

Introduction to Botany. Lecture 13

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1 Questions and answers

2 Mitosis and meiosis

- Syngamy (Y!)
- Meiosis (R!)



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2 Mitosis and meiosis

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Previous final question: the answer

Why do organisms have sexual process?



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Why do organisms have sexual process?

- To diversify the population because diversity is a basement of natural selection and subsequent adaptation
- To reduce genetic load because carriers of lethal mutations will die; consequently, these mutations will not be transferred to the offspring



Mitosis and meiosis

Syngamy (Y!)



Definition of syngamy

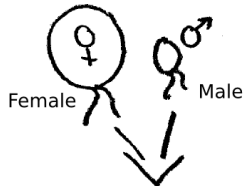
- *Fusion of two cells, where resulted cell will have two times more chromosomes*
- Initial cells are **gametes**, resulted cell is a **zygote**
- Chromosome formula: $X + X \longrightarrow XX$
- **The goal of syngamy** is the renovation of genetic material
- Syngamy changes genotype of cells



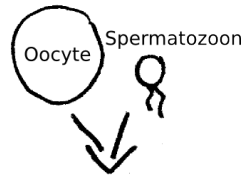
Types of syngamy



Isogamy:
different
genotypes



Heterogamy:
different
size



Oogamy:
different
motility

Mitosis and meiosis

Meiosis (R!)



Some useful terms

- Gene
- Protein
- Enzyme
- Genotype
- Genome
- Population
- Mutation
- Syngamy



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) number of chromosomes reduced, (2) chromosomes are **recombined** and (3) 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



Polyploids

- If for some reason, meiosis will not run correctly, one of resulted cells could receive double set of chromosomes ($2n$ instead of n)
- If this cell goes to syngamy, resulted zygote will have $3n$ chromosomes
- Cells with $> 2n$ chromosomes are **polyploids**



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



A. Shipunov.

Introduction to Botany [Electronic resource].

2010—onwards.

Mode of access:

http://ashipunov.info/shipunov/school/biol_154



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.

Plant Biology. 2nd edition.

Thomson Brooks/Cole, 2006.

Chapter 12 (skip the angiosperm life cycle!.

