Ministry education and Science of Republic of Kazakhstan
Karaganda State University named after academician Ye.A. Buketov

Biological and geographical faculty

Botany Department

Course – Botany
Specialty - 5B011300 – «Biology»

Lecture № 16

General characteristic of vascular plants

(1 hour)

Lecturer: candidate of biological science, associated professor
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Plan of lecture:

1 Vascular plants origin.
2 Peculiarities of vascular plants in comparative with low plants.
3 Differences between pore and seed plants.

Main literatures:

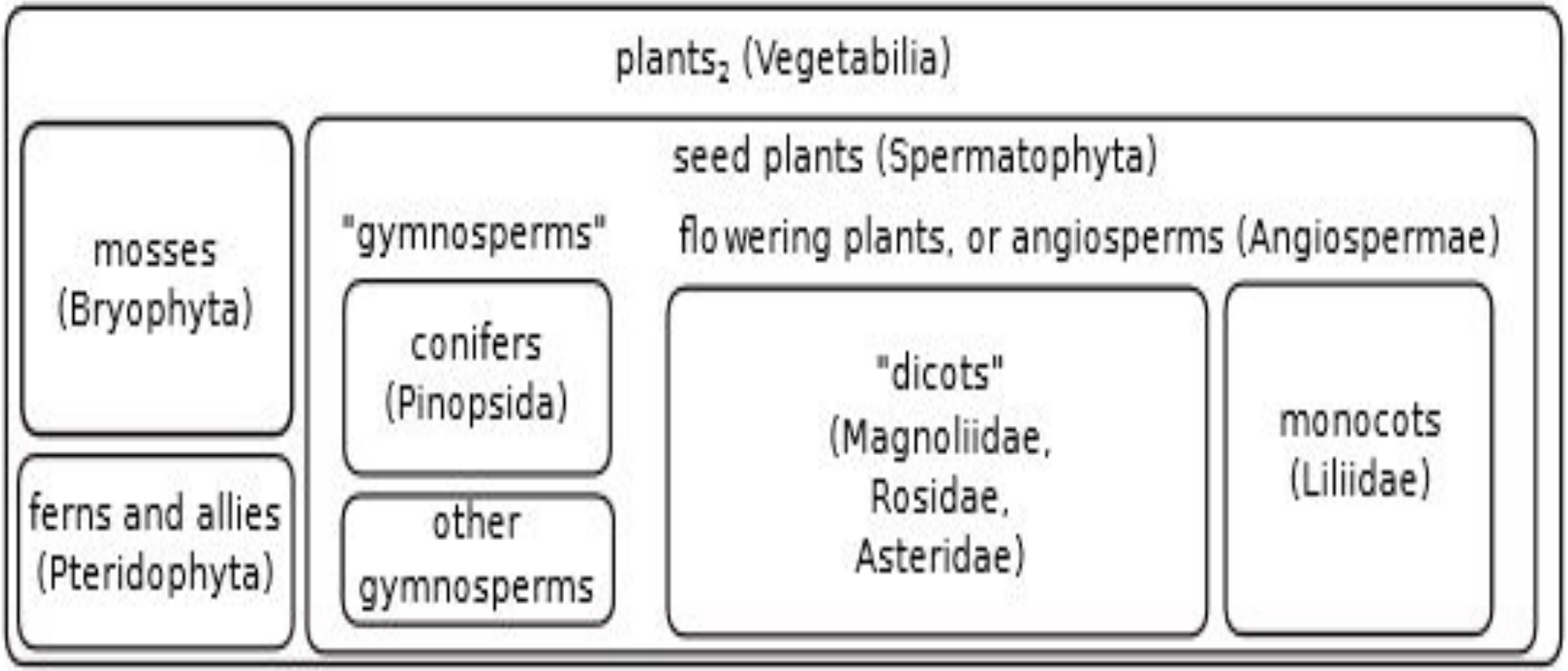
1 Еленевский А.Г., Соловьев М.П., Тихомиров В.Н. Ботаника: систематика высших, или наземных, растений. 2 изд. - М.: Academia, 2001. - 429 с.
2 Нестерова С.Г. Лабораторный практикум по систематике растений. - Алматы: Қазақ ун-ті, 2011. - 220 с.
3 Родман А.С. Ботаника. – М.: Колос, 2001. - 328 с.

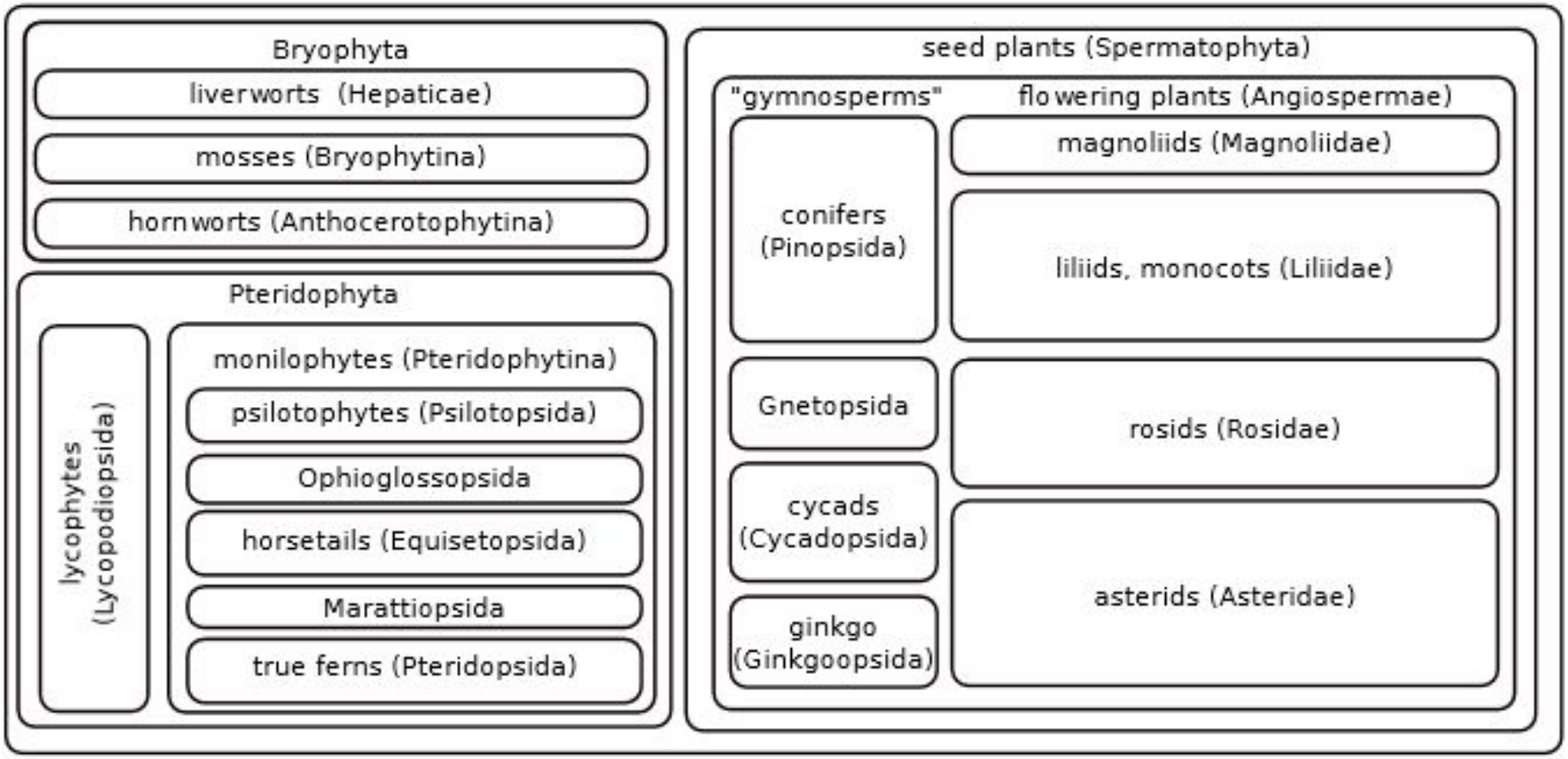
Additional literatures:

1 Абдрахманов О.А. Систематика низших растений. – Караганда: Изд-во КарГУ, 2009. - 188 с.
2 Билич Г.Л., Крыжановский В.А. Биология. Т. 2: Ботаника. - М.: Оникс 21 век, 2002. - 543 с.
3 Ишмуратова М.Ю. Систематика и интродукция растений (курс лекций). - Караганда: РИО Болашак-Баспа, 2015. - 100 с.
4 Тусупбекова Г.Т. Основы естествознания. Ч. 1. Ботаника. – Астана: Фолиант, 2013. – 321 с.

Kingdom Plantae include about 300 000 species from 9 divisions – *Rhyniophyta, Zosterophyllophyta* (died form), *Bryophyta, Lycopodiophyta*, *Psilotophyta*, E*quisetophyta*, *Polypodiophyta*, *Pinophyta* and *Magnoliophyta*. They are characterized domination of sporophyte (exept *Bryophyta*) in life circle, domination of asexual generation, have vascular or tracheas. That why these plants were called vascular plants.

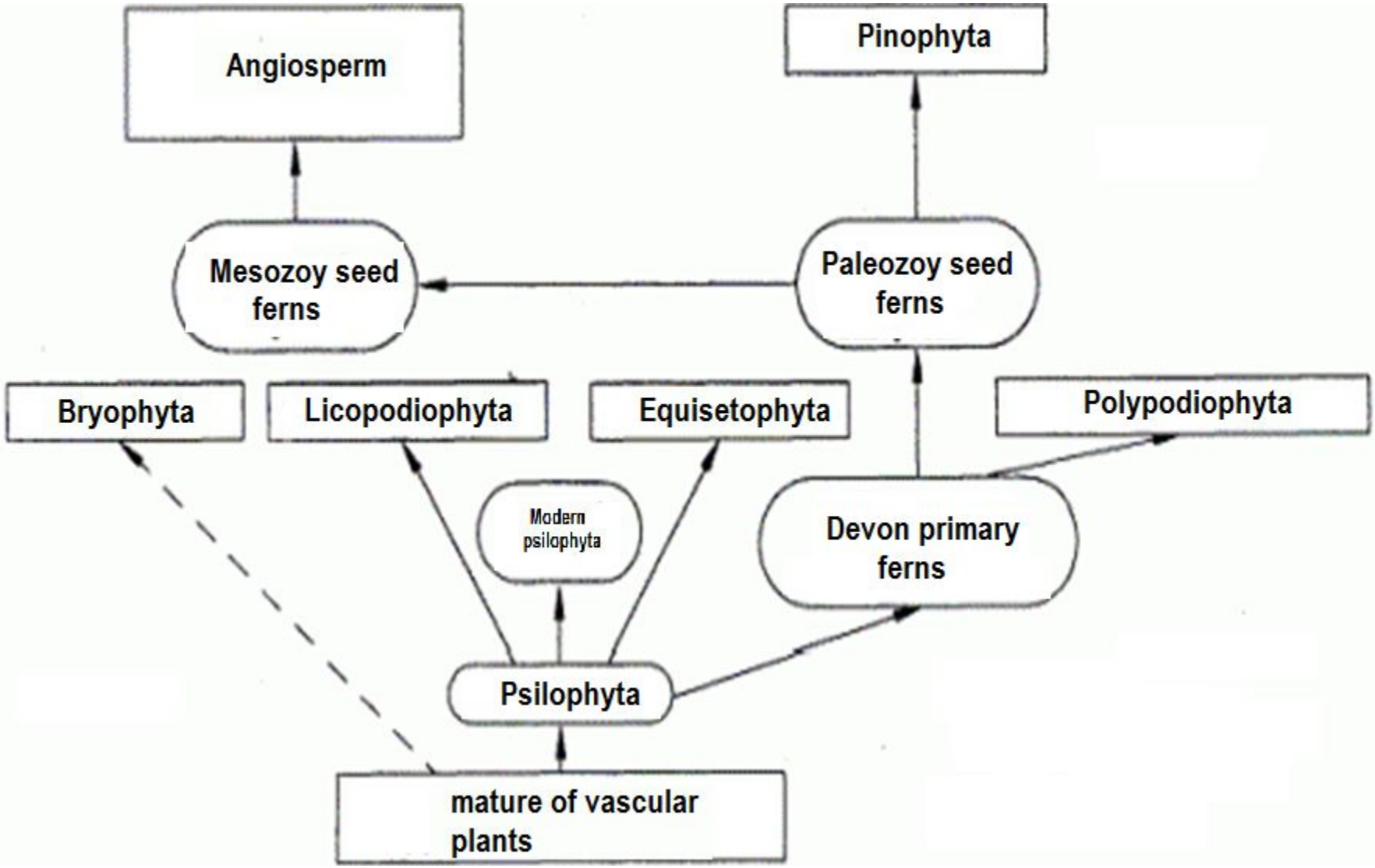
Plant classification (overview)





Plants$_2$ classification: detailed scheme.

Schemes of evolution of vascular plants



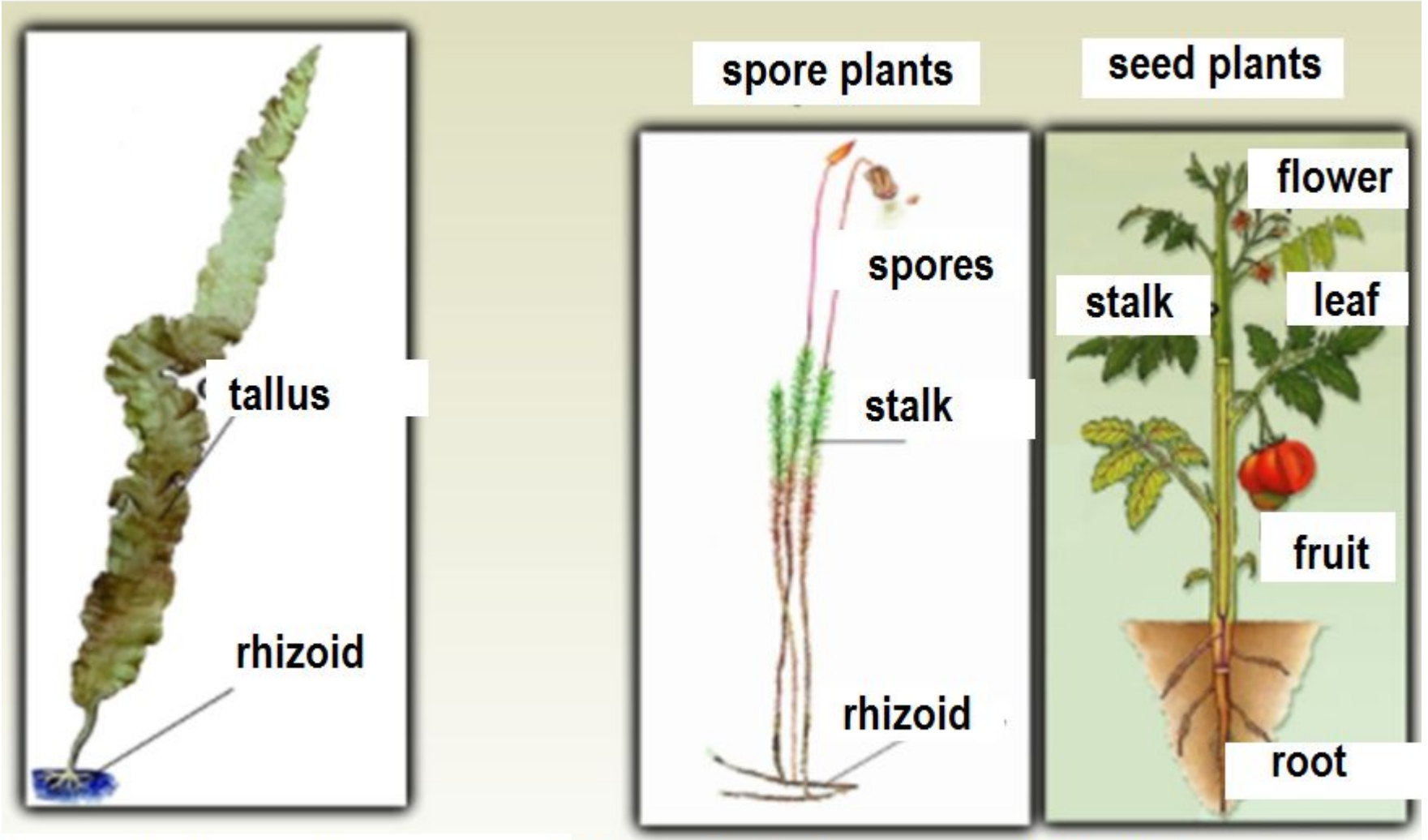
Historical stages of development of vascular plants

Stages	Environment	Time of origin
Origin of life on the Earth	Water	2-3 billions years ago
Origin and domination of algae	Water	1,5-2 billions years ago
Enter of plants on soil	Earth-water	350-400 millions years ago
Origin and domination of ferns	Earth humid	300 millions years ago
Origin and domination of Pinophyta	Earth	Over 200 millions year ago
Origin and donimation of Magnoliophyta	Earth	About 120 millions years ago

Peculiarities of organization of lower and higher plants

lower plants

higher plants



lower plants are algae

higher plants have more difficult structures

Angiosperms

The angiosperms or flowering plants produce flowers and seeds, the latter developing within fruits. Nearly all crop, food, and ornamental plants are angiosperms. There are two major groups of flowering plants, primarily distinguished by the number of seed leaves (cotyledons). Here are their characteristics:

Monocots

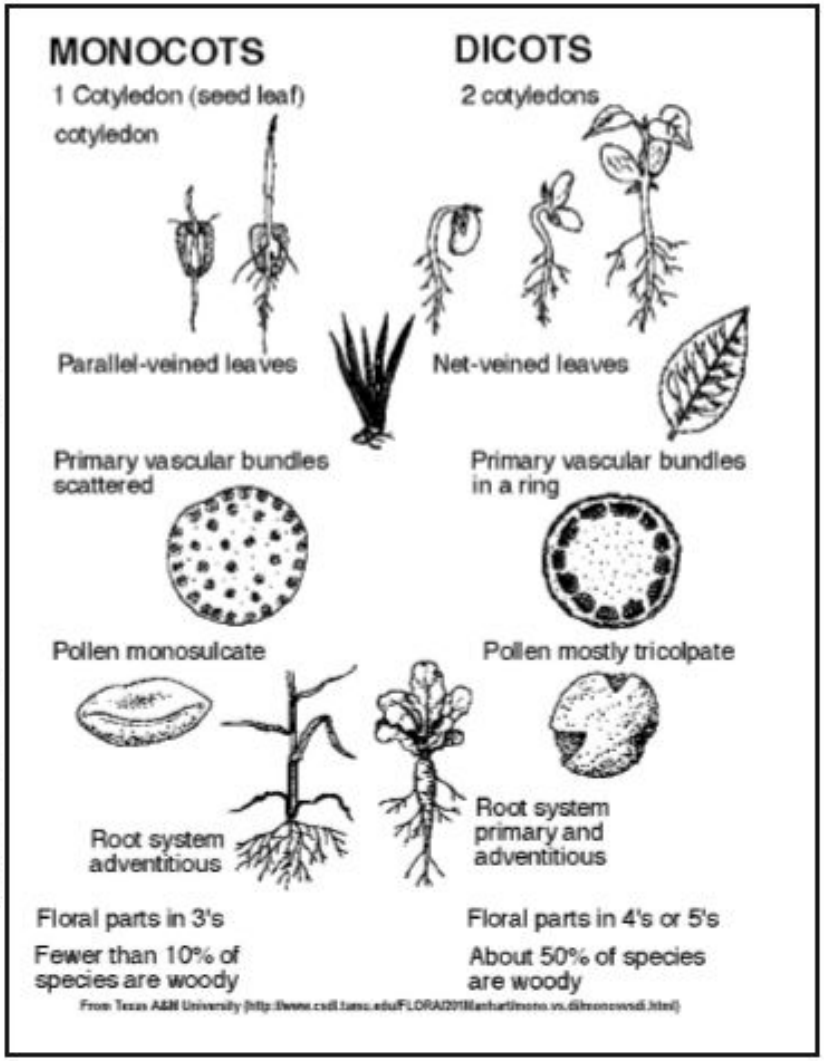
(single cotyledon or seed leaf)

- Leaves have parallel venation.
- Flower parts are usually in multiples of three.
- Do not typically produce wood.
- Examples include: grasses, corn, sedges, cat-tails, lilies, orchids, bananas, and palms.

