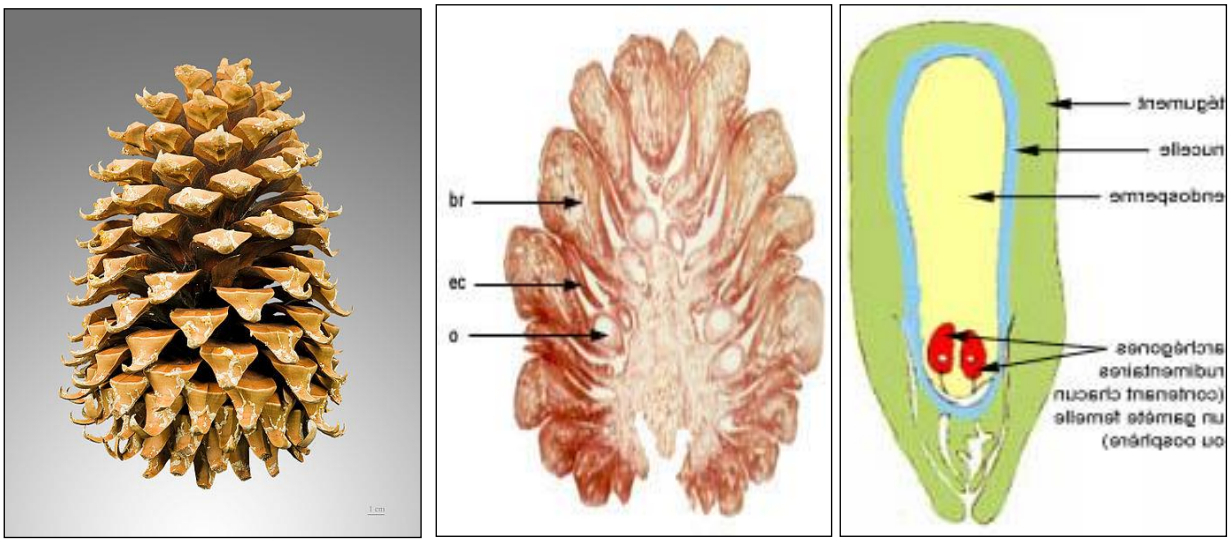
Class Gymnosperms or plants with naked ovules

1-General characteristics :

- Includes 790 species divided into 12 families

- Gymnosperms (from the Greek gumnos=naked and sperma=seed) have naked ovules carried by a flat scale known as the ovuliferous or seminal scale.



a b c

Figure 01: (a) Structure of a cone, (b) Longitudinal section of a cone, (c) Structure of a scale.

- Are all woody, with a development cycle extending over several years. Ex: Long-lived pine= Pinus longeva lives for over 4,000 years.

2. Classification:

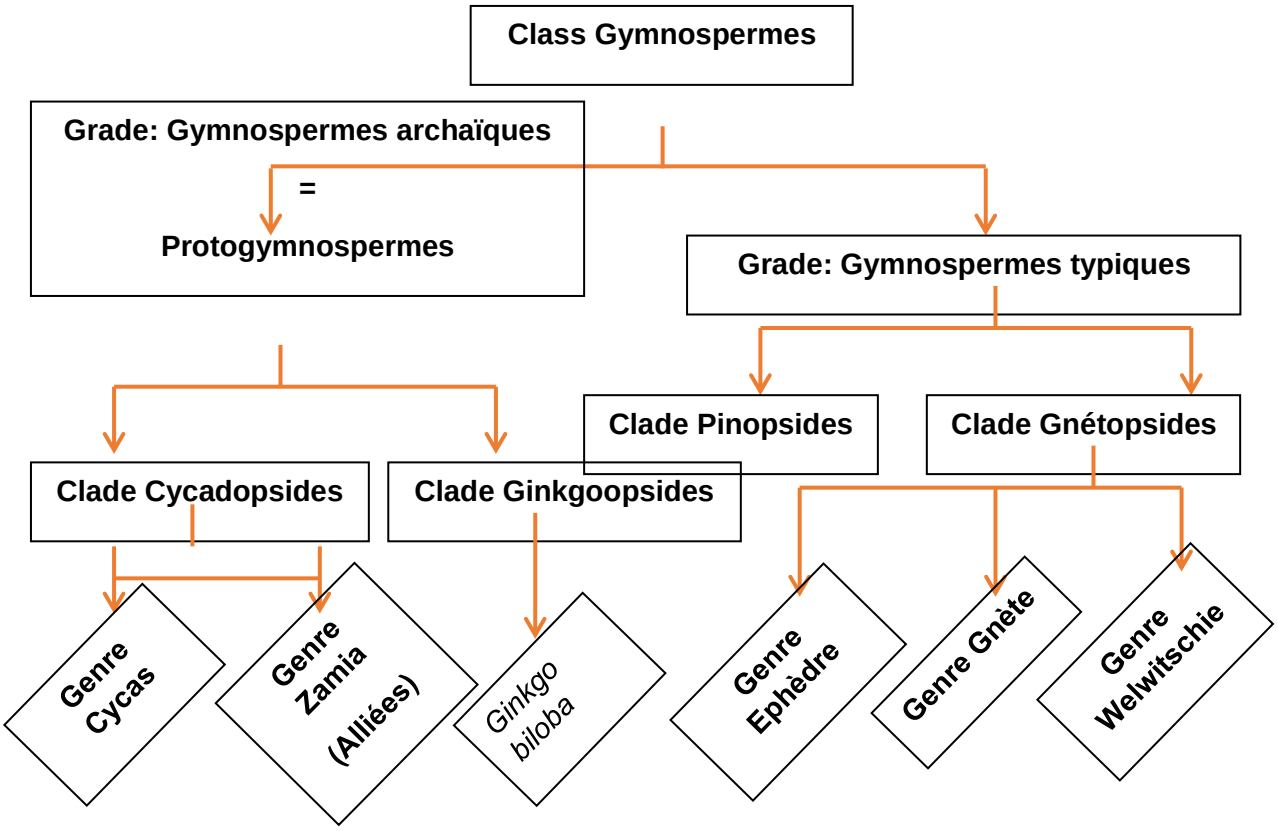


Figure 02: Classification of Gymnosperms

2-1-Grade of Protogymnosperms (archaic Gymnosperms) :

The protogymnosperms or archaic Gymnosperms comprise two basal clades: the Cycadopsids and the Ginkgoopsids, represented in particular by the Cycas and allies and the Ginkgo biloba.

❖ **Ginkgoopsid clade**

1.General:

- Dioecious tree, up to 30 m tall

- Native to China

- The Ginkgoaceae family is the oldest known tree family, having appeared over 270 million years ago. It is represented by a single species, Ginkgo biloba.

2.Vegetative apparatus:

- Branched habit, more or less conical depending on whether the plant is male or female.

- Deciduous fan-shaped leaves with dichotomous venation: formed of 2 lobes, palm-shaped and without a central vein.

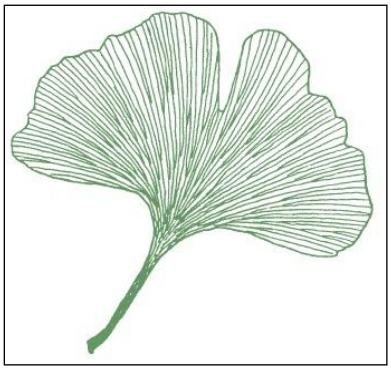


Figure 03: Ginkgo biloba leaf

3.Reproductive system

- Female stem: 2 ovules, 1 of which is aborted

- Male stem: catkins made up of numerous stamens with 2 pollen sacs

Advantages:

- Ornamental

- Resistant to urban pollution and atomic bombs

- Leaves used in China for 5000 years

- Preparation of leaf extracts: antioxidant and brain tonic, improves tissue irrigation and cell metabolism

- Leaves rich in diterpenes (ginkgolides) and biflavonoids

- The 'almond' of the ovule is consumed in China and Japan (the pulp of the envelope is nauseating and very irritating).

2-2- Grade of typical Gymnosperms:

A- Pinopsid clade (Conifers)

1.General:

- 510 species divided into 7 families: Pinaceae (Pine, Fir, Spruce, Larch, Cedar...etc), Cupressaceae (Cypress, Juniper...etc), Taxodiaceae (Sequoias, Bald Cypress...etc), Araucariaceae, Podocarpaceae (Podocarpus...etc), Siadopityaceae.

2.Vegetative system:

- Plants always woody; mainly trees or shrubs;

- Leaves usually in the form of needles (Pines and Firs) or flattened linear leaves (Juniper) or scales (Cypress).

- Evergreen leaves

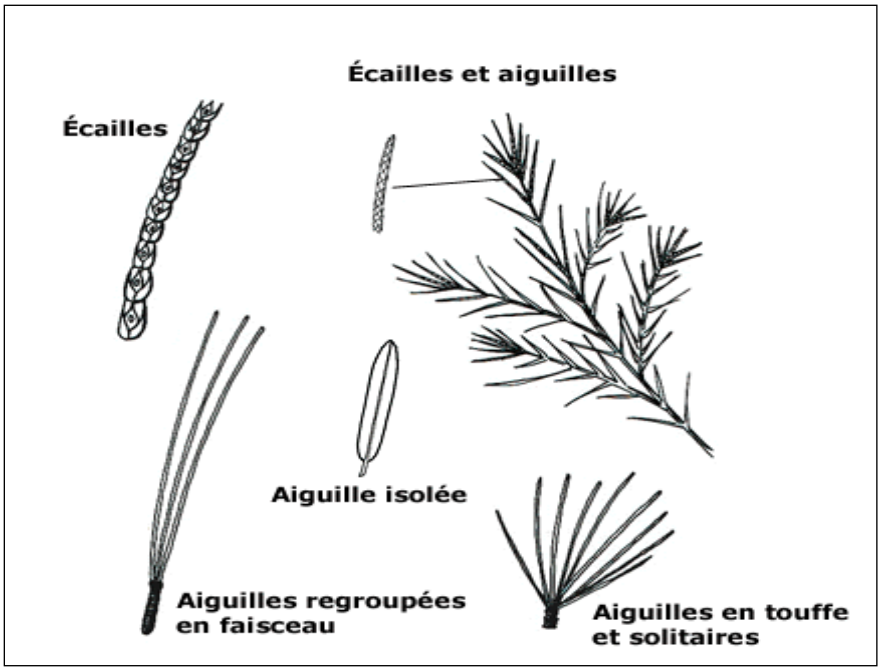


Figure 04: Leaf shapes of conifers

3.Reproductive system:

- Reproductive organs in unisexual cones (or strobiles) (cones are sometimes compared to flowers or inflorescences)

- Monoecious plants rarely separated (dioecious e.g. Yew)

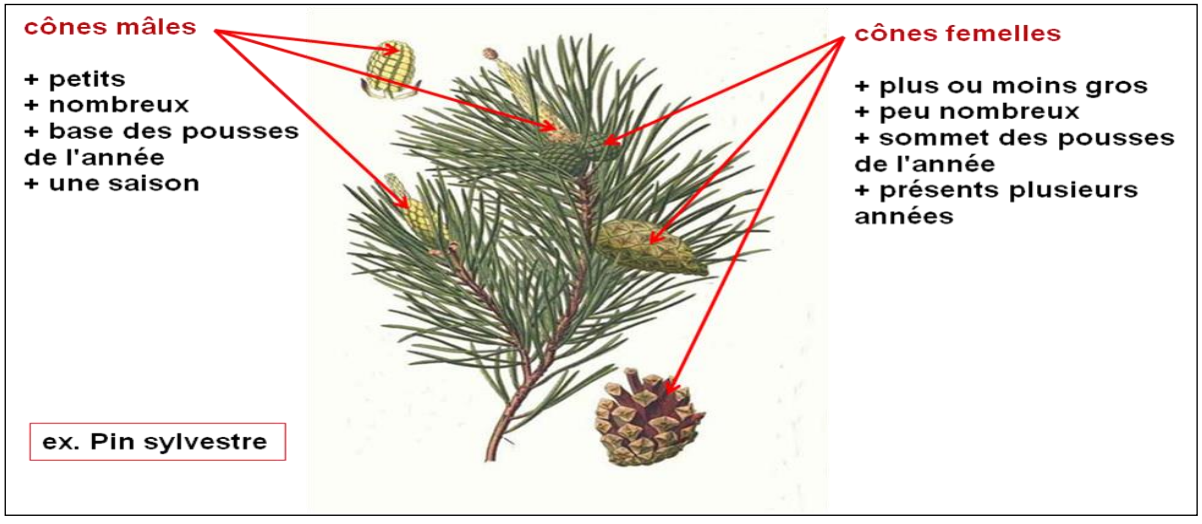


Figure 05: Male and female Scots pine cones

Anatomy

- Homoxylated wood made up of a single type of element: Tracheids with areolate punctations

- Resin-secreting canals (with some exceptions)

Phytochemistry :

- generally rich in terpene compounds (alpha and beta pinene in particular),

- presence of flavonoids, sometimes alkaloids (yew)

- Wood (especially poles, furniture and paper pulp)

- Resin (turpentine)

- Taxol, an active ingredient extracted from Pacific yew (Taxus brevifolia), has anti-cancer properties.

- Cypresses: windbreaks and ornamental trees, their pollen is responsible for respiratory allergies at the end of winter.

Study of some examples of Conifers

❖ **Yew: Taxus baccata**

- shrub or tree (10-15m)

- flattened linear leaves, 2-3cm in 2 rows, dark green, not prickly

- no resin-secreting canals (exception)

- dioecious (rare)

- black seed surrounded by a fleshy aril: "yew berry".

- All parts of the plant (except the aril) are highly toxic: diterpenic taxoids and a mixture of alkaloids or pseudo-alkaloids: taxine

- from the bark of Pacific yew (Taxus brevifolia) : Paclitaxel (Taxol), an anti-cancer diterpene

- from a precursor present in the foliage of the European yew (0.2-1g/kg) hemisynthesis of taxol and analogues including Docetaxel (Taxotere), more active than taxol

Cypress: Cupressus sempervirens

- Small leaves with triangular scales

- Female cones, 8-12 scales, rich in tannins, used, green, against venous insufficiency "cypress galls" or "cypress nuts".

- Highly allergenic pollen (April-May)

Scots pine : Pinus sylvestris

- needle-like leaves, 2-3cm, 2 per leaf

- female cones called "pine cones

- buds rich in EO, used for coughs and mild bronchial problems (antiseptic properties)

Maritime pine: Pinus pinaster

- the distillation of its resin provided Bordeaux turpentine, rich in alpha and beta pinenes (other pine species provide turpentine)

- bark rich in tannins, used to treat venous insufficiency

- needles /2, 10 to 20 cm

- female cones 12 to 18 cm now used mainly to make paper pulp (with turpentine recovered)

Cadier : Juniperus oxycedrus

- Mediterranean region

- its distilled wood provides cade officinale oil or tar, rich in sesquiterpenes, with antiseptic properties (shampoos, skin treatment)

- more or less fleshy red-brown cones, about 15mm in diameter

B- Gnetopsides clade

General

- ovule in unclosed envelope (Saccovulate)

- pseudo-fruit

- unisexual pseudo-flower, stamens with net

- Heteroxylated wood :

  + perfect vessels or tracheae for sap (areolate punctations)

  + woody parenchyma for support

Classification

- group comprising 96 species

- characters of both Conifers and Angiosperms, but molecular analyses show that Gnetophytes are a sister group to Conifers

Family Ephedraceae :

- Genus Ephedra: around 40 species, warm regions, horsetail bushes, found in dry mountain and Mediterranean areas. Certain Himalayan species are used medicinally for their alkaloids (ephedrine and isomers) and ephedrine has now been synthesised.

The branches are spindly and jointed and the leaves are in whorled scales.

Seeds are toxic (ephedrine but low content)

Ex: sea grape, ephedra : Ephedra distachya