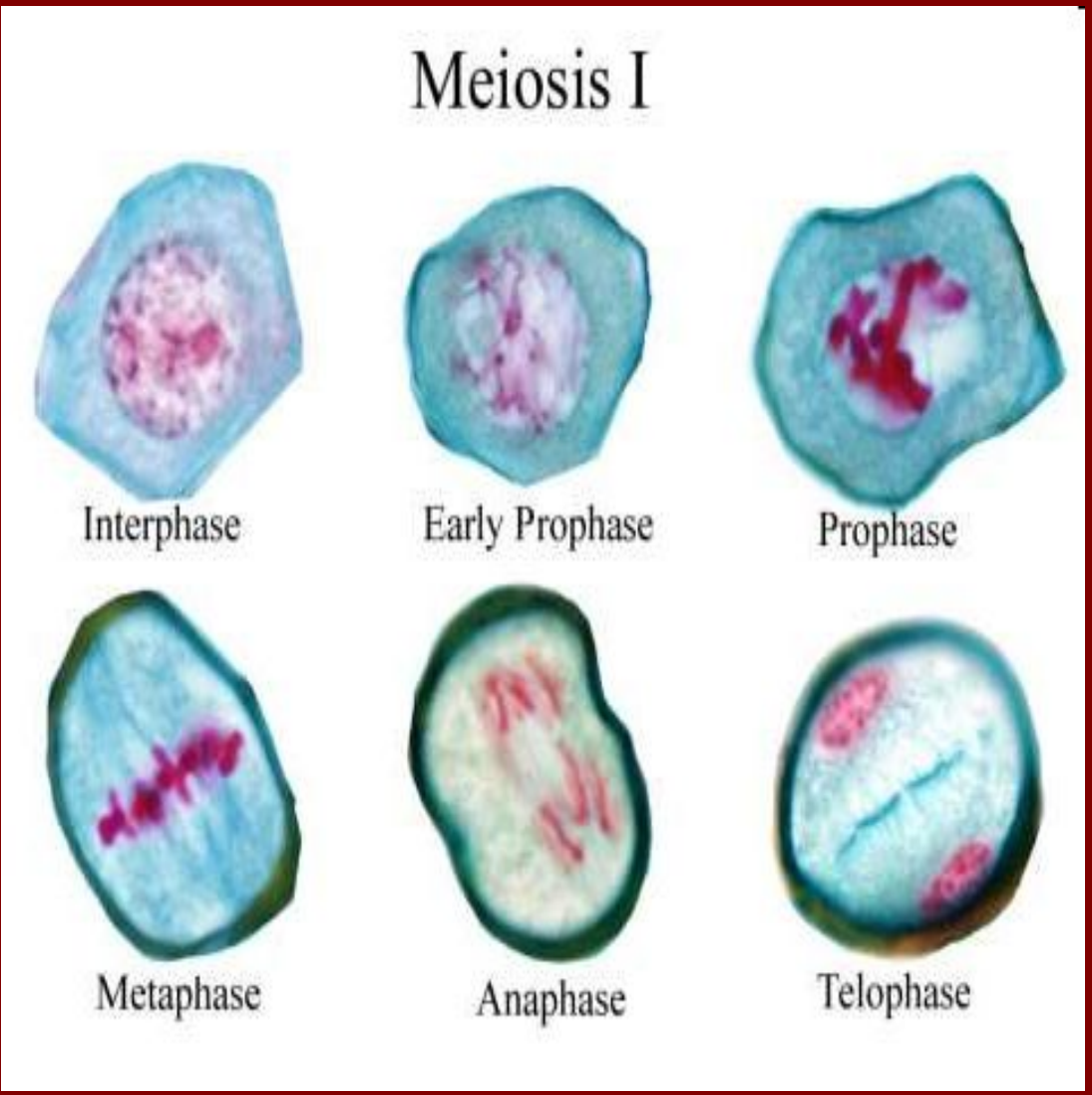
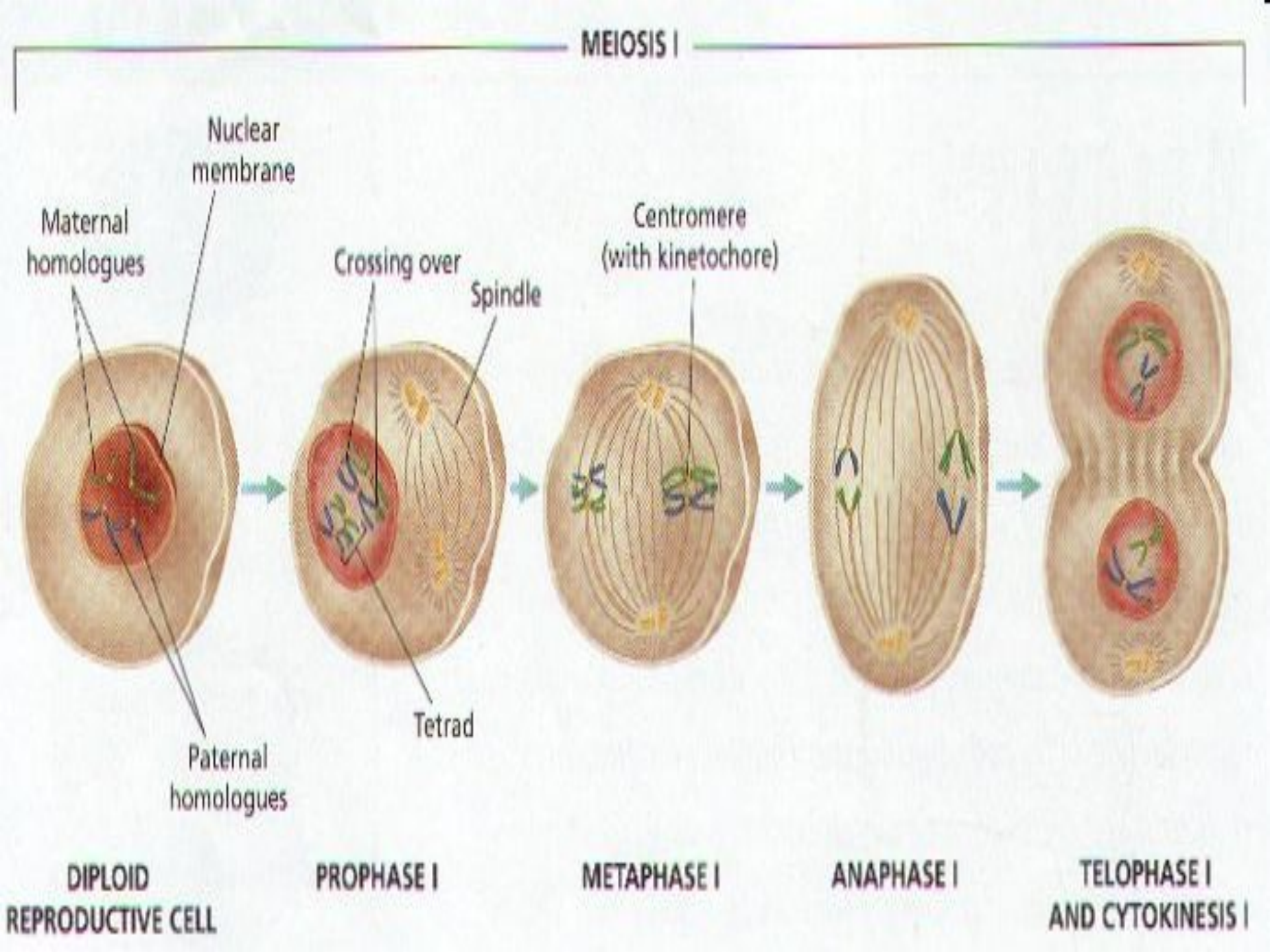
Meiosis and Sexual Reproduction

