

Sample questions based on lectures and labs in Biology of Fungi, PB 110

Fall 2008

These questions are examples of the type of questions that will be asked on exams. We cannot promise that they will be the exact questions, but they will be similar. On exams, there will be some questions requiring diagrams with labels, some questions about the nuclear condition of fungi (haploid, diploid or dikaryotic; n , $2n$ or $n+n$), some short answer questions and some requiring longer answers. We are particularly fond of questions that combine information from several different fungi. While you are studying, you might think of how several of these questions could be combined into one question.

Introduction

Why is there more than one estimate of the time when various groups of fungi and other organisms diverged or radiated? What is the range of estimates?

In what other type of life was the first fossil fungus found? What was the likely ecological role of this fungus?

In the big radiation of higher eukaryotes what groups were involved?

From the perspective of fungi, what large group of organisms is their nearest relative?

Of the three most visible eukaryotic groups, animals, plants and fungi, which ones can convert radiant energy into chemical energy? Can any prokaryotic groups accomplish this feat?

There are three ways that fungi obtain chemical energy from the biosphere; what are they? What is the main, ultimate source of almost all of this chemical energy?

When you see a mushroom, you are seeing only one of three important parts of the whole fungus. What are the other two parts?

Describe the form of the basic unit of most fungal vegetative thalli. Where does growth occur?

How does a fungus obtain food from the substrate? What is exported and what is imported?

How is fungal nutrition similar to animal nutrition?

How do fungi move long distances?

Draw a fungal life cycle with all of the options.

How do fungal life cycles compare to the human life cycle? What is the key difference in terms of reproduction?

Myxomycota

How are the Myxomycota related to the kingdom Fungi?

How does the thallus of a myxomycete compare to that of a hyphal fungus?

How does a myxomycete obtain food?

Contrast nuclear and cell division of myxamoebae with that of plasmodia.

What morphological interconversions is a myxamoeba capable of?

What are three ways that a stressed myxomycete can use to avoid harsh environments?

Where does meiosis occur in the myxomycete life cycle? What happens to the meiotic nuclei?

What are the two types of sporangial development in myxomycetes and how do they differ? What other life-cycle features are correlated with this difference?

What is the genetic basis of mating compatibility in myxomycetes? That is, how many loci and how many alleles in the population at the loci?

Would any of the myxamoebae arising from spores from one sporangium be able to mate with each other? If so, from the perspective of one myxamoeba what percentage of the other myxamoebae from the same mating can be potential partners?

From the perspective of one myxamoeba, what percentage of myxamoebae from other plasmodia of the same species in nature would be potential partners?

Describe the spore color, abundance and morphology of capillitium, and the durability of peridium for members of the Physarales, Stemonitales, Trichiales and Liciales that you have seen.

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What differences in development result in either sporangia, plasmodiocarps and athelia?

Why is *Physarum* a model system for cell biology? That is, what features of its biology interest cell biologists and what features of its form make it easy to work with in the lab. Why aren't other myxomycetes used in cell biology research?

Although no one has ever suggested that *Physarum* has a brain, there is evidence that it can solve problems, such as a maze. What sort of experiment forms the basis for this claim?

Dictyosteliomycota, Arcasiomycota and Protostelids

Of the Acrasids, Dictyostelids and Protostelids the Protostelids were the last to be discovered (in 1960). Why?

If each amoeba makes just one spore in Protostelium, how can this organism increase in number?

Does Protostelium have any flagella in its life cycle?

Both Protostelium and Acrasis have a simple life cycle with amoeba and spores alternating through time, and with each amoeba making at most one spore. What difference in their life cycles allows Acrasis to make a multi-spored fruiting body?

How do the stalk and spore cells of Acrasis differ? How are they the same?

Dictyostelium is another example of an organism where each amoeba makes at most one spore, but the sporangia have many spores. What does Dictyostelium do that Protostelium does not do, and Acrasis only partly does, to achieve this type of life cycle?

How do Dictyostelium amoeba feed? What do they feed on?

What happens to Dictyostelium amoebae when the food runs out?

How do Dictyostelium amoebae synchronize their behavior?

What is the role of cyclic AMP (first known as acrasin) in the life cycle of Dictyostelium discoideum?

