

OVERVIEW: Chapter 22 introduces the *seed plants* with four phyla known generally as gymnosperms, the “naked seeded plants. Gymnosperm phyla represent four of the final five phyla in our survey of the Plant Kingdom. So, take courage and continue what I hope is a faithful effort on your part.

READING: Read Chapter 22, pages 409-427, to note the fascinating array of economic and medical uses of the gymnosperms.

EMPHASIS: As usual, this guide is intended to help you focus on the main emphasis of the chapter. Our major emphasis will be upon the Pinophyta, the conifers, but you should learn to distinguish the following minor phyla of gymnosperms as well:

Cycadophyta – the Cycads

Ginkgophyta – *Ginkgo biloba* is the only species in this phylum!!

Gnetophyta – a group of very bizarre-looking plants, including *Ephedra* (source of the drug, ephedrine) and *Welwitschia*

STUDY

QUESTIONS:

Answer these after your reading, and after studying through the STUDY OUTLINE.

1. What morphological features distinguish gymnosperms as a group? Which features are commonly associated with gymnosperms though not universal within this group?
2. Which of the following structures are *not* shared in common between *seedless vascular plants* and gymnosperms: spores, sporangia, strobili, archegonia, ovules?
3. QUIZ QUESTION (See attached page):
 - a. Compare the life cycle of *Pinus* with that of the spike mosses (e.g. *Selaginella*) and explain how the spike moss life cycle would have to be modified to introduce *seeds*.
 - b. What adaptive advantages are afforded to plant species that have seeds as the primary *propagule* (structure designed for propagation) as opposed to spores? What advantages are represented by spores over seeds?

STUDY OUTLINE: GYMNOSPERMS

I. INTRODUCTION -- Identifying "Gymnosperms"

A. We associate NEEDLES, EVERGREENness, and CONES with "Gymnosperms" but there are exceptions. Complete the following:

Feature: Taxon →	<i>Pinus, Picea, etc.</i>	<i>Juniperus</i>	<i>Taxus</i>	<i>Ginkgo biloba</i>
Needles, Scales, or Broadleaf?				
Evergreen or Deciduous?				
Cones or Fleshy Integument?				

B. What characteristics do distinguish gymnosperms?

1. Absence of a covering or _____ around seeds [*GYMNO* = naked (seeds)]
2. A characteristic **O** _____, which consists of *nucellus* (megasporangium surrounding female gametophyte) and *integument*; matures to become a *seed*
3. GAMETOPHYTE STRUCTURE -- two or more *archegonia*, each bearing an egg, surrounded by haploid tissue
4. MALE GAMETES transferred by air within _____ grains to *pollen chamber* of ovule

II. TAXONOMIC CLASSIFICATION OF "GYMNOSPERMS":

A. PHYLA – PINOPHYTA, GINKGOPHYTA, CYCADOPHYTA, and GNETOPHYTA

B. PINOPHYTA -- Major emphasis for our study:

> List other species besides pines in the PINOPHYTA: _____

III. PINE LIFE CYCLE -- Figure 22.8

A. FOCUS OF ACTIVITY --> CONES (*strobili*) <heterosporous>

B. MICROSPORANGIUM (in microstrobilus)

> Microsporocyte → MEIOSIS --> 4 _____ --> 4 pollen grains (*n*)
[or microspore mother cell (*2n*)]

C. MEGASPORANGIUM (in megastrobilus)

> Megasporeocyte → MEIOSIS --> 4 _____ --> 3 degenerate / 1 develop -> ♀ gametophyte
[or megaspore mother cell (*2n*)]

IV. TRANSFER OF MALE GAMETES -- marvelous design in two stages: Pollination and Fertilization:

- A. POLLINATION -- getting pollen from male cone to female cone which has **P** _____ **C** _____
1. Via wind -- pollen grains with "air bladder" wings; cone designed like a "wind turbine"
 2. Pollination drops --exude from micropyle --> evaporation --> draws in pollen
 3. Cone scales close
- B. FERTILIZATION = union of sperm in pollen tube with egg after the pollen tube digests thru NUCELLUS (15 months). Meanwhile, female gametophyte develops from a megaspore.

NOTE: NO flagellated sperm in gymnosperms except in *Ginkgo biloba*

Calender of Events:

1. Pollination in 2007 (red cone)
2. Fertilization in 20__ (green) --- zygote ---> embryo [fill in this calender year]
3. Seeds mature by 20__ (brown cone)
4. INTEGUMENT ---> seed coat

- C. SEED DISPERSAL -- wind, or "fire release" in some *Pinus* species

Discussion Topic for Cooperative Learning Group – Attendance/Participation Question

The following outline should serve as a guide to your individual study and Cooperative Learning Group discussion in preparation for participation in class discussion. You may be asked for **oral** and possibly **written** responses (via the Attendance/Participation Quiz Form provided with this Guide). Use Part V. below to prime your thinking, and then write your individual answers on the attached Quiz Form. You may participate with your Group, but bring your own copy of the completed Form to class. You may leave some space beside each answer for elaboration from class discussion, but be sure to have at least attempted answers to each.

V. GETTING YOUR THINKING STARTED: WHAT MAKES A SEED PLANT ? – Creationist Perspective

- A. Based upon Authority of Scripture: God created seed plants
- > Gen. 1:11 -- "plants bearing seed" – i.e. plants were created with seed in them
- B. OUR PURPOSE
1. Not *phylogeny* but rather, *comparative morphology* and adaptive advantages.
 2. Approach: How was creative blueprint for seedless plants altered to introduce seeds ??
- C. COMPARE SPIKE MOSS (*Selaginella*) TO PINE (A Gymnosperm) [See Lecture Slides, #SA 25.]
1. Are strobili present in both?
 2. ARE BOTH HETEROSPOROUS ? _____ -- spores are present in seed plants
 3. FROM WHERE DO SEEDS ORIGINATE ? ANS: By mitosis/development of _____
 4. HOW DOES DEVELOPMENT PROCEED FROM SPORE TO SEED ?

KEY: Fertilization must occur WITHIN megasporangium (surrounded with $2n$ tissue)

NAME(S): _____

See instructions in Study Outline. Use individual and, if agreed a Group effort, to complete this form.

A. How might the creative blueprint for seedless plants have been altered to introduce seeds ?

State three "design changes" necessary to alter a "spike moss design" to produce a "seed plant design" Use a logical progression.

1.

2.

3.

Additional notes:

B. WHAT ADAPTIVE ADVANTAGE(S) is(are) possible to seed plants based on the above design features, considering the reproductive challenges of many species in Kingdom Plantae?

C. DO ANIMALS HAVE any variation in reproductive mechanisms analogous to these features of seed plants? List and explain: