Chapter 7-6: Life Cycle of a Pine

Among the more adapted and complex members of the kingdom Plantae are the seed-producing vascular plants. These plants have true roots, stems, and leaves, as well as an enclosed embryonic sporophyte known as a seed. Seeds are an advantage in terrestrial environments because they can withstand droughts and very cold temperatures in their dry, inactive state. When favorable conditions prevail, the embryo uses the stored food in the seed and becomes a seedling and eventually an adult.

Plants that produce their seeds on surfaces with no covering are called gymnosperms. These plants have cones rather than flowers; their seeds are not enclosed in fruits as they are in flowering plants. Among the three groups of gymnosperms are the conifers, which include the pines, firs, cedars, spruces, hemlocks, redwoods, and yews. These plants provide the great majority of the lumber used in the United States today.

In this plate we will study the life cycle of a pine as a representative gymnosperm and seed-bearing plant. The plate contains several views of the life cycle, which may be compared to that of the fern and moss in the previous plates. You should notice that the sporophyte generation is more complex than the gametophyte generation.

We begin the life cycle of the pine with a **sporophyte (A)**, which is outlined by a bracket. The sporophyte is the familiar pine tree, it consists of true **roots (B)**, the tree trunk itself which is the **stem (C)**, and a number of needle-shaped **leaves (D)**. These leaves are an adaptation to the harsh, windy environments in which pine trees often live.

Conifer trees such as the pine produce two kinds of cones. The male cone is the smaller **pollen cone (E)**, seen here among a number of leaves (D). Also known as a staminate cone, it is often found dropped around the base of the pine tree and produces pollen grains that develop within a structure called the **sporangium (F)** at the lower surface of the cone scale.

Within the sporangia, a microspore mother cell undergoes meiosis to produce a number of haploid **microspores (G)**, each of which develops into a **pollen grain (H)**, outlined by the bracket. The pollen grain consists of a **male gametophyte (I)** bound by two **air sacs (J)** that add buoyancy when the grain is released into the air. The pollen grain is equivalent to the spore of the sporophyte generation, and is haploid (N). Pollen grains are released by the millions, and may land on female cones.

We have examined the production of male gametophytes in the form of pollen grains, and we will now see how female gametophytes are produced in a second type of cone. Continue your reading below as you color the appropriate structures. For purposes of simplicity, we are omitting some of the details in female gametophyte production.

The second type of cone associated with the pine tree is the **ovulate (seed) cone (K)**; in our drawing, a single cone is shown among a number of pine leaves (D). Three years are required for the cone to reach seed-bearing maturity, and pollination takes place late in the first year of development. The ovulate cone contains an **ovule (L)**, in which nutritive tissues and a spore mother cell are stored. This spore mother cell undergoes meiosis to produce a number of megaspores that each have a single set of chromosomes and are haploid (N). A megaspore develops into the **female gametophyte (M)** shown within the ovule, and after a complex series of transformations, each female gametophyte develops two or more **egg cells (N)**.

Pollination is the process in which the male gametophyte comes in contact with the female structures of the pine tree, but it is not the same as fertilization, which is the joining of a sperm and egg cell. The pollen grain is trapped by the sticky fluid in the ovulate (seed) cone, and a long period of time passes. Pollen grains drawn into the seed cone grow **pollen tubes (O)**. On reaching an egg cell, the pollen tube releases a sperm nucleus, fertilization takes place, and a zygote develops. The zygote has two sets of chromosomes and is diploid (2N).

We have now seen how fertilization occurs, and will begin our study of the sporophyte generation of the pine tree.

After another year or so, the zygote develops into an **embryo (P)**. Embryonic development continues, and a hard **seed (Q)** eventually takes shape. Extending from the end of the seed is a **wing (R)**, which aids in dispersal of the seed. When the seed falls onto a suitable site and germinates, it gives rise to a new sporophyte. This small seedling eventually becomes the pine tree, which is the mature sporophyte.

Life Cycle of a Pine

- ○ Sporophyte .....A
- ○ Roots.....B
- ○ Stem C
- ○ Leaves .....D
- ○ Pollen Cones .....E

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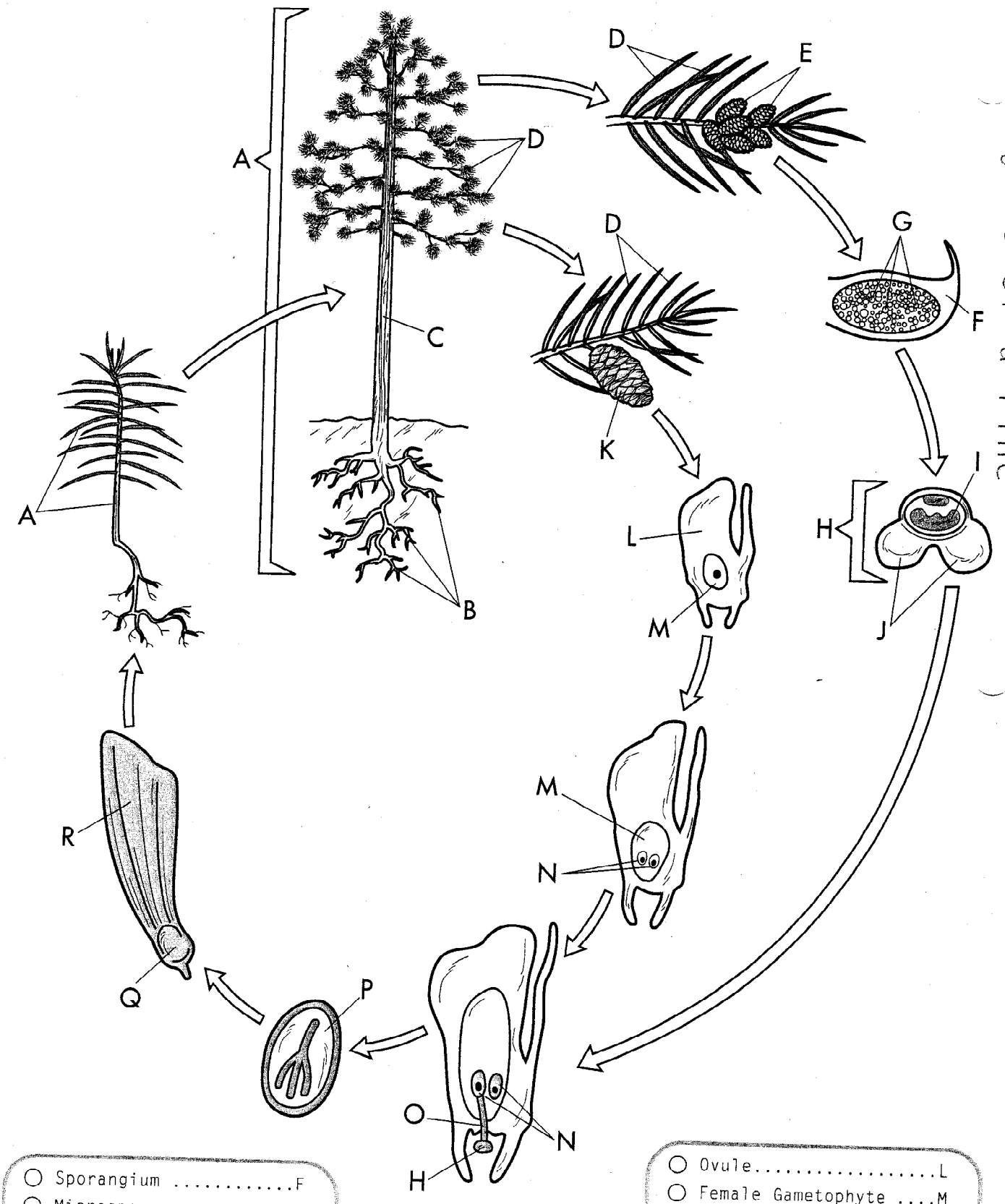

- ○ Sporangium .....F
- ○ Microspores.....G
- ○ Pollen Grain .....H
- ○ Male Gametophyte I
- ○ Air Sacs .....J
- ○ Ovulate (Seed) Cone....K

- ○ Ovule.....L
- ○ Female Gametophyte ....M
- ○ Egg Cell .....N
- ○ Pollen Tube.....O
- ○ Embryo .....P
- ○ Seed .....Q
- ○ Wing .....R