Dicots

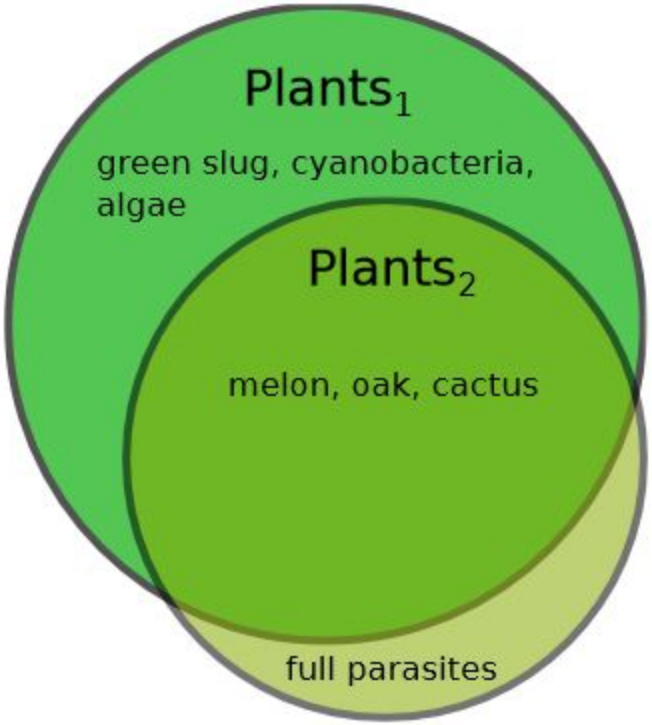
(two cotyledons or seed leaves)

- Leaves have net-venation.
- Flower parts are mostly in multiples of four or five.
- Wood is produced by long-lived dicots.
- Examples include: roses, carrots, elms, magnolias, buttercups, apples, and sunflowers.

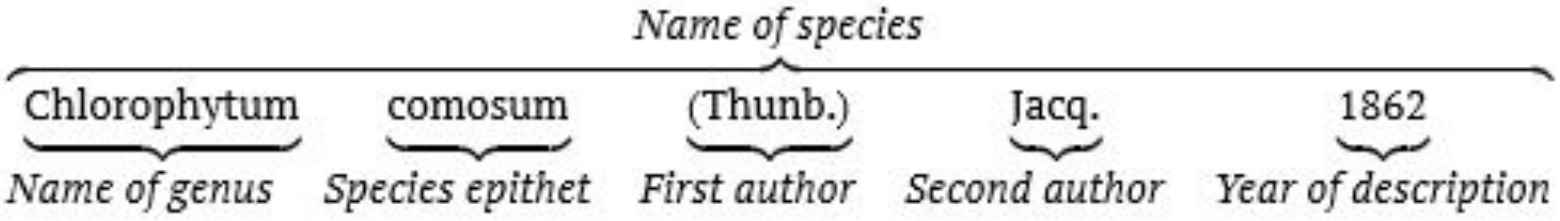


Taxonomy, **systematics** and **classification** are terms with similar meanings; they are all about the overwhelming diversity of living organisms, for there are more than 2,000,000 species (and 300,000 of them belong to plants$_2$). **Phylogenetics** is a more fashionable term; it emphasizes the evolutionary history (**phylogeny**) of taxonomic groups (**taxa**).

This taxonomic organization is hierarchical. Most scientists accept seven main levels of taxonomy (**ranks**): the highest is **kingdom**, followed by **phylum**, **class**, **order**, **family**, **genus**, and lastly, **species.**



English	Latin	Example 1	Example 2
Kingdom	Regnum	Vegetabilia	Animalia
Phylum	Phylum	Spermatophyta	Chordata
Class	Classis	Angiospermae (Magnoliopsida)	Mammalia
Order	Ordo	Liliales	Primates
Family	Familia	Asparagaceae	Hominidae
Genus	Genus	*Chlorophytum*	*Homo*
Species	Species	*Chlorophytum comosum* (Thunb.) Jacq.	*Homo sapiens* L.

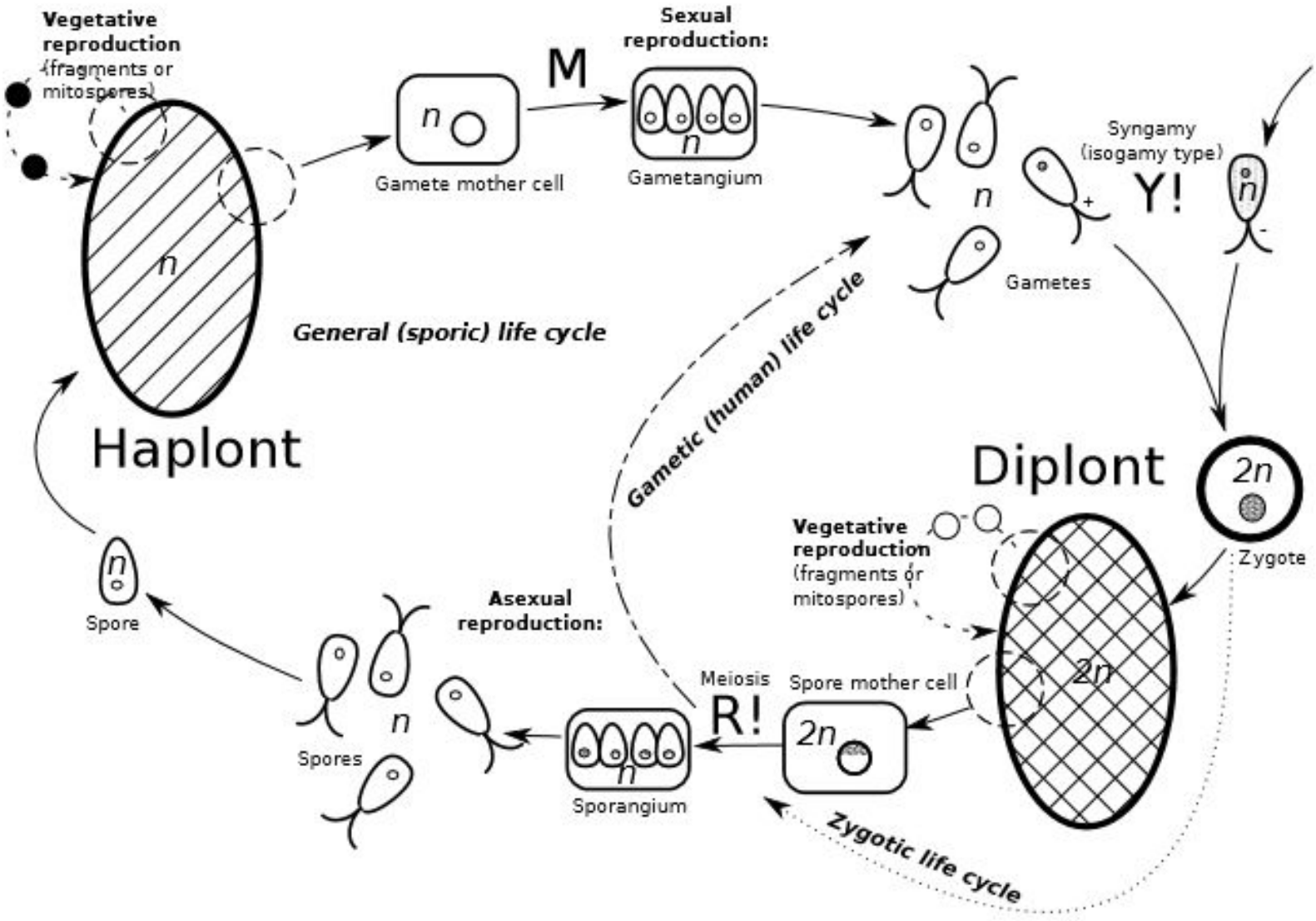


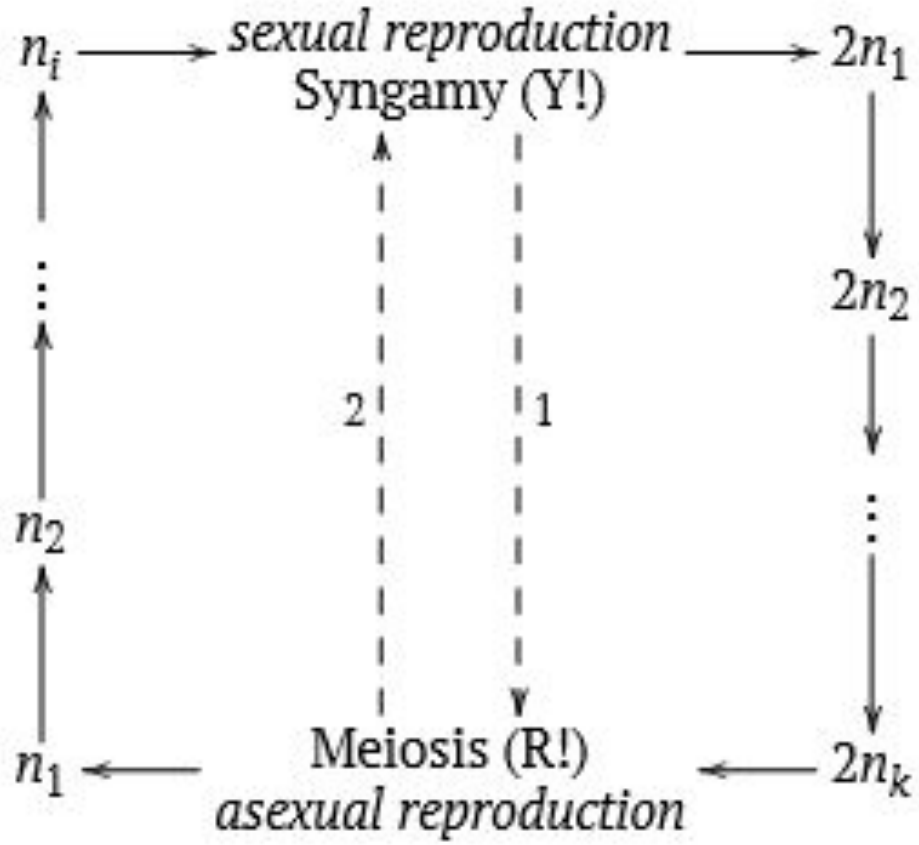
Throughout the long history of taxonomy, too many names were given to the same taxa. At the moment, we have almost 20,000,000 names to describe 2,000,000 species. These 18,000,000 "excess names" are **synonyms** which should not be used in science. To regulate the use of names, **nomenclature codes** were created. These codes specify, for example, the **rule of priority**: *when two names are given for the same group, only earlier name is valid*. Consequently, it is recommended to list the author and the year of description along with a name: "*Homo sapiens* L. 1758", which means that founder of taxonomy, Carolus Linnaeus ("L." shortcut) described this species in 1758.