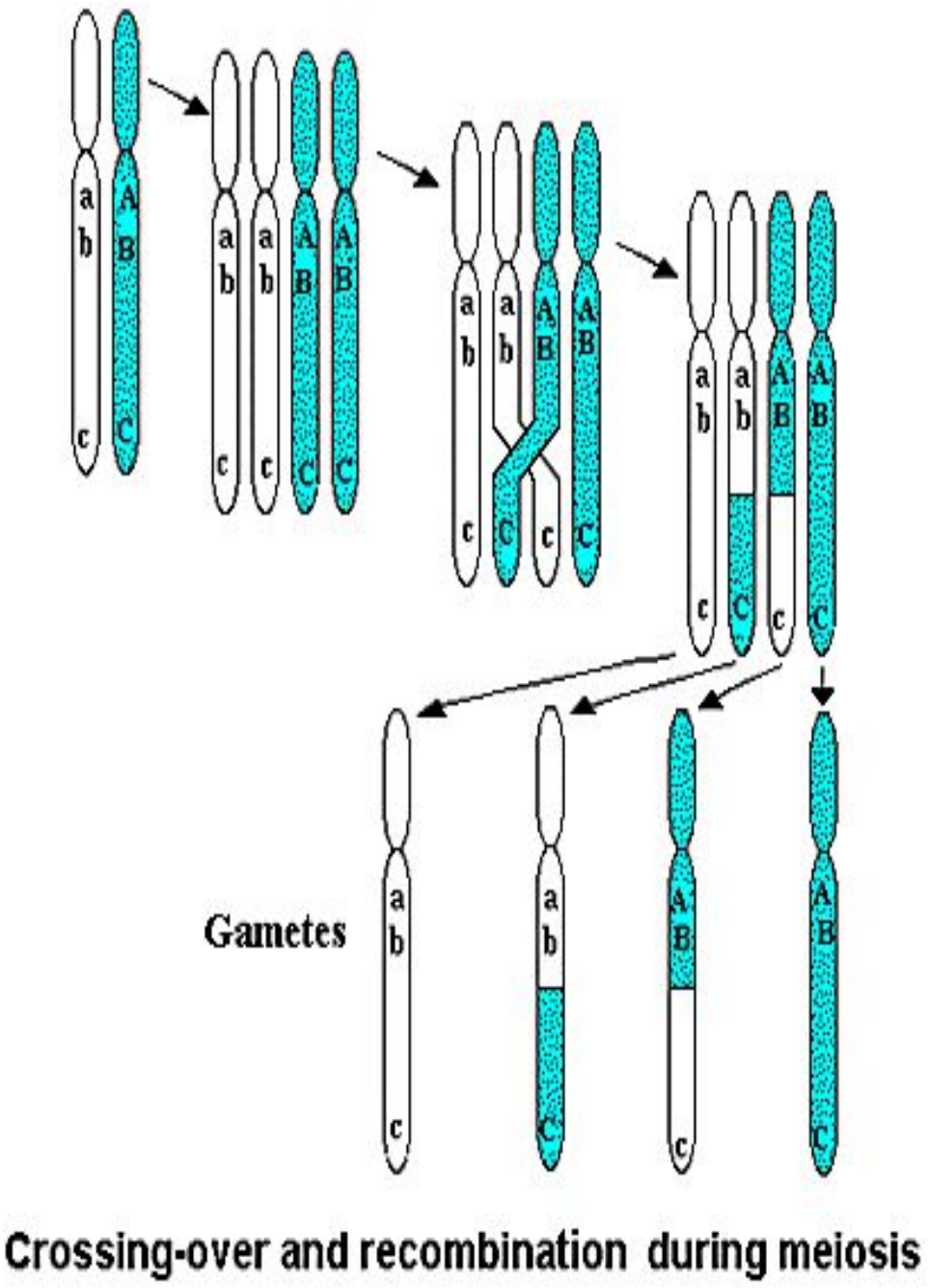
Chapter 7

Meiosis Section 1



- Meiosis – a form of cell division that halves the number of chromosomes when forming specialized reproductive cells, such as gametes or spores
- Meiosis involves only one replication of DNA, but two divisions of the nucleus, Meiosis I and Meiosis II


MEIOSIS I
Nuclear membrane
Maternal homologues
Crossing over
Spindle
Centromere (with kinetochore)
Tetrad
Paternal homologues
DIPLOID REPRODUCTIVE CELL
PROPHASE I
METAPHASE I
ANAPHASE I
TELOPHASE I AND CYTOKINESIS I



Crossing-over and recombination during meiosis

- Prophase I – chromosomes condense
  -homologous chromosomes pair up
- **<u>Crossing over</u>** –when portions of a chromatid on one homologous chromosomes are broken and exchanged with the corresponding chromatid portions of the other homologous chromosome

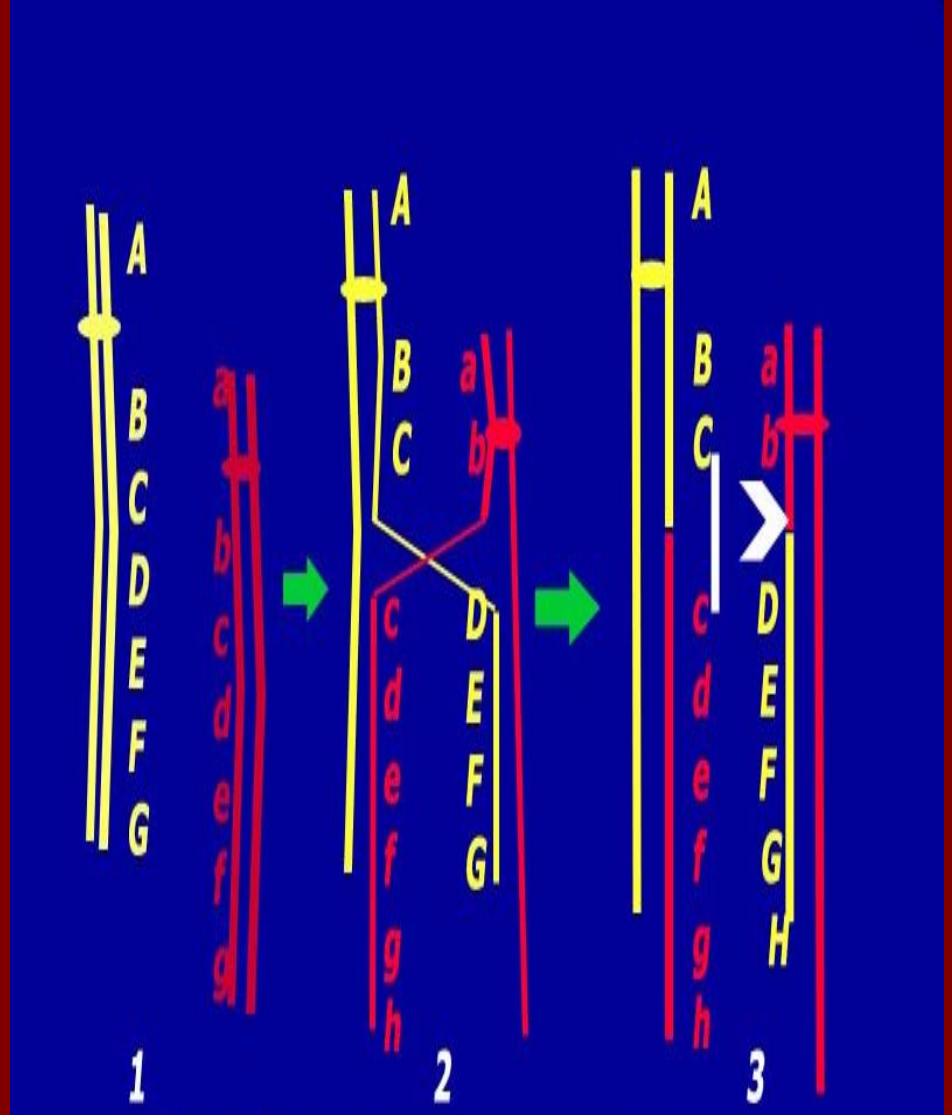


Схема:дупликација и делеција као последица неправилног кросинг-овера

1 - несиметрично постављене хроматиде хомологих хромозома;

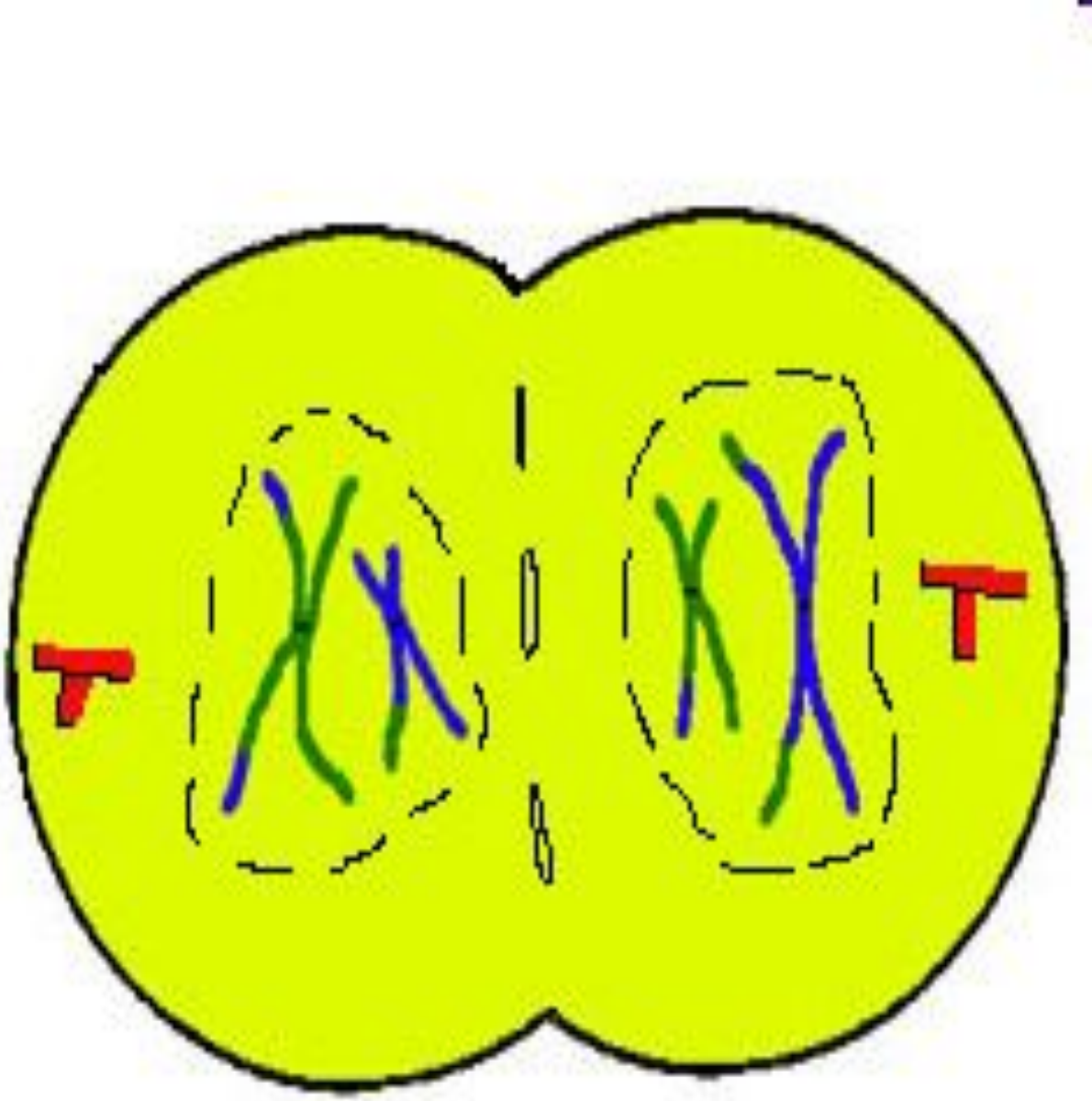
2 - неправилан кросинг-овер;

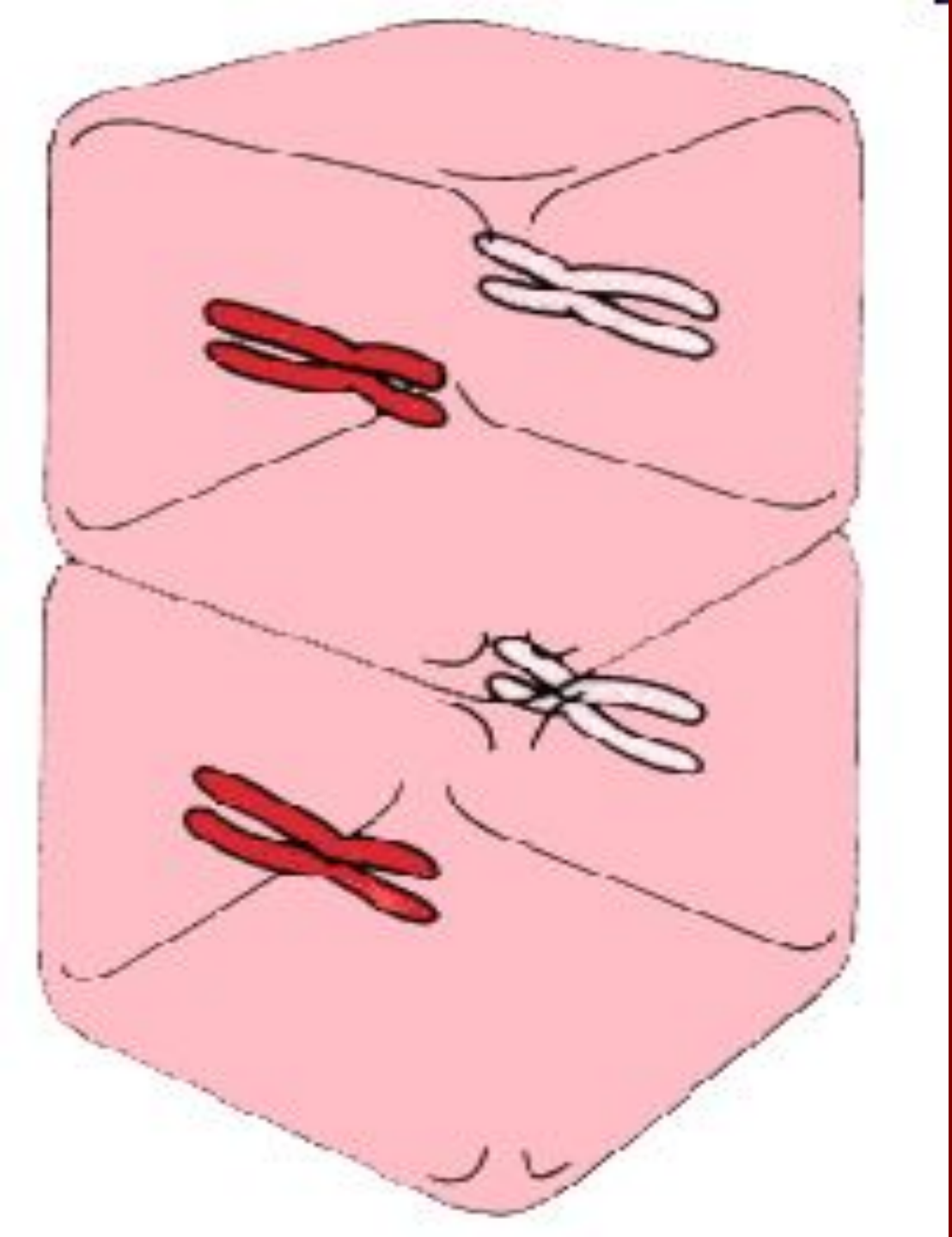
3 - једна хроматида има дупликацију гена C (редослед гена на њој је ABCcdefgh), а друга има делецију тог гена (редослед гена на њој је: abDEFGH)

- Crossing over is an efficient way to produce **genetic recombination** the formation of new combinations of genes
- As a result of crossing-over, the two chromatids of a chromosome no longer contain identical genetic material
- Also provides a source of genetic variation
- Has an enormous impact on how rapidly organisms change

- **<u>Metaphase I</u>** - pairs of homologous chromosomes are moved by the spindle to the equator of the cell – pairs remain together
- **<u>Anaphase I</u>** - homologous chromosomes separate. *The chromatids do not separate at their centromeres – each chromosome is still composed of two chromatids – genetic material has recombined*

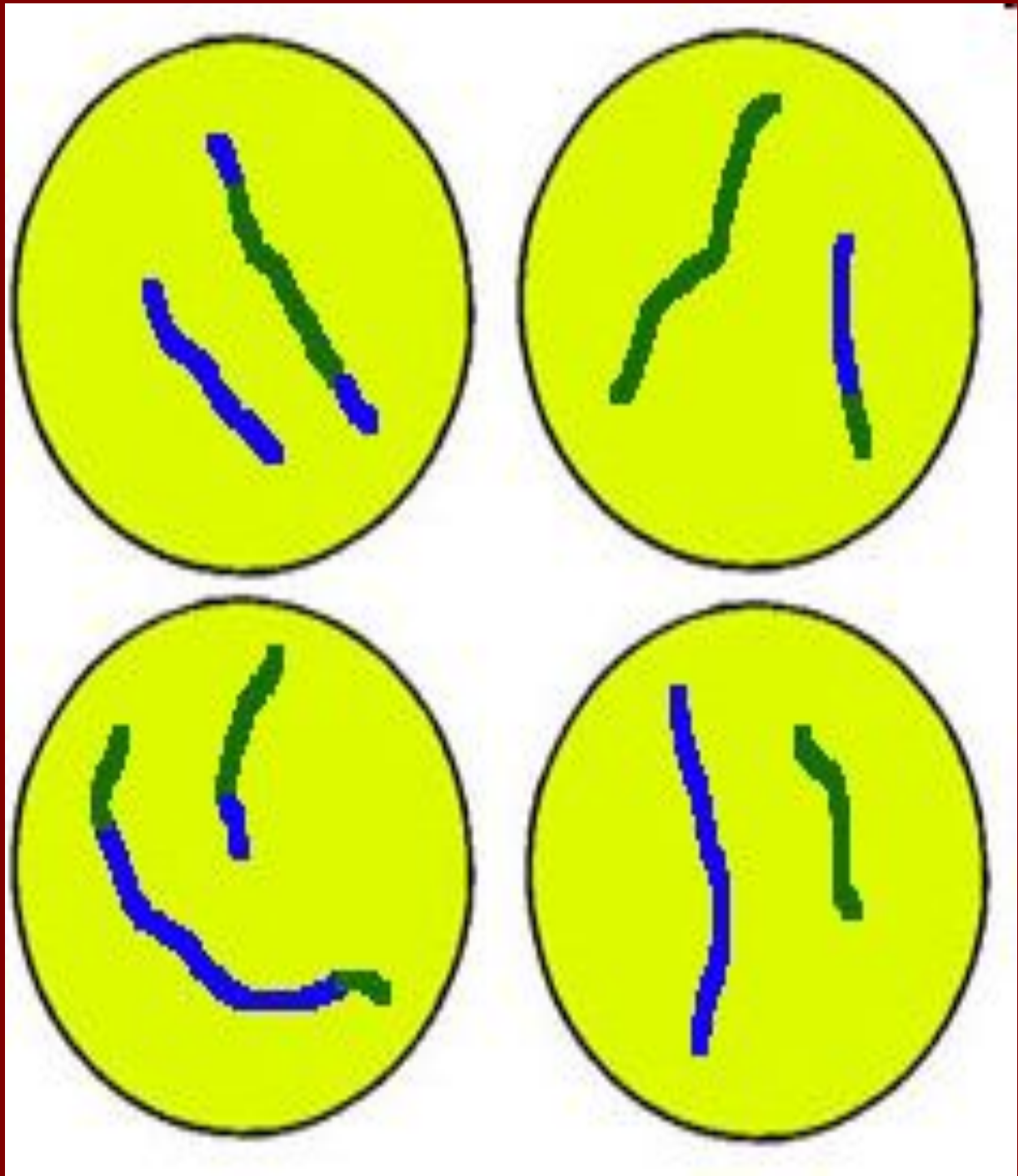
- **<u>Telophase I</u>** – individual chromosomes gather at each of the poles - cytoplasm divides (cytokinesis) forming two new cells
- *Chromosomes do not replicate between meiosis I and meiosis II*



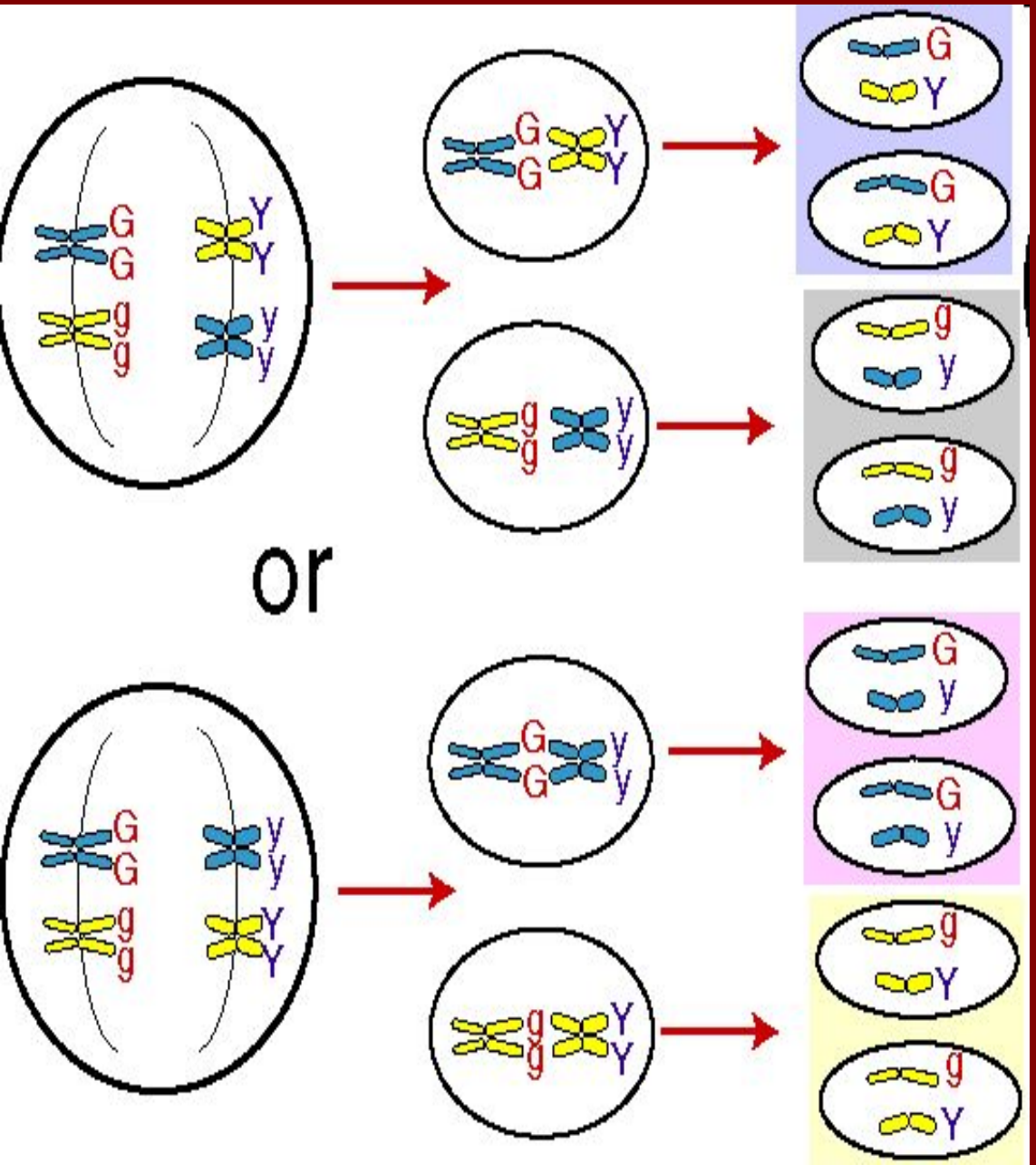


- Prophase II – a new spindle forms around the chromosomes
- Metaphase II – chromosomes line up along the equator and are attached at their centromeres to spindle fibers

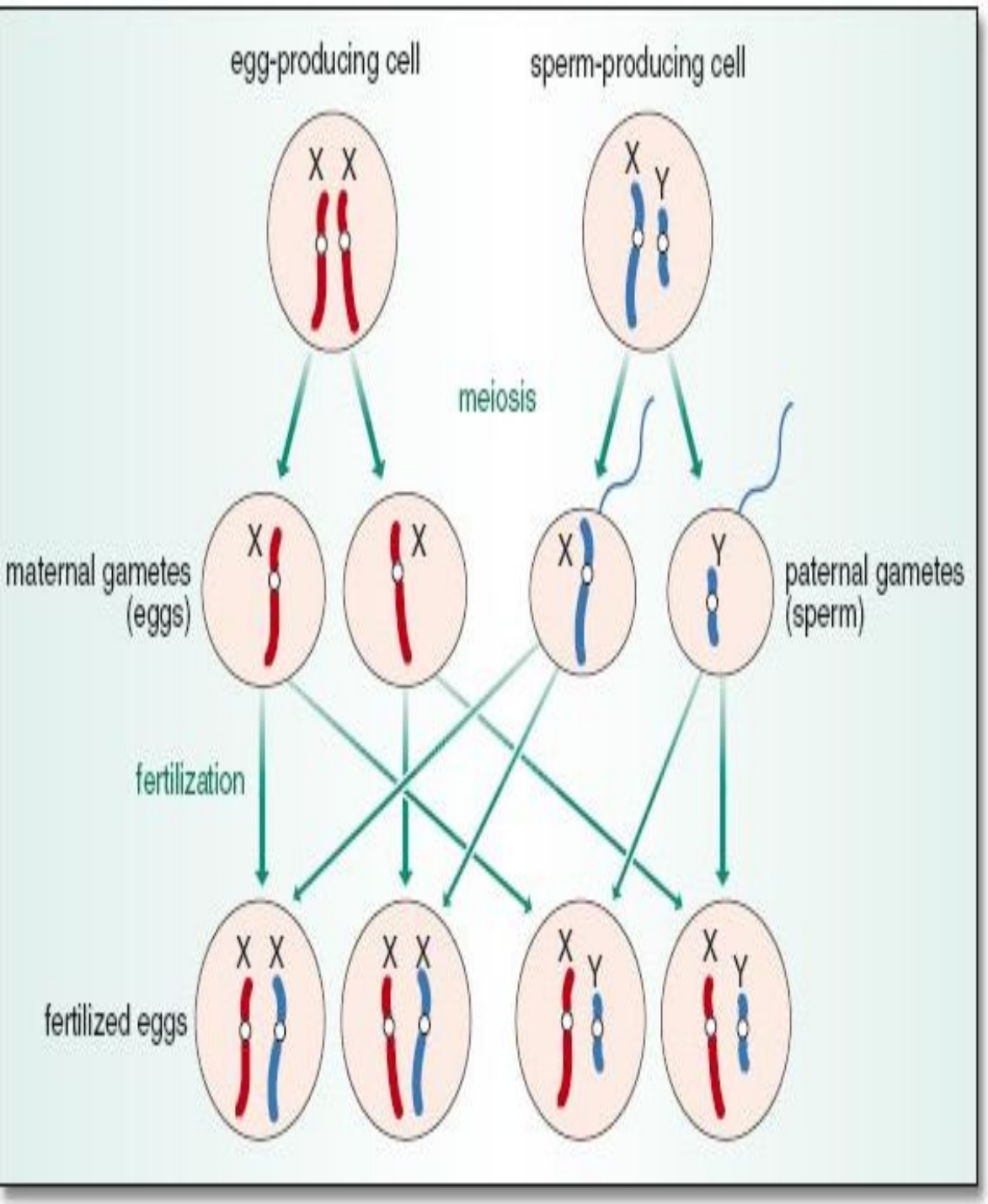
- Anaphase II – centromeres divide –chromatids move to opposite poles
- Telophase II – nuclear envelope forms around each set of chromosomes – result of meiosis is four haploid cells



Meiosis and Genetic Variation



- Three mechanisms make key contribution to genetic variation: independent assortment, crossing over, and random fertilization
- Independent assortment random distribution of homologous chromosomes during meiosis



- Fertilization of an egg by a sperm is random, the number of possible outcomes is squared (2_{23} x 2_{23} = 64 trillion)
- The number of genetic combinations that can occur among gametes is practically unlimited

