

### Topic 3: Fungi Imperfecti & Concepts of Anamorph, Teleomorphy, Holomorphy

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#### FUNGI IMPERFECTI (Deuteromycota)

nonphylogenetic group of fungi without known sexual cycles or with unobserved sexual cycles.

#### Unique Phylum

1. groupings may or may not represent phylogeny  
e.g., species in same genus may be less related than species in different genera
2. most species are, in reality, members of other Phyla, particularly Ascomycota and Basidiomycota, but cannot be classified morphologically because nonsexual\*
3. members often have two and sometimes more acceptable scientific names

\*currently being classified molecularly

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#### WHY FUNGI IMPERFECTI?

1. Recognition that sexual cycles of fungi, particularly of Ascomycota and Basidiomycota, were important for understanding relationships. However, this created a problem
2. Problem was what to do taxonomically with fungi that had no known sex cycles?\*
3. Problem solved by creating a unique Phylum of fungi in which fungi are named with little regard for relationships. Identification without regard to classification; based on morphological observations and naming of asexual states.

\* majority

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#### ASEXUAL STATES = IMPERFECT STATE

Therefore: Fungi Imperfecti = Deuteromycota

1. Fungi Imperfecti named according to rules of Botanical Nomenclature for asexual (mitosporic) fungi\*
2. When perfect (sexual) states become known they are classified and renamed according to rules of Botanical Nomenclature for sexual fungi\*

\*mitosporic fungi, anamorphic fungi, imperfect fungi, etc.

Older Fungi Imperfecti names usually better known

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Question - Why are asexual states usually known before sexual states?

1. If organism grows, then it usually exhibits its asexual (anamorphic) phase first.  
vegetative growth → asexual reproduction - then sexual reproduction
2. With medically important fungi one can identify and treat fungus causing disease without knowing about sexual stage or how the fungus is classified.
3. Induction of sexuality is often dependent upon inducing sex in mated self-sterile (heterothallic) strains.
4. Induction of sexuality often requires special environmental or physiological conditions.

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### Homothallism vs Heterothallism

Most medically important fungi are heterothallic\*

<p>haploid self-sterile (nonsexual) strains</p> <p>A haploid (1N) x karyogamy → a haploid (1N)</p>	<p>Aa (2N)**** → meiosis** →</p>	<p>haploid (1N) A*** A a a</p>
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Only a relatively few are homothallic (self-fertile)

\* sex requires = pairs of "opposite" mating strains

\*\*meiosis often requires special physiological conditions

\*\*\*meiotic nuclei incorporated into meiospores

ascospores

basidiospores

\*\*\*\* or N+N (dikaryon) → 2N → 1N

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### Concept of Anamorph, Teleomorphy, and Holomorphy, Synanamorphy

Asexual phases of fungi are termed their anamorphic phase or anamorph\*

Sexual phases of fungi are termed their teleomorphic phase or teleomorph\*\*

Both phases termed holomorph\*\*

\* Fungi Imperfecti name

\*\* Phylogenetic name

Synanamorph(s)? Same fungus, but different asexual morphology.

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### Examples of medically-important fungi with 2 valid names

	Anamorphic (asexual phase)	Teleomorphic (sexual phase)	
	<u><i>Histoplasma capsulatum</i></u> Hyphomycete	<u><i>Ajellomyces capsulata</i></u> Ascomycota	
Form- species	<u><i>Blastomyces dermatitidis</i></u> Hyphomycete	<u><i>Ajellomyces dermatitidis</i></u> Ascomycota	meiospores
	<u><i>Cryptococcus neoformans</i></u> Blastomycete	<u><i>Filobasidiella neoformans</i></u> Basidiomycota	

Holomorph

Good News -- perfect states of many fungi have been and continue to be discovered

Bad News -- hundreds of common fungi have new names

More Bad News -- great resistance to learning and understanding about why we are having reclassifications

Great resistance to use of new names by non-mycologists & professionals

Both imperfect and perfect names of sexual fungi commonly used (more often than not, old imperfect species name)

Particularly true in regard to applied fields like

-medical mycology

-plant pathology

-industrial mycology

\*This phylum may become obsolete because of molecular biology.

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#### Fungi Imperfecti

##### Form-classes

##### Characteristics

Blastomycetes

Asexual yeasts or the nonsexual yeast phases (anamorphs) of ascomycetous, basidiomycetous or dimorphic fungi

Hyphomycetes

Asexual conidial fungi or nonsexual phases (anamorphs) of ascomycetous or basidiomycetous hyphal fungi

Coelomycetes

Asexual fungi or nonsexual phases (anamorphs) of ascomycetous or basidiomycetous hyphal fungi that produce conidia in multihyphal aggregates called conidiomata (conidioma)

Mycelia Sterilