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**2017**

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**Group A**

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## Group 'A'

### Question: 1

Answer the following questions (Alternative are to be noted):

[2 x 7 = 14]

- a. Mention the site where syngamy occurs in amphibians and reptiles respectively.

#### Answer:

- Amphibians: outside the body or in external medium.
- Reptiles: inside the body

- b. How is snow blindness caused in humans?

#### Answer:

High dose of UV-B radiation, inflammation of cornea.

OR

Name the enzyme involved in the continuous replication of DNA strand. Mention the Polarity of the template strand.

#### Answer:

(DNA dependent) DNA polymerase 3' to 5'

- c. Offspring's derived by asexual reproduction are called clones. Justify giving two Reasons.

#### Answer:

Morphologically (structurally) is genetically identical.

- d. Biotechnologists refer to Agrobacterium tumefactions as a natural genetic engineer of plants. Give reasons to support the statement.

#### Answer:

It can transfer gene naturally and can deliver a piece of TDNA and has tumor inducing plasmid.

OR

Write a difference between net primary productivity and gross productivity.

#### Answer:

Gross productivity:

Rate of production of organic matter during photosynthesis.

Net primary productivity:

Available biomass for the consumption to heterotrophs

e.

- i. Write the name of the organism that is referred to as the 'Terror of Bengal'.

[1]

#### Answer:

Eichhornia crassipes / Water Hyacinth

- ii. What are 'true breeding lines' that are used to study inheritance pattern of traits in plants?

[1]

#### Answer:

Self-pollination continuous, for several generations / homozygous.



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f.

i. What is Antrum?

[1]

**Answer:**

Antrum is a general term for a cavity or chamber which may have specific meaning in reference to certain organs or sites in the body.

ii. Name any two breeds of wild rock pigeon that have been developed through artificial selection.

[1]

**Answer:**

A special breed, called homing pigeons has been developed through selective breeding to carry messages and members of this variety of pigeon are still being used in the sport of pigeon racing and the white release dove ceremony at weddings and funerals.

g. What are the two functions of DNA polymerase?

[2]

**Answer:**

DNA polymerase is the first known of the enzymes whose function is to promote the bond formation of the joining units that make up the DNA backbone. E.Coli has various numbers of DNA polymerases, assigned by Roman numerals that play important roles in DNA replication and repair.



## Group 'B'

### Question: 2

Answer the following questions? (Alternatives are to be noted):

[3x12=36]

- a. Explain the phenomena of multiple allelism and co-dominance taking ABO blood group as an example. [3]

### Answer:

In codominance, neither phenotype is completely dominant. Instead, the heterozygous individual expresses both phenotypes. It can be easily expressed from the example is the ABO blood group system.

The gene for blood types has three alleles: A, B, and i. i causes O type and is recessive to both A and B. The A and B alleles are co-dominant with each other. When a person has both A and B, they have type AB blood.

### Example

Punnett square for a father with A and I, and a mother with B and i:

```
-----A-----i
B-----AB-----B
I-----A-----O
```

### Multiple Alleles

The ABO system in humans controlled by three alleles that are referred to as  $I^A$ ,  $I^B$ , and  $I^O$  the “I” stands for iso-haemagglutinin.  $I^A$  and  $I^B$  are co-dominant and produce type A and type B antigens, respectively, which migrate to the surface of red blood cells, while  $I^O$  is the recessive allele and produces no antigen.

The blood group arising from the different possible genotypes are summarized in the following table. HLA genes code for protein antigens that are expressed in most human cell types and play an important role in immune response.

These antigens are also the main class of molecule responsible for organ rejections following transplantations thus their alternative name: major histocompatibility complex (MHC) genes.

Genotypes	Blood Group
$I^A I^A$	A
$I^A I^O$	A
$I^B I^B$	B
$I^B I^O$	B
$I^A I^B$	AB
$I^O I^O$	O

- b. How does industrial melanism support Darwin's of Natural Selection? Explain. [3]

### Answer:

The effect of Industrial melanism in the support of Darwin's theory can be traced back to collection of moth in 1850s before industrialization. It was observed that there was whiter winged moth on trees than dark winged or melanised moths. But after industrialization in 1920 there were darker winged moth in the same area i.e., the proportion was reversed.



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It was due to the fact the predators will spot a moth against a contrasting background. Hence moths those were able to camouflage themselves because of after effects of industrialisation that was dark smoke and soots, survived easily.

OR

Explain the method used for carrying this programme for cows.

[3]

**Answer:**

In this method a cow is administered hormones, with FSH like activity to induce follicular maturation and super ovulation instead of one egg which they normally yield per cycle they produce 6-8 eggs

The animal is either mated with elite bull or artificially inseminated the fertilized eggs at 8-32 cell stages, are recovered nonsurgically and transferred to surrogate mothers. The genetic mother is available for another round of super ovulation.

c. Trace its life cycle in human body.

[3]

**Answer:**

When an infected mosquito bites, the sporozoite is injected along with saliva into the human bloodstream. Plasmodium first enters liver cells, where it multiplies asexually, and then red blood cells, where it continues to proliferate.

Inside the red blood cell, it changes shape and divides into smaller form called merozoites. The red blood cell, containing these merozoites rupture, releasing them into the blood. The merozoites infect other red blood cells, and the life cycle is repeated.

The rupturing of red blood cell causes the symptoms of fever and chills plasmodium enters the sexual phase when some merozoites in the erythrocytes develop into gametocyte, cells capable of producing both male and female gametes. Erythrocytes containing gametocytes do not rupture.

OR

Inheritance pattern of ABO blood groups in humans shows dominance, co dominance and multiple allelisms. Explain each concept with the help of blood group genotypes.

[3]

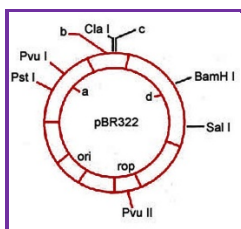
**Answer:**

Inheritance pattern of ABO blood groups in humans show dominance, co-dominance and multiple allelism. ABO blood groups are controlled by the gene I. The plasma membrane of the red blood cells has sugar polymers that protrude from its surface and the kind of sugar is controlled by the gene.

The gene (I) has three alleles  $I^A$ ,  $I^B$  and i. Therefore this is an example of multiple alleles. The alleles  $I^A$  and  $I^B$  produce a slightly different form of the sugar while allele i doesn't produce any sugar.

Because humans are diploid over I, in other words when  $I^A$  and i are present only  $I^A$  expresses (because i does not produce any sugar), and when  $I^B$  and i are present  $I^B$  expresses. This explains principle of dominance. But when  $I^A$  and  $I^B$  are present together they both express their own types of sugars: this is because of co-dominance.





- d. i. Identify the selectable markers in the diagram of Ecoli vector shown above.

[3]

**Answer:**

a = Ampicillin, d = Tetracycline

- ii. How is the coding sequence of  $\alpha$ -galactosidase considered a better marker than the ones identified by you in the diagram? Explain.

**Answer:**

This is because when a recombinant DNA is inserted within the coding sequence of an enzyme,  $\beta$  – galactosidase results into inactivation of the enzyme, which is referred to as insertional inactivation. The presence of a chromogenic substrate gives blue colored colonies if the plasmid in the bacteria does not have an insert.

Presence of insert results into insertional inactivation of the  $\beta$  – galactosidase and the colonies do not produce any color and thus these colonies are identified as recombinant colonies.

- e. Explain the experiment performed by Griffith on streptococcus pneumonia. What did he conclude from this experiment?

[3]

**Answer:**

Griffith's experiment was conducted in 1928 by Frederick Griffith which was one of the first experiments suggesting that bacteria are capable of transferring genetic information. In 1928, the bacteriologist Frederick Griffith, a British scientist performed an experiment with bacterium *Streptococcus pneumonia* that causes pneumonia in mammals including humans.

The disease causing or S- strain has cell surrounded by a capsule, and forms smooth glistening colonies when grown on agar medium. Some mutant strains from rough colonies or R strain. This strain does not cause pneumonia.

Also, when S strain is heat-killed and injected into mouse, no disease symptom appears. Amazingly, however, when mixture of heat-killed S reappeared. Live S type cells could be recovered from the blood of dead mice.

Griffith proposed that a 'transforming principle', a chemical substance was released by the killed S cells, which transformed the R bacteria into S type. This was a permanent genetic change as S type bacteria continued to produce similar cells. This is the first known example of bacterial transformation.

- f. If a desired gene is identified in an organism for some experiments, explain the process of the following:

- i. Cutting this desired gene at specific location

**Answer:**

The process involves:



- ✓ Identifying the restriction endonuclease that recognizes the palindromic nucleotide sequence of the desired gene.
- ✓ The restriction endonuclease inspects the DNA sequences that finds and recognizes the site.
- ✓ It cuts each of the double helix at the specific point a little away from the center of the palindromic site which is between the same two bases on the opposite strand.
- ✓ Makes the overhanging stretch single stranded portion as a sticky end.

ii. Synthesis of multiple copies of this desired gene

**Answer:**

The process involves,

- By PCR
- Desired gene is synthesized in vitro
- DNA is denatured
- Annealed using two sets of primers
- Thermo stable Taq polymerase extends the primers using nucleotides provided in the reaction and genomic DNA as template
- Amplified fragments are ligated.

g.

i. Describe the characteristics a cloning vector must possess.

**Answer:**

The characteristics that a cloning vector must possess are:

- It should have ori or origin of replication.
- It has selectable marker, genes encoding for an antibiotic resistance and genes encoding for  $\alpha$  galactosidase.
- Has cloning site or recognition site for the restriction enzyme to recognize.

ii. Why DNA cannot pass through the cell membrane? Explain. How a bacterial cell is made 'competent' to take up recombinant DNA from the medium?

**Answer:**

DNA is a hydrophilic molecule. So it cannot pass through the cell membrane.

Bacterial cell is made competent by treating with specific concentration of  $\text{Ca}^{++}$  ion or divalent ions, incubating them on ice, heat shock for a short period and placing it back on ice again.

h. What is Leukemia and Leucopenia? Name the instrument used in T.L.C. [2+1]

**Answer:**

It is blood cancer in which white blood cells (WBC) show an abnormal increase in number and pass into the tissue like bone marrow, spleen and lymph nodes. As a result, spleen and lymph nodes get enlarged. Bleeding, tiredness or weaknesses are the primary symptoms.

Leukopenia (also known as leukocytopenia, or leucopenia, from Greek is a decrease in the number of white blood cells (leukocytes) found in the blood, which places individuals at increased risk of infection.

Instrument used in T.L.C is Hemocytometer.

i. How can DNA segments, separated by gel electrophoresis, be visualized and isolated? How do Darwin's finches illustrate adaptive radiation? [2+1]



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**Answer:**

Visualized by staining the DNA fragments with ethidium bromide, exposing them to UV radiation. Bands are cut out from agarose gel, extracted from gel piece (by elution).

Original stock of seed eating finches migrated to different habits (of Galapagos Islands), adapted to different feeding methods by altered beak structure, evolved into different types of finches.

- j. Explain the role of baculoviruses as biological control agents. Mention their importance in organic farming. [1+2]

**Answer:**

Baculoviruses produce narrow spectrum insecticides to kill insects and other arthropods which are species specific, does not affect non target organisms or no negative impact on other insects, mammals, birds, or fish. It eliminates the use of chemical pesticides, conserves beneficial insects, integrated pest management.

OR

Why is the process of fertilization in a flowering plant referred to as double fertilization? Explain. What is Antrum? [3]

**Answer:**

Double fertilisation refers to the process in angiosperms (flowering plants) during reproduction, in which two sperm nuclei from each pollen tube fertilise two cells in an ovule. The pollen grain adheres to the stigma of the carpel (female reproductive structure) and grows a pollen tube that penetrates the ovule through a tiny pore called a micropyle.

Antrum is a general term for a cavity or chamber which may have specific meaning in reference to certain organs or sites in the body.

- k. What is eutrophication? Explain with reference to aquatic ecosystem. [3]

**Answer:**

It is defined by excessive growth of algae, plants and animals in water bodies due to nutrient enrichment particularly with nitrogen and phosphorus.

The uncontrolled growth of algae and their subsequent descent into the depths of the body of water stimulates an active benthic community (bacteria), which depletes oxygen levels due to respiration. The algae may also cover the surface of the water, reducing the amount of light that penetrates into the photic zone, decreasing photosynthesis in aquatic autotrophs. The decreased level of dissolved oxygen can result in the death of any number of larger communities.

OR

- i. Name any two breeds of wild rock pigeon that have been developed through artificial selection. [1]

**Answer:**

A special breed, called homing pigeons has been developed through selective breeding to carry messages and members of this variety of pigeon are still being used in the sport of pigeon racing and the white release dove ceremony at weddings and funerals.

- ii. What are the two functions of DNA polymerase? [2]

**Answer:**





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DNA polymerase is the first known of the enzymes whose function is to promote the bond formation of the joining units that make up the DNA backbone. E.Coli has various numbers of DNA polymerases, assigned by Roman numerals that play important roles in DNA replication and repair.

- I. A cross between a red flower bearing plant and a white flower bearing plant of Antirrhinums produced all plants having pink flowers. Work out a cross to explain how this is possible.

[2+1]

**Answer:**

Snapdragon or Antirrhinum sp. is a good example for the study of incomplete dominance. In a cross between true breeding red flowered (RR) and true breeding white flowered plants (rr), the F<sub>1</sub> (Rr) was pink. When the F<sub>1</sub> was self-pollinated the F<sub>2</sub> resulted in the following ratio 1 (RR) Red: 2 (Rr) Pink: 1 (rr) White.

Ratio of the genotype is same as explained by Mendelian monohybrid cross mean while phenotypic ratio obtained was 3:1. Because R was incompletely dominant over r this made it possible to distinguish Rr as pink from RR (red) and rr (white).

OR

Explain any three advantages the seeds offer to angiosperms

[3]

**Answer:**

- i. Since reproductive process such as pollination and fertilisation are independent of water, seed formation is more dependable.
- ii. Seeds have better adaptive strategies for dispersal to new habitats and help the species to colonise in other areas.
- iii. As they have sufficient food reserves young seedlings are nourished until they are capable of photosynthesis on their own.
- iv. The hard seed coat provides protection to the young embryo.
- v. Being products of sexual reproduction, they generate new genetic combinations /variations.



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## Group 'C'

### Question: 3

Answer the following questions? (Alternatives are to be noted):

[5x4=20]

- a. What is different type of RNA? How can you differentiate between them according to function? [1+4]

### Answer:

There are actually several types of ribonucleic acid or RNA, but most RNA falls into one of three categories:

- **mRNA or Messenger RNA**  
mRNA transcribes the genetic code from DNA into a form that can be read and used to make proteins. mRNA carries genetic information from the nucleus to the cytoplasm of a cell.
- **rRNA or Ribosomal RNA**  
rRNA is located in the cytoplasm of a cell, where ribosomes are found. rRNA directs the translation of mRNA into proteins.
- **tRNA or Transfer RNA**  
Like rRNA, tRNA is located in the cellular cytoplasm and is involved in protein synthesis. Transfer RNA brings or transfers amino acids to the ribosome that correspond to each three-nucleotide codon of rRNA. The amino acids then can be joined together and processed to make polypeptides and proteins.

OR

Differentiate between a catalyst and enzyme. What is Antrum?

[4+1]

### Answer:

One of the differences between a catalyst and an enzyme is the reaction rate. Catalysts typically have a slower reaction rate while enzymes have a faster reaction rate. Catalysts have a lower molecular weight while enzymes have a higher molecular weight. Catalysts are low in molecular weight whereas enzymes are high in molecular weight globular proteins.

Antrum is a general term for a cavity or chamber which may have specific meaning in reference to certain organs or sites in the body.

- b.  
i. What is eutrophication? Explain with reference to aquatic ecosystem.

[3]

### Answer:

It is defined by excessive growth of algae, plants and animals in water bodies due to nutrient enrichment particularly with nitrogen and phosphorus.

The uncontrolled growth of algae and their subsequent descent into the depths of the body of water stimulates an active benthic community (bacteria), which depletes oxygen levels due to respiration. The algae may also cover the surface of the water, reducing the amount of light that penetrates into the photic zone, decreasing photosynthesis in aquatic autotrophs. The decreased level of dissolved oxygen can result in the death of any number of larger communities.

- ii. Why is the length of a food chain in an ecosystem generally limited to 3 – 4 trophic levels? Explain with an example.

[2]

### Answer:

Because of 10% law, energy reduces by 10% when it goes to next trophic level in food chain. for example: grass - Grasshopper - Rabbit - Snake - Eagle will have the least energy. That is why food chains have only 3-4 trophic levels.



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OR

- i. Cancer is one of the most dreaded diseases of humans. Explain 'Contact inhibition' and 'Metastasis' with respect to the disease. [1]

**Answer:**

Contact with other cells inhibits their uncontrolled growth. Tumour cells reach distant sites, through blood.

- ii. Name the group of genes which have been identified in normal cells that could lead to cancer and how they do so ? [1]

**Answer:**

Proto oncogenes when activated under certain condition could lead to oncogenic transformation of the cells.

- iii. Name any two techniques which are useful to detect cancers of internal organs. [1]

**Answer:**

Biopsy / radiography / CT / MRI.

- iv. Why are cancer patients often given -interferon as part of the treatment? [1]

**Answer:**

It activates immune system, destroys tumour.

- v. Write the name of the organism that is referred to as the 'Terror of Bengal'. [1]

**Answer:**

Eicchornia crassipes / Water Hyacinth

c.

- i. Name the technology that has helped the scientists to propagate on large scale the desired crops in short duration. List the steps carried out to propagate the crops by the said technique. [3]

**Answer:**

Tissue culture / micropropagation.

Explants, grown in a test tube, under sterile condition, in special nutrient medium / culture medium.

- ii. How are somatic hybrids obtained? [2]

**Answer:**

Isolated single cells, digests cell walls, to obtain protoplast from two different varieties, fusion of protoplast.

OR

- i. Why are beehives kept in crop field during flowering period ? Name any two crop fields where this is practiced. [2]

**Answer:**

To increase pollination efficiency , increase crop yield / honey yield



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Sunflower , Brassica , apple , pear

- ii. How did the process of RNA interference help to control the nematode from infecting roots of tobacco plants ? Explain. [3]

**Answer:**

Using Agrobacterium vectors , nematode specific genes introduced into host plant , produced sense - antisense RNA in host cells , ds RNA - initiated RNAi , silenced specific mRNA of nematode , parasite could not survive in transgenic host

- d.  
i. Describe the stages in embryo development in a dicot plant. [3]

**Answer:**

The zygote divides unequally to form two cells. The smaller cell divides repeatedly to produce a row of 4-8 cells. The terminal cell divides to produce a cluster of cells called the globular embryo. The remaining cells constitute the suspensor. A few cells of the proembryo nearest of the suspensor develop into hypocotyls and radical while other cells give rise to epicotyl, plumule and cotyledons.

- ii. What is cryopreservation? Give its one use. [2]

**Answer:**

Cryopreservation is a preservation process at  $-196^{\circ}\text{C}$  in liquid nitrogen.

Use of Future assisted reproduction treatment cycles - Future assisted reproduction treatment cycles.



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## Group 'D'

### Question: 4

[6×5=30]

- a.
- Explain the increase in the numbers of melanic (dark winged) moths in the urban areas of post-industrialization period in England. [3]

#### Answer:

- Male produces two types of sperms ( X & Y type in the ratio 1 : 1 ) , Female produces only one type of ovum (X type) , hence the sex of baby is determined by the type of sperm fertilizing the ovum therefore women should not be blamed // A genetic cross showing sex determination in human beings covering above value points can be considered in lieu of the explanation
- Sensitivity towards community / Social awareness / Self-discipline / Responsible behaviour / Leadership quality / Caring attitude / Responsible attitude towards society / Concern for others / Sharing of knowledge or information / Presence of mind /Being proactive / any other relevant value.
- Mendel published his work on inheritance of characters in 1865, but it remained unrecognized till 1900. Give three reasons for the delay in accepting his work. [3]

#### Answer:

- The communication was not easy in those days and his work could not be widely publicised.
  - His concept of genes as stable and discrete units that controlled the expression of traits and of the pair of alleles which did not 'blend' with each other was not accepted by contemporaries as an explanation for the apparently continuous variation seen in nature.
  - Mendel's approach of using mathematics to explain biological phenomena was totally new and unacceptable to many of the biologists of his time.
  - Though Mendel's work suggested that factors (genes) were discrete units, he could not provide any physical proof for the existence of factors and what they were made of.
- b.
- Describe the characteristics a cloning vector must possess. [3]

#### Answer:

The characteristics that a cloning vector must possess are:

- It should have ori or origin of replication.
  - It has selectable marker, genes encoding for an antibiotic resistance and genes encoding for  $\alpha$  galactosidase.
  - Has cloning site or recognition site for the restriction enzyme to recognize.
- Why DNA cannot pass through the cell membrane? Explain. How a bacterial cell is made 'competent' to take up recombinant DNA from the medium? [3]

#### Answer:

DNA is a hydrophilic molecule. So it cannot pass through the cell membrane.

Bacterial cell is made competent by treating with specific concentration of  $\text{Ca}^{++}$  ion or divalent ions, incubating them on ice, heat shock for a short period and placing it back on ice again.

- c.
- How did Alfred Hershey and Martha chase arrive at the conclusion that DNA is the genetic material? [5]



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**Answer:**

Hershey and Chase grew viruses in a medium that contained  $^{32}\text{P}$  radioactive phosphorus. These were allowed to infect E.Coli medium was agitated in a blender viral coats and the bacterial cells with viral particles were separately by spinning them in a centrifuge.

In this case no radioactivity in the supernatant as the protein coats do not incorporate  $^{32}\text{P}$ , but the viral DNA had  $^{32}\text{P}$  and passed to it to the bacterial cell. So radioactivity was detected in the cells, proves that DNA is the hereditary material.

They repeated the procedure with radioactive sulphur  $^{36}\text{S}$ , in this case no radioactivity was detected in the bacterial cell as s is not incorporated in DNA, while radioactivity was detected in the supernatant with protein coats of viruses.

- ii. How does phosphorus cycle differ from carbon cycle? [1]

**Answer:**

- No respiratory release of phosphorus unlike  $\text{CO}_2$  in carbon cycle, no gaseous exchange.
- Inputs of phosphorus through rainfall are less than carbon input.

- d.
- i. Explain the role of baculoviruses as biological control agents. Mention their importance in organic farming. [3]

**Answer:**

Baculoviruses produce narrow spectrum insecticides to kill insects and other arthropods which are species specific, does not affect non target organisms or no negative impact on other insects, mammals, birds, or fish. It eliminates the use of chemical pesticides, conserves beneficial insects, integrated pest management.

- ii. Why is Agrobacterium tumefaciens a good cloning vector? Explain. [3]

**Answer:**

If any desired or foreign gene is linked with Ti plasmid of Agrobacterium tumefaciens, the bacterium is modified into non-pathogenic plasmid is cloned into multiple copies, can be delivered into a variety of plants, desired chemical will be produced.

- e.
- i. Explain the steps involved in the production of genetically engineered insulin. [3]

**Answer:**

Insulin, secreted from  $\beta$ - cells of Islet of Langerhans of pancreas, maintains blood sugar level and cures Diabetes mellitus in humans.

- **Banting and Best**, along with **Macleod**, succeeded in extracting a pure form of insulin from pancreas of dog and demonstrated that administration of insulin could cure diabetes in human beings.
- **Banting and Macleod** got the Nobel Prize in medicine in 1923 for their outstanding feat.
- **Later** insulin was also extracted from slaughtered pigs and cattle to be used as medicine.
- But this insulin was slightly different from human insulin and thus caused allergies that were not desired.

- ii. What is eutrophication? Explain with reference to aquatic ecosystem. [3]

**Answer:**



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It is defined by excessive growth of algae, plants and animals in water bodies due to nutrient enrichment particularly with nitrogen and phosphorus.

The uncontrolled growth of algae and their subsequent descent into the depths of the body of water stimulates an active benthic community (bacteria), which depletes oxygen levels due to respiration. The algae may also cover the surface of the water, reducing the amount of light that penetrates into the photic zone, decreasing photosynthesis in aquatic autotrophs. The decreased level of dissolved oxygen can result in the death of any number of larger communities.

