tongue has one brother who is a non-roller and two sister who are roller. If both parents are rollers, find the genotype of their parents.

8 Nucleic Acids

Learning Outcomes

- Know about different micro molecules present in living organisms.
- Understands the components of Nucleic Acid.
- Differentiates DNA and RNA.
- Understands Corona Virus has RNA as genetic material.

Teacher Activity

Activity-1

Teacher provides an article on nucleic acids and ask the students to discuss in groups and share their ideas and makes a note of it on the black board.

Activity-2

Students, living organisms have different macromolecules like polysaccharides proteins. Can you name a macromolecule present in living organism?

Activity-3

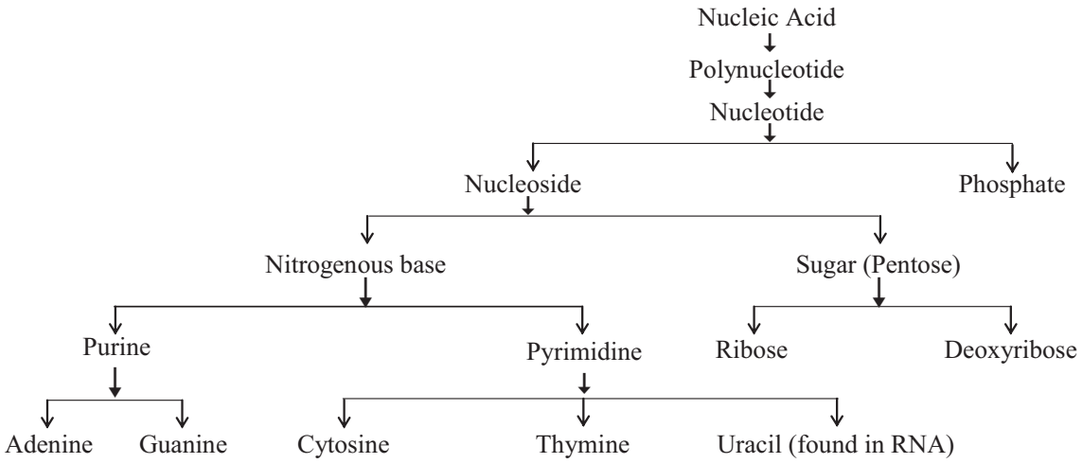
The principle components of atmosphere is O_2, N, Ar etc. Then what will be the components of Nucleic acid.

Activity-4

Students, the building blocks of living organism is cell, for protein, is amino acid. Can you guess the building blocks of Nucleic acids? Show your answers.

Activity-5

Concept Map (Chargaff Rule: A = T, G ≡ C).



Students Activities

Group Activity

Count the students off by twos, creating one group that represent DNA and another to represent RNA. Then one at a time call out facts about Nucleic acids. If a student thinks the fact is relevant to their kind of Acid they should Jump.

Activity-2

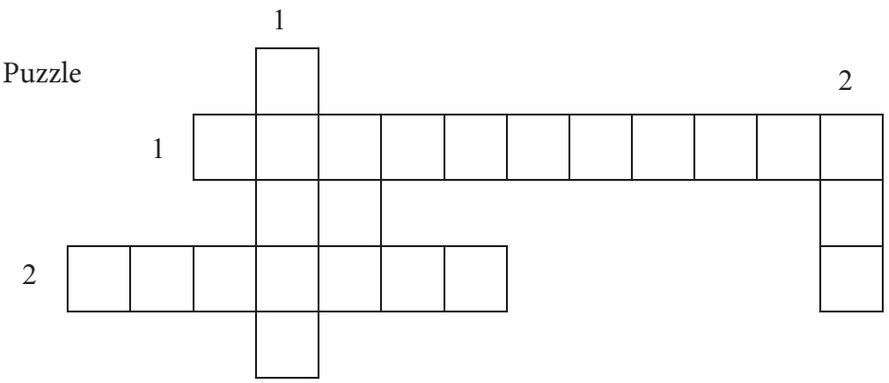
According to Chargaff's law the proportion of adenine in DNA is always equal to that of thymine and proportion of guanine always equal to that of cytosine, if 20% of adenine is present, what will be the percentage of thymine.

Activity-3

DNA has Adenine, Guanine, Cytosine and Thymine, what will be there in RNA, instead of Thymine?

Activity-4

Gross-word Puzzle



Across:

1. Macromolecule found in living organism.
2. One of the purine bases.

Down:

1. One of the Nitrogen base.
2. Nucleic acid mostly found in higher forms.

Activity-5

Nucleotide = Nucleoside + Phosphate

Nucleoside = ––––––––– + –––––––––

Evaluation

1. Write the name of nucleic acid present in Corona Virus.
2. What does Chargaff's rule say?
3. mRNA – messenger RNA
   tRNA – _____
4. Is it possible for the Human being to have 2 sets of DNA?
5. How many hydrogen bonds are found between Guanine and Cytosine?

9 Principles of Inheritance and Variation - Blood Groups

Learning Outcomes

- To understand the term inheritance and variation.
- Knowing the different types of Blood Groups.
- Learn the inheritance of multiple alleles with reference to human blood group.
- Understanding the term Rh factor.

Teacher Activities

Activity-1

Define the following keywords through the pictures charts:

- Multiple alleles
- ABO Blood Groups
- Null alleles
- Rh-Factor
- Erythroblastosis foetalis

Activity-2

Explain genetic basis of the human ABO blood group.

Genotype	Phenotype	Antigen present on Red Blood Cell	Antibodies Present in Blood Plastics
I^AI^A	A	A	Anti-B
I^AI^O	A	A	Anti-B
I^BI^B	B	B	Anti-A
I^BI^O	B	B	Anti-A
I^AI^B	AB	A and B	Neither anti-A nor Anti-B
I^OI^O	O	Neither A nor B	Anti-A and Anti-B

Activity-3

Diagramatic Presentation of Incompatibility of Rh factor - *Erythroblastosis foctalis.*

Rh^{-ve} mother x Rh^{+ve} father

↓

1^{st} baby (Mother not sensitized by Rh^-)

↓

2^{nd} baby Mother sensitized by Rh^-

↓ (Production of IgG against Rh^{+ve} Ag on fetal RBC)

2^{nd} baby death

Student Activities

Activity-1

The following table shows the genotype or ABO Blood grouping and their phenotypes. Fill in the gaps left in the table.

S. No.	Genotype	Blood Group
1.	I^AI^A	A
2.	–	A
3.	I^BI^B	B
4.	–	B
5.	I^AI^B	–
6.	–	O

Activity-2

Find out the blood groups in children from the parents with blood groups O and AB.

Evaluation

1. Who is the father of Blood groups?
2. Co-dominant blood group is –
   a) A b) AB c) B d) O
3. How do Erythroblastosis foetalis can be prevented?
4. What is the possible genotype and phenotype of blood groups?

10 DNA Structure and Replication

Learning Outcomes

- Understand the structure of DNA.
- Recognize the different compounds of DNA.
- Knows the role of DNA in the life of organisms.
- Understand how DNA replicates.
- Learn the enzymes involved in DNA replication.

Teacher Activities

Dear students did you know there is a secret code contained within every one of your body's cell. Yes, its Nick Name is DNA.

Activity-1

Teacher shows the picture of DNA, asks students to say a fact of it, but not to be repeated. She writes name of the students participating and marks star against their names and gifts a smiley.

Activity-2

How many of you have Laptop/Computer at home? Do you know computer needs some codes to work? Similarly, our body also has some codes for coding a protein - Can you guess, what is it?

Activity-3

Experiment:

Aim: To identify the DNA structure.

Materials:

- Isopropyl alcohol (kept in freezer).
- Test-tubes, beakers, Graduated Cylinders, Dish Soap, Strainer, Salt, Ziploc bag, Measuring Spoon, Grapes, Water, Funnel.

Procedure:

- Take 90 ml of water in a beaker, add 10 ml of dish soap and mix well.
- Add ¼ tsp of salt to the mixture.
- Peel the skin/tissues of grapes and place in zip-lock.
- Add that dish soap + salt mixture to zip-lock and seal it and smash the content.

- Place a strainer in a funnel over a beaker and pour the mixture from zip-lock.
- Then transfer the mixture to a small beaker, add 1 tsp chilled isopropyl alcohol.
- Remove the top white layer with a stirring rod/spoon.
- Keep it under a microscope.

Inference

The structure of DNA is seen and explained.

Activity-4

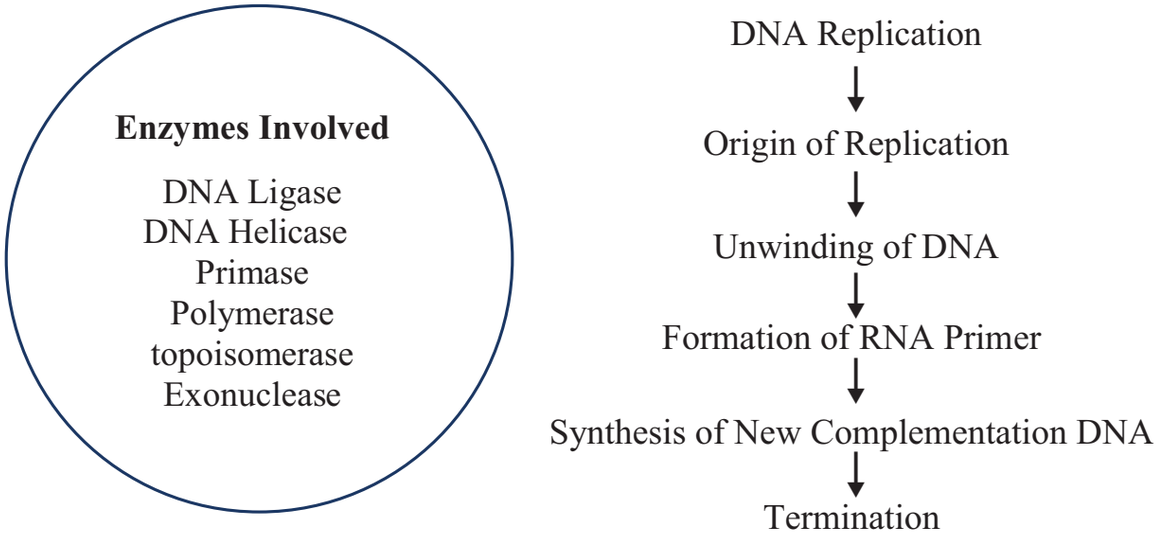
The teacher asks a boy to pass the book from the first desk to the last desk boy and explains, like this only DNA is passed from one generation to other.

Activity-5

Before your exams, you prepare like that the cells before cell Division, prepare themselves. They double the contents in them to divide equally to the upcoming cells.

Teacher gives one copy of biology material and asks students to take xerox of it. Now she asks students, do you understand, student reply yes, from one original DNA, two identical replies are synthesized man.

Concept Map



Students Activity

1. Students bring a purse and unlock the zip, using the runner and says runner acting as DNA helicase
2. DNA Replication (Find the pair)

A	T	C	C	C	T	T	G	C	G

3. **Group Discussion:**

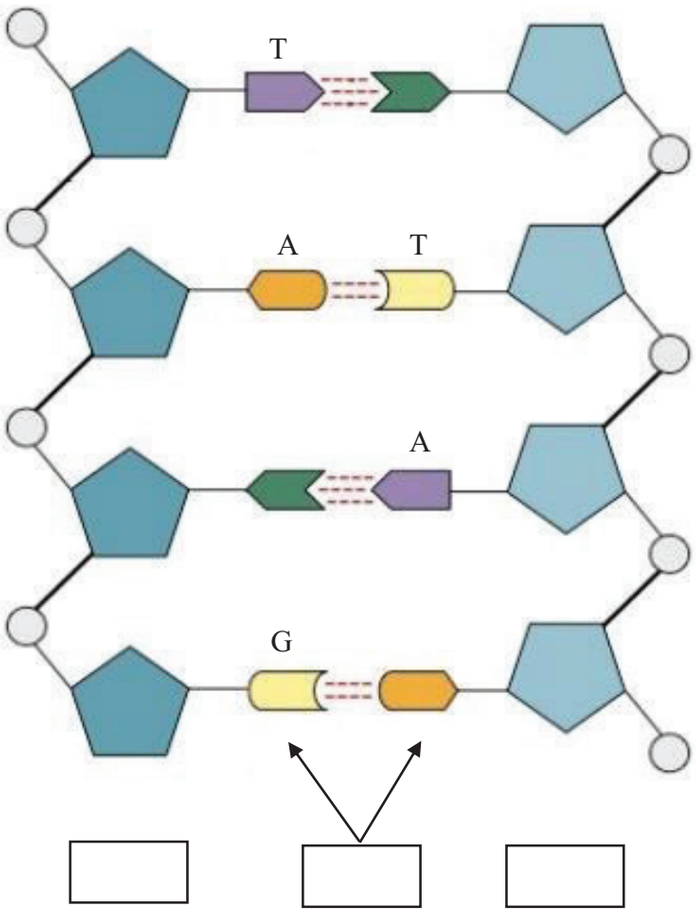
   "Every cell in the human body had its DNA damaged atleast 10000 times during life time." Think and discuss about it in groups and paste a note on it in your thinking file.

4. Vertebrae forms the backbone of all of us. Can you guess which forms the backbone of DNA.

5. **The structure of DNA:**

   i) Label the different components of DNA as 'base', phosphate group, deoxyribose sugar.

   ii) Add missing complementary base pairs to the diagram.



Evaluation

1. Is there any need for replication of DNA?
2. In Chimera type of humans, how many sets of DNA are there?
3. Name the enzyme which unwinds the DNA strand.
4. What type of sugar is present in DNA?
5. If the DNA is damaged, whether it can be reversed.

11 Modes of Reproduction in Organisms

Learning Outcomes

- Understanding the term Reproduction and its Significance.
- Knowing and grasping the different modes of Reproduction.
- Understanding the importance of copying of DNA in reproduction.
- Learning the importance of variation.

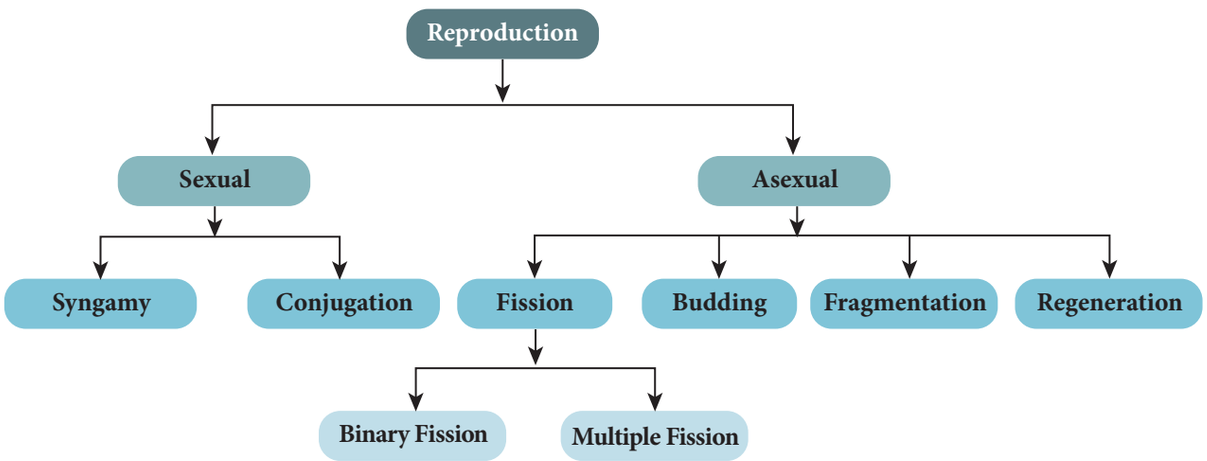
Teacher Activity-1

Define the following keywords through pictures and explains them.

1. Reproduction	6. Sexual dimorphism	11. Gametes
2. DNA copying	7. A sexual reproduction	12. Gonads
3. Variation	8. Sexual reproduction	13. Clones
4. Monoecious (Hermaphrodite)	9. Cytokinesis	
5. Dioecious	10. Karyokinesis	

Teacher Activity-2

Explain the types of reproduction in organizing by showing some charts.



Teacher Activity-3

To demonstrate the modes of reproduction used by single organism (Asexual reproduction):

- Dissolve 10 g of sugar in 100 ml of water.
- Take 20 ml of this solution in a separate test-tube and add a pinch of yeast granules to it.
- Put a cotton plug on the mouth of the test-tube and kept it in a warm place.
- After one hour put a small drop of yeast culture on a slide and cover it with cover slip.
- Observe the slide under a microscope and ask the students to observe it. Compare and contrast the ways in which yeast grows.

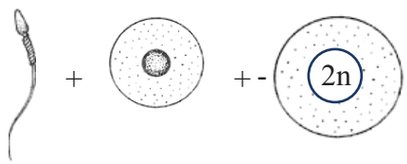
Students Activity-1

- Ask the students,
- To observe a permanent slide of Amoeba under a microscope.
- Similarly, observe another permanent slide of Amoeba showing binary fission.
- Now ask the students to compare the observations of both the slides.

Students Activity-2

- Divide and conquer:
- Divide the students into many groups.
- Give the pictures of animals to each group of students.
- Teaching many write the different mode of reproduction on the blackboard.
- Now ask the students to arrange the animal based on different mode of reproduction written on blackboard.
- Now praise the students who arrange correctly.

Evaluation

1. What is the importance of reproduction?
2. What is the importance of DNA copying in reproduction?
3. Find out the organism which can regenerate:
   a) Hydra b) Planaria c) Amoeba d) both 'a' and 'b'
4. 

   The above chart indicates which mode of reproduction is
   a) Conjugation b) Syngamy c) budding d) Sporulation
5. Write the significance of variation in reproduction.
6. Distinguish sexual and asexual reproduction.

12 Sex Determination and Karyotype

Learning Outcomes

- To understand the mechanism of sex determination in human beings.
- To learn about preparation of karyotype and significance.
- To understand the disease associated with chromosomal abnormalities.

Teacher Activity-1

Activity-1

Define the following keywords through the pictures:

- Sex determination
- Autosome (somatic / body chromosomes)
- Allosome (sex choromosome)
- Karyotype
- Down syndrome

Activity-2

Sex determination of human. Explain with flow chart.

	Male		**Female**	
	Heterogametic		Homogametic	
	Parents: 44A + XY		Parents: 44A + XX	
	Gametes (22A + X) (22A + Y)		(22A + X) (22A + X)	
Offspring	44A + XX	44A + XX	44A + XY	44A + XY
Progeny	female	female	male	male

Activity-3

Explain the preparation of Karyotype with help of PPT clips.

- Simple method of culturing lymphocyte from the human blood.
- Mitosis is induced by addition of colchicine.
- Colchicine to arrest cell division at metaphase stage.
- The suitable spread of metaphase chromosome is photographed.
- Chromosomes are arranged in orderly fashion in homologous pairs.

This arrangement is called Karyotype.

Student Activities

Activity-1

A diagrammatic representation of female chromosome and where is X chromosome located.

Activity-2

Show the picture of disease to the students.

Match the following:

1.	13-Trisomy	–	Klinefelter's syndrome
2.	21-Trisomy	–	Turner's syndrome
3.	XO	–	Patan's syndrome
4.	XXY	–	Down's syndrome

Evaluation

1. What are karyotypes?
2. How is sex determination in human being?
3. What are the applications of Karyotype?
4. Down's syndrome is also referred to as:
   a) 13-Trisomy b) 18-Trisomy
   c) 21-Trisomy d) None of these

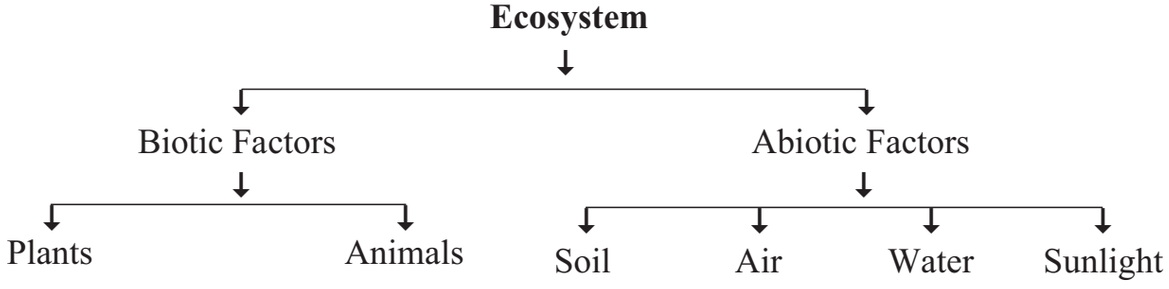
13 Organisms and Population - Environmental Adaptations

Learning Outcomes

- To understand the students the organisms how to combined the environment.
- To understand the environmental factors.
- To understand how to relate plants and animals in environment.
- To be create awareness about the environmental cleanliness.

Teacher Activity

1. All living organisms live in and interact with each other in a specific environment.
2. Two types of environmental factors:
   i) Biotic factors
   ii) Abiotic factors
3. A biotic factors:
   i) Solar Energy
   ii) Temperature
   iii) Gases
   iv) Water
   v) Soil
   vi) Elements
4. All living organisms are live directly or indirectly depended in a biotic factors.
5. Some insects and birds are using plants pollination.
6. Classification of Ecological Factors:



7. Abiotic factors which influence or effect organisms and their functioning in their environment.
8. The environmental factors are always dynamic. Justify.

Student Activity

1. Students prepare the chart of Biotic factors and Abiotic factors.
2. To list out the temperature fluctuated animals in the environment.
3. Identified the hot and polar region animal's name.
4. The class students are identified the school campus inside live in plants and animal name.
5. The students discussed merits and demerits of environmental factors.

Evaluation

1. What is meant by Ecosystem?
2. What is environmental factor?
3. Differences between biotic and abiotic factors?
4. The students list out various adaptations / living organisms.

14 Genetic Engineering and its Applications

Learning Outcomes

- To know about interest of genes transfer from one animal to other animal.
- To know about how to manipulate recombinant DNA
- To understand about significance of genes.

Teacher Activity

r-DNA - Introduction

Interest of Gene + Plasmid DNA = Recombinant DNA/Hybrid DNA

Using the chart form ribbon like structure and manipulate Recombinant DNA to show the students.

Requirements of tools

1. Interests of DNA
2. Plasmid DNA
3. Restriction enzymes - (Molecular Scissor)
4. DNA ligase enzyme.

Basic Steps involved r-DNA

i) Isolation of interest of DNA using restriction enzymes.
ii) Insertion of interest of DNA and plasmid DNA to make r-DNA.
iii) Transfer of r-DNA into bacterial cell.
iv) Multiplication of r-DNA into bacterial cells.
v) Expression of cloned gene in host cell.

Application of r-DNA

To produce valuable proteins an medicine.

Student Activity

1. An individual student using the chart form ribbon like structure and cut specific site of gene, show it.
2. Students using the chart form ribbon like structure to make r-DNA by using scissors.
3. Write down some name of medicine using r-DNA technology with help of doctor near to hospital.

Evaluation

1. r-DNA
   a) Vector DNA
   b) Circular DNA
   c) Plasmid DNA and interest of DNA
   d) Satellite DNA
2. Molecular Scissor also known as _____.
3. Enzymes to join two kinds of DNA.
4. What are the basic steps involved rDNA technology.
5. Write down the uses of r-DNA in medicine.

15 DNA Finger Printing Technology and Uses

Learning Outcomes

- To understand the DNA sequence of human being.
- To know about the significance of DNA finger printing technology.
- To know about genetically modified plants and animals.

Teacher Activity-1

Instruct the students - Take the finger print of 20 students by using stamp pad and find out the difference.

Every students finger print is not similar.

Every individual has difference in DNA nucleotide sequence.

To compare the genetic difference among the two individuals. Eg. Hair, finger prints.

To show the DNA sequence of an individual and stating the specific characteristics.

VNTR

Variable Number Tandem Repeats - it helps molecular marker for identification.

Satellite DNA

Continuous display of a small parft of DNA sequence.

Person-1: GCCAGCTAGCTAGCTAGCTAGCTAGCTTTCAT
1 2 3 4 5 6

Person-2: GCCAGCTAGCTAGCTAGCTAGCTTTCAT

Person-3: GCCAGCTAGCTAGCTAGCTAGCTAGCTAGCTTTCAT
1 2 3 4 5 6 7

VNTR illustration of three persons

Person 1 → 6 AGCT Pattern

Person 2 → 5 AGCT Pattern

Person 3 → 3-7 AGCT Pattern

Uses

To identify a person involved in criminal activities through forensic science.
To detect the child's father in disputes.

Teacher Activity-2

Introduction of transgene: The DNA fragment inserted into plants and animals.
Show the pictures to the students genetically modified organisms of some plants and animals.
Significance of transgenic plants: They are more stable, improved nutrition quality, resistant to diseases, similarly transgenic animals are used to produce proteins of medicinal importance.

Genetically modified plants and animals

1. Transgenic sheep
2. Transgenic fish (Tilapia)
3. Golden rice (Vitamin A)
4. Insect resistant plants

Student Activity

1. Record the finger prints of the students in the class and ask them to write their names and list out the patterns found.
2. Students are asked to collect the pictures of Transgenic plants and animals and naming them..

Evaluation

1. The basic step of identification of DNA sequence _____.
   a) Single
   b) Mutation change
   c) Polymorphism
   d) Repeated sequences
2. What is satellite DNA?
3. Write down the applications of DNA finger printing.
4. What is transgens and state its significances?
5. Name some genetically modified plants and animals.

16 Gene Therapy

Learning Outcomes

Students to get knowledge about biotechnology and its application. To know about in gene therapy technique in human welfare. To under the applications of Technology in the field of Science and Engineering.

Teacher Activity

To explain the Gene Therapy to the Students:

If a person is born with a hereditary disease can a corrective therapy by a process of gene therapy. This process involves the transfer of a normal gene into a persons cell that carries one or more mutant alleles by using vector.

Types of Gene Therapy

Somatic Gene Therapy:

Genes transferred in to any cell of the body does not produce by sperm or egg. Introduction of genes into bone narrow cell, blood cells, it will not inherited in later generation.

Germline Gene Therapy:

Gene transferred into sperm or egg introduced into egg and sperm, heritable and passed into later generation.

Steps in Gene Therapy

1. Identification of gene
2. Duplication of that gene
3. Insertion of the gene into human genome.

Student Activity

Students who know about:

1. The first clinical gene therapy was given in 1990 by French Anderson to a four-year-old girl with adenosine deaminase (ADA) deficiency.
2. Gene therapy can treated the diseases like hemophilia, AIDS, cancer and heart diseases.
3. Countries use gene therapy:
   US ⇒ 66.81% IN Clinical Trail; UK ⇒ 9.45%, Germany ⇒ 3.95%, China & Japan ⇒ 2%

Evaluation

1. What is gene therapy?
2. What are the types of gene therapy?
3. What are the steps in gene therapy?

17 Fermentation

Learning Outcomes

Students to get knowledge about microbes in Human Welfare and its importance, and role of microbes in fermentation in human activities in day to day life.

Teacher Activity

Teacher explains about fermentation and role of microbes in human activity. The study of fermentation is known as Zymology.

a) **Fermentation:**
It is metabolic process produce chemical changes in Organic Substrates through enzyme action from carbohydrate in absence of oxygen.
Alcoholic fermentation:
$C_6H_{12}O_6$ $2C_2H_5OH + 2CO_2$
1 mole glucose 2 mole ethanol + 2 mole CO2 = produce 2 mole of ATP

b) **Types of Fermentation:**
Lactic acid, alcoholic and acetic acid fermentation.

c) **Stages of Fermentation:**
Primary, Secondary and Conditioning.

d) **Where does Fermentation in Cell:**
Cytoplasm of prokaryotic and Eucaryotic cell in absence of oxygen.

e) **Fermented food and its uses:**
Fermented food contains probiotic bacteria which is increase health of gut, immunity, digestion, fermented food gives taste, aroma, texture and appearance. Example of food in our day to day life are curd, idli, butter, beer, wine, bread and yogurt.

Student Activity

Students to know about Oenology, Zymology, and Brewer's yeast.

Oenology: Studyabout wine and wine making.
Zymology: Study of fermentation and its uses.
Brewers Yeast: Yeast fermenting matted cereals, fruit juices produce alcoholic beverages.

Evaluation

1. What is fermentation?
2. What are the types of fermentation?
3. What are the uses of fermentation?
4. Define 'Zymology'.
5. What is Oenology.

18 Enzyme Reaction

Learning Outcomes

Students get knowledge about biotechnology about enzyme reaction, role of enzyme in our body in metabolism.

Teacher Activity

- Teacher gives abut enzyme reaction and the role of enzyme in our body, in metabolic activity like digestion.
- Enzyme allow many chemical reaction occur in living system its function as a organic catalysts, it's a protein molecule.
  a) Examples of Specific Enzyme:
  Amylase is found in saliva.
  Maltase break sugar maltose into glucose.
  Trypsin - found in small intestine breaks protein into amino acid.
  b) Functions of Enzyme:
  - It creates chemical reaction in body.
  - Speed up chemical reaction to help support life.
  - Perform important task such as building muscle, destroy toxin, breaking food during digestion.
  - Making energy molecule ATP.

  c) Properties of Enzyme:
  i) Catalytic property, ii) Specificity, iii) Sensitiveness to heavy metal.

Student Activity

Student you know about:

Catalyst ⇒ Function may increase or decrease the rate of chemical reaction and remains unchanged
Feed source rich in enzyme ⇒ Natural digestive enzyme in pineapple, papaya, mangoes, banana, ginger, adding any of these to our food may help to promotes digestion.

Evaluation

1. What are enzymes?
2. Example of enzyme in our body.
3. Food - Rich in enzymes.
4. Function of enzymes.

19 Microbial Diseases

Learning Outcomes

- To know about microbes.
- To gain knowledge about bacterial and fungal diseases to human.

Teacher Activities

Activity-1

Moist soil was collected in a beaker and water was added to it. When the soil particle settles down, a drop of water from the beaker was observed under the microscope. Tiny organisms are observed. These are called microorganisms.

Activity-2

Teacher tries to elicit the answers from the student for the following questions.

1. What is meant by disease?
2. Mention the types of diseases.

   The term disease literally means without .... (uneasiness) disease. Any deviation from normal functioning or the state of complete physical or mental well being is called a disease.

   Diseases may be grouped under three categories: They are:

   a) **Infectious diseases** - caused by microbes.

   b) **Deficiency diseases** - caused by lack of proper nutrients.

   c) O**rganic diseases** - are caused when particular organ of a body does not function properly.

Activity-3

Some bacterial diseases, their causative agents and mode of transmission were explained to the students through the following mind map.

Activity-4

When you observe red circular patches on the skin (human) it shows the infected condition. What is the clinical name of the disease? How does it spread?

It is a fungal disease called Ringworm caused by a fungus Microsporum. It is also called as dhobisitch washing and maintaining the dress material in unhygienic way causes, this disease.

