REPRODUCTION IN PROTOZOA

- The life process of producing young ones of the same kind is - Reproduction
- Reproduction in protozans takes place by - asexual and sexual methods

ASEXUAL REPRODUCTION
- Reproduction without the fusion of pronuclei is called - asexual reproduction
- Asexual reproduction generally occurs in protozoans during - the favourable conditions.
- The favourable conditions are - optimum temperature, availability of nutrients and other suitable ecological conditions of water.
- The methods of asexual reproduction are - binary fission, multiple fission, budding or gemmation, plasmotomy and sporulation
- In asexual reproduction - genetic recombination does not occur.
- The young ones show uniparental inheritance, without any genetic variation (clone) in - asexual reproduction.

BINARY FISSION
- The most common type of reproduction in protozoans is - Binary fission.
- The division of nuclei is called - Karyokinesis
- The division of cytoplasm is called - Cytokinesis
- During the binary fission karyokinesis is followed by cytokinesis

TYPES OF BINARY FISSION
- The binary fission is irregular in - Amoeba proteus
- Longitudinal in - Euglena
- Transverse in - Paramecium
- Longitudinal binary fission is common in - Mastigophores
  a) Euglena is a - spindle shaped organism
  b) The body is surrounded by - proteinaceous pellicle
- The contractile vacuole in Euglena is present in - ectoplasm
- Endoplasm contains - nucleus, chloroplasts etc.
- Near thy base of longer flagellum is - parabasal body (photoreceptor)
- The organelle present close to the cytopharynx is - stigma
- Binary fission in Euglena takes place during - favourable conditions and also in the encysted state.
- During binary fusion of Euglena karyokinesis - Occurs by mitosis.
- The cytokinesis takes place by - a longitudinal furrow from the anterior end which proceeds towards the posterior end.
- With the result of the karyokinesis and cytokinesis Euglena divides into - two daughter individuals
- Besides the nucleas, the organelles that undergo division are - blepharoplasts and chloroplasts.
- The old flagella go to one daughter individual and the other individual develops the new flagella.
- The organelles which disappear (donot divide) during binary fusion and newly developed by the daughter individuals are - the contractile vacuole, stigma and paraflagellar body.
- The daughter Euglenae formed as a result of Binary fission are like mirror images, hence called - Symmetrogenic division.

TRANSVERSE BINARY FISSION IN PARAMECIUM
- Paramecium is a - Ciliate protozoan
- The common name of paramecium is - Slipper animalcule
- The body is - slipper shaped (hence the common name is slipper animalcule)
- The oral surface is - flat
  and the aboral surface is - convex
• The oral surface contains - **oral groove**
• The oral groove opens - **into the cytopharynx through cytostome**.
• The ectoplasm contains - infraciliary system and trichocysts.
• The endoplasm contains - **two nuclei and two contractile vacuoles, food vacuoles**.
• The two nuclei are
  1. **large kidney shaped macronucleus** and
  2. **a small spherical micronucleus**.
• Macronucleus controls - **vegetative function**
• Micronucleus controls - **reproductive function**
• The contractive vacuoles are present - **one at each end**.
• During binary fission Paramecium - **stops feeding and the oral groove disappears**.
• During Karyokinesis:
  Macronucleus divides by - **amitosis**
  Micronucleus divides by - **mitosis and form each two daughter nuclei**
• Then two oral grooves begin to appear - **one in the anterior half and another in the posterior half**.
• During cytokinesis - **a constriction appears in the middle of the body**.
• By the deepening of the constrictin transversely - **two daughter cells are formed**.
• The plane of fission is at right angles to - **Kinetia (perikinetal fission)**
• The anterior daughter individuals is called - **Proter**
• The posterior daughter individual is called - **Opisthe**
• Each daughter individual receives - **One contractile vacuole of the parent**.
• The second contractile vacuole is formed - **newly by each daughter individual**.
• The cytopharynx of the parent is retained by - **Proter**
• In the Opisthe - **new cytopharynx is formed**
• The process of binary fission in paramecium is completed in about - **2 hours**
• In paramecium the number of binary fissions that may take place in a day is - **four**
• All the Paramecia produced asexually by repeated binary fissions from a single parent constitute - **a clone**
• The transverse binary fission in Paramecium is called - **homothetogenic binary fission**

**MULTIPLE FISSION**
• The division of the parent into numerous daughter individuals is called - **multiple fission**
• The nucleus divides into many nuclei followed by the cytoplasmic division and many daughter individuals are formed during - **multipole fission**
• Multiple fission is seen in - the **sarcodines and sporozoans**
• Schizogony is - **asexual multiple fission**.
• The end products of schizogony grow into - **trophozoites**
• The multiple fission by which gametes are formed is - **Gamogony**
• The multiple fission by which spores or sporozoites are formed is - **Sporogony**.

