Public Description of ***Physarum polycephalum*** Schwein.

Title: Public Description (Default)
Name: ***Physarum polycephalum*** Schwein.
View: public
Edit: public
Version: 2
Previous Version (/name/show_past_name_description/1634?version=1)

Descriptions: Create (/name/create_name_description/30400)
Public Description (Default) (/name/show_name_description/1634) [Edit (/name/edit_name_description/1634)]

Description status: Unreviewed

Taxonomic Classification:

Kingdom: *Amoebozoa* (http://mushroomobserver.org/observer/lookup_name/Amoebozoa)
Phylum: *Mycetozoa* (http://mushroomobserver.org/observer/lookup_name/Mycetozoa)
Class: *Myxogastria* (http://mushroomobserver.org/observer/lookup_name/Myxogastria)
Order: *Physarida* (http://mushroomobserver.org/observer/lookup_name/Physarida)
Family: *Physaridae* (http://mushroomobserver.org/observer/lookup_name/Physaridae)
Genus: *Physarum* (http://mushroomobserver.org/observer/lookup_name/Physarum)

General Description:

Physarium polycephalum is one of the most widely recognized and cultivated plasmodia. P. polycephalum undergoes distinctive transformations from spore, to amoeboid, to plasmoid and sporangium. To the naked eye, the spores appear as a reddish or purplish brown mass; amoebas and myxoflagellates can only be seen under microscope; the plasmodium will be a bright yellow, highly reticulate network and have a much finer, denser, distinctive “fan” shape in the direction of movement. Sporangia are dark orange to brown and consist of gregarious lobes connected to a shriveled, thin stipe.

Spores are uninucleate, globose, minutely spinose, 8 to 11 microns in diameter, brownish yellow individually, appear reddish to purplish brown in mass, and require 15 to 48 hours for incubation, defined as the time when seeds are sowed to the splitting of the spore walls. Incubation duration is constant whether a spore is fresh or 18 months old. Cultures are readily started on water drops on the surface of slides. Once germination begins, the spore walls split open and the protoplast emerges.

The amoeboid protoplast will divide mitotically one time right before, during, or after it exits the spore case. The resulting hyaline non-flagellate protoplasmic bodies typically become quiescent temporarily once they exit the spore case (Howard 1931). If the amoeboid are grown in liquid media, they will become uniflagellate, occasionally monopolar biflagellate with a very short secondary flagellum, will assume a comma shape, temporarily move about through posterior pseudopodia, and then begin their characteristic rotating motion. The transformation into myxoflagellates (“swarmcells”) is rapid and reversible, does not require gene activation or protein synthesis (Adelman 2003). If subjected to dry conditions, myxoflagellates will form cysts and can be stored in this state for several months. Swarmcell behavior lasts about 24 hours, but gradually disappears from cultures (Howard 1931). During this time stained preparations will show a characteristically beaked nucleus connected by deeply stained threads to the blepharoplast and flagellum (Howard 1931). It is typical for two swarmcells to touch their non-flagellated ends and begin to fuse, acting as isogametes. The resulting zygotes will them merge or grow into the plasmoid phase and retract the flagella (Howard 1931).

The plasmodium tends to be yellow in color, and is in actuality a large syncytium (multinucleate organism with a common cytoplasm) that can spread over many square centimeters, reportedly up to two square feet. During this stage P. polycephalum can move by forming a network of tubes through which it streams its protoplasm and can do so at a rate of up to 3 centimeters per hour (Howard 1931). The reticulate is quite distinctive and assumes a general, broad, fan shape as P. polycephalum searches for food. Once food has been found, the plasmodium will then concentrate around this source and has the ability to recognize the shortest distance between possible nutrient sources.

When P. polycephalum encounters low atmospheric humidity, the plasmodium will begin to desiccate, forming a bright orange or dark brown sclerotium. The sclerotium can be reactivated many months later in suitably aerobic and humid conditions (Howard 1931).
Sporangia are formed at night through a process spanning approximately 12 hours. In anticipation of fruiting, P. polycephalum will assume a very dense, opaque yellow color, will search for a dryer location, and then form a thick, continuous, verrucose layer that will segment within an hour. Over the following hour, the flat segments round up into knobs, which then lengthen out into vertical, finger-like pillars, eventually the stipe and sporangium become distinct although no membrane separates the two (Howard 1931). The protoplasm moves up in apical swelling, and the sporangial head begins a series of dichotomous division into lobes although each lobe remains connected to the center stipe. At this point, one can observe nuclei measuring 3.2 to 4.8 microns in diameter, as well as degenerating, deeply staining nuclei 2.5 to 3.5 microns in diameter. Mitosis then begins from the periphery and advances to the center of the lobe. Cytokinesis and mitosis then occur over the next 30 to 60 minutes, sometimes concurrently (Howard 1931). The segments then differentiate into spores, which exit once the outer sporangium wall ruptures in moist conditions.

Diagnostic Description:

The bright yellow plasmodium and distinctively gregarious sporangia usually serve to identify a myxomycete as P. polycephalum. The plasmodium is highly reticulate, and in some instances consists of one main vein stretching along dozens of centimeters, which becomes denser and more delicate on its fan-shaped moving front. Although the sclerotium might be recognizable, it is advised to first reactivate the plasmodium before identifying (Adelman 2003).

Distribution:

This organism is most definitely cosmopolitan and reported globally, as is demonstrated by Discover Life's Eumycetozoan Project which aggregates information from the Global Biodiversity Information Facility and universities and institutions worldwide (Discover Life 2009). Most observations of P. polycephalum, like most Myxomycetes, have for historical reasons been made in temperate forests in North America and Europe (Adelman 2003). Most US states east of the Mississippi have reported P. polycephalum, as has Washington State and Hawaii. Other confirmed locations include Mexico, Cuba, Brazil, Argentina, Peru, Paraguay, Canada, Costa Rica, Jamaica, Puerto Rico, Dominican Republic, French Guiana, Venezuela, Uruguay, Democratic Republic of Congo, Spain, Romania, India, Nepal, Taiwan, Korea, Australia, and Japan.

Habitat:

The microhabitat preferred by P. polycephalum for the most part consists of moist, shaded areas over decaying plant matter. Since fungi are a preferred nutrient source P. polycephalum will also seek out those areas. This is further corroborated by the plasmodium's avoidance of visible light and preference for dark conditions during bio-computing experiments (Saigusa 2008).

Look Alikes:

Since Physarum have distinctly colored plasmodium, misidentification can happen among similarly colored species. Notable are P. decipiens, P. flavicomum, P. melleum, and P. viride (Shirley). Especially in the United States, Fuligo septica, or "dog vomit slime mold," is very common on lawn turf and can be confused with P. polycephalum because of its bright yellow color. However, F. septica is frothy in appearance (Baker 2003).

Uses:

P. polycephalum has been extensively studied and used for greater insight into molecular genetics (Haugli 1977), cellular differentiation during sporulation (Adelman), simple intelligence and memory (Saigusa et al. 2008), as well as biological computing (Adamatzky 2008). In August, 2004 the National Human Genome Research Institute announced that P. polycephalum was one of 18 strategically selected organisms which were to undergo sequencing, "each of which represents a position on the evolutionary timeline marked by important changes in animal anatomy, physiology, development or behavior (NGHRI 2004)."

References:

Adamatzky, A. 2009. "Steering plasmodium with light: Dynamical programming of Physarum machine," New Mathematics and Natural Computation Journal, http://arxiv.org/PS_cache/arxiv/pdf/0908/0908.0850v1.pdf (http://arxiv.org/PS_cache/arxiv/pdf/0908/0908.0850v1.pdf)

Adelman, M. 2003. "Life Cycle of Physarum polycephalum," http://www.educationalassistance.org/Physarum/LifeCycle.html (http://www.educationalassistance.org/Physarum/LifeCycle.html)

Baker, C. 2003. "Slime in the Yard and Garden," Yard and Garden Column. Iowa State University Extension News, http://www.extension.iastate.edu/... (http://www.extension.iastate.edu/newsrel/2003/mar03/mar0303.html)

Haugli, K. et al. 1977. "Nucleolar vacuolization at non-permissive temperature in a heat sensitive strain of Phyrasum polycephalum," Norwegian Journal of Botany, Vol. 24. pp. 159-165.

Howard, F. L. 1931. "The Life History of Physarum Polycephalum," American journal of Botany, XVIII. Botanical Society of America. pp. 116-133

James, D. E. 1981. "Physarum Polycephalum," Carolina Tips, Vol. 44, No. 4. Carolina Biological Supply Company, Burlington, North Carolina. pp. 17-19.

Rusch, H. P. 1980. Growth and differentiation in Physarum polycephalum. Princeton University Press , Princeton New Jersey.

Saigusa, T. et al. 2008. "Amoeba Anticipate Periodic Events," Physical Review Letter., Hokkaido University, Sapporo, Japan, http://eprints.lib.hokudai.ac.jp/... (http://eprints.lib.hokudai.ac.jp/dspace/bitstream/2115/33004/1/PhysRevLett_100_018101.pdf)

Shirley, C. "Physarum," Hidden Forest, http://www.hiddenforest.co.nz/... (http://www.hiddenforest.co.nz/slime/family/physaraceae/physarum.htm#flavicomum)

NHGRI. 2004. "NHGRI Adds 18 Organisms to Sequencing Pipeline," National Human Genome Research Institute. National Institute of Health, Bethesda, Maryland. http://www.genome.gov/12511858 (http://www.genome.gov/12511858)

"Physarum Polycephalum Schwein", Discover Life: The Eumycetozoan Project, http://www.discoverlife.org/... (http://www.discoverlife.org/mp/20q?search=Physarum+polycephalum&btxt=The+Eumycetozoan+Project&burl=http://slimemold.uark.edu/databaseframe.htm)

Description author: Manuel Rincon-Cruz (/observer/show_user/1661) (Request Authorship Credit) (/observer/author_request/1634?type=name_description)
Description editor: Nathan Wilson (/observer/show_user/1)

Created: 2009-12-16 02:50:06 GMT (+0000) **by** Manuel Rincon-Cruz (ManuelRC)
Last modified: 2013-01-21 14:44:21 GMT (+0000) **by** Manuel Rincon-Cruz (ManuelRC)
Viewed: 865 times, **last viewed:** 2017-04-27 10:30:38 BST (+0100)