

# *Dictyostelium discoideum*

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- [Brief facts](#)
- [Life cycle](#)
- [References](#)

## Brief facts

- *Dictyostelium discoideum* (slime mold) are a free living amoebae whose natural habitat is the upper layer of soil rich in decaying organic material. Bacteria are the main source of food of the *D. discoideum*. When the food supply is abundant the slime mold organisms live in unicellar form. Once the food becomes sparse they aggregate to form a multicellular fruiting body that behaves as a single organism.
- *Dictyostelium discoideum* is an important model organism for studies of cell type determination, spatial patterning, altruistic cell death and other fundamental features that are essential in multicellular organisms.
- Because *Dictyostelium*'s chemotaxis and phagocytosis (feeding by particle uptake) abilities are very similar to that of leukocytes and macrophages respectively, the organism is used for maintaining cultures or as a host model for several pathogens including *Pseudomonas aeruginosa*, ***Cryptococcus neoformans*** (at

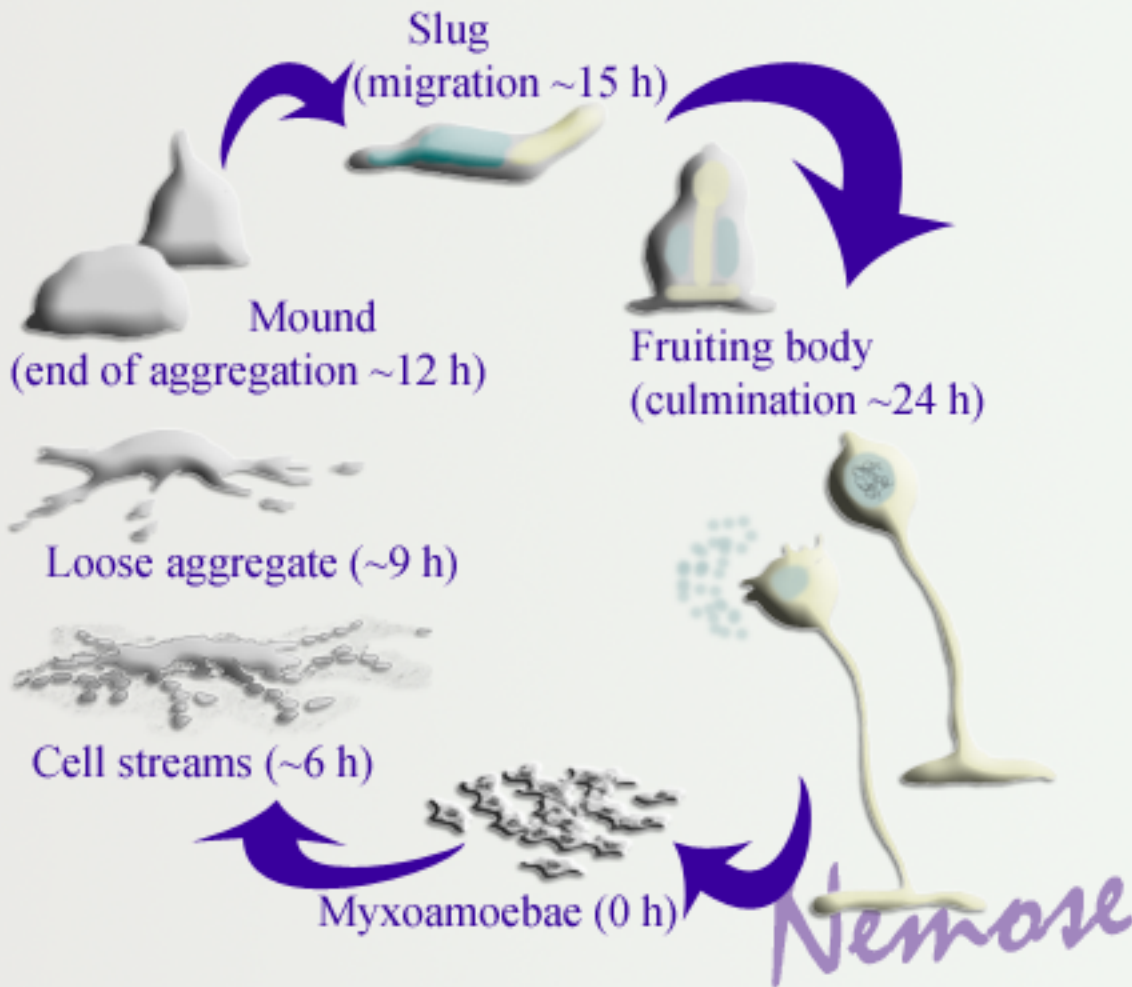
MetaPathogen), *Mycobacterium spp.* and *Legionella pneumophila*.

- Infection of *Dictyostelium discoideum* with intracellular pathogenic bacteria *Legionella pneumophila* parallels the infection of mammalian macrophages and the fresh-water amoebae *Hartmannella vermiformis* and *Acanthamoeba castellanii*. This model system of host-pathogen interaction has a critical distinction: because *Dictyostelium discoideum* cannot survive in temperatures higher than 27°C, the incubation temperature of the model has to be about 25.5°C. Many pathogens, however, start expressing their key virulence factors only at 37°C (temperature of human body).

Related organisms:

- ***Cryptococcus neoformans*** (facts, life cycle, bibliography at MetaPathogen)
- ***Legionella pneumophila*** (Legionnaire's disease, Pontiac fever, legionellosis at MetaPathogen)

# Life cycle of *Dictyostelium discoideum*



## Life cycle

*Dictyostelium* has 3 modes of reproduction: sexual, asexual (spores) and vegetative - mitotic division of unicellular organisms.

- **vegetative**

myxamoeba stage; free-living amoebae; unicellular form; vegetative growth by mitotic division

- **sexual**

*Dictyostelium* are both haploid and diploid organisms; the sexual cycle is initiated by the fusion of cells that are of opposite mating types; it results in the formation

of a multiwalled macrocyst whose development begins with the formation of a zygote which ingest the surrounding myxamoebae as it increases in size; on germination, haploid myxamoebae escape from the ruptured macrocyst; these cells originate by cleavage of the single large protoplast of the mature macrocyst

- asexual

- aggregation

upon starvation a few amoebae acting as the aggregation center start to produce periodic cAMP pulses, which are detected, amplified and relayed by the surrounding amoebae; individual cells move chemotactically towards increasing cAMP concentrations; the aggregate of approximately 100,000 cells undergoes a series of morphogenetic changes

- stream formation

attraction of other amoebae to the forming group

- loose aggregate

- tight aggregate

- mound

non-differentiated slug

- slug

pseudoplasmodium; typically consists of about 100,000 cells that are differentiated into 2 distinct cell types: cells in posterior of the slug will become spores, and cells in anterior which direct the pseudoplasmodium are destined to become stalk cells of the fruiting body; slug stage enables cellular slime molds to migrate

- culmination

towards the surface of the soil thus to have a better chance for spore dispersal

the stalk cells form a cellulose framework on which the spore mass is lifted up in the air

## References

### PubMed articles

- Steinert M, Heuner K. Dictyostelium as host model for pathogenesis. *Cell Microbiol.* 2005 Mar; 7(3):307-14. **PMID: 15679834**
- Solomon JM, Isberg RR. Growth of Legionella pneumophila in Dictyostelium discoideum: a novel system for genetic analysis of host-pathogen interactions. *Cell Microbiol.* 2005 Mar; 7(3):307-14. **PMID: 11044684**
- **PubMed: free full text articles about *Dictyostelium***

### Websites

- **Pattern Formation in *Dictyostelium discoideum***
  - **dictyBase**
  - **Model Organisms for Biomedical Research: *Dictyostelium discoideum***
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nemose@live.com

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