Student Activity-1

Cholera, Typhoid, Diphtheria, Pneumonia, Dwarfism, Night blindness, Rickets, Gigantism, Anaemia and Diabetic mellitus. Categorise the diseases under the following headings:

S. No.	Infectious Diseases	Deficiency Diseases	Organic Diseases
1)			
2)			
3)			
4)			
5)			
6)			

Student Activity-2

Group activity and submitting reports: Form three groups and discuss the following questions?

1. How bacterial diseases can be prevented? It should be discussed in small groups.
2. How food can be handled safely from the time of preparation till it is served?
3. How can we prevent bacterial diseases that spread through water.

Student Activity-3

When your friend comb his hair white scales fall like snow on the shoulder. Name this fungal disease and mention its causative agent.

Disease:
Dandruff

Causative Agent:
Microsporum furfur (fungus)

Student Activity-4

You are wearing the shoes most of the time you may develop crack and sores between the toes. Mention the clinical name of the disease. How can it be prevented?

Disease - Athletic foot
Casuative agent - Taenia pedis (fungus)
Prevention: Can be prevented by applying talcum powder on toes before wearing shoes.

Evaluation

1. Typhoid is a bacterial disease that spreads:
   a) Through contaminate food and water
   b) Through air
   c) Through contaminated soil

2. Athelet's foot is a
   a) Bacterial disease
   b) Fungal disease
   c) Viral disease

3. Gigantism is a
   a) Organic diseases
   b) Deficiency diseases
   c) Infectious disease

4. What are microorganisms?

5. List out some bacterial diseases.

20 Role of Microbes in Household Products

Learning Outcomes

- Student gains knowledge about the role of microbes in household products.
- To know about how fermentation of microbes are useful in our day-to-day life.

Teacher Activity-1

Milk is boiled and transferred to a bowl. A spoon-full of curd is added to it and stirred it well. The bowel is covered with a lid and left undisturbed for some time. After 5 hr, you open the lid and observe it What do you observe? Name the process involved in this activity. Name the microbe involved.

Observation: milk

Transformed to: Curd

Process: Fermentation

Teacher Activity-2

Teacher makes a vegetable pickle by mixing the cut pieces of cabbage, cucumber, chili powder, turmeric powder and salt. It is stirred well and kept undisturbed for a day or two. Delicious pickle is ready to consume, which microbe involved in this process.

Fermenting action of lactic acid bacteria makes the delicious pickle. This bacteria act on the sugar content of the vegetables.

Teacher Activity-3

½ kg of Maida flour is taken sugar (A spoonful) and warm water was added to it. A pinch of yeast is added to the flour and kneaded it well to make the dough soft. What do you observe after two hours? Did you find the dough rising?

Conclusion: Yeast reproduces rapidly and produce CO_2 during respiration. Bubbles of the gas fill the dough and increase its volume. Here the sugar is converted to alcohol and carbon-di-oxide.

Teacher Activity-4

How Paneer (cottage cheese) is prepared at home?

It is made by curdling hot milk with lemon juice or vinegar. Coagulation occurs. The solids are separated and pressed to form cheese. Large hole is cheese is due to production of large amount of CO_2 by the bacteria.

Student Activity-1

Students are asked to give reason for the following one. Why do bread become more porous and spongier? The process of bread-making involves kneading a mixture of flour, salt, sugar, yeast cells and water to dough yeast converts sugar to alcohol and carbon dioxide.

As more and more CO_2 is produced the dough rises in volume. This makes the bread porus and spongy. Baking expanded dough at 180°. Kills yeast .....? Alcohol evaporates.

Student Activity-2

1. Ask your mother whether idli and dosa can be prepared from fresh dough (immediately after grinding).
2. Mention the factor responsible for softness and flavour of idli.
   The dough is fermented by the bacteria which give softness and flavour to idli.

Evaluation

1. Give the correct term for the following:
   a) The process of conversion of sugar into an aid or an alcohol by the action of microorganism.
   b) Rising of dough due to the production of this gas makes the bread porous and spongy.
2. Name some Indian food prepared by using fermentation process.
3. The yeast is used in the production of:
   a) sugar b) alcohol
   c) hydrochloric acid d) oxygen

21 Role of Microbes in Industrial Products

Learning Outcomes

Student gains knowledge about the role of microbes in industrial products and understand about the single cell protein.

Teacher Activity-1

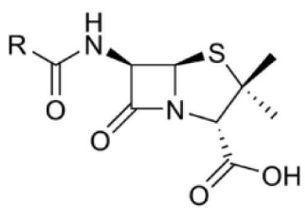
500 ml beaker is taken and ¾th of the beaker is filled with water. 2 to 3 tablespoon of sugar is added to it. Half teaspoon of yeast powder is added to a sugar solution. It was kept in a warm place for 4 to 5 hours. Students are asked to smell the solution.The smell is due to alcohol. Saccharomyces cerevisiae is the major producer of ethanol an industrial alcohol.

Teacher Activity-2

What is antibiotic?

Antibiotics are chemical substances produce by microorganisms which can kill or retard the growth of other disease-causing microbes.

Pencillin is called a queen of drugs. Why? Teacher explains...



Teacher Activity-3

Teacher shows the mushroom and spirulina tablet to the students and states its importance. Microorganisms have long been widely used as human food. Cells from varieties of microorganisms, viz. bacteria yeast fungi and algae are used as and asked single cell protein (SCP). It is a protein supplements rich in vitamins. It reduces blood sugar level.

Spirulina tablets are prescribed as enriched vitamin for most of the people. Yeast cells helps to increase hemoglobin in human blood. Yeast cells are dried to form yeast tablets which are used in medicines.

Student Activity-1

In your childhood, you might have been vaccinated to protect yourself against diseases. Can you prepare the list of vaccines? You have taken against which disease. You may get help from your parents or staffs from nearby Primary Health Centre.

Nowadays vaccines are made on a large scale from microorganisms.

Student Activity-2

Students are asked to collect information from their parents how the traditional drink Neera (*பதநீர்*) is prepared.

Actually,it is prepared from fermenting sap of palms and coconut trees. It is a refreshing drink, which on boiling produce jaggery or palm sugar when Neera is left undisturbed for few hours it gets fermented to toddy, with the help of yeast.

