

Introduction to Botany. Lecture 21

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October 19, 2011

Outline

1 Questions and answers

2 Mitosis and meiosis

- Mitosis
- Meiosis

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1 Questions and answers

2 Mitosis and meiosis

- Mitosis
- Meiosis

Previous final question: the answer

What is guttation?

Previous final question: the answer

What is guttation?

- Consequence of high root pressure and low transpiration potential

Mitosis and meiosis

Mitosis

Definition of mitosis

- *Equal cell division, where each of daughter cells receives the same number of chromosomes as a mother cell*
- Chromosome formula: $X \longrightarrow I + I$
- **The goal of mitosis** is the equal distribution of pre-synthesized DNA
- Mitosis does not change genotype of cells

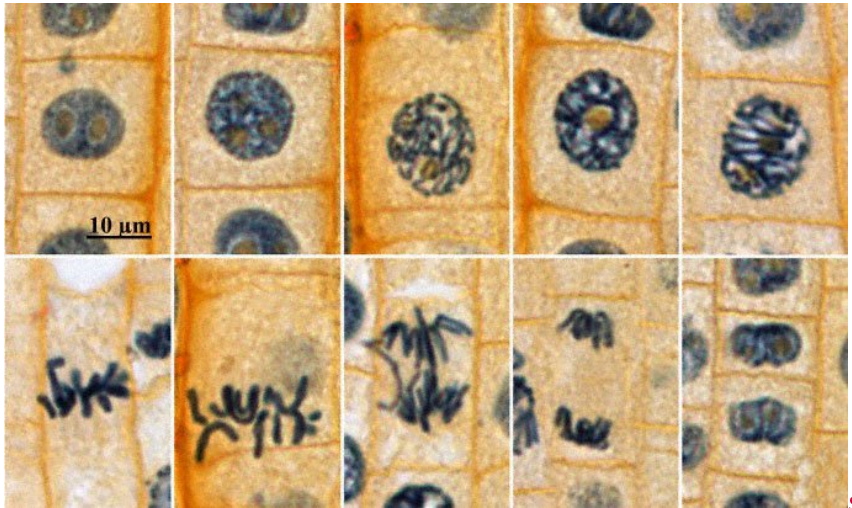
Mitosis, karyokinesis and cytokinesis

- Mitosis is the kind of karyokinesis
- Cytokinesis is a different process, the part of **cell cycle**

Stages of mitosis

- Prophase
- Metaphase
- Anaphase
- Telophase

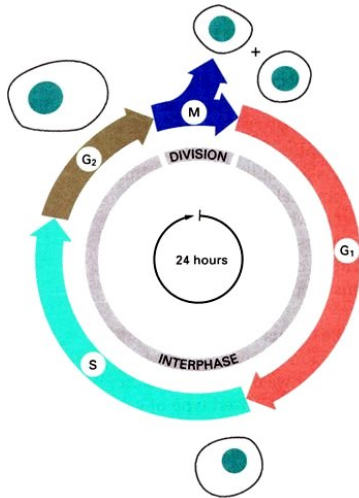
Which stage?



Cell cycle

- Interphase
 - Pre-synthetic stage (G_1)
 - Synthetic stage (S): DNA duplicated
 - Post-synthetic stage (G_2)
- Mitosis
- Cytokinesis

Cell clock



Mitosis and meiosis

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: $XX \longrightarrow X + X \longrightarrow I + I + I + I$
- **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: $2n \longrightarrow 2n + 2n$
- In syngamy, ploidy will increase: $n + n \longrightarrow 2n$
- In meiosis, ploidy will reduce: $2n \longrightarrow n + n$

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

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**

Final question (2 points)

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

For Further Reading



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



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