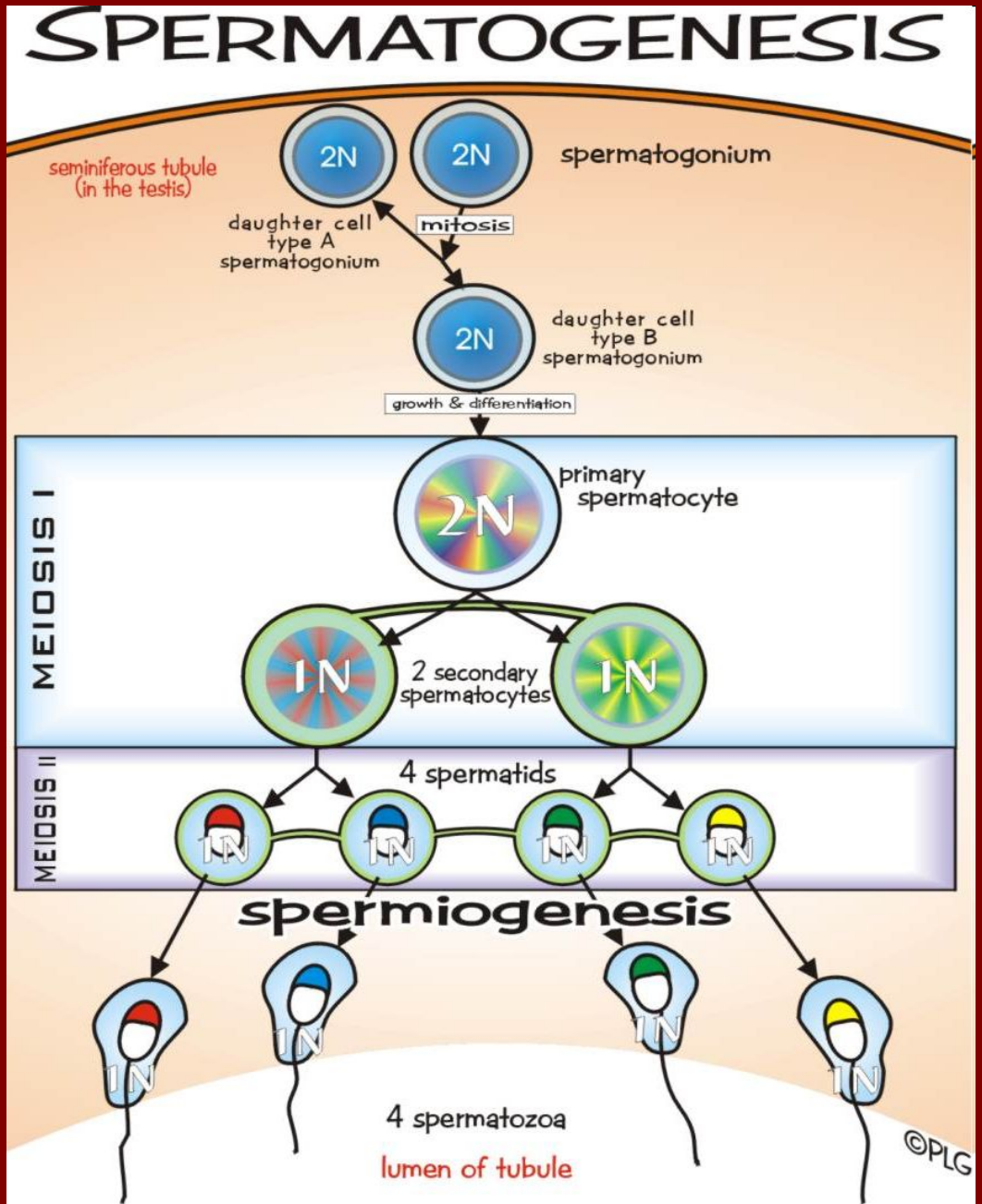
Video on Meiosis

- http://highered.mcgraw-hill.com/olcweb/cgi/pluginpop.cgi?it=swf::535::535::/sites/dl/free/0072437316/120074/bio19.swf::Stages%20of%20Meiosis

Importance of Genetic Variation

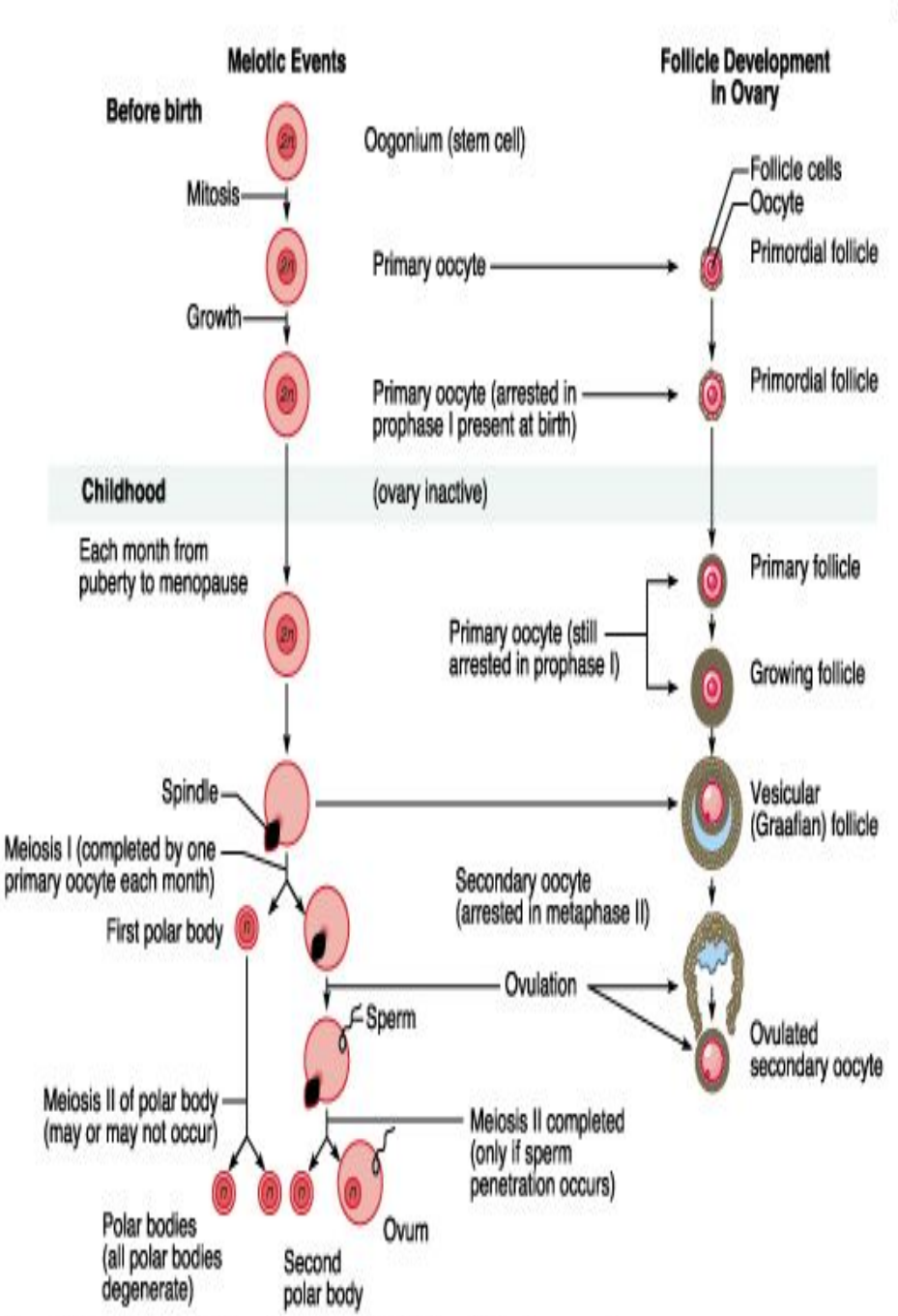
- Meiosis and the joining of gametes are essential to change
- The pace of change appears to increase as the level of genetic variation increases
- Natural selection does not always favor genetic change
- Modern organisms are little changed from their ancestors, slowing the pace of change

Meiosis and Gamete Formation



- Spermatogenesis – the process by which sperm are produced in male animals, which occurs in the testes
- Large cell (2*n*) undergoes meiosis I, forming 2 cells (1*n*) that undergo meiosis II, forming 4 haploid cells (1*n*) that change to form and develop a tail to become sperm

- Oogenesis – the process by which gametes are produced in female animals – occurs in the ovaries
- During cytokinesis following meiosis I, the cytoplasm divides unequally
- Cell receiving almost all the cytoplasm will become the ovum – the smaller cells are called polar bodies and will not survive
- Ovum has a rich storehouse of nutrients to nourish the young organism if fertilization occurs



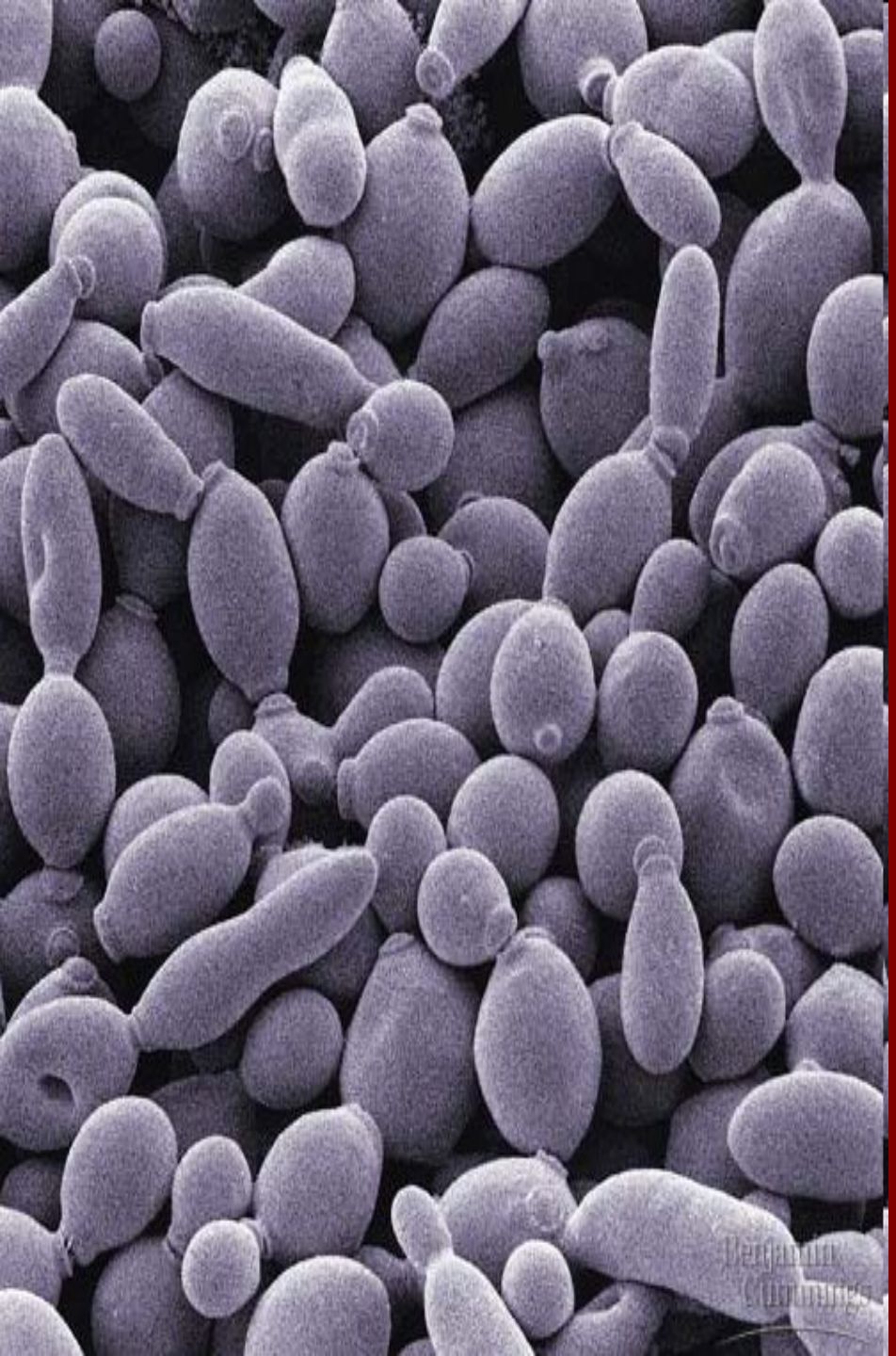
Classwork/Homework

- Chapter review p. 156 1-3, 5a, 6-8, 11,16, 18

Sexual Reproduction
Section 2

Sexual and Asexual Reproduction

- Reproduction, the process of producing offspring, can be asexual or sexual
- Asexual reproduction – a single parent passes copies of all of the genes to each of the offspring, there is no fusion of haploid cells – results in uniform progeny
- Clone – an organism that is genetically identical to its parent – an individual produced by asexual reproduction

