PARTHENOGENESIS (VIRGIN ORIGIN)

Usually an unfertilized ovum develops in to a new individual only after the union with the sperm or fertilization but in certain cases the development of the egg takes place without the fertilization.

The peculiar mode of sexual reproduction in which egg development occur without the fertilization is known as the **parthenogenesis**.

Parthenogenesis:- Gr; *parthenos*= virgin + *genesis*= origin.

- The phenomenon of parthenogenesis occurs in different groups of the animals as in certain insects (Hymenoptera, Homoptera, Coleoptera), crustaceans and rotifers.
- Parthenogenesis may be of two types:-

1. Natural parthenogenesis
2. Artificial parthenogenesis

I. NATURAL PARTHENOGENESIS

- In animals the parthenogenesis occurs regularly, constantly and naturally in their life cycles and is known as the **natural parthenogenesis**.
- Natural parthenogenesis may be of two types viz.,

(i) Complete Parthenogenesis
(ii) Incomplete Parthenogenesis

(i) Complete Parthenogenesis:-

- Certain insects have no sexual phase and no males.
- They depend exclusively on the parthenogenesis for the self-reproduction.
- This type of parthenogenesis is known as the **complete parthenogenesis** or **obligatory parthenogenesis**.

(ii) Incomplete Parthenogenesis:-

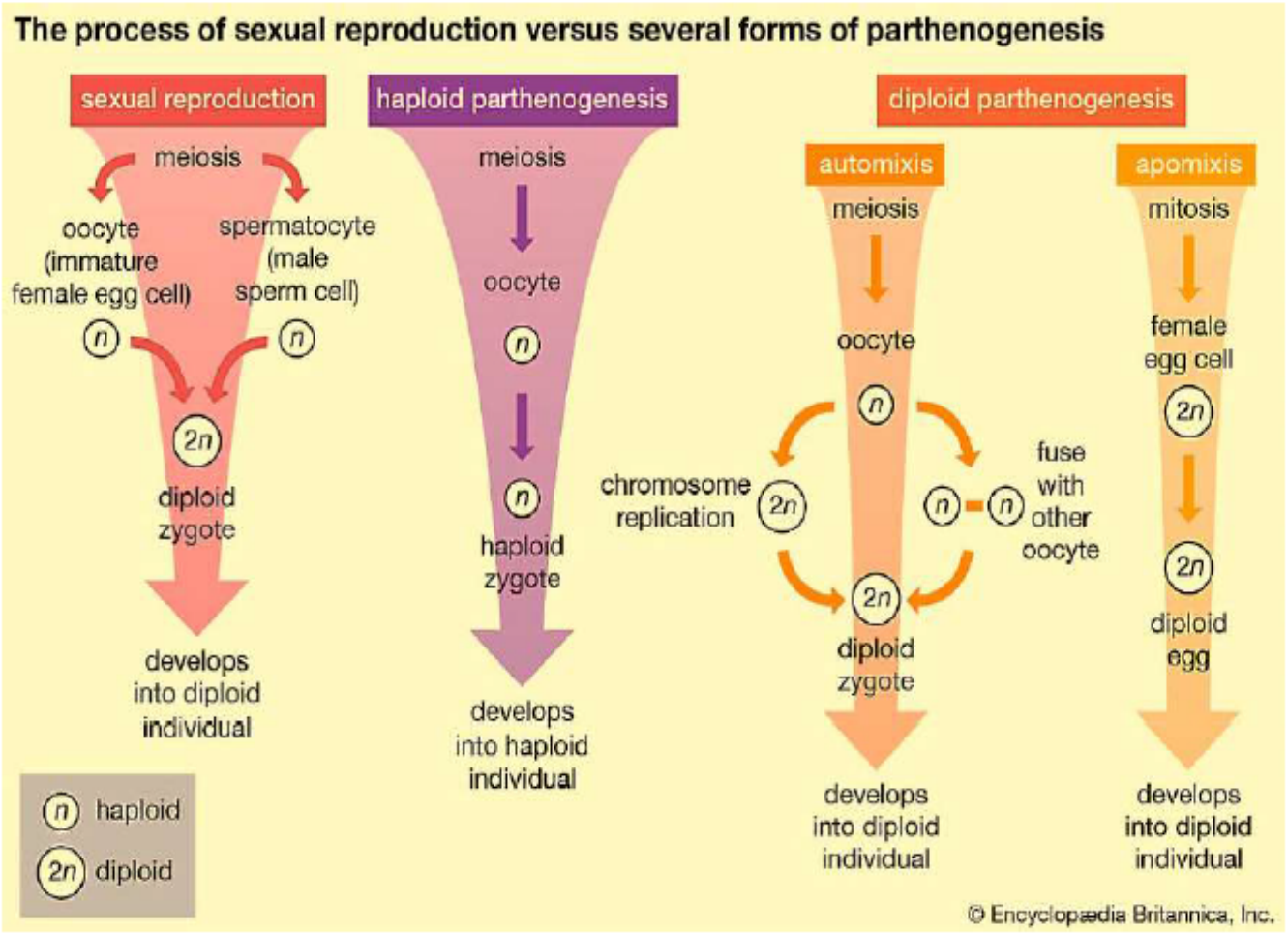
- The life cycle of certain insects includes two generations the sexual generation and parthenogenetic generation, both of which alternate to each other.
- In such cases, the diploid eggs produce females and the unfertilized eggs produce males.
- This type of parthenogenesis is known as the **partial** or **incomplete** or **cyclic parthenogenesis**.

The complete or incomplete type of natural parthenogenesis may be of following two types:-

1. Haploid or arrhenokous parthenogenesis
2. Diploid or thelytokous parthenogenesis

1. Haploid or arrhenotokous parthenogenesis:-

- In the arrhenotokous parthenogenesis, the haploid eggs are not fertilized by the sperms and develops in to the haploid individuals.
- In these cases the haploid individuals are always males and the diploid individuals are the females, e.g.,
  - Insects: (i) Hymanoptera (bees and wasps)
    (ii) Homoptera
    (iii) Coleoptera (*Micromalthus debilis*)
    (iv) Thysanoptera (*Anthothrips verbasi*)
  - Arachnids: e.g., Ticks, mites and certain spiders (*Pediculoides ventricusm*)
  - Rotifers: e.g., *Asplanchne amphora*



2. Diploid or thelytokous parthenogenesis:-

- In the diploid parthenogenesis, the young individuals develop from the unfertilized diploid eggs

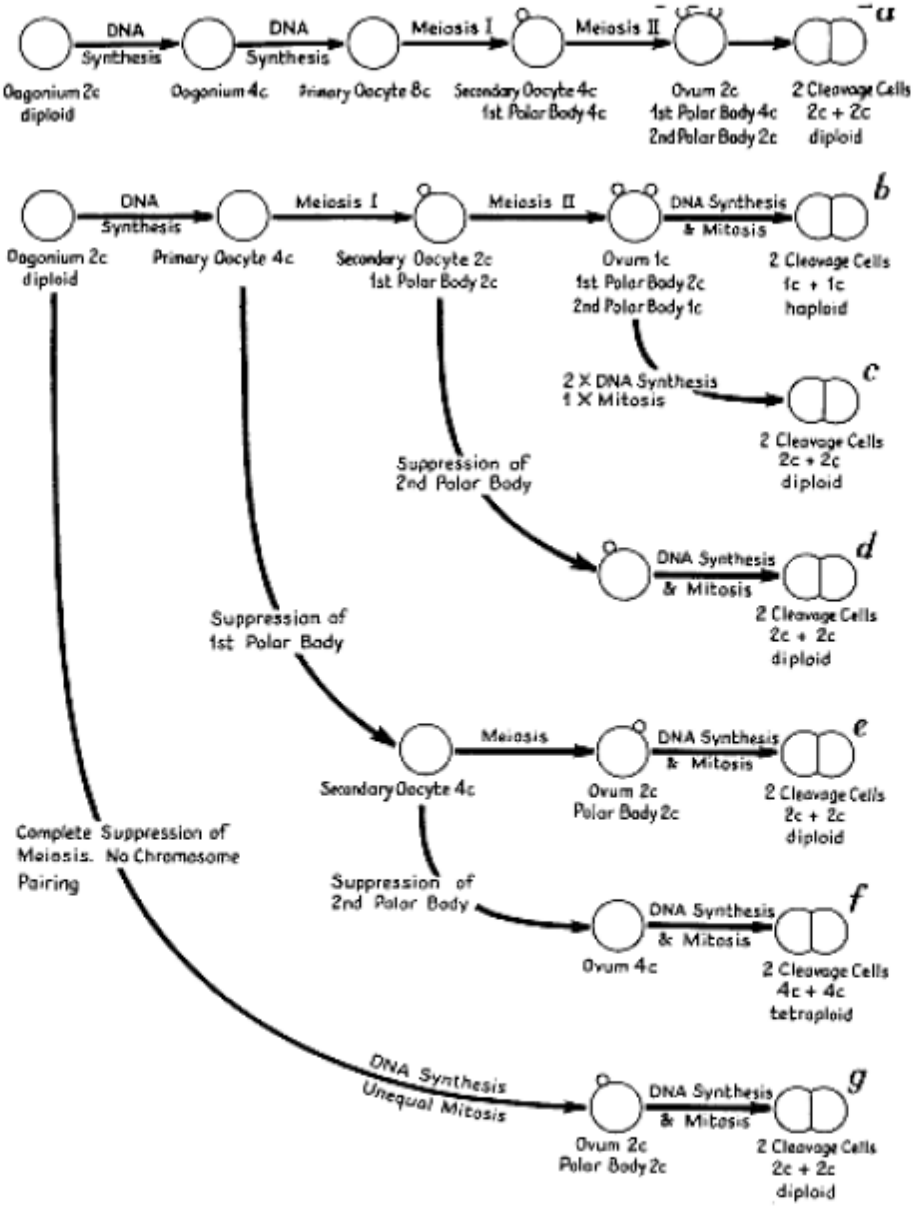


Fig. *Different routes of parthenogenesis in diploid females. (a) Premeiotic endoreduplication; (b) development of normally reduced egg; (c) postmeiotic endoreduplication; (d) suppression of 2nd polar body; (e) suppression of 1st polar body; (f) suppression of 1st and 2nd polar bodies; (g) ameiotic parthenogenesis. Additional routes are described in the text.*
The symbol c refers to the amount of DNA present in the chromosomes of a haploid cell before DNA synthesis. If parthenogenesis were to occur in a polyploid female, routes (a) and (g) would result in similarly polyploid daughters.

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Following types of the thelytoky have been recognized.

(i) Ameiotic parthenogenesis:-

- Sometimes during the oogenesis, first meiotic or reduction division does not occur but second meiotic division occurs as usual.

- Such eggs contain diploid number of chromosomes and develop into new individuals without the fertilization.
- This type of parthenogenesis is known as apomictic or ameiotic parthenogenesis and occurs in *Trichoniscus* (Isopoda), *Daphnia pulex* (Crustacea), *Campelona rufum* (Mollusca), Weevils and long-horned grasshoppers.

(ii) Meiotic parthenogenesis:-

- Certain eggs develops by the usual process of oogenesis but at certain stages diplosis or doubling of chromosome number and production of diploid eggs occur.
- Such eggs develop into the diploid individuals and this phenomenon is known as the meiotic parthenogenesis.
- The diplosis of the diploid thelytoky may occur by the following methods:-

(i) By autofertilization:-

- In certain cases the oocyte divides meiotically up to the formation of ootid or ovum and secondary polocyte.
- But the ootid and the secondary polocyte unite together to form a diploid egg which develops into a new individual, e.g., ***Artemia salina*** **(Crustacea)** and various other organisms.

(ii) By restitution:-

- Sometimes in primary oocyte karyokinesis forms a nucleus of the secondary oocyte and nucleus of the first polocyte.
- The chromosomes of both daughter nuclear arranged on the equator and undergo second meiotic division to form a diploid ootid and a diploid polocyte.
- The diploid ootid or ovum develop into a parthenogenetic diploid individual.
- This type of diplosis is known as the restitution, e.g., insects of order Hymenoptera (*Nemertis conesceus*) and Lepidoptera.

II. ARTIFICIAL PARTHENOGENESIS

- The eggs which always develop into the young individuals by the fertilization sometimes may develop parthenogenetically under certain artificial conditions.
- This type of parthenogenesis is known as artificial parthenogenesis.
- The artificial parthenogenesis may be induced by various chemical and physical means.

A. Physical means:-

The following physical means cause the parthenogenesis.

(i) **Temperature:-** The range of temperature may induce parthenogenesis is induced.

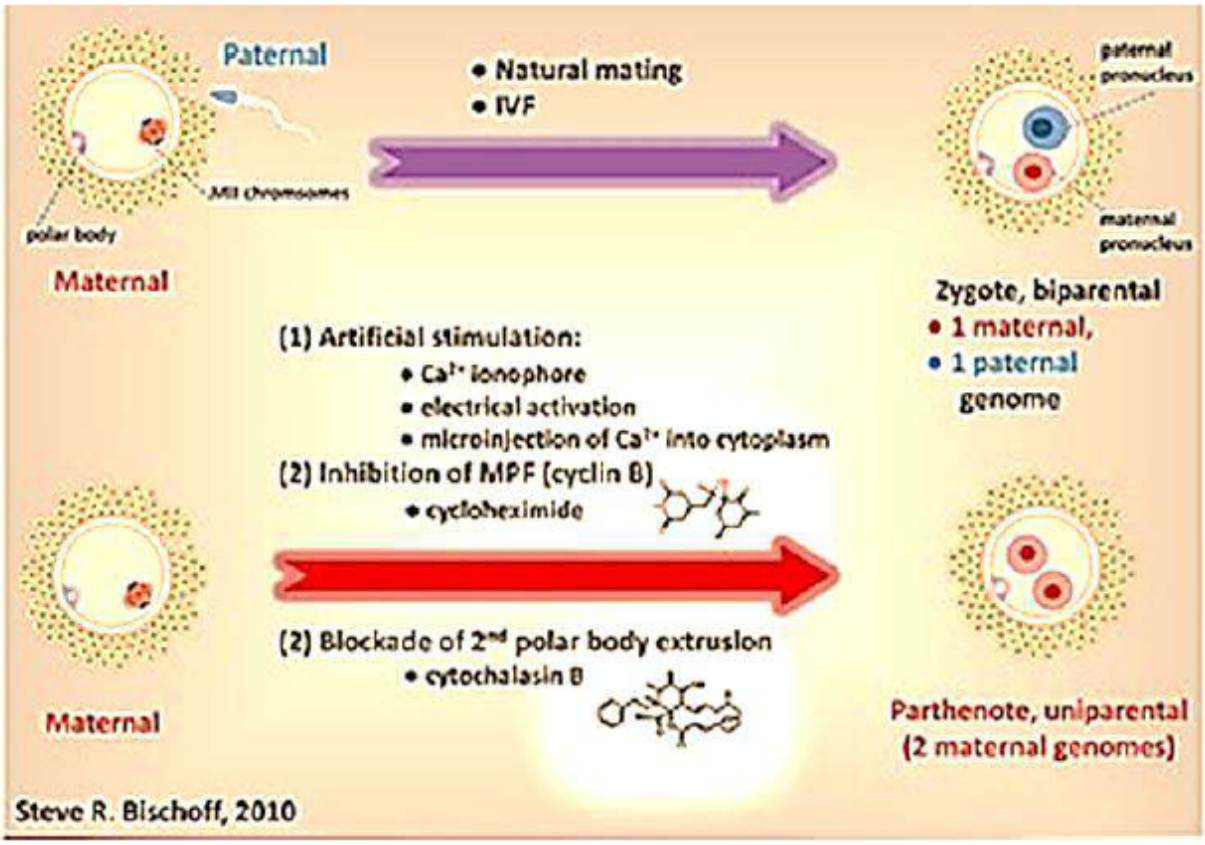
(ii) **Electrical shocks:-** It can cause parthenogenesis is induced.
(iii) **Ultraviolet light** can cause parthenogenesis.
(iv) When the eggs are pricked by the fine glass needles the development of young sones take place parthenogenetically.

B. Chemical mean:-

The following chemicals have been found to cause parthenogenesis in the normal eggs;

1. Chloroform
2. Strychnine
3. Hypertonic and Hypotonic sea waters
4. Chlorides of K^+, Ca^{++}, Na^+, Mg^{++} etc.
5. Acids such as butyric, lactic acid, oleic acid and other fatty acids.
6. Fat solvents, e.g., toluene, alcohol, benzene and acetone.
7. Urea and sucrose.

The artificial parthenogenesis has been induced by above mentioned physical and chemical means by various workers in the eggs of most echinoderms, molluscs, annelids, amphibians, birds and mammals.



SIGNIFICANCE OF PARTHENOGENESIS

1. The parthenogenesis serves as the means for the determination of sex in the honey bees, wasps etc.

2. The parthenogenesis supports the chromosome theory of inheritance.
3. The parthenogenesis is the most simple, stable and easy process of reproduction.
4. The parthenogenesis eliminates the variation from the populations.
5. The parthenogenesis is the best way of high rate of multiplication in certain insects, **e.g., aphids**.
6. The parthenogenesis cause the polyploidy in the organisms.
7. The parthenogenesis encourages development of the advantageous mutant characters.
8. The parthenogenesis checks the non-adaptive combination of genes which may be caused due to the mutation.
9. Due to the parthenogenesis, there is no need for the organisms to waste their energy in the process of mating but it allows them to utilize that amount of energy in the feeding and reproduction.
10. The parthenogenesis avoids the sterility in the races.
However, parthenogenetic forms, i.e., individuals produced due to parthenogenesis are not much successful in the struggle for existence due to the fact that no recombination of genetic material occurs, hence, variations are not produced.