

## LAB: Ferns and Conifers

### Lab Atlas Chapters 7 and 8

This Lab is about identifying Key characteristics of each of the groups (ferns and 4 phyla of gymnosperms), Knowing the key stages of their life cycles (ferns and conifers), and identifying the structural and reproductive parts.

#### I. Seedless Vascular plants continued: Phylum **Pterophyta**, the ferns

Ferns are Tracheophytes with large well-developed vascularized leaves called megaphylls and a life cycle which includes homospority (in most but not all) and minute, independent gametophytes.

Below is a guide to 'parts', terms and processes to know and characterize

#### Sporophyte:

- Rhizome
- Megaphyll/Sporophyll
- Vascular tissue
- Sporangia
- Sori
- indusium

#### Gametophyte

- prothallus
- rhizoids
- antheridia
- archegonia

–Identify the structural parts of a fern sporophyte.

–Recognize and name the fern gametophyte and its reproductive organs.

–Outline the life history of a fern.

#### A. Observations of the fern sporophyte

1. Examine a living fern and note the underground stem or **rhizome** bearing roots (local fern stems are usually entirely underground or horizontal along the surface of the ground). Growing upward from the rhizome are the **megaphylls** (called **sporophylls** if there are **sori** on them), leaves or fronds. Each megaphyll is on a petiole. Note the veins of vascular tissue running through the leaflets. On the undersides of some of the megaphyll leaves are **sporangia**, which are in clusters called **sori** (sorus singular). In some ferns, the sori are protected by an **indusium** (an umbrella-like outgrowth). Locate all of these structures, *draw them!* Note too the fiddle-necks, new leaves coming out of the ground in their characteristic shape.

2. Study the slide of the cross section through the fern leaf sorus to show the sporangia containing spores attached by stalks to an outgrowth from the ventral surface of the leaf which also bears the umbrella-like indusium. Note that most ferns are homosporous (though you will

not make a friend of Michelle Smith unless you acknowledge that some are heterosporous). Draw these structures and be able to identify them.

## B. Observations of the fern gametophyte

1. Study a slide bearing a whole mount of a fern gametophyte which is a tiny, flat, heart-shaped structure often called a **prothallus**. Note the many **rhizoids** from the lower surface. Scattered among the rhizoids note the globose **antheridia**, some of which contain sperm. Near the notch of the "heart" find the **archegonia**. Each is a small vase-shaped structure with an egg in the bottom. *Draw, label.*

2. Examine the living fern gametophytes. Note the variation in shape from the 'perfect heart' shape. Try and locate the **antheridia** (usually near the tail end) and the **archegonia** (usually in the notch of the heart near the 'top').

3. Review the **life cycle** of the fern, be able to draw and label it.

## II. The 'naked seeds': Gymnosperms and especially **Conifers (Coniferophyta)**

The Gymnosperms "Vascular Plants with Seeds" are plants with large, well developed leaves that are **heterosporous** and produce seeds borne in **cones**, not in fleshy fruits.

Phylum **Coniferophyta**; "The Conifers" are gymnosperms with heavy woody stems in which the seed lies openly on the **megasporophyll** in a cone (naked seed), the sperm are nonflagellated, borne in pollen grains on **microsporophylls**, and the leaves are needle-like or scale-like.

Below is a guide to 'parts', terms and processes to know and characterize

- Stem
- Leaves (needles)
- Staminate cones – microstrobili (male)
  - Microsporophylls (scales)
  - Microsporangia (pollen sacs)
  - Microspores (pollen)
  - Male gametophyte
- Ovulate cones – megastrobili (female)
  - Megasporophylls (ovuliferous scales)'
  - Ovule
  - Micropyle
  - Megaspore mother cell
  - Integuments
  - Archegonia
  - Egg
  - Pollen tube?
  - Female gametophyte
- Seed
  - Seed coat
  - Young sporophyte
  - Cotyledons (seed leaves)

- Life cycle!