Student Activity-3

Teacher tried to elicit the answer from the following questions:

1. What is silage?
2. Name the microorganisms used in making tooth-paste.

Evaluation

1. The preparation of killed or weakened disease causing microbes are called _____.
2. Shells of _____ are used in toothpaste to give it a texture:
   a) Bacteria b) Diatoms c) Yeast d) Fungi
3. _____ is referred as queen of medicine
   a) Penicillin b) Tetracycline c) Erythromycin d) Streptomycin
4. What is SCP cell protein?
5. Name the microorganisms used in the preparation of single cell protein.
6. How microbes are used in curing of tea and tobacco?
7. Name the bacteria which are used in retting of fibers.

22 Human Health and Diseases

Learning Outcomes

- To know about that the malnutrition, neglects thed personal and public hygeine malfunctioning of body parts.
- Understanding the name of the disease how they are transmitted from one person to another (Communicable disease) and understanding how they disease is not transmitted from one person to another (non-communicable disease).
- Knowing how our body protects the body from various diseases and the various functions of the immune system.

Teacher Activity-1

Explaining disease caused by malnutrition:

- **Kwashiorkr, Marasmus due to protein deficiency**
- **Deficiency of minerals:**

  Calcium - Rickets

  Phosphorus - Osteomalacia

  Iodine - Goiter or Cretnism

  Iron - Aneamia
- **Deficiency of Vitamins:**

  Night blindness

  Scurvy

  Rickets

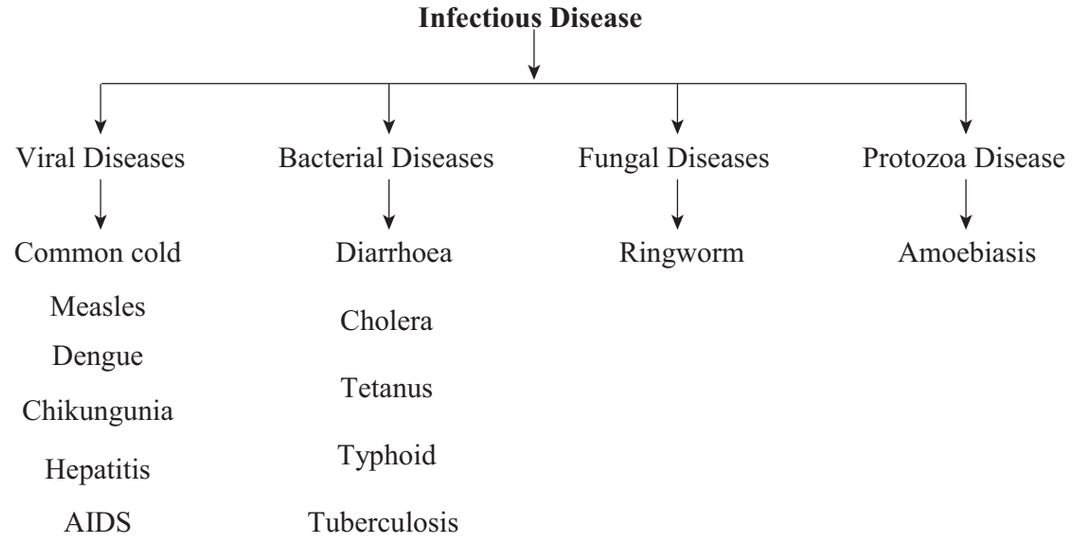
  Beriberi

When personal hygiene is ignored
Diarrhoea, Tooth Decay, Athlet's foot, Dandruff

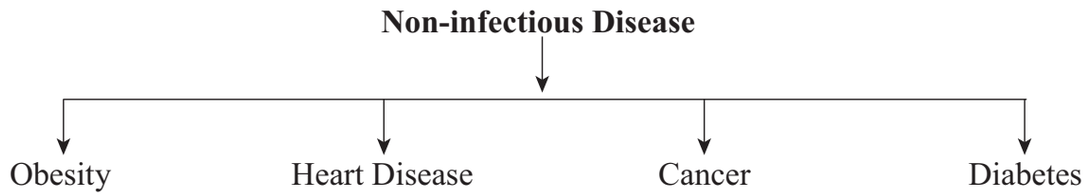
Teacher Activity-2

Explaining types of diseases

Polluted air, contaminated food, water and vector (animal or pets) can be transmitted at least from one person to another is called infectious diseases.



Some disease are caused by metabolic disorders. That are not transmitted from one person to another. These are called non-infectious or non-communicable diseases.



There is also becoming a social disease caused by the misuse of the drug, alcohol a tobacco.

Explain the sexual abuse of children and their predisposition to mental and physical illness.

Explaining how our body functions and protects from various diseases.

Skin ⇨ Prevents germs from entering the body.

Mucus Membrane ⇨ Foreign objects get caught up in the Mucus membrane.

Body Temperature ⇨ Fever inhibits the growth of pathogen.

Protecting the children by vaccination

Student Activity

1. Prepare a food map card to provide a balanced diet.
2. Go to the nearest doctor or hospital and ask for list vaccines.

Evaluation

1. Rickets is caused due to the deficiencies of _____ minerals
2. Define infectious diseases.
3. Explain about viral disease.
4. List the disease caused by Vitamin deficiency.

23 Sexually Transmitted Diseases

Learning Outcomes

- To understand the sexually transmitted diseases and their symptoms.
- To know about the mode of transmission and prevention of AIDS.
- To know about sexually transmitted bacterial diseases.
- To understand the sexually transmitted viral diseases and mode of transmission.

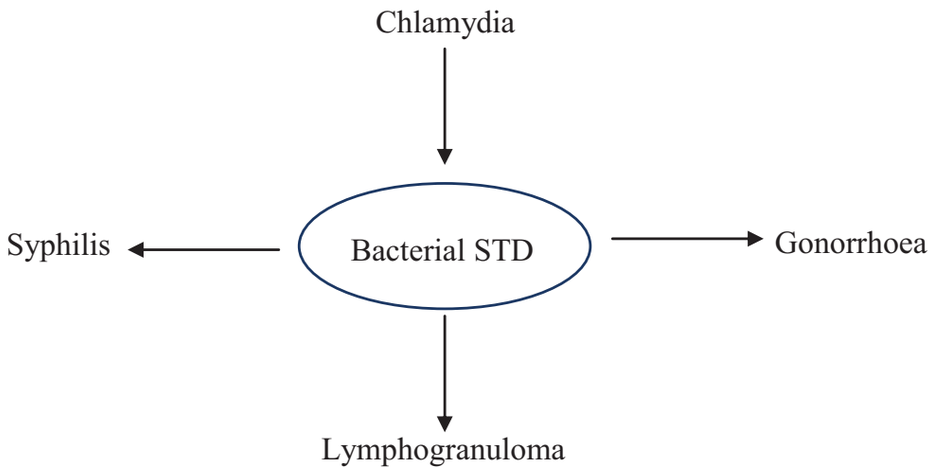
Teacher Activity-1

Explain the sexually transmitted diseases, mode of transmission, symptoms and preventive measures The teacher should mention the symptoms of a disease and should ask the students to identify the disease and then should explain the disease and their symptoms.

