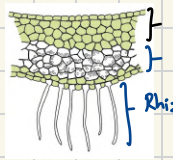
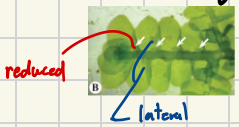
Non - vascular Plants

- Liverworts (P. Hepatophyta)
  - → elaters : ผัก spores ออก
  - → oil bodies
  - Thalloid liverworts
    - → Thallus
    - → gemma cup (Caseckuul)

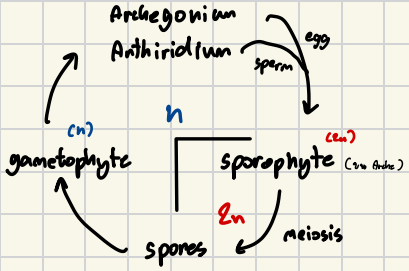


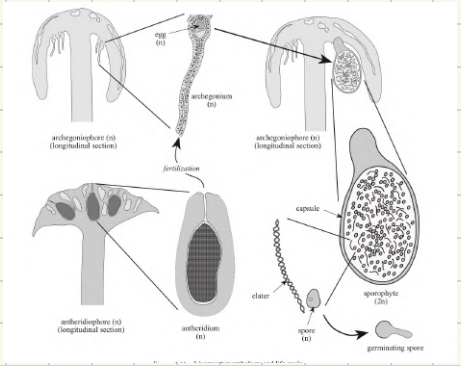
  - Leafy liverworts
    - → Leafy : 3 leaves



↳ 2 lateral leaves
↳ 1 reduced leaves

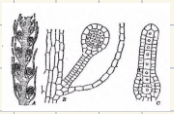
- Liverworts lifecycle



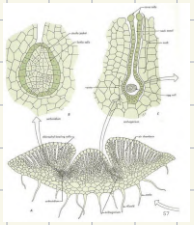


- Liverwort gametophytes
  - → Archegonium (Female gametangium)
    - → ก้าน = Archegoniophore
  - → Anthiridium (Male gametangium)
    - → ก้าน = Anthiridiophore
  - → Gametophyte positions

ลำต้นขนาน
↳ Marchantia
↳ Asterella

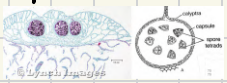


ขึ้นเหนือดิน
↳ Plagiochilla



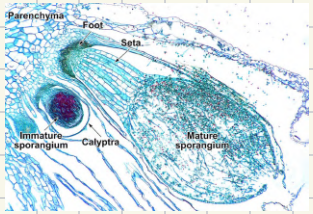
ฝังใน Thallus
↳ Riccia

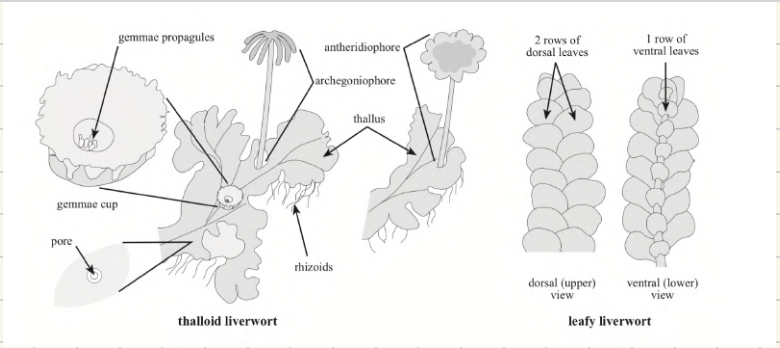
- Liverwort sporophytes
  - → Capsule = Sporangium
  - Capsule diversity
    - → Capsule ใน Thallus:

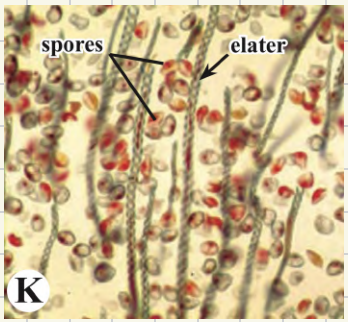


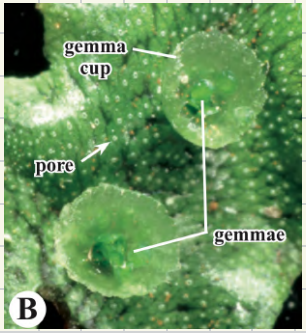
ไม่มี elaters :
if ช่วยกระจาย spores
↳ สร้าง tissue ขึ้นมา

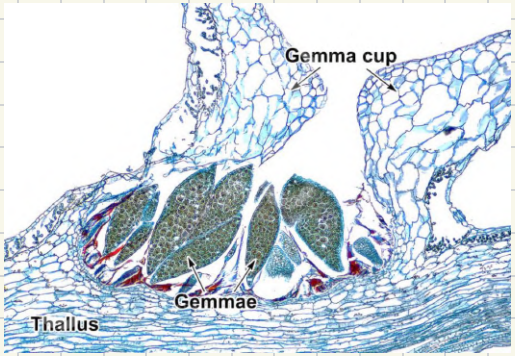
→ Capsule ปกติ
↳ foot, seta มีเหมือน gametophyte
↳ มี Elaters





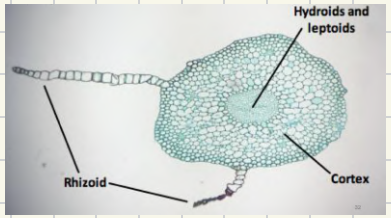




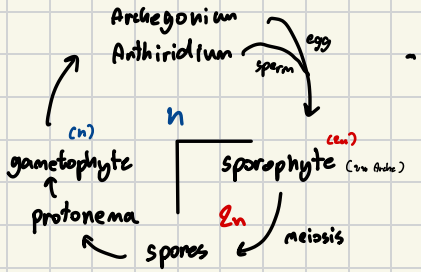


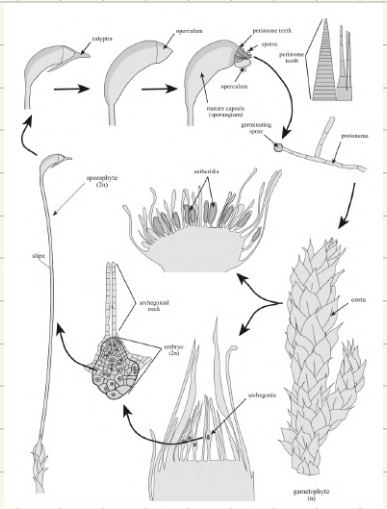
Non-vascular Plants

- Mosses (P. Bryophyta)
  - → มี costa : Resembles leaf viens
  - → Rhizoid : อีกเกาะ
  - → hydroid : xylem-like, dead
  - → leptoid : phloem-like, alive

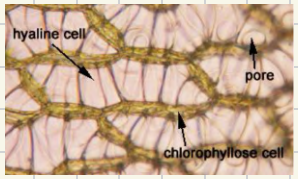


- Moss lifecycle

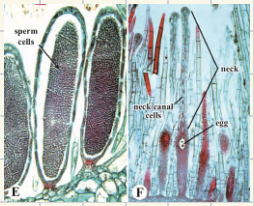




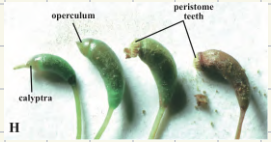
- Moss gametophytes
  - → Sphagnum มีเซลล์ 2 ประเภท
    - ↳ hyaline cells → ดูดน้ำดี
    - ↳ chlorophyllose cells



  - → กลุ่ม Anthiridium = Anthiridial head
  - → กลุ่ม Achegonium = Archegonial head



- Moss sporophyte
  - → มี foot, seta อีกต้น gametophyte
  - → calyptra คลุม immature capsule
  - → operculum คลุม peristome teeth (ที่ดัก spores)
    - ↳ water sensitive

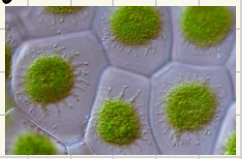


  - → spores ตกลงพื้น → งอกเป็น Protonema
  - → gametophyte อยู่นอก sporophyte
    - ↳ exosporic gametophyte

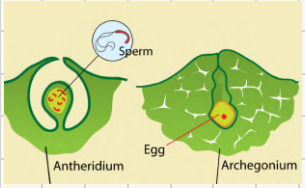
→ Protonema

- Hornworts (P. Anthocerophyta)
  - → "Leaf" = Thallus
  - → unicellular Rhizoid
  - → symbiotic relationship
    - ↳ Cyanobacteria in thallus cavity

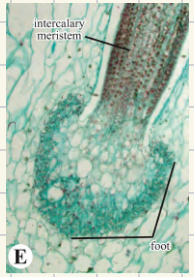
- Hornwort gametophyte
  - → 1 big chloroplast per cell

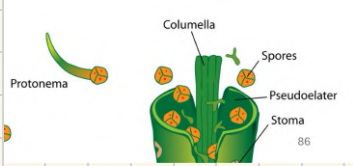


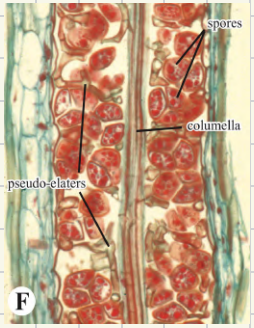
  - → Antheridium : ใน thallus cavity
  - → Archegonium : ขุดขึ้นมาจาก thallus cavity



- Hornwort sporophytes
  - → Photosynthetic + มี stomata
  - → foot มี collar/involucre (ล้อมรอบ gametophyte)
  - → มี intercalary meristem
  - → กลาง seta มี collumella
  - → ยอดสุด=มี sporangium
  - → Pseudoelaters





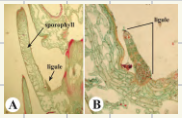


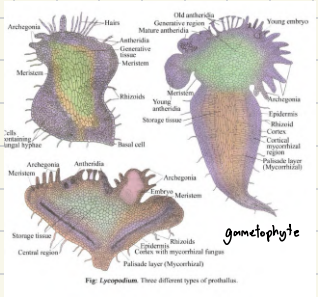
Seedless vascular plants

→ มี Vascular bundle
→ sporophyte เด่น
→ มีการสะสม lignin
→ ใบ
  ↳ Microphyll : มี vein โผล่แยกแขนง
  ↳ Megaphyll : มี vein แตกแขนง
→ spores
  ↳ Homospores : 1 ขนาด gametophyte เพศผู้และ sporangium
  ↳ Heterospores : 2 ขนาด gametophyte เพศผู้ใน sporangium

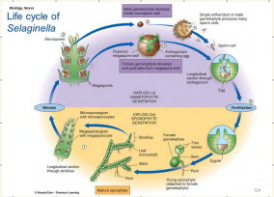
→ sporagium
  ↳ Eusporangium
    ↳ เพศผู้จากหลาย cell
  ↳ Leptosporangium
    ↳ เพศผู้จาก cell เดียว

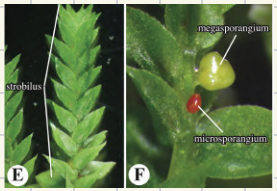
- Phylum Lycophata
  ↳ microphyll leaves
  → Lycopodium sp. (club moss)
    ↳ Homosporous
    ↳ Aerial stem + Rhizhome (ลำต้นใต้ดิน)
    ↳ Rhizoid ราก
    ↳ Sporophyll = Strobilus, eusporangiate



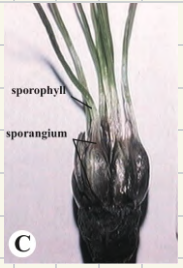


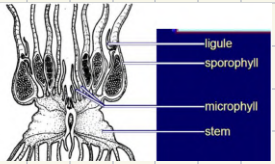
- Phylum Lycophyta
  - Selaginella sp. (spike moss)
    - Microphyll
    - Ligule ที่โคนใบ
    - Aerial stem + Rhizome
    - Root + Rhizophore (เจริญมาจาก aerial stem)
    - Heterospore → endosporic, eusporangiate
      ↳ Megaspore
      ↳ microspore

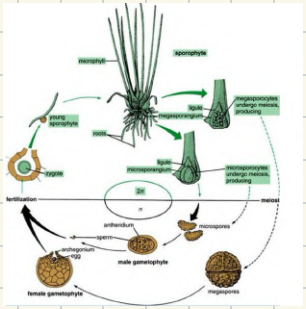


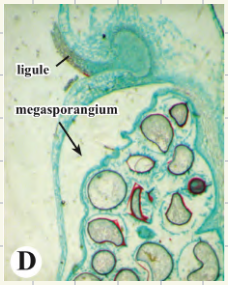


- Isoetes sp. (Quillwort)
  - Ligule, microphyll
  - Heterospore → endospore

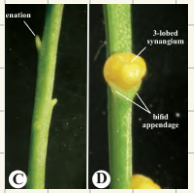


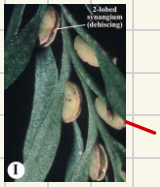


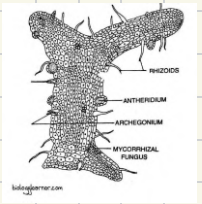




- Phylum Monilophyta
  - Psilotum sp. (whisk fern)
    - Rhizhome + aerial stem (Photosynthetic)
    - Rhizoid
    - Scale ขนาดเล็ก
    - Homosporous → exosporic gametophyte
      ↳ Sporangium = Synangium (2-3 lobe)

