26.1B: Evolution of Gymnosperms

Seed ferns gave rise to the gymnosperms during the Devonian Period, allowing them to adapt to dry conditions.

Learning Objectives

- Explain how and why gymnosperms became the dominant plant group during the Permian period

Key Points

- Seed ferns were the first seed plants, protecting their reproductive parts in structures called cupules.
- Seed ferns gave rise to the gymnosperms during the Paleozoic Era, about 390 million years ago.
- Gymnosperms include the gingkoes and conifers and inhabit many ecosystems, such as the taiga and the alpine forests, because they are well adapted for cold weather.
- True seed plants became more numerous and diverse during the Carboniferous period around 319 million years ago; an explosion that appears to be due to a whole genome duplication event.

Key Terms

- **cupule**: any small structure shaped like a cup
- **gymnosperm**: any plant, such as a conifer, whose seeds are not enclosed in an ovary
- **mutualism**: any interaction between two species that benefits both
Evolution of Gymnosperms

Figure 1: Seed ferns: This fossilized leaf is from *Glossopteris*, a seed fern that thrived during the Permian age (290–240 million years ago).

The fossil plant *Elkinsia polymorpha*, a "seed fern" from the Devonian period (about 400 million years ago) is considered the earliest seed plant known to date. Seed ferns produced their seeds along their branches without specialized structures. What makes them the first true seed plants is that they developed structures called cupules to enclose and protect the ovule (the female gametophyte and associated tissues) which develops into a seed upon fertilization. Seed plants resembling modern tree ferns became more numerous and diverse in the coal swamps of the Carboniferous period. This appears to have been the result of a whole genome duplication event around 319 million years ago.

Figure 1: Gymnosperms of the taiga: This boreal forest (taiga) has low-lying plants and conifer trees, as these plants are better suited to the colder, dryer conditions.

Fossil records indicate the first gymnosperms (progymnosperms) most likely originated in the Paleozoic era, during the middle Devonian period about 390 million years ago. Following the wet Mississippian and Pennsylvanian periods, which were dominated by giant fern trees, the Permian period was dry. This gave a reproductive edge to seed plants, which are better adapted to survive dry spells. The Ginkgoales, a group of gymnosperms with only one surviving species, the *Gingko biloba*, were the first gymnosperms to appear during the lower Jurassic. Gymnosperms expanded in the Mesozoic era (about 240 million years ago), supplanting ferns in the landscape, and reaching their greatest diversity during this time. It has been suggested that during the mid-Mesozoic era, pollination of some extinct groups of
gymnosperms was performed by extinct species of scorpionflies that had a specialized proboscis for feeding on pollination drops. The scorpionflies probably engaged in pollination mutualisms with gymnosperms, long before the similar and independent coevolution of nectar-feeding insects on angiosperms.

The Jurassic period was as much the age of the cycads (palm-tree-like gymnosperms) as the age of the dinosaurs. Gingkoales and the more familiar conifers also dotted the landscape. Although angiosperms (flowering plants) are the major form of plant life in most biomes, gymnosperms still dominate some ecosystems, such as the taiga (boreal forests) and the alpine forests at higher mountain elevations because of their adaptation to cold and dry growth conditions.