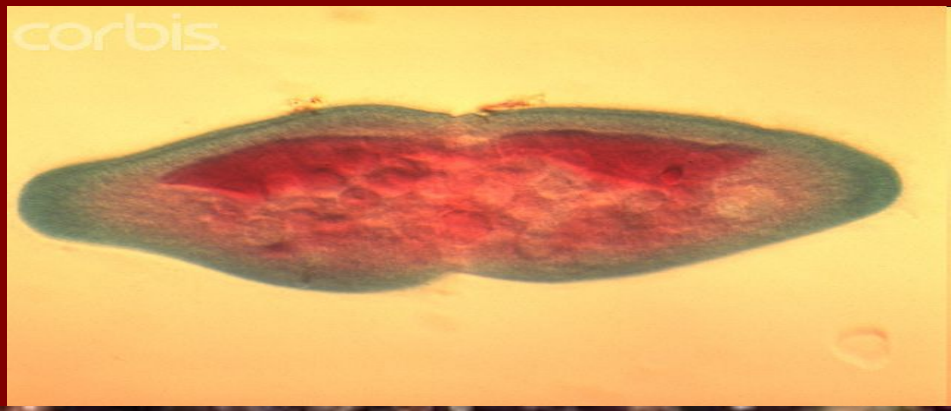


- Prokaryotes reproduce by a type of asexual reproduction called <u>binary fission</u>
- Asexual reproduction is advantageous in:

  a) stable environments
  b) conditions in which physical damage is frequent and severe
  c) harsh environments where sexual reproduction often fails

Types of Asexual Reproduction

- Fission – the separation of a parent into two or more individuals of about equal size



- Fragmentation – a type of reproduction in which the body breaks into several pieces which can develop into adults when missing parts are regrown

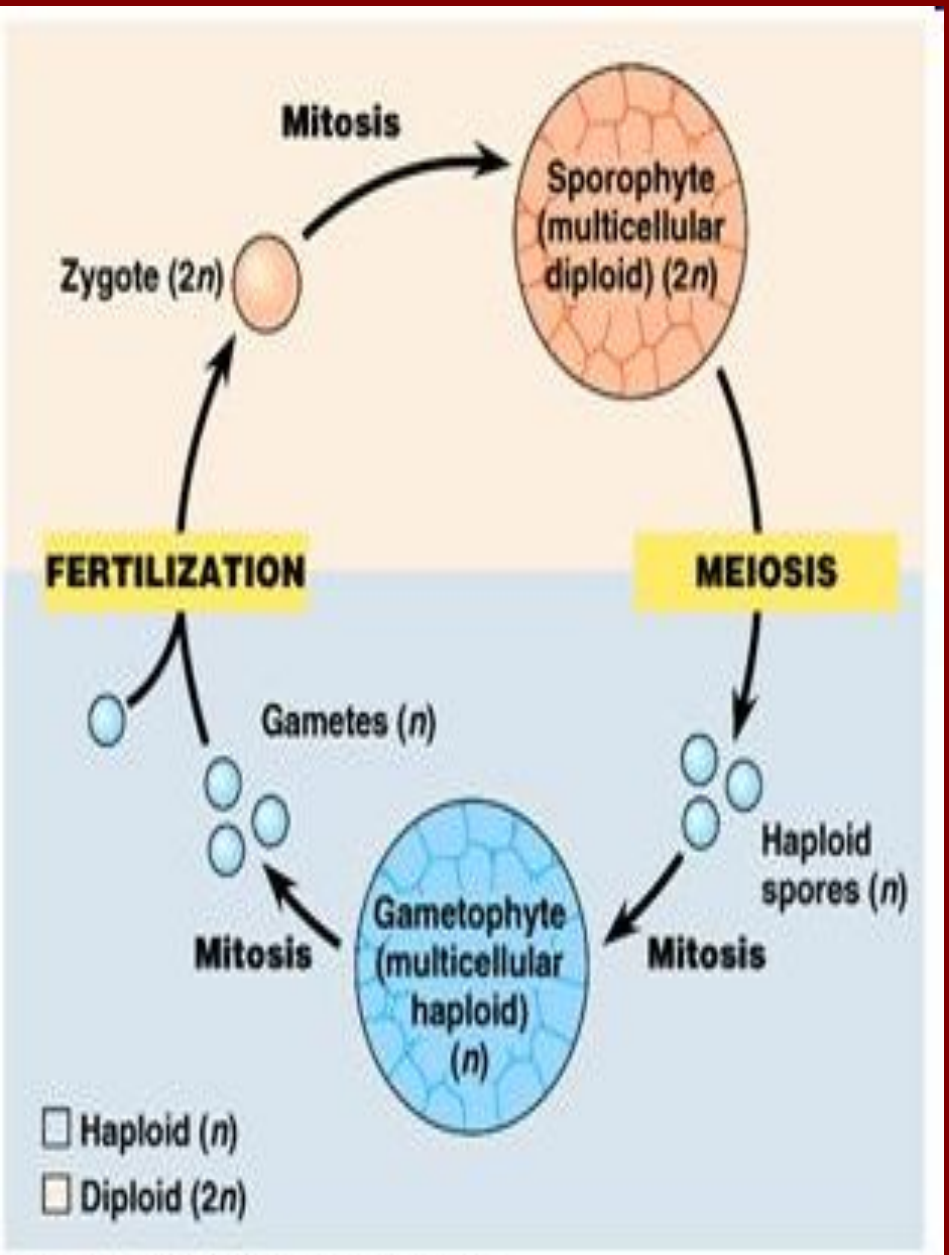
- Budding – new individuals split off from existing ones
- Bud may break off & become independent or remain attached to the parent

Genetic Diversity

- Asexual reproduction is the simplest and most primitive method
- Allows organisms to produce many offspring in a short period of time, without using energy to produce gametes or find a mate
- Sexual reproduction provides a powerful means of quickly making different combinations of genes among individuals

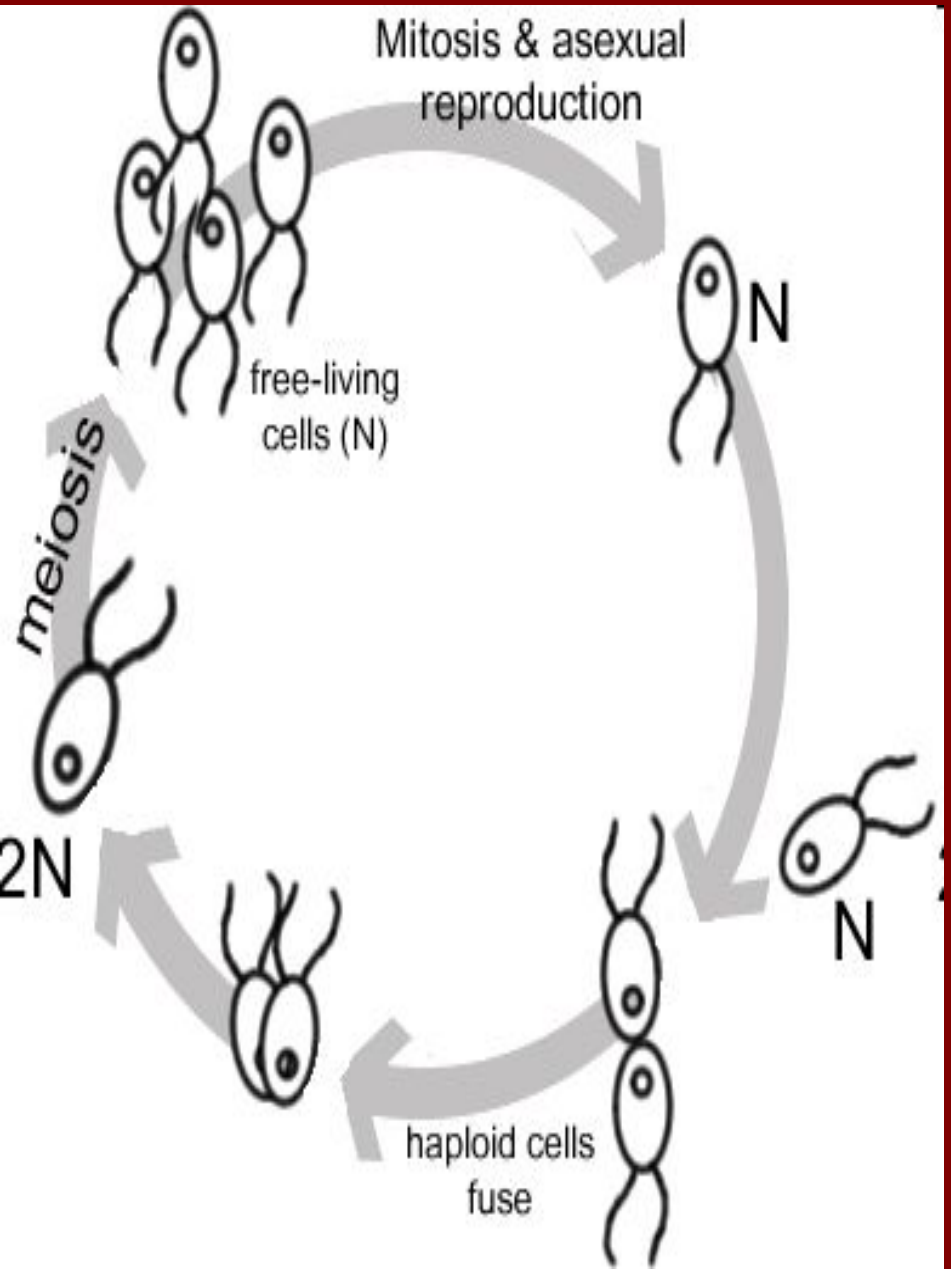
- Hypothesis of sexual evolution is based on that many enzymes that repair DNA are involved in meiosis
- Sexual reproduction would have to work at fantastic precision – just not for one species but for all species
- Only diploid cells can repair certain kinds of chromosome damage
- Many modern protests are haploid most of the time, & reproduce asexually

