

THE CONIFER LIFE CYCLE

AN EXAMPLE OF SEED PLANT
REPRODUCTION

As with ferns, the dominant plant is the sporophyte, which in this case, is the conifer tree.

- Since all these trees ultimately produce seeds, it may seem contradictory that they represent the spore-bearing generation or sporophyte
- Actually, conifers produce two kinds of spores, tiny ones inside pollen cones, and large ones inside ovules or future seeds
- The haploid or sexual generation is not obvious because it is so reduced in size

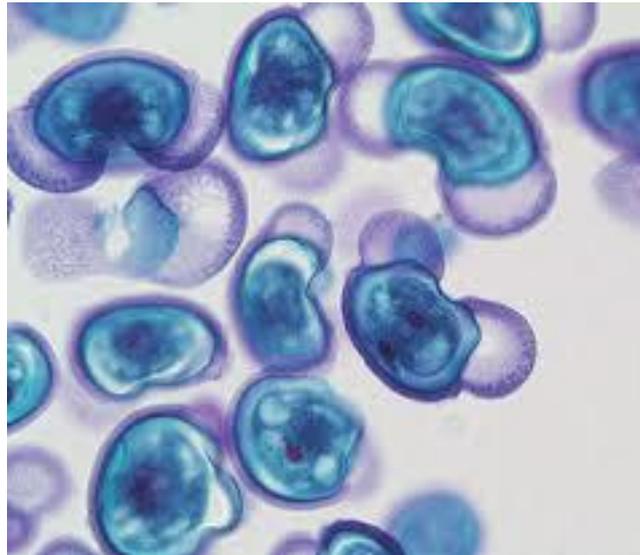
Here are the pollen cones of a pine, produced in dense clusters in early spring



Inside each small pollen sac are cells that develop into haploid *microspores*

- Before the pollen cones open, the microspores have divided to form tiny pollen grains with wings for wind dispersal
- Each pollen grain represents the entire tiny, usually microscopic male *gametophyte*
- On a windy day, the pollen cones open to release thousands of pollen grains to the wind, so many that you can see a cloud of yellow

Here under magnification are the two-winged pollen grains



Meanwhile, the young female seed cones are developing and getting ready to receive pollen. These cones are tiny at this stage.



Although the seed cones are small, they still have the number of scales of the mature cone

- Inside the cone each scale bears a pair of tiny, egg-shaped *ovules*, which after fertilization develop into seeds
- Initially the scales are tightly closed but at just the right time, they open to allow wind-borne pollen grains in

When the pollen enters the seed cone and lands on an ovule, it grows a *pollen tube* as seen here, which delivers the sperms to the archegonia at the top of the female gametophyte



Note that the sperm no longer have to swim through water as they do with ferns, thanks to the pollen tube

- You may also recall that the female gametophyte inside the ovule has more than one archegonium and thus, more than one egg
- This means that more than one egg can be fertilized if more than one pollen grains grows a tube
- Despite this and in most cases, the egg that is strongest develops an embryo that outgrows the others

Once fertilized, the egg develops into a tiny embryo pine tree embedded inside the original female gametophyte, which itself is contained inside the ovule for protection. This constitutes the developing seed.



In pines, it takes two years for the seeds inside the cone to mature and be ready to leave the cone. Here you see at the top whole pine seeds with the seed coat intact, and below with the seed coat removed. This inner part is the so-called pine nut, which contains the embryo



Most pine seeds are small and have wings, and so are carried away on the wind when the cones open

- Only the large seeded species as seen in the previous slide lack wings because they're too heavy to travel by wind
- Instead these seeds are gathered and buried for later use by jays and squirrels
- In California, the gray pine (*Pinus sabiniana*), Coulter pine (*P. coulteri*), Torrey pine (*P. torreyana*), and the pinyon pine (*P. monophylla*) have such large seeds and serve as excellent food for humans

Here is a baby pine seedling just germinating. Notice that pines are *polycots*, that is they have several cotyledons. At the top the seed coat is still being pushed off.



Once the seedling has germinated it may or may not grow fast enough to avoid predation or establish effective roots so there's a high mortality. Here is a robust seedling of the Coulter pine



From this seedling stage, it will take a couple of decades at least before the tree produces both pollen and seed cones. The seedlings here are the result of fire and represent the fire-adapted knobcone pine.