Another important concept of nomenclature is the **nomenclature type**. Practically, this means that every species name must be associated with the physical museum specimen. In botany, these museums are collections of dried and pressed plants, called **herbaria**. Type specimens are of immense importance because there are no labels in nature, and only these specimens will "tell" about real plants or animals associated with particular names.

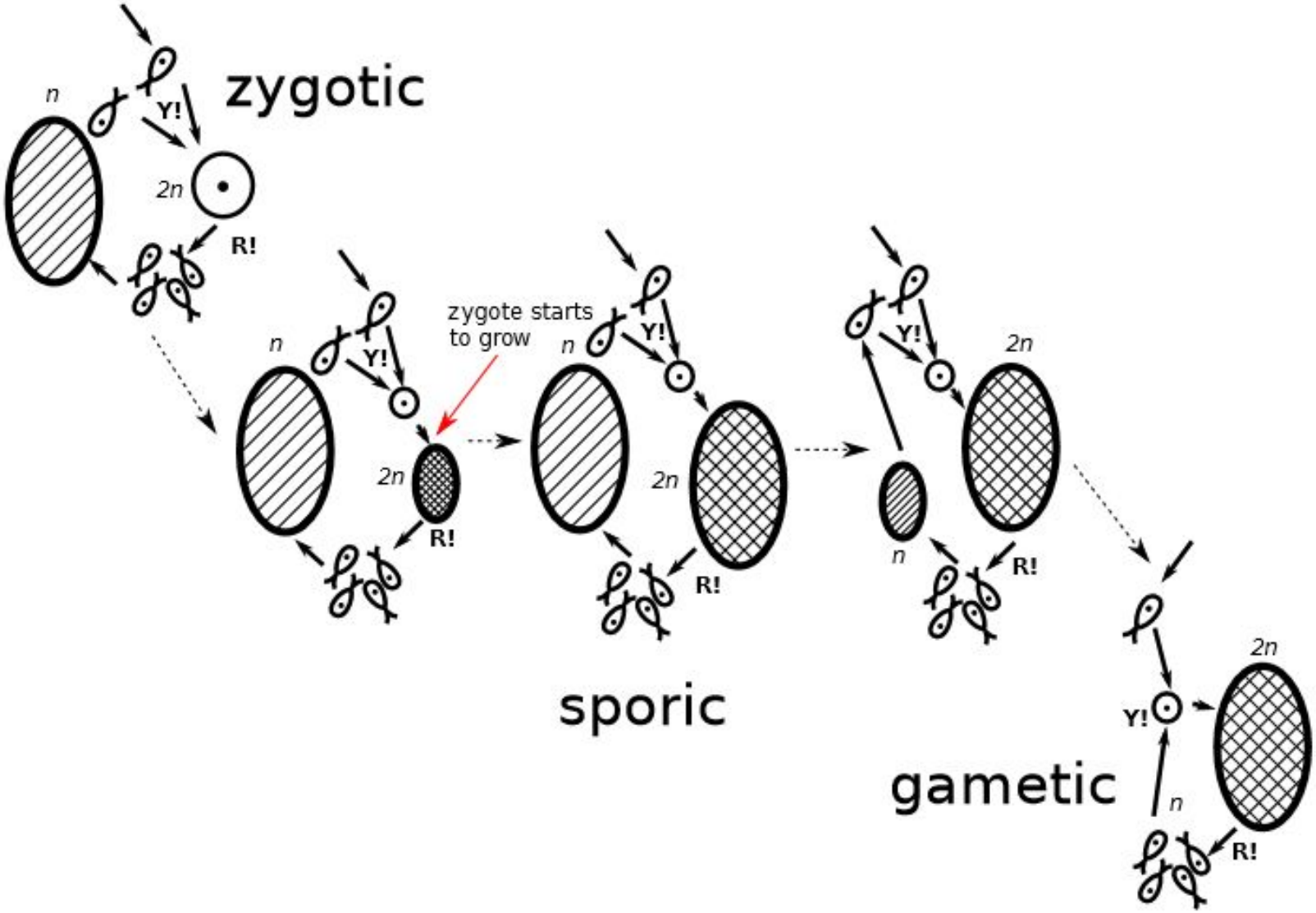
Names of taxa higher than species also have nomenclature types, but in these cases they are other names, not specimens. This example may clarify the use on nomenclature types. Initially, oleaster family (Elaeagnaceae) contained two genera, *Elaeagnus* (oleaster) and *Hippophaë* (sea-buckthorn). The second genus included *Hippophaë rhamnoides* (Siberian sea-buckthorn, **type species**) and *Hippophaë canadensis* (North American plant). Thomas Nuttall decided to split sea-buckthorns in two genera. Since one of them contains *Hippophaë rhamnoides*, the **type species**, it should keep the name *Hippophaë*. The second genus can be named arbitrarily. Nuttall gave it name "*Shepherdia*". As a result, the species which had name *Hippohaë canadensis* L., became *Shepherdia canadensis* (L.) Nutt.

Life circle of living organisms

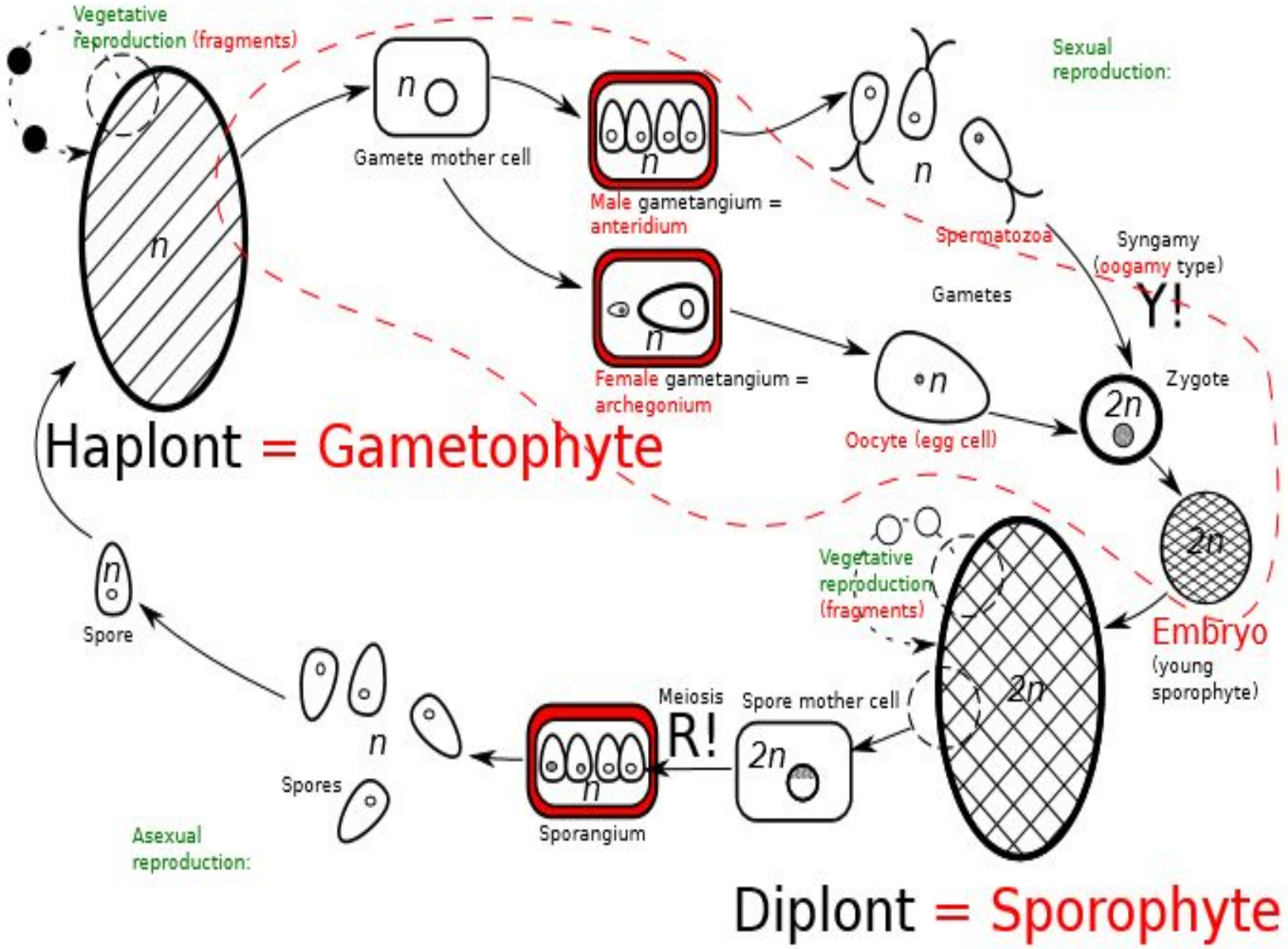




Schematic representation of three types of life cycle. The whole scheme is a sporic cycle; 1 zygotic cycle (Y!→R!); 2 gametic cycle (R!→Y!).



The evolution of life cycles (from left to right, dashed arrows represent four evolutionary transitions) from zygotic to gametic through different variants of sporic cycles.



Life cycle of land plants. Red color is used for innovations, comparing with previous (general) life cycle scheme.

Control questions:

1 Why did appear transport tissues at above ground plants?
2 What are the differences between lower and higher plants?
3 Why higher plants were called vascular plants?
4 Which is leading group of plants present days?
5 Which have theories of evolution of vascular plants origin?
6 What are the differences between spore and seed plants? Between monocots and dicots plants?

Test question:

Kingdom Plantae includes ….. divisions:

A) 2
B) 3
C) 4
D) 5
E) 6
F) 7
G) 8
H) 9

Plants went on soil from water ……years ago:

A) 400 000 000
B) 150 000 000
C) 350 000 000
D) 100 000 000
E) 50 000 000
F) 200 000 000
G) 300 000 000
H) 450 000 000