**PLASMOTOMY**
• The division of a multinucleate protozan into multinucleate daughter individuals by cytoplasmic division but without nuclear divisional is called - **Plasmotomy** eg : **Opalina**

**BUDDING**
• Budding is common in - **Suctorian protozoans eg : Acinata**
• The bud is - **a smaller individual formed after nuclear division**
• If only one bud is formed at a time such budding is called - **monotonic budding**.
• Monotonic budding occurs in - **Vorticella**
• Multiple buds are formed in - **Suctorians**.
- Exogenous buds are formed in - **Ephelota**
- Endogenous buds are formed in - **Acineta**

**SEXUAL REPRODUCTION**
- Reproduction that takes place by the fusion of pronuclei with or without the formation of gametes is - **Sexual reproduction**.
- Genetic recombination occurs during - **Sexual reproduction**.
- The fusion of similar gametes is called - **Isogamy** eg : Monocystis.
- The fusion of dissimilar gametes is called - **Anisogamy** eg : Plasmodium
- Temporary pairing or two individuals for the exchange of the pronuclei and the fusion of pronuclei takes place during - **conjugation**
- The individual that participate in conjugation are called - **Conjugants**.
- During conjugation, fusion of pronuclei is followed by - **Postconjugation fissions**.
- Generally, after the mutual exchange of the pronuclei the conjugants - **separate** eg : **Paramecium**

**SYNGAMY**
- In protozoans, sexual reproduction takes place by - **syngamy and conjugation**.
- Complete fusion of two gametes is called - **Syngamy**

**CONJUGATION**
- The scientists who defined conjugation as a temporary union between two ciliates belonging to two different mating types for the exchange and reconstitution of nuclear materials (nuclear reorganization) is - **Wichterman. (1953)**

**Factors and conditions for conjugation :**
- Unfavourable conditions like shortage of food.
- It always occurs only between the individuals belonging to two different 'mating types'.
- They exhibit physiological differentiation but appear like morphologically (Paramecium) (Morphologically also different in Vorticella)
- Conjugation occurs between two inactive individuals, which have lost their vigour and vitality due to chromosomal imbalance in their macronuclei, caused by repeated amitotic divisions.
- Conjugation does not take place during **favourable conditions**.

**CONDITION IN VORTICELLA**
- Vorticella is a - fresh water ciliate protozoan - bell shaped and sessile, attached to the substratum by a long stalk.
- Cilia are present - **around the mouth as peristomial cilia (adoral cilia)**
- Body is covered by - **Pellicle**
- Endoplasm contains - a horse shoe shaped macronucleus and a round micronucleus
- Macronucleus is - **a vegetative nucleus & disappears during conjugation**.
- Micronucleus is a reproductive nucleus and involved in - **Conjugation (sexual pronuclei)**
- New macronucleus after conjugation is formed from - **Micronucleus**
- Conjugation in Vorticella moniliata takes place between - a long stalked macro conjugant and a small free swimming microconjugant

**EVENTS IN THE CONJUGATION**
- Formatin of micro and macroconjugants.
- Attachment of the conjugants
- Disappearance of macronucleus
- Prezygotic nuclear divisions
- Amphimixis
- Postzygotic nuclear divisions
Formation of Micro and Macrojugants

- Conjugants in Vorticella are formed by - longitudinal binary fission and unequal division
- The larger part develops into - Macroconjugant
- The smaller part develops into - Microconjugant
- The microconjugant acquires cilia - at the aboral end.
- The free swimming conjugants is - microconjugant
- The conjugant which does not feed or encrust and survive for about 24 hours only is - microconjugant
- The macroconjugant is - sessile & stationary.
- The conjugant which physiologically differs from the normal young, individual is - Macrojugant
- Macroconjugant attracts the microconjugant for about - 2 hours
- Macro & Micro conjugants differ - physiologically & morphologically

II Attachment of the conjugant
- Attachment of microconjugant (of different parentage) with the macroconjugant takes place - at the aboral surface end
- Microconjugant loses its cilia - after attachment.

III. Disappearance of the macronucleus
- Macronucleus is a - vegetative nucleus & has no role in conjugation
- Macronucleus of the conjugants - distintegrates and disappears

IV. Prezygotic nuclear divisions
- The divisions of nucleus without cytokinesis before zygote formation are called - prezygotic nuclear divisions
- The micronucleus of the microconjugant undergoes - three successive divisions.
- These divisions are - first two divisions are meiosis I & meiosis II and the third one is mitosis (cytokinesis does not occur)
- The total number of nuclei formed after prezygotic nuclear divisions in the microconjugant are - eight (8) haploid nuclei (half the no of parent chromosomes)
- Of these eight nuclei the number of nuclei that disappear are (7) seven. (only one nucleus remains)
- The number of prezygotic nuclear divisions that occur in the micronucleus of Macroconjugant - two successive nuclear divisions.
- The type of these nuclear divisions is - two divisions of meiosis (Meosis I and II) (without cytokinesis)
- The total number of nuclei formed after prezygotic nuclear divisions in the macroconjugant are - four haploid nuclei.
- Of these four nuclei - three distintegrate and disappear (only one nucleus remains)
- The remaining one nucleus in each conjugant (micro & macro) undergoes one mitotic division and forms a - migratory (male) pronucleus and a stationary (female) pronucleus.

V. Amphimixis
- Between the two conjugants a passage at the place of contact is formed due to - dissolving of the pellicle
- The migratory pronucleus (male) of the microconjugant migrates into - the cytoplasm of macroconjugant.
- The migratory pronucleus, after entering the cytoplasm of the macroconjugant it fuses with - the female (stationary) pronucleus of macroconjugant
- The union of the two pronuclei and the cytoplasm is called - Amphimixis
The migratory nucleus of macronucleus enters the - microconjugant
The two pronuclei in the microconjugant - does not fuse but disintegrate.
The synkaryon (diploid) in the macroconjugant is called - zygote nucleus.
Heploid chromosomal number of vorticella is -2

VI. Post Zygotic nuclear division :
- The number of divisions that take place in the zygotic nucleus are - three series of successive mitotic divisions (post zygotic nuclear divisions)
- The number of nuclei formed by post zygotic nuclear divisions - (8) eight.
- Of these eight postzygotic nuclei - 7 becomes macronuclei and one becomes micronucleus.
- During the postzygotic nuclear divisions - cytoplasm does not undergo division

VII. Post Conjugation Fissions
- During the post conjugation fissions, the number of divisions are - three series of binary fissions.
- During postconjugation fissions - only the micronucleus divides & the macronuclei are distributed.
- The number of daughter Vorticella formed at the end of conjugation are - (7) seven

Significance of Conjugation
- The vigour and vitality lost due to chromosomal imbalance is regained (Rejuvenation) during - Conjugation.
- The macronucleus becomes senile (inactive) due to - repeated binary fission.
- During conjugation new and active macronucleus is formed from - micronucleus (material of skynkaryon).
- Conjugation is a process of - nuclear reorganization
- As meiosis and gametic nuclear fusion of different parentage occur during conjugation, it results in - gene recombinations and genetic variations.
- Multiplication of Vorticella occurs - during conjugation.

II. Other Methods of Nuclear Reorganization:
  i. Autogamy :
- The process of autogamy was described by - W.F. Diller
- Autogamy occurs in - P.aurelia
- The asexual reproduction resembling conjugation is - autogamy.
  ii. Cytogramy :
- The process of cytogamy was reported by - R. Wichterman.
- Cytogamy occurs in - P. caudatum.
- The sexual process without nuclear exchange is - Cytogamy.
- It occurs between - two individuals.
- Only cytoplasm exchanging method is - cytogamy
  iii. Endomixis :
- The process of endomixis was reported by - Woodruff and Erdmass.
- Endomixis occurs in - P.aurelia.
- In endomixis micronucleus divides by - Mitosis.
- Nuclear fusion does not occurs in - Endomixis
- Senile macronucleus disintegrates and new active macronucleus is formed from - micronucleus.