

Gametophyte Morphology Chart

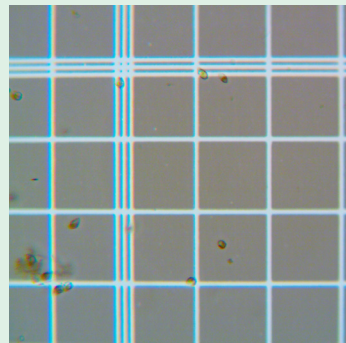
Sex



Female and male gametophytes

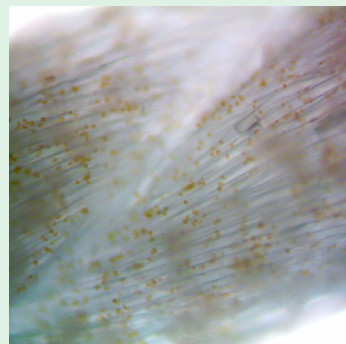
Female gametophytes have a larger cell size than males. When they are next to one another, this size difference is obvious, but when the gametophytes are far apart it is harder to tell. The cell size for females is typically 1.5 to 2 times as big as males. Females also tend to have shorter branches and rounder cells than males. The picture shows an outgrown female gametophyte next to an outgrown male gametophyte.

Spore



Upon release

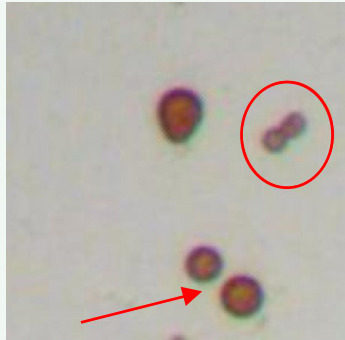
Under the right conditions, the reproductive tissue (sorus) of kelp releases millions of single-cell meiospores. When meiospores are first released they move around using flagella. During this phase, the spore looks like a teardrop shape and the flagella are lateral.



Settle in 1 hour (depending on environmental conditions). This picture is of spores after 4-7 days.

Once the environmental conditions for settlement are met, the flagella are shed from the meiospores and the spores settle on a substrate. At this point the meiospore looks round from above.

Compact



7-10 days

Compact is used to describe the stage of gametophyte growth when the meiospores have developed into gametophytes but they have not started to branch out yet. This picture shows a small cluster of 3 males (circle) and a couple of females (arrow). Females are 1.5 to 2 times larger than males.



10-20 days

The second stage of compact is when the single cells begin to grow out in a direction. The circle shows a second stage compact female gametophyte.



10-20 days

Larger clusters that do not show branching are still considered compact. This image shows a cluster of compact female gametophytes.

Outgrowing



20-30 days

Gametophytes are considered outgrowing when it is branching out with more than two cells. The circled female gametophyte has the initial cell and two more cells branching out off of it.



30-40 days

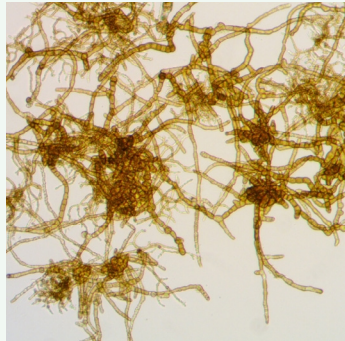
As gametophytes continue to grow outward, they will branch. Gametophytes that are branching once, like a "T" shape, are considered outgrowing.

Outgrown



40-60 days

Maturing gametophytes continue to branch out. Once a gametophyte has multiple branches, it is considered outgrown. The gametophyte in the photo has two branches.



60+ days

Any point beyond the “H” shape is considered outgrown. The gametophytes in the photo are very outgrown.

Antheridium

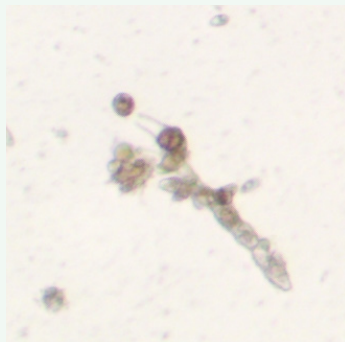
Antheridia are difficult to see with the average microscope. This is a simple drawing of what they look like coming from a male gametophyte cell.



Formation depends on environmental conditions

The reproductive part of male gametophytes are antheridia. When the environmental conditions are right, sperm are released from the antheridium into the water column. These motile sperm find and fertilize female oogonia (eggs) with release of sex attractants between the sex cells.

Oogonium



Formation depends on environmental conditions

The reproductive part of female gametophytes are oogonia (eggs). When the environmental conditions are right, female gametophytes form oogonia that are later fertilized by sperm. Fertilization is dependent upon the phytohormones.

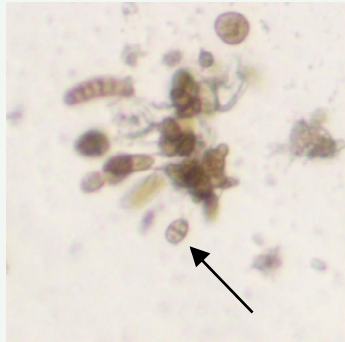
Between Phase



7 days after induction

After the oögonium is fertilized, it begins to elongate. Although, technically the cell is considered a sporophyte once it is fertilized, we consider this elongated cell between phase for simplicity.

Sporophyte



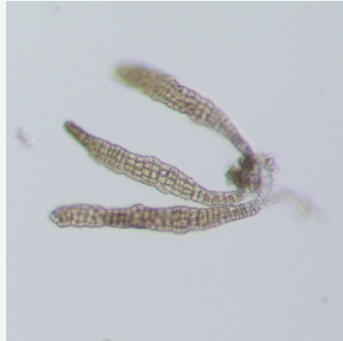
14 days after induction

Once cell division starts to happen, the group of cells is considered a sporophyte. You can see the divisions between cells under the microscope. At this stage, the cell divisions are only happening in one direction.



21 days after induction

Once the sporophyte reaches ~10 cells, cell divisions of a healthy sporophyte begin to happen in two directions.



35 days after induction

As a sporophyte continues to grow, cell divisions are happening more frequently. The sporophytes continue to grow in length more than they do in width. Healthy sporophytes typically have a consistent streamlined shape. The presence of sporophytes that look misshapen may be a result of environmental conditions or mutation.

Kelp Life Cycle

All kelps have a two-part life cycle, called a heteromorphic life cycle, consisting of a large visible stage (called the sporophyte phase), and a microscopic stage (called the gametophyte phase) (Figure 3.4).

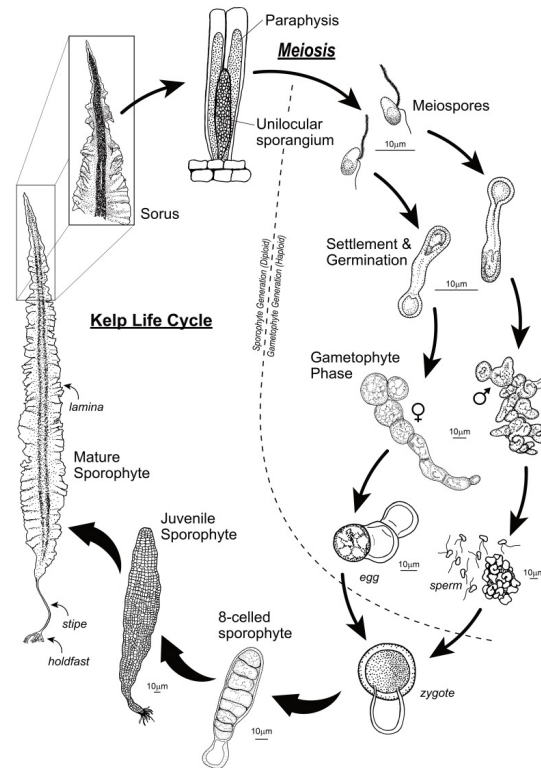


Illustration by Virge Kask, 2012 © Charles Yarish

Figure 3.4. The kelp life cycle

This life cycle illustration, taken from the *New England Seaweed Culture Handbook - Nursery Systems* published in 2014, shows the complete life cycle of sugar kelp.