Symptoms	Identification	Diseases
Pain during urination	→	Gonorrhoea
Prolonged fever and sweating at night	→	AIDS

Teacher Activity-2

Sexually transmitted bacterial disease described through word web.



Teacher Activity-3

Sexually transmitted viral diseases, causative organism, mode of transmission, affected organs and symptoms should be explained with the help of a tabular column prepared on a chart paper.

Student Activity

(Individual Activity)

The following Hints are discussed in a class room and should explain the prevention and control measures of AIDS.

- Using disposable syringe and needles in hospitals and clinics.
- Having safe and protected sex.
- Screening of blood donor before blood donation.
- Sharing of razors should be avoided.
- Create awareness.

Evaluation

1. Name any two bacterial sexually transmitted diseases?
2. Name the two symptoms of syphilis.
3. Can you get STD from kissing?
4. What are the preventive measures of AIDS?

24 Immunology

Learning Outcomes

- To understand about Vaccines.
- Get the knowledge about AIDS.
- To know about Tumour.

Teacher Activity-1

By showing the picture, teacher asking what is this?

Teacher explain about, why should we take vaccines.

Teacher Activity-2

Teacher ask, what are two types of vaccines and explain:

- Live attenuated vaccines
- Killed (inactivated) vaccines.

Teacher Activity-3

Teacher asks, why we should use the needles, which is used to other and we should not take unchecked blood? Yes AIDS. It with affects our immune system of the body. AIDS is caused by HIV retrovirus, ELISA and Western blot test are do to the people. Make awareness about AIDS.

Teacher Activity-4

Teacher ask the students, why should we avoid Tobacco, Hans, Panprac and all?

It will cause Cancer. It is most dangerous diseases. Oncology is the study of Cancer. It will affect our liver, lungs, intestine, bones and skin. Surgery, Radiation and Chemotherapy are the good treatment for this.

Student Activity-1

Ask the students to write note about the vaccines prepared for Corona, by all the countries.

Student Activity-2

Teacher writes the names, MMR Vaccine, Smallpox Vaccine, DPT Vaccine, and Polio Vaccine on the blackboard, ask them to classify.

Student Activity-3

Divide the students in two groups, ask them to discuss about, what are the routes of HIV, and how can it be prevented?

Student Activity-4

Ask the students to collect the pictures and causative agents of cancer in a chart.

Evaluation

1. We should protect our body from Corona. Explain what are the vaccines we should take and how?
2. How can you know a person is affected by AIDS? Write about Tests.
3. What are the symptoms of AIDS?
4. A person gets a small tumor in his body, it continuous to grow. What is this? How will you cure it?

25 Endangered Species

Learning Outcomes

By the end of the training, the learner will be able to:

- Identify the endangered species.
- Explain the causes for endangered species.
- List out the steps for protecting endangered species.

Teacher Activity-1

The teacher displays a picture to the students. The teacher then calls out a random person and asks them to brief the class about the picture portrayed.

Snow Leopard | **Asiatic Lion** | **Malabar Glory Lily**

Lion Tailed Macque | **Night Tahr** | **Rafflesia**

Teacher Activity-2

Teacher asks the student to name some of the endangered species that they have seen while watching television or through other mass media resources.

Teacher Activity-3

Teacher splits the students into five groups and distributes flash card to each group. Teacher then instructs each group to discuss about the flash card within the group for a small duration.

Finally, the teacher asks each group to appoint a representative for the group who will then present the ideas discussed in the group to the entire class.

Over hunting and Poaching | **Pollution** | **Diseases**

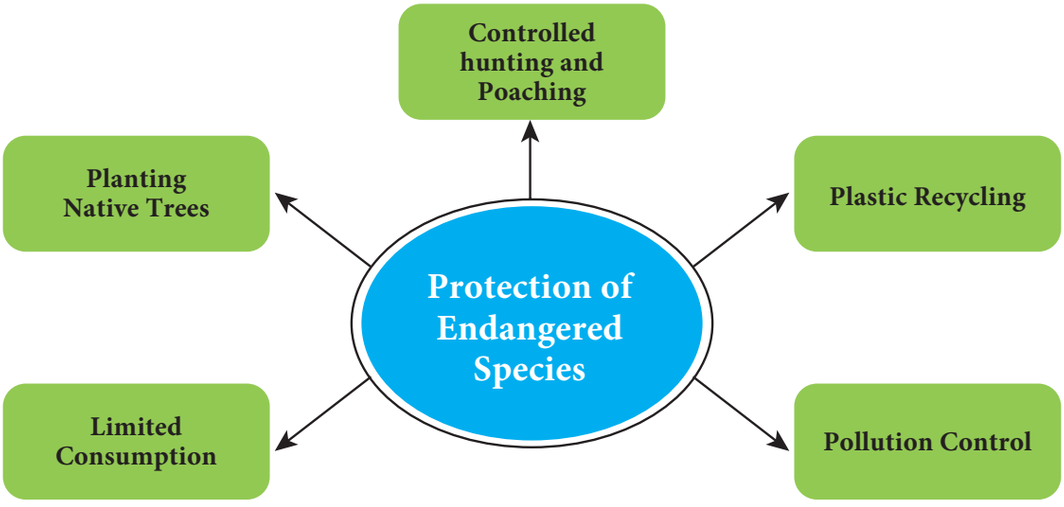
Natural Calamities | **Deforestation**

Student Activity-1

Select the odd one from the group and justify the reason for your selection.

Student Activity-2

Look at the flash card you have received and go join your relevant group.



Note: Above image contains the two major groups along with the related flash cards.

Evaluation

1. List out any four endangered plant and animal species.
2. Suggest any three measures you could take to protect the plants and animals in your surroundings.

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