What changes occur in Dictyostelium amoebae upon perceiving cAMP? How do these changes allow them to cooperate?

Do Dictyostelium amoebae fuse to form a plasmodium?

What environmental signals can be perceived by Dictyostelium slugs?

In both Acrasis and Dictyostelium, some individual amoebae sacrifice themselves for other amoebae. Is this a common type of organismal behavior? What feature of the genetics of these amoebae may explain this behavior?

If you were a Dictyostelium amoeba, how might you cheat during reproduction to ensure your reproduction? Is there evidence that such cheating occurs?

What evidence is there that Dictyostelium is a popular research organism?

How many species of fungi have been described? How many species do mycologists believe exist in nature? Why is there a discrepancy?

What feature of the life cycle of Dictyostelium is commemorated by its name? How does this feature differ from Acrasis? Does the name Dictyostelium tell you anything?

What can the prestalk and prespore cells of Polysphondylium do that cannot be done by those of Dictyostelium?

In Dictyostelium, sex results in the fusion of two nuclei, but many cells seem to be involved. What happens to the extra cells? What might they do for the zygote?

We didn't say much about Ceratiomyxa (but your textbook does). What evidence could you use to place this fungus in the Myxomycota? What evidence is there that it could be closely related to the Protostelids?

Labyrinthulomycota and Plasmodiophoromycota

Draw a spindle cell of Labyrinthula paying particular attention to the plasma membranes. Now add a second spindle cell to your drawing and show how they interact. What is the name for the cell wall modification that permits membrane invagination in Labyrinthula. What does this modification do with regard to cell organelles?

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What plant disease does *Labyrinthula* cause?

What cell machinery is responsible for the pulsing of *Physarum* plasmodia and the motility of *Labyrinthula* spindle cells?

Draw a *Labyrinthula* zoospore, particularly the flagella and cell surface.

What features of *Thraustochytrium* suggest a close evolutionary relationship with *Labyrinthula*? Do these features suggest a close relationship with other members of the Myxomycota?

What organ does *Thraustochytrium* use for acquiring food? Through what organelle does this organism obtain food?

Plasmodiophora causes plant cells to enlarge, how does it do this? What is the term for abnormally enlarged cells and organs?

Describe how the zoospore cyst of *Plasmodiophora* enters a plant cell. A drawing with labels will help this answer.

Why is the thallus of *Plasmodiophora* called a plasmodium?

How could you tell if you were looking at a primary or secondary plasmodium of *Plasmodiophora*?

What is the nuclear condition (n , $n+n$ or $2n$) of secondary plasmodia of *Plasmodiophora*? How about the resting spores?

According to the modern interpretation of the *Plasmodiophora* life cycle, the infecting amoebae can develop along two lines. What type of reproductive structure arises from each developmental line?

Oomycota

Oomycetes 1

What features of the Hyphochytridiomycota separate them from the Oomycota?

Name a member of the Hyphochytridiomycota, describe the features of its life-cycle that are known, and tell where you would expect to find it in nature.

What types of evidence show that the Oomycota are Stramenopiles and not fungi?

What is the difference between primary and secondary zoospores in terms of morphology, location in the life cycle, and distribution throughout the Oomycota.

As applied to zoospores define the following terms and explain the differences between them monomorphic, dimorphic, aplanetic, monoplanetic, diplanetic, polyplanetic.

Define the following types of thalli (Holocarpic, eucarpic, monocentric, polycentric) and give an example of a taxon that has each (you can expand to the Chytrids and Hyphochytrids for your answer)

Select a member of the Saprolegniales and diagram its lifecycle indicating the main structures (thalli, sporangia, gametangia, etc.) nuclear condition (haploid or diploid) of various structures, and the sites of karyogamy and meiosis.

What are the various ways that members of the Saprolegniales release zoospores from their sporangia. For each indicate a genus where this method of release can be found.

What is the sequence of hormonal interactions that causes differentiation of gametangia and mating in heterothallic *Achlya* species.

What are some of the ecological roles that members of the Saprolegniales fill? When possible give specific examples.

Oomycetes 2

What features separate the Peronosporomycetidae from the Saprolegniomycetidae?

Diagram the lifecycle of *Pythium* or *Phytophthora* and discuss the important structures and events in it.

Compare the ecological roles of *Pythium* and *Phytophthora*; when possible give examples of species that fill these roles.