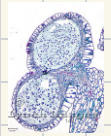




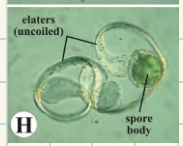


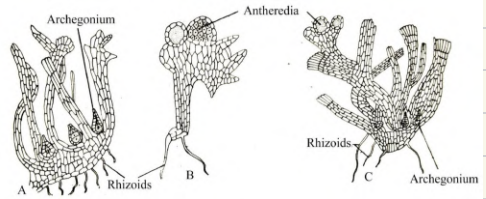
Exosporic gametophyte

- Tmesipteris sp. (folk fern)
  - Homosporous
    ↳ 2 lobed sporangium



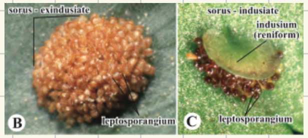
- Equisetum sp.
  - Rhizhome + Aerial stem (whorld branches)
  - มีซิลิกา SiO_2 → แข็ง
  - Microphyll, scaled leaves
  - Homosporous → exosporic gametophyte
    ↳ Strobilus มี sporangiophore ชูขึ้น
      ↳ Stalk + sheild
        ↳ มี sporangium
          ↳ elaters

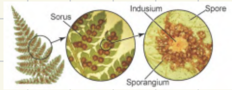


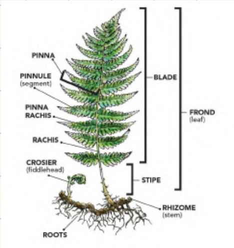


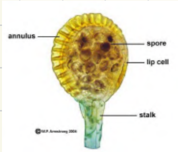
Seedless vascular plants (Phylum Monilophyta)

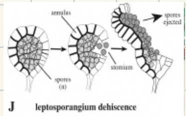
- Ferns
  - ↳ Leptosporangiate ferns (Homosporous) / land ferns
    - ↳ Cereivate vernation ขดใบ
    - ↳ frond : Megaphyll
      - ↳ sterile
      - ↳ fertile
        - ↳ มี sorus (sporangium)
          - ↳ Induciate : มีเยื่อคลุม inducium
          - ↳ Exinduciate : ไม่มี
          - ↳ stalk, annulus, lip cell
            - stalk ↓ ชูขึ้น
            - annulus ↓ ผนัง
            - lip cell ↓ ฉีกออกง่าย เปิดตอนต้องการกระจาย



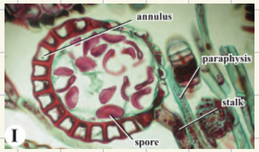




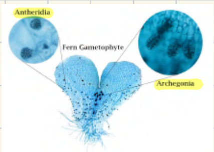




- ↳ gametophytes : exosporic
  - → young gametophytes = prothallus
- ↳ Leptosporangiate fern life cycle



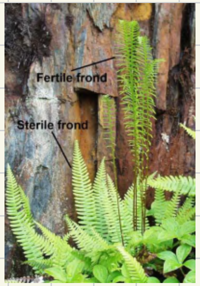
*see กับ gametophyte position . .

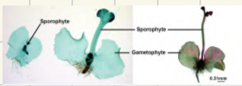


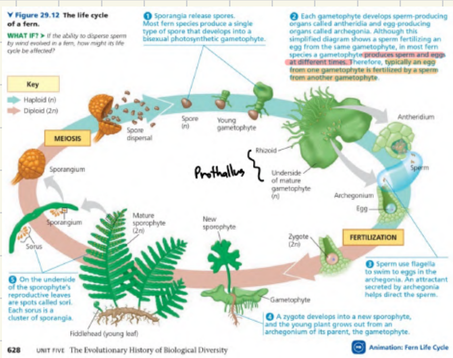
Sporophyte → meiosis → spore → prothallus → Arche / Anthi → zygote → mito → young sporophyte (on gametophyte) → Sporophyte

n

2n



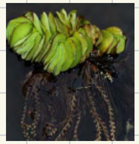




- ↳ Leptosporangiate ferns (Heterosporous) / water ferns
  - ↳ Marsilea sp. (ผักแว่น)
    - ↳ 4 ใบย่อย, Rhizome
    - ↳ Cercinate vernation
    - ↳ ฤดูแล้ง : สร้าง sporocarp → megaspore / microspore
      - ↳ มี inducium
      - sporophore : วงแหวน gelatin

- ↳ Azolla sp. (แหนแดง) → ปุ๋ยพืชสด
  - ↳ symbiosis with Anabena azollae
  - ↳ sporocarp

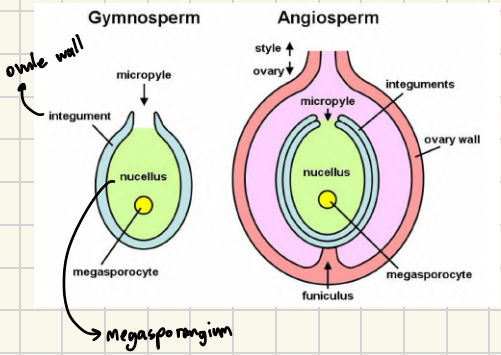
- ↳ Salvinea sp. (water moss / จอกหูหนู)
  - ↳ sporocarp
  - ↳ ใบใต้น้ำ → ราก



- ↳ Eusporogiate ferns
  - ↳ class Marittiopsida (เฟิร์นกีบแรด)
    - ↳ Megaphyll
    - ↳ Homosporous
  - ↳ familly Ophioglossacene (เฟิร์นใบลิ้น / ลิ้นงู)
    - ↳ class เดียวกับ Psilotum sp. (class Psilopsida)
    - ↳ Homosporous
    - ↳ Sporangium เชื่อมกัน
    - ↳ gametophyte เจริญใต้ดิน

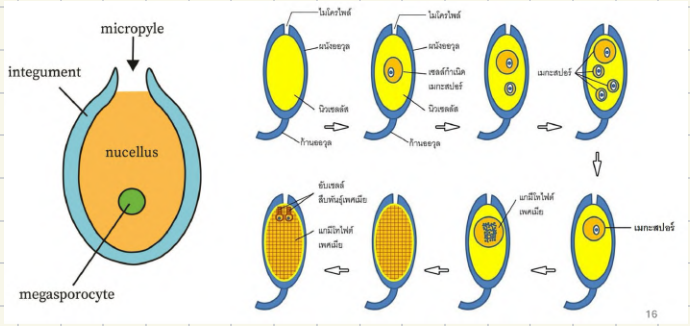
Vascular Seed plants

- Megaphyll, Heterosporous
  - Pollen: Male gametophyte
  - Ovule: Female gametophyte



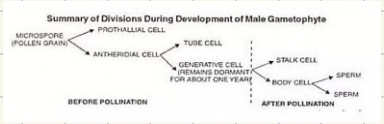
Gymnosperms

- no ovary wall
- ovule develops on
  - megasporophyll (leaves)
  - scales (branches)
- อริ่มพ์ double fertilization สร้างพืชดอก
  1. male gametophyte + female gametophyte → zygote (2n)
  2. male gametophyte + cell in ovule
     - 2n cell (won't develop to endosperm)

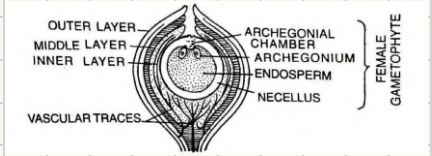


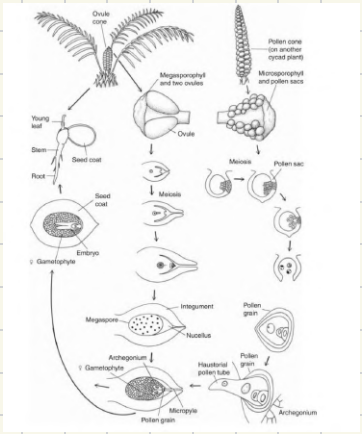
Phylum Cycadophyta

- megaphyll, pinnately compound leaves
- Cerebrate vernation
- Coralloid root: symbiosis w/ cyanobacteria
- Dioecious plant
- Male cone
  - microsporophyll ≈ strobilus



- Female cone
  - 1 megaspore → female gametophyte
  - 1 female gametophyte → 2-6 archegonium (micropyle side)
  - 1 archegonium → 1 egg cell



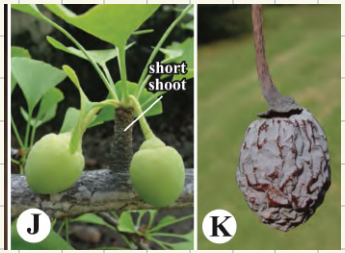


Phylum Ginkophyta

- Living fossil → Ginko biloba
- Single leaf
  - อริ่มจากกิ่งย่อย → spur

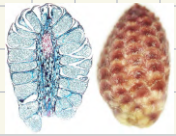
- Dioecious plant
- Male strobilus
  - สร้างช่องอก
  - มี Male sporophyll หลายอัน
    - สร้าง Pollen

- Ovule (Female sporangium)
  - สร้างบนก้านที่ถูกพัฒนาขึ้น
  - ก้านที่มี ovule เจริญอยู่ = pedunculate ovule
    - มักมี 2 อัน
  - 1 female gametophyte = 2 ovule
  - 1 ovule มี 1 egg cell @ micropyle end
  - เนื้อที่กิน = female gametophyte



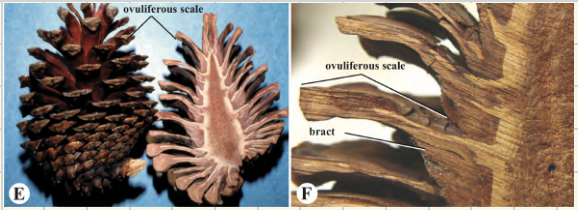
Vascular seed plants

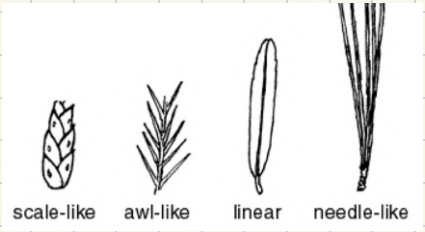
- Phylum Coniferophyta
  - ↳ cone ≈ strobilus
  - ↳ Male cone / pollen cone
    - ↳ มาก microsporophyll
      - ↳ แต่ละอันมี microsporangium 2 อัน
    - ↳ male gametogenesis

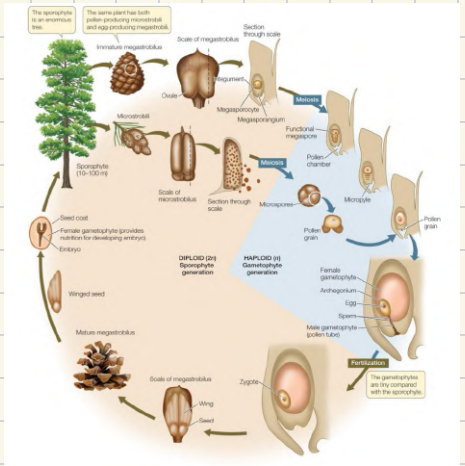


microspore
↙ ↘
1st prothelial initial
↙ ↘
2nd prothelial initial
↙ ↘
body cell generative tube
↑ ↙ ↘
spermatogenous Sterile (stalk cell)
↓
2 male gamete

  - ↳ Female cone / seed cone
    - ↳ ovuliferous scale ≈ megasporophyll
      - ↳ modified branch
    - ↳ ovule อีกชื่อหนึ่ง ovs 2 อัน







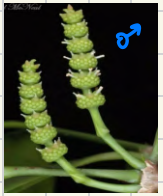
- Phylum Gnetophyta
  - ↳ มี vessel
  - ↳ มี Double fertilization
    - ↳ ไม่เกิดเนื้อเยื่อ endosperms
  - ↳ Ephedra sp.
    - ↳ Jointed pine, Mormon tea

    - ↳ ไม้พุ่ม, dioecious
  - ↳ Welwitschia sp.
    - ↳ พบที่เดียว Welwitschia mirabilis

    - ↳ มี 2 ใบตลอดชีวิต, dioecious
  - ↳ Gnetum sp.
    - ↳ มะเม่าบ้าน หน่าง

    - ↳ เนื้อแข็ง ตรงข้อมองเห็นชัด

    - ↳ dioecious, สร้าง strobilus



Male cone

Female cone

Gnetum seed