

Introduction to Botany. Lecture 25

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Outline

- 1 Questions and answers
- 2 Cell division
 - Meiosis
 - Syngamy



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- 2 Cell division
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Previous final question: the answer

List names of cell cycle stages.



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- Interphase, mitosis, cytokinesis



Cell division

Meiosis



Exchange and renovation of DNA

- To sustain with the ever-changed environment, organisms must evolve
- To evolve, they need a genetic diversity: different genotypes in different organisms
- To be genetically diverse, they need a process of genetic exchange
- One of ways of exchange is a sexual process in a form of **syngamy**
- However, constant syngamy will result in constant increase of DNA amount
- Meiosis is a counterbalance to syngamy



Definition of meiosis

- *Reductive cell division, where each of daughter cells receives the half of mother cell chromosomes*
- Chromosome formula: $XX \rightarrow X + X \rightarrow I + I + I + I$
- **The goal of meiosis** is to counterbalance the syngamy
- Meiosis changes genotype of cells because: (1) chromosomes are **recombined** and (2) chromosomes exchange their genetic material



Ploidy, or chromosome set

- In diploid ($2n$) organisms, chromosomes form pairs
- Paired chromosomes (XX) are **homologous**
- In haploid (n) organisms, all chromosomes are single
- In mitosis, ploidy will be the same: $2n \rightarrow 2n + 2n$
- In syngamy, ploidy will increase: $n + n \rightarrow 2n$
- In meiosis, ploidy will reduce: $2n \rightarrow n + n$

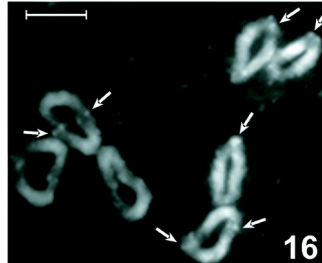
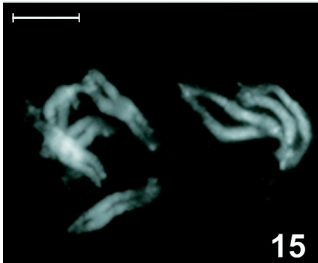
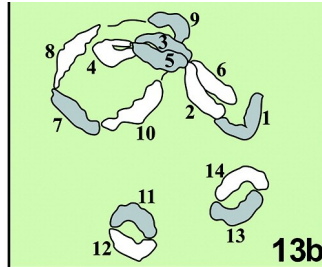
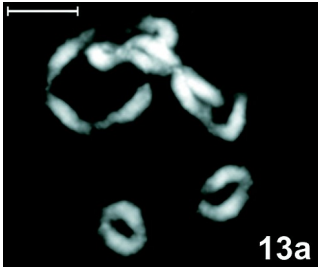


Stages of meiosis

- First division: reductive part
 - Prophase I: homologous chromosomes form pairs (**synapses**) and start to exchange DNA (**crossing-over**)
 - Metaphase I
 - Anaphase I: homologous chromosomes will go *independently* to different poles
 - Telophase I becomes Prophase II, without interphase (and typically without cytokinesis)
- Second division: equal part (similar to mitosis)
 - Prophase II
 - Metaphase II
 - Anaphase II
 - Telophase II



Unusual meiosis of evening primrose, *Oenothera*



Cell division

Syngamy



Definition of syngamy

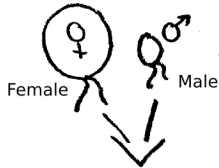
- *Fusion of two cells, where resulted cell will have two times more chromosomes*
- Initial cells are **gametes**, resulted cell is a **zygote**
- Chromosome formula: $X + X \longrightarrow XX$
- **The goal of syngamy** is the renovation of genetic material
- Syngamy changes genotype of cells



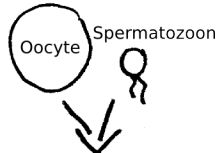
Types of syngamy (Y!)



Isogamy:
different
genotypes



Heterogamy:
different
size



Oogamy:
different
motility

Final question (2 points)



Final question (2 points)

What is the difference between anaphase I of meiosis and anaphase of mitosis?



Summary

- **Mitosis** is a process of cell multiplication, **ploidy stays constant**, **genotype does not change**
- **Meiosis** is a process of reduction of DNA amount, **ploidy halves**, **genotype changes**



For Further Reading



J. E. Bidlack, Sh. H. Jansky.
Stern's introductory plant biology. 12th edition.
McGraw-Hill, 2011.
Chapters 9, 12.



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.
Plant Biology. 2nd edition.
Thomson Brooks/Cole, 2006.
Chapters 11, 12 (skip the angiosperm life cycle!).