**A. Males first in this case: Observations of Microstrobili or staminate cones**

1. Obtain a Pine branch and note the woody stem covered by a thin layer of bark. Note the long thin leaves or needles which are attached to the stem in bundles of 1,2,3,4,5 or more depending on the species. Not all conifers have these bundles of fascicles, they are characteristic of the genus *Pinus* (look at some of the others).
2. Examine a cluster of **microstrobili** or "Staminate cones" or "male cones" on branch (best collected in the spring) under the *dissecting* microscope. Note the small brownish **microsporophylls** or scales. Remove one and note that each microsporophyll bears two sac-like microsporangia or pollen sacs on the underside. Each microsporangium contains many tiny yellow microspores or **pollen grains**.
3. Study a slide of a longitudinal section through a microstrobilus and note the **microsporophylls**, the **microsporangia** and the **microspores** or pollen grains.
4. Make your own slide of pollen! Get a prepared slide of pollen too to compare. Look at the pollen grains and note their characteristic shape (Mickey mouse?). Note the structure of a single mature microspore and the cells of the male gametophyte within. The microspore and the male gametophyte make up a **pollen grain**. There are balloon-like "wings" on either side of the central region. The central part contains the male gametophyte composed of a large **tube cell** with a nucleus, a smaller **generative cell** with a large nucleus and two tiny prothallial cells which may not be apparent.

**B. Now the female: Observations of the megastrobili or ovulate cones**

1. Examine branches showing the **megastrobili** or **ovulate** cones or **female cones** in various stages of development. They take many years to mature, so the smaller they are the younger. Note the **megasporophylls** or **ovuliferous** scales. In older cones these grow a great deal after pollination occurs and later become woody and eventually may open and drop the contained **seeds** (some need environmental cues, even fire, to achieve this). Look into an open mature cone in which two winged seeds or at least their scars are visible at the base of each woody scale.
2. Study a slide of a longitudinal section through a young **ovulate** cone (megastrobilus) and note the **ovuliferous scales** (megasporophylls) with bracts in section (recall this is a thin section of a cone so there are bits and pieces of scales all around the central axis). Find a cone that shows the scale attached to the central axis and observe an **ovule** developing (an ovule is a megasporangium plus surrounding **integuments**) with an opening facing the stem end called a **micropyle** through which the pollen (male) enters.

In the center of an ovule in a young cone you may see a large cell or **megaspore mother cell** which will undergo meiosis to produce four haploid cells, three of which disappear. The remaining one gives rise to a multicellular female gametophyte (n) containing two archegonia (if pollination occurs).

3. Examine a slide labelled *Pinus* archegonium. This is a section through one entire ovule. Starting on the outside, notice the integuments (2n), which have a pore or **mycophyle** at one end (may not be clear). The integuments merge on the inside with **megasporangial tissue** (2n) (or nucellus). Internal to this (and separate) is the mass of the female gametophyte (n). Each has two **archegonia** (your section may show only one), each of which contains one large **egg** with vacuolated cytoplasm and a nucleus in the micropylar end. You may see signs of a **pollen tube** growing through the mass of megasporangiate tissue at the micropylar end. (This will appear as a break in the tissue). The fertilized egg develops into a young **sporophyte**.

C. Then comes baby: **Observations of the seed.**

1. Study a slide of a *Pinus* ovule containing a young **sporophyte** (2n). This is a section through a **seed**. A complete seed in longitudinal section has the following structures starting from the outside: a **seed coat** which develops from the integuments and is therefore **diploid** and is derived from the original sporophyte (this layer may be missing in your slide); internal to that is **foodstore** which is **female gametophyte tissue** and is therefore **haploid**; the **young sporophyte** which develops from the fertilized egg and is therefore **diploid** lies within the female gametophyte. In the young sporophyte note the developing **stem-root** and seed leaves (**Cotyledons**). (A seed, then, contains parts of three generations.) *Draw these structures and label as to their ploidy.*
2. Obtain a pine "nut" which is, in fact, a **seed** and remove the **seed coat** (2n) exposing the female gametophyte tissue (n). Cut this tissue carefully along its long axis and separate the young embryo (2n) and note the cotyledons and the stem-root.
3. Review the life cycle of a pine. Be sure you know how all the parts you have studied fit in. Realize it takes **years** to complete just the life cycle!

<b>III. Other gymnosperm phyla (3):</b> Know characteristics and how to ID them
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I recommend having out your table of traits and characteristics and drawing some major ones. You'll need to be able to identify these on the exam and place them in the correct phylum, and list some distinguishing characteristics.

- a. Phylum Cycadophyta (cycads)
- b. Phylum Gnetophyta (Gnetales)
  - i. Welwitschia
  - ii. Ephedra
  - iii. Gnetum (we probably won't have this one)
- c. Phylum Ginkophyta (ginkos)

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