

# Introduction to Biology. Lecture 27

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- 1 Where we are
  - Plants
- 2 Genetics and inheritance
  - Meiosis
- 3 Genetics and inheritance
  - Gregor Mendel



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# Where we are Plants



# Origin of tissues and organs of plants: first steps

- (a) Availability of light, (b) temperature-gases conflict and (c) ecological interactions “pushed” plants to land.
- Two first tissues, (1) isolating/ventilating compound epidermis and (2) photosynthetic/storage ground tissue were response to desiccation.
- Epidermis could be developed in advance as adaptation to spore delivery.
- Next stages: (3) supportive tissues to solve “Manhattan problem”, (4) vascular tissues to transport water and sugars, (5) branching and (6) absorption tissues (or mycorrhiza) for water uptake.



# Terms associated with origin of plants and their tissues

- *Thallus*: primary, pancake-like plant body (like in contemporary liverworts)
- *Epidermis* as a compound tissue which consists of (a) epidermal cells covered with cuticle, and (b) stomata
- *Stomata* are transpiration openings surrounded with *guard cells*
- Ground tissue
- Supportive tissues
- Shoot system is a result of branching
- Vascular tissues
- Absorption tissue, *mycorrhiza* (interaction with soil fungi) and root system



# Three main phyla of plants

- **Bryophyta:** mosses  
No roots, leaves thin or absent, withstand desiccation
- **Pteridophyta:** ferns and allies (like clubmosses and horsetails)  
Roots adventitious, leaves are not associate with buds, stem-like or scale-like, water-savers
- **Spermatophyta:** seed plants (including conifers and flowering plants)  
Body with two poles, typical leaves associate with buds, water-savers





# Three main phyla of plants

- **Bryophyta:** mosses  
No roots, leaves thin or absent, withstand desiccation, **gametophyte dominance**
- **Pteridophyta:** ferns and allies (like clubmosses and horsetails)  
Roots adventitious, leaves are not associate with buds, stem-like or scale-like, water-savers, **sporophyte dominance, no seeds**
- **Spermatophyta:** seed plants (including conifers and flowering plants)  
Body with two poles, typical leaves associate with buds, water-savers, sporophyte dominance, **seeds**



# Genetics and inheritance

## Meiosis

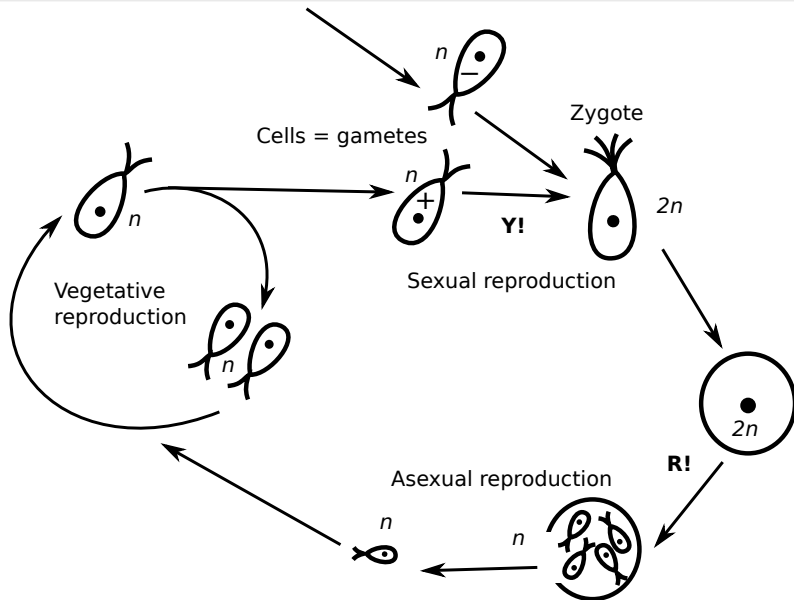


# Exchange and renovation of DNA

- 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 recombination, 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



# Life cycle of unicellular organism



# Terms associated with 1-cell life cycle

- mitosis, **meiosis** (R!), **syngamy** (Y!)
- result of syngamy: **zygote**
- participant of syngamy: **gamete**
- smaller gamete: **male**, bigger gamete: **female**
- movable male gamete: **spermatozoon (sperm)**, motionless female gamete: **oocyte (egg cell)**
- results of meiosis: **spores**
- **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:  $2n \rightarrow n + n$



# Definition of meiosis

- **The goal of meiosis** is to counterbalance the syngamy
- Since DNA is *already duplicated*, meiosis goes in two stages:  
 $XX \rightarrow X + X \rightarrow I + I + I + I$
- Meiosis changes genotype of cells because: (1) chromosomes are **recombined** and (2) chromosomes exchange their genetic material



# Stages of meiosis

- First division: reductive part
  - Prophase I: homologous chromosomes form pairs (**synapses**) and start to exchange DNA (**crossing-over**)<sup>1</sup>
  - 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

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<sup>1</sup>See later.



# Genetics and inheritance

## Gregor Mendel





# Pea

- Self-pollinated: to cross, one needs to pollinate it artificially
- Contrasting characters (flower color, seed coat color, seed coat surface, plant height, pod wall color etc.)
- Pure lines: always produce the same characters



# First and second generations

- First: all the same
- Second:  $3/4$  like one parent and  $1/4$  like another parent



# Theory

- Two different factors (variants of one character)
- Factors are paired in plant but separated in gametes
- One factor is dominant



# Theory and explanation

- Two different factors (variants of one character): *two variants (alleles) of one gene*
- Factors are paired in plant but separated in gametes: *meiosis*
- One factor is dominant: *one variant is working DNA, the other is not*



# Genes and characters

- Genotype and phenotype
- Homozygous and heterozygous plants
- $3/4$  and  $1/4$  is the result of **combining probabilities**



# Summary

- Plant body and its tissues is the result of adaptation for the life on land
- The life cycle is the sequence of events between two syngamies
- Gender is the result of division of labor between two gametes: female gametes invest in resources whereas male invest in numbers
- Mendelian (classic) genetics is based on (1) segregation, (2) dominance and (3) independent assortment



# For Further Reading



## Plant tissues.

[http://en.wikipedia.org/wiki/Tissue\\_%28biology%29#Plant\\_tissues](http://en.wikipedia.org/wiki/Tissue_%28biology%29#Plant_tissues)



## Plants.

<http://en.wikipedia.org/wiki/Embryophyte>



## [From the lab]: Mendel's laws.

[http://en.wikipedia.org/wiki/Mendelian\\_inheritance](http://en.wikipedia.org/wiki/Mendelian_inheritance)