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Define and/or diagram the following terms: indeterminate sporangiophore, amphigynous anteridium, direct germination, damping off; give an example of a species where you could find each.

What are some specific examples of diseases caused by *Phytophthora* species that have had major impacts on agriculture or ecosystems

Oomycetes 3

What is an obligate biotroph? Give an example of a member of the Oomycota that is one.

Diagram a lifecycle from a member of the Peronosporaceae, discuss the major features of it, and compare it to that of *Phytophthora infestans*.

How do weather conditions interact with the spread of downy mildews? What are some historically important epidemics?

Diagram and discuss the infection process of a typical downy mildew.

What features of *Albugo* are similar to other Oomycota and which are unique to the genus?

What distinguishes *Lagenidium* from *Pythium*?

What features of the Rhipidiales or Leptomitales make members of each of these orders unique? Where might you look for members of these orders in nature.

Looking at the evolution of the Oomycota as a whole, what features or behaviors seem to have been derived repeatedly? How does this correlate with the niches they exploit?

Chytridiomycota

Species of Chytridiomycota account for approximately what percentage of described fungal species?

Give four pieces of evidence that chytrids are part of the kingdom Fungi.

What feature of the chytrid life cycle caused biologists to consider the chytrids to be protozoa?

What three ways do chytrids earn a living?

One order of chytrids is symbiotic. What is the other partner in this symbiosis? What special environment do these chytrids require? What gas is toxic to these chytrids? What common eukaryotic organelle is changed in this chytrid into an organelle that evolves hydrogen gas?

Draw and label the asexual cycle of chytrids. Where in the life cycle does the number of cells increase?

Part of the chytrid life cycle relies on single cells without walls. What are these cells called? When do they get walls?

We discussed three types of organelle organization within chytrid zoospores. What are the diagnostic features of the Spizellomyces type of zoospore? What are the diagnostic features of the Chytridium type of zoospore? What are the diagnostic features of the Blastocladales type of zoospore?

How does the zoospore of Rhizidiomyces differ from that of Rhizophydium?

How is the Neocallimastix type of zoospore unlike that of any other chytrid?

When zoospores exit the zoosporangium, they pass through an opening. The opening may be simple, have an operculum or a discharge net. How are these different structures formed?

A zoospore of the Chytridiomycota is a power plant moving a nucleus. Using labeled diagrams, tell how the power plant works by tracing the flow of energy from the fuel to the propulsion system.

Olpidium and many other chytrids have no rhizoids, but Chytriomycetes does. Why might Olpidium be able to do without something that Chytriomycetes always has?

Draw a holocarpic and a eucarpic thallus, label the important features.

In epibiotic thalli, the nucleus stays in the enlarging zoospore cyst. What happens to the nucleus in endobiotic thalli?

What is "Big vein" and what fungus contributes to its spread?

When Chytriomycetes mates, how do the nuclei reach each other?

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What type of sporangium usually results from sexual reproduction in chytrids? What type of nuclear division is associated with its germination?

Synchytrium endobioticum causes what disease of potato?

How can fungi like *Synchytrium* manipulate the form of their host plants? What happens to the plant cells in terms of growth and division?

Why would Homeland Security be interested in *Synchytrium*? What part of the life cycle makes this fungus a potential agent of terror (at least in Maine or Idaho)?

What can happen to the contents of rhizoids just before zoospore formation?

How are rhizoids and hyphae similar? How are they different?

Give two examples where nuclei are found in rhizoids? In one of these examples, the name for the rhizoids has been changed to acknowledge the presence of nuclei; what is this name?

In *Allomyces macrogynus*, can you distinguish a young haploid thallus from a young diploid thallus? If so, what features do you use? Can you distinguish old thalli? Again, if so, what features do you use?

Can you distinguish zoosporangia from resistant sporangia? How?

Can you distinguish mitospores from meiospores? How?

Can you distinguish male and female gametes? How?

What is sirenin? What bio-assay was used to purify sirenin? What does sirenin do?

Describe the swimming patterns of *Allomyces* male gametes in the absence of and in the presence of mature female gametes. How do the male gametes note the presence of the females?

Coelomomyces has a euallomyces life cycle (albeit with very simple thalli), except for one missing part. What part is missing? Why would it be wonderful to find a *Coelomomyces* species with the missing part?

