

ANSWERS

Nonvascular Plants: Alternation of Generations

Crash Course Biology #36

1. The first plants to evolve were nonvascular plants, which include the **liverworts**, the **hornworts**, and the **mosses**.
2. Key traits of nonvascular plants:
 - Don't have specialized **conductive** tissues such as roots and stems
 - Take moisture in directly through their **cell walls** and move it through osmosis
 - Rely on **diffusion** to transport minerals
 - Limited **growth** potential
 - Need water for **reproduction**
 - True plants – multicellular; cell walls made of **cellulose**; do photosynthesis
3. All the non-vascular plants are collectively referred to as **bryophytes**. There are three phyla of bryophytes. It is not understood which phylum evolved first.
 - Phylum Bryophyta – the **mosses**; about 15,000 species
 - Phylum Hepatophyta – the **liverworts**, about 9,000 species
 - Phylum Anthoceroophyta – the **hornworts**, about 100 species
4. In animal reproduction, two haploid gametes (one from the mom and one from the dad) fuse to make a **diploid** cell that combines the genetic material from both parents. That diploid cell divides and divides and divides and divides until a new organism results.
5. Plants, along with algae and a handful of invertebrate animal species, have evolved a cycle in which they take on two different forms over the course of their lives. This type of reproductive cycle is called **alternation of generations**.
6. In all **land** plants, the alternating generations fundamentally differ from each other.
7. One generation, called the **gametophyte**, reproduces sexually by producing gametes, eggs and sperm (haploid cells that only carry one set of chromosomes).
8. When the sperm and egg fuse, they give rise to the second generation, called the **sporophyte** generation, which is asexual.
9. The sporophyte itself is diploid (has two sets of chromosomes in each cell). It has a little capsule called a **sporangium**, which produces haploid reproductive cells called **spores**.
10. During its life, the sporophyte remains attached to its parent gametophyte, which it relies on for water and **nutrients**.

11. This means that the green, leafy parts of non-vascular plants that we all recognize are actually **gametophytes**. Sporophytes are only found tucked inside the **females**, and they're super small and hard to see.

12. In the gametophyte generation, individuals are always either male or female.

- Males makes sperm in **antheridia**
- Females make eggs in **archegonia**

13. By way of **water**, the sperm finds its way to the female and then into the egg, where the two gametes fuse to create a diploid **zygote**, which divides by mitosis and grows into a sporophyte.

14. The sporophyte grows inside the mother gametophyte, until it cracks open and the sporophyte sends up a long stalk with a little cap on top called the **calyptra**. Under it is a capsule full of thousands of little diploid **spores**.

15. When the capsule is mature, the lid falls off, and the spores are exposed to the air. If **humidity** levels are high enough, the capsule will let the spores go to meet their fate.

16. If a spore lands on moist ground, it germinates, producing a little filament called the **protonema**, that gives rise to the buds.

17. The **buds** eventually grow into a patch of moss, which is a just a colony of haploid gametophytes. That generation will mate, and make sporophytes, and the generations will continue their alternation indefinitely!

18. In contrast, reproduction in vascular plants is complex because they have many kinds of specialized tissue.

- plants that produce unprotected seeds, like conifers or ginkgo trees, are **gymnosperms**
- at this level that we start to see **pollen**
- flowering plants are called **angiosperms** are the most diverse group of land plants

19. Summary: The main difference between the alternation of generations in vascular and non-vascular plants is:

- In bryophytes you recognize the **gametophyte** as the plant part (moss, liverwort, hornwort). The sporophyte is less recognizable and smaller.
- In vascular plants, the **sporophytes** become the dominant phase, more prominent or recognizable. The flower of an angiosperm, for instance, is actually the sporophyte.

