

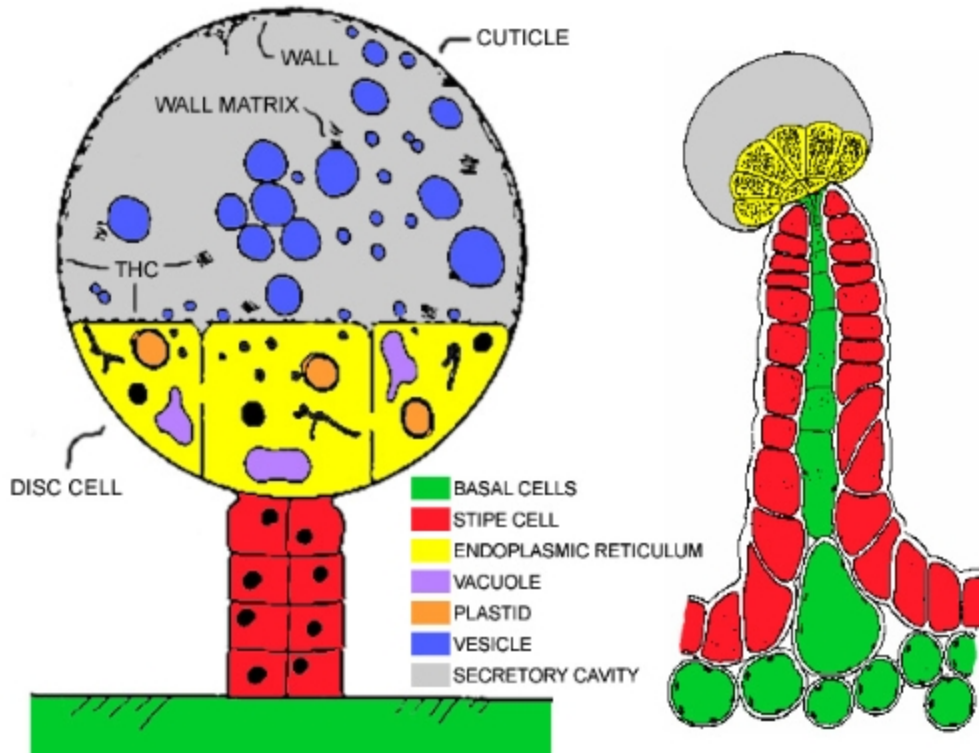
# Trichomes

by Dab Science

## What is a Trichome:

Trichomes are hair like outgrowths found on several plants. In cannabis, there are three glandular forms of trichomes; Bulbous, Capitate-Sessile, and Capitate-Stalked. There is also one non-glandular form of trichome; Cystolithic (Cystolith hairs). In this article we will focus on the glandular form, because cannabinoids and terpenoids are found within those glands.

Glandular trichomes are special in the fact that they have secretory glands, or cells that secrete resin as the cannabis plant matures. Within the swollen glandular head of a mature trichome lies a range of; cannabinoids, terpenes, other essential oils, lipids, and waxes. Trichome heads can swell anywhere from 25-220 microns, although the average is closer to 60-100 microns.



## **Why Does Cannabis Have Trichomes?:**

Trichomes provide a protective barrier in order to prevent invasions by pathogens and herbivores. These hair-like protrusions are the most easily identified, defense-related structures on any trichome bearing plant. Studies indicate that trichome density is both highly adaptive to and functionally important for resistance against herbivory. Within the trichome consists a variety of substances that may produce repellent effects on countless plant eating animals and insects. Some of the major compounds responsible for this trichome-defense are; terpenoids, phenylpropanoids, alkaloids, flavonoids, and defensive proteins. Rupturing the cuticle of a trichome releases the gland contents, which can rapidly oxidize, becoming a sort of sticky trap that can physically catch insects. Cannabinoids may also play a role in this defense mechanism, however it is still widely unknown why they are produced by cannabis.

Trichomes also play a role in the following: *controlling leaf temperature, increasing light reflectance (UV protection), preventing loss of water, reducing leaf abrasion, pollination attraction, and fungal protection.*

## Types of Trichomes in Cannabis:

- Bulbous

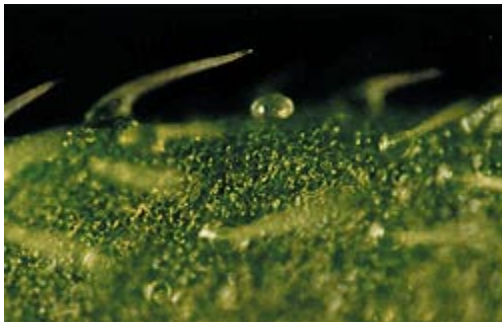
(approximately 15-30 micron)

*Bulbous* glands are found throughout the surfaces of cannabis plant material. The base/stalk is made up of one to four cells, while the head accounts for another one to four cells. The head cells secrete small amounts of cannabinoids and terpenes, which build up between the head cells and cuticle (protective layer around head). Through maturity, more resin is secreted from the head cells causing the gland to swell, resulting in a nipple-like protrusion.

- Capitate-Sessile

(approximately 25-220 micron resin head; one micron tall stalk)

The second type of gland is much larger and much more numerous than the first. These are called *capitate-sessile*. Essentially meaning globular head attached without stalk. These glands actually do have a one cell high stalk, but it is not visible when observed by macro. Instead, the globular head seems to be sitting flush on the plant. The head is usually composed of eight to 16 cells that create a convex rosette formation. These head cells secrete cannabinoids and terpenes between that rosette and cuticle, resulting in a spherical shape.



(a)



(b)

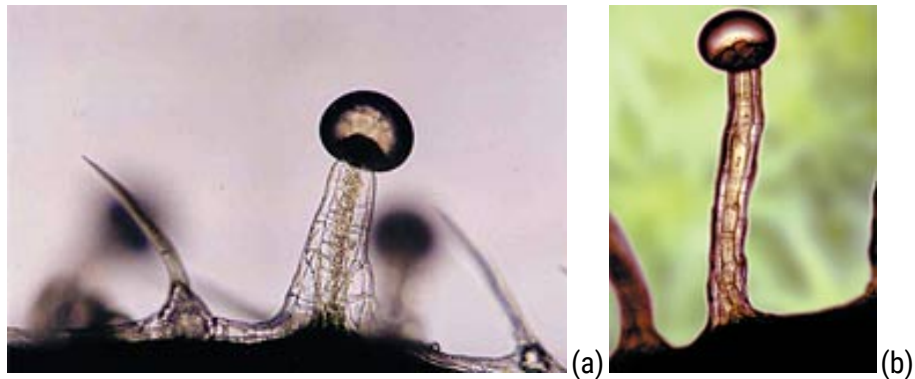
- a. *Capitate-sessile* trichome (center) on cannabis leaf surrounded by non-glandular trichomes or cystolith hairs.
- b. Close-up of same *capitate-sessile* trichome (backlit) showing the secretory cavity (clear top) and secretory/disc cells (darker bottom) within the glandular head.

- Capitate-Stalked

(approximately 25-220 micron head; 150-500 micron stalk height)

During the flowering process, newly formed parts of the plant show a new type of capitate gland known as *capitate-stalked*. Cannabinoids and terpenes are more abundant here than any other gland. A study (Mahlberg and Kim, 2007) showed on average that the THC content was 20 times as concentrated in the *capitate-stalked* vs. *capitate-sessile* gland heads. Cannabinoid content can vary slightly from head to head. The head is raised anywhere from 150-500 microns when their

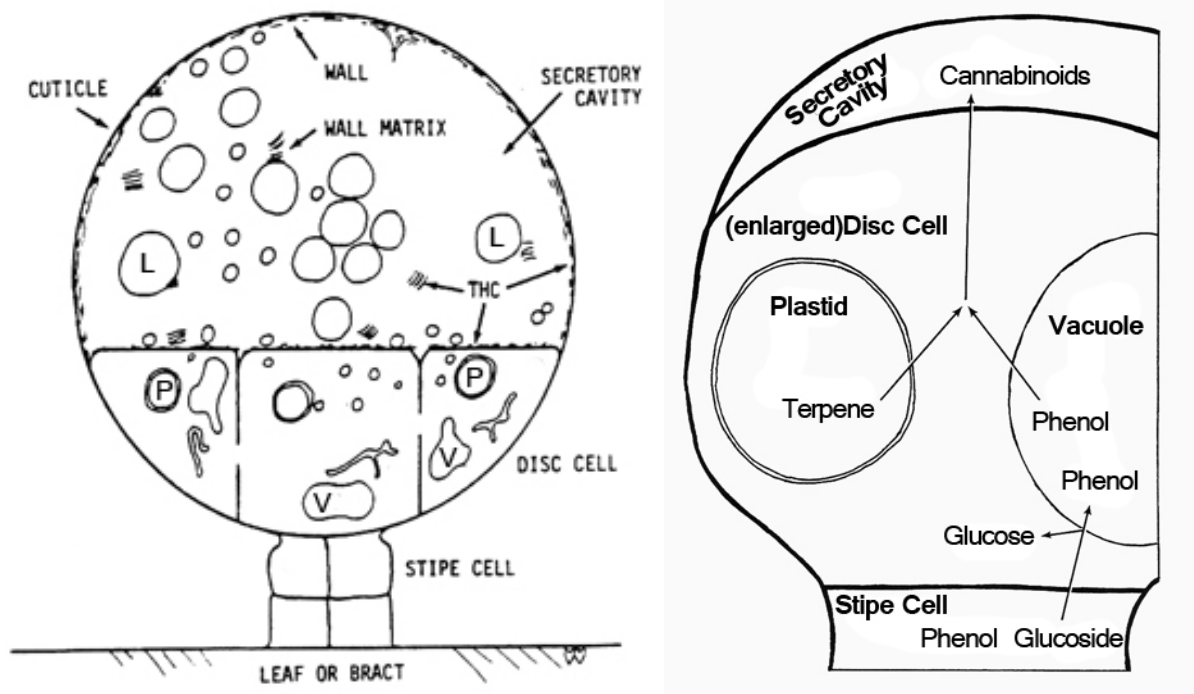
stalks stand straight. Since they appear during flowering, they are most abundant on and around the female flowers(bud), but can also be found in *much* more minute amounts on male flowers.



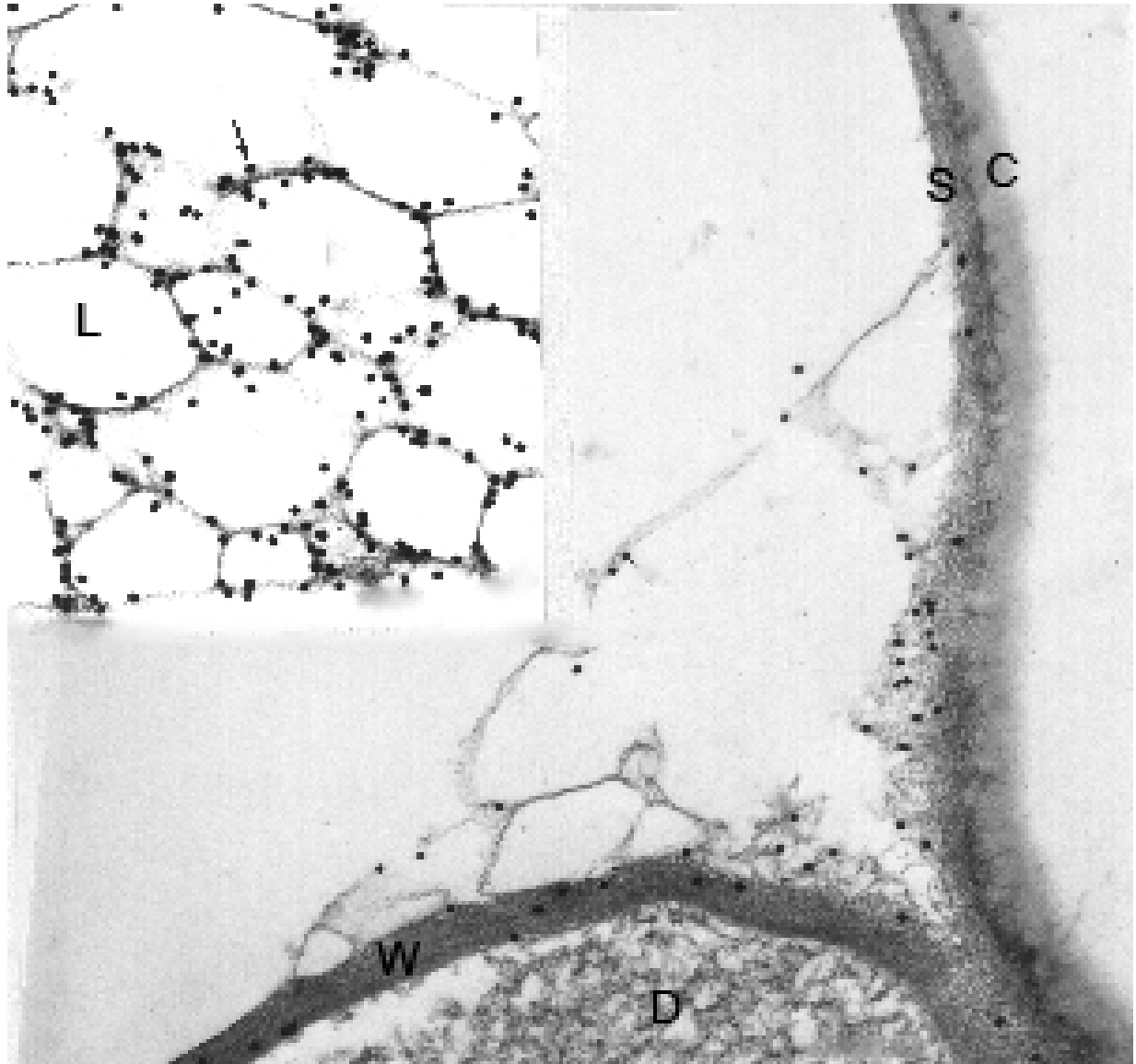
- a. Backlit cystolytic non-glandular trichomes (Left and Right) with *capitate-stalked* glandular trichome (center).
- b. *Capitate-stalked* trichome again showing the secretory cavity (clear top) and secretory/disc cells (dark bottom) within glandular head.

## How Cannabinoids Are Formed in the Trichome:

There are two types of organelles within the disc cells, plastids and vacuoles. The plastids secrete terpenes into the disc cell. They contribute to the odors of the plant and vary from strain to strain. They also play a huge role in the taste of harvested cannabis. Vacuoles are where it starts to get a bit more complicated. It is believed that phenol glucoside (a sugar compound) is transported to the disc cells where the sugar is separated and only phenol is accepted into the vacuole. The vacuole then secretes the phenol into the disc cell. Terpenes and phenols accumulate at the membrane and cell wall between the disc cell and secretory cavity. It is here that unknown enzymes help combine terpenes and phenols into cannabinoids. UV light also plays a role in the formation of the several cannabinoids.



As mentioned above, cannabinoids are contained within the glandular trichome head. More specifically, they are most commonly found within the secretory cavity. Even though secretions from the disc cells are responsible for filling the secretory cavity, the disc cells themselves have been found to have *extremely low* cannabinoid concentrations. The highest concentrations are thought to be on the inner walls of the of the secretory cavity and the outer walls of vesicles. It has been theorized that cannabinoids may somehow be bound to these surfaces, but that is not known for certain.



***\*Black dots represent gold attached to the THC antibody***

<b>+L</b>	<b>W</b>	<b>D</b>	<b>S</b>	<b>C</b>
Vesicle	Disc Cell Wall	Disc Cell	Subcuticle Wall	Cuticle

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