Coelomomyces is an unusual fungal parasite because it requires two hosts to complete its life cycle. What are these hosts and what parts of the *Coelomomyces* life cycle are found in each?

Blastocladiella emersonii has what type of Allomyces life cycle? How can the environment be manipulated to have *B. emersonii* make resistant sporangia or zoosporangia?

What is the difference between zoospores of *B. emersonii* made from zoosporangia and those made from resistant sporangia? What cell cycle process must account for the difference?

Diagram the life cycle of *Blastocladiella variabilis* and tell why it would or wouldn't make a good model organism. Why can't you read about it in Nature or Science every week, as you can for yeast?

Catenaria anguililae, a mosquito parasite in nature, can be cultured in the lab. For a chytrid, it has an unusual thallus; please describe it. Its life cycle is similar to one of the three life cycles seen in *Allomyces*. Which one?

Why did mycologists think that *Basidiobolus ranarum* was a member of the Chytridiomycota? What other group of fungi has been the traditional home of *Basidiobolus*?

What is *Batrachochytrium* and why do herpetologists care about it?

Which chytrid now is thought to be the most basal fungus in the Tree of Life?

Is the Chytridiomycota a monophyletic group? That is, do all the living members form a single clade composed only of chytrids?

What is *Rozella allomycis*? How does it earn its living? Why are mycologists so excited about it?

Many organisms that are found at the base of groups of organisms are parasites that live in hosts that must have evolved after the parasite evolved. What logical problem does this situation present? What are two possible explanations?

Zygomycota

Zygomycetes 1

Diagram the development of a typical zygospore, label the structures involved, and indicate where you would expect to find karyogamy and meiosis.

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What is the difference between opposed and apposed suspensors and how do these two types correlated with where the zygospores are produced.

What hormonal interactions are involved with gametangial maturation and fusion in the Mucorales?

What is an azygospore? and how is it thought to correlate with homo or heterothallism?

Discuss how spore dispersal is accomplished through space and time by members of the Mucorales. How are these methods related to the habitats that they exploit?

What spore states other than sporangiospores and zygospores exist in the Mucorales?

In what groups of Zygomycetes would you expect to find heterothallism?

Draw a sporangium and label the parts.

The families in the Mucorales are defined in large part by type of sporangia and sporangia that are produced. Given what you know about the evolutionary pattern of the families, what does this say about these spore characters?

Zygomycetes 2

What are sporocladia and pseudophialides and where could you find them.

Why are members of the Dimargaritales often difficult to maintain in culture.

What types of spore dispersal are used in the Entomophthorales?

What is a haptor and where might you find one?

Where would you expect to find members of the following orders and what would they likely be doing in these habitats: Kickxellales, Dimargaritales, Entomophthorales, Zoopagales.

What are some morphological structures and behaviors that are employed by members of the Dimargaritales and the Zoopagales to parasitize other fungi.

What is a trichospore, what does it look like, and where would you expect to find one?

Are the Trichomycetes a natural group (monophyletic)? What is the basis for the Trichomycetes being placed in their own class distinct from other Zygomycetes? Given what we now know is this justified?

Zygomycetes 3

What is a sporocarp? What is an example of a member of the Zygomycota that has one, and how does it facilitate spore dispersal?

Diagram the features in a typical arbuscular mycorrhizal symbiosis and describe what each one does (to the extent we know), and discuss the what plant and fungal partners receive in this interaction.

The spores of the Glomales are variously called azygospores or chlamydospores. What type of morphological variation exists in glomalean spores and why all the confusion over what they are?

Glomalean fungi are always biotrophs, but are they always mutualists? Provide examples with your answer.

How does *Geosiphon* make its living and why is it in the Glomales (or Glomeromycota)

Overview questions:

What are some common trends throughout the Zygomycota.

Looking at what we currently call the Zygomycota what actually unites them? What is the problem with this character or characters?

Repeat the above question but substitute the Chytridiomycota.

What are the similarities between the resting sporangium of the Chytridiomycota and the Zygosporangium of the Zygomycota. How can one distinguish between them?

Pick two pairs of taxa in which the members look or behave in very similar ways, yet do not share a unique common ancestor. What has selected for this convergence?