Sexual Life Cycles in Eukaryotes



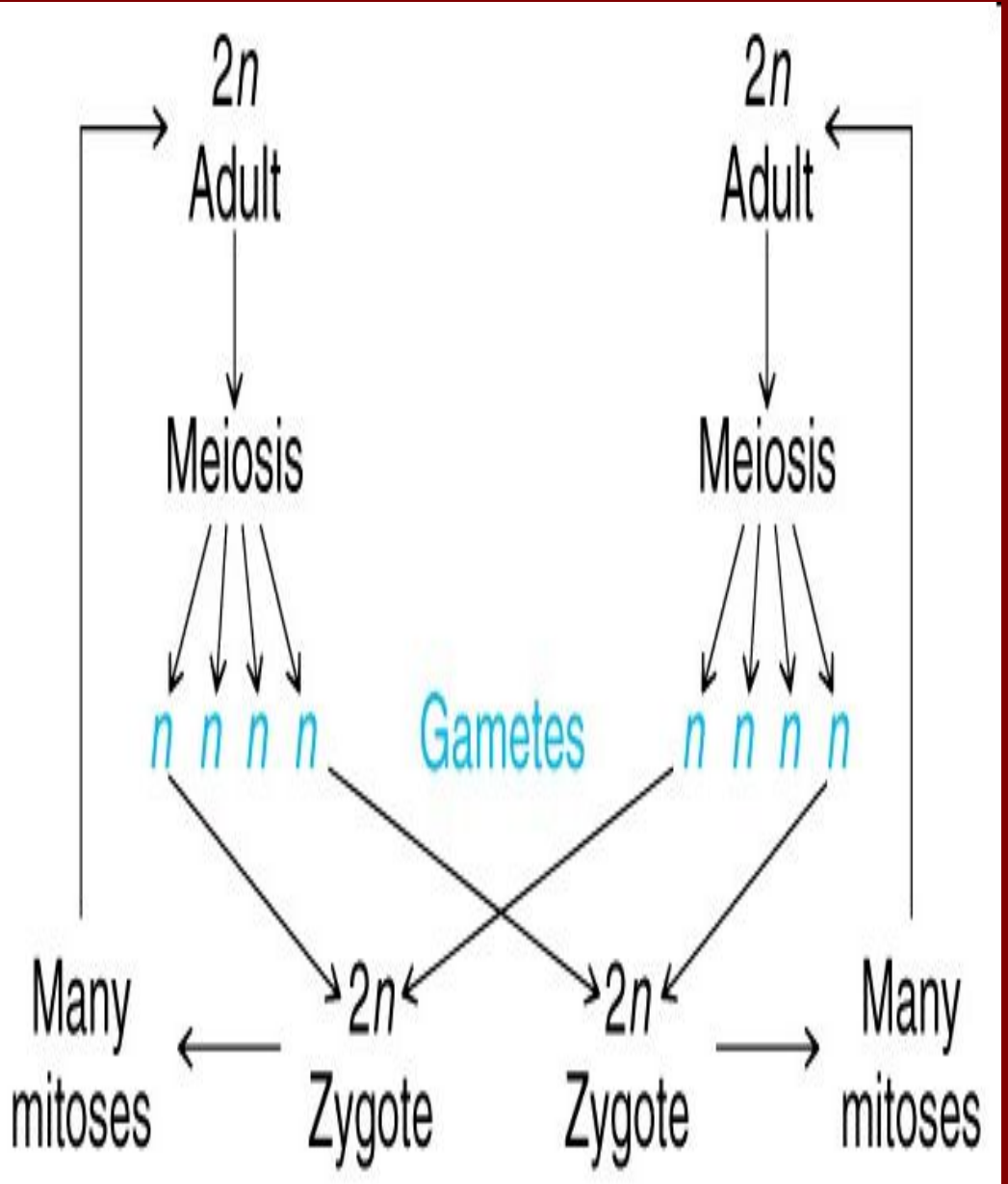
- Life cycle – the entire span in the life of an organism from one generation to the next
- Eukaryotes that undergo sexual reproduction can have one of three types of sexual life cycles:
  a) haploid
  b) diploid
  c) alternation of generations

Haploid Life Cycle



- Is the simplest of sexual life cycles
- Haploid cells occupy the major portion of life cycle
- Zygote is the only diploid cell, & undergoes meiosis immediately after it is formed
- Give rise to gamete by mitosis not meiosis
- During meiosis of the zygote, chromosome damage is repaired

Diploid Life Cycle



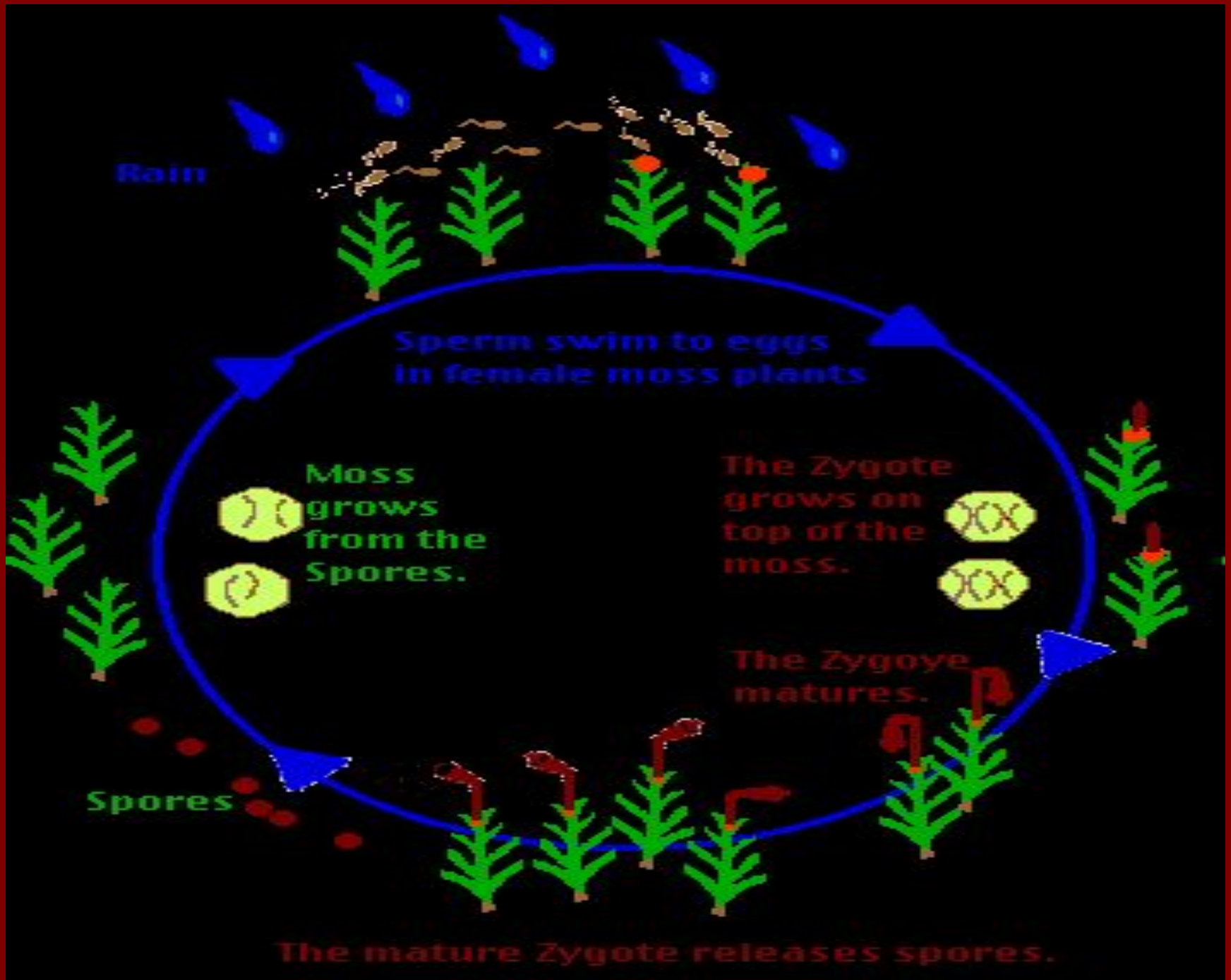
- Outstanding characteristic is the adult individuals are diploid, each individual inheriting chromosomes from two parents
- Fertilization – the gametes (sperm & egg) join to produce a diploid zygote which divides by mitosis
- Gametes are the only haploid cells in diploid cycle

Cloning by Parthenogenesis

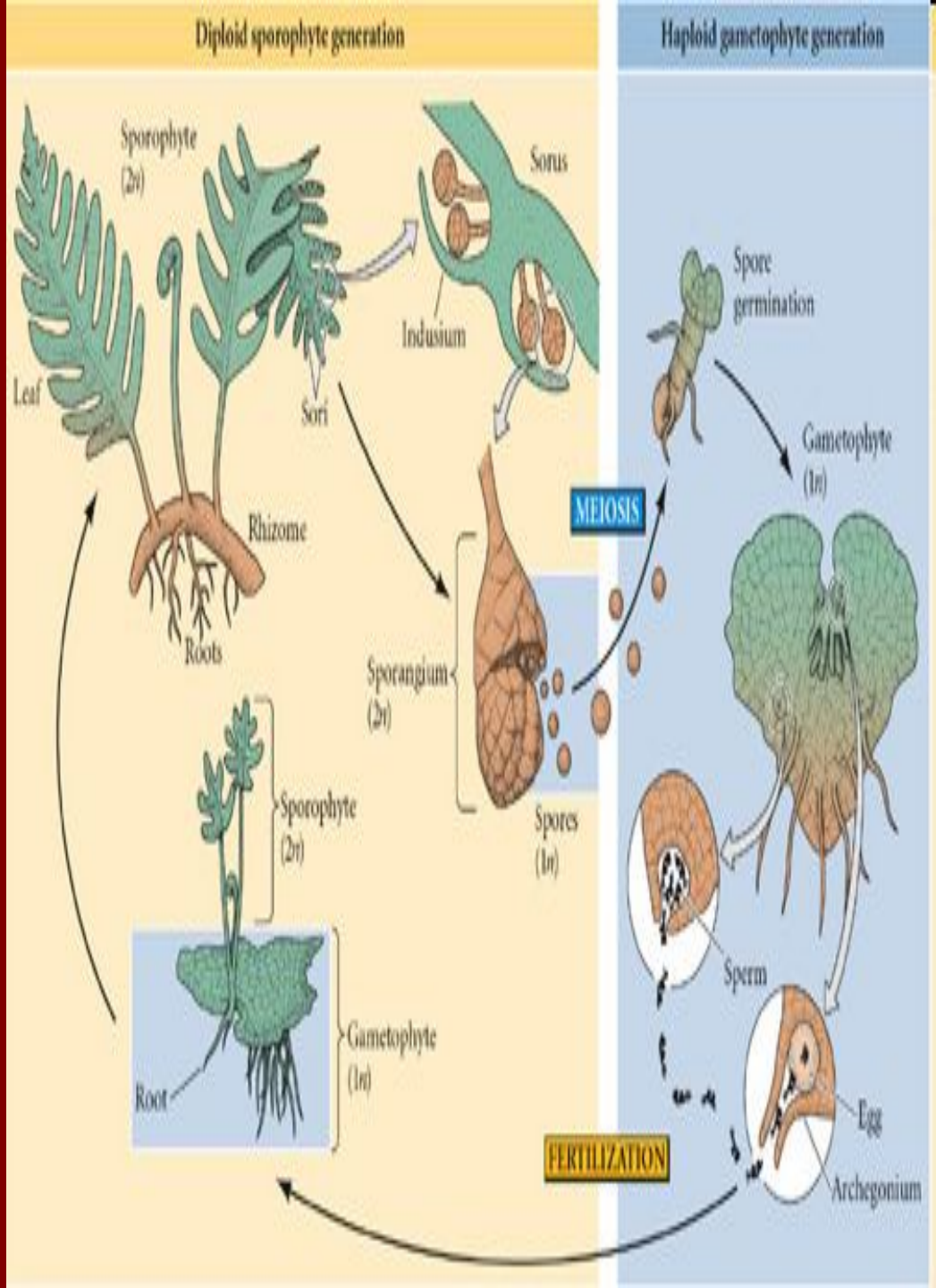
- Read 153 Exploring Further
- How Does Parthenogenesis occur?
- What are some organisms that reproduce using this method?
- Are mammals thought to be able to reproduce this way? Explain.

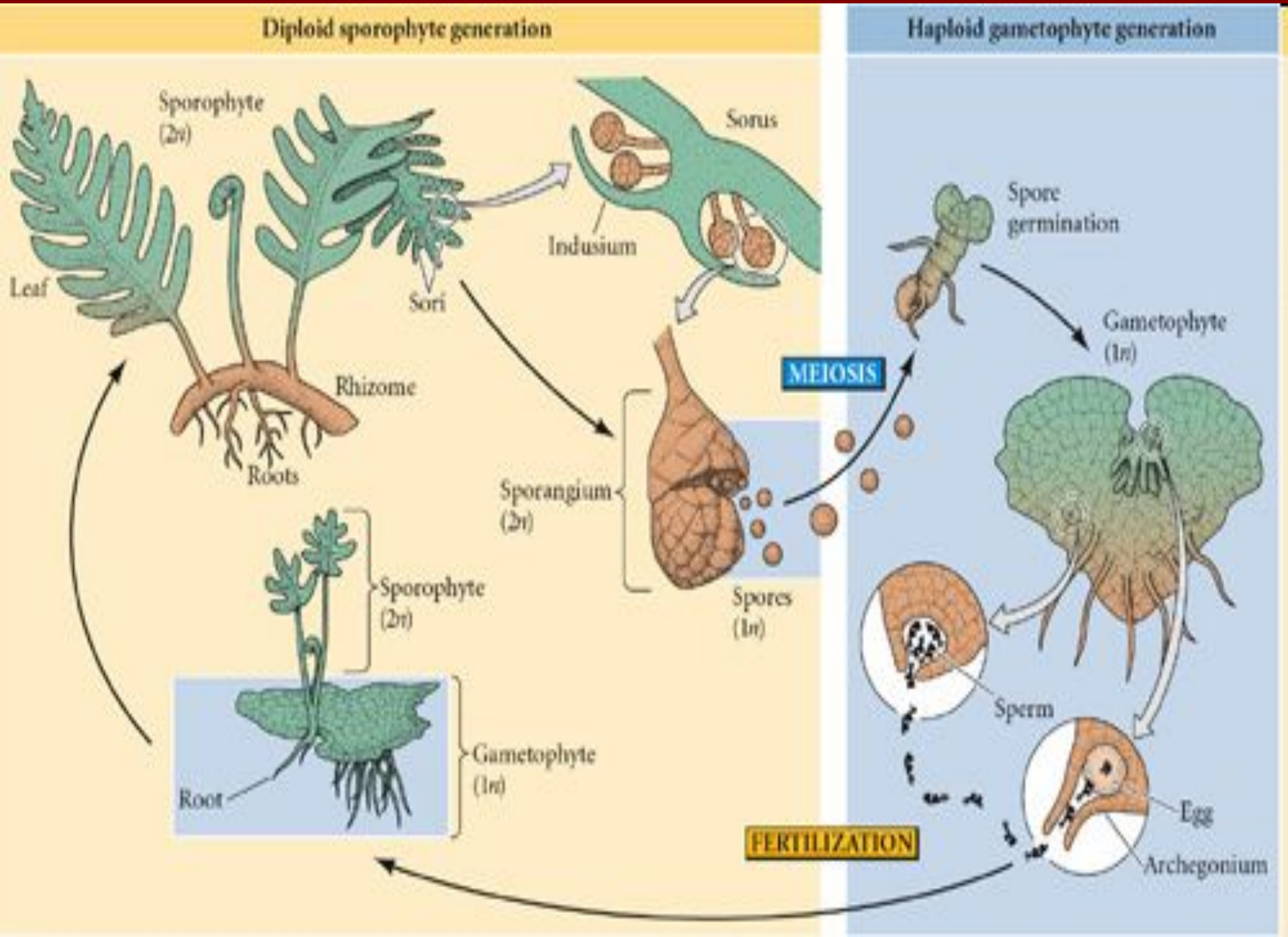
Alternation of Generation

- Plants, algae, and some protists have a life cycle that regularly alternates between a haploid phase and a diploid phase
- Sporophyte – the diploid phase in the life cycle that produces spores
- Spore – a haploid reproductive cell produced by meiosis that is capable of developing into an adult without fusing with another cell


Rain
Sperm swim to eggs in female moss plants
Moss grows from the Spores.
The Zygote grows on top of the moss.
The Zygoye matures.
Spores
The mature Zygote releases spores.

- Gametophyte – the haploid phase that produces gametes by mitosis
- Gametes fuse and give rise to the diploid phase
- Sporophyte and gametophyte generations take turns
- All three involve an alternation of haploid & diploid phases
- Only differ in which phases become multicellular




Diploid sporophyte generation
Haploid gametophyte generation
Sporophyte (2n)
Leaf
Rhizome
Roots
Sori
Sorus
Indusium
Sporangium (2n)
Spores (1n)
MEIOSIS
Spore germination
Gametophyte (1n)
Sperm
Egg
Archegonium
FERTILIZATION
Sporophyte (2n)
Root
Gametophyte (1n)

Classwork/Homework

- Chapter review p. 156 & 157
  questions 4, 5b-c, 9, 10, 19, and
  Standardized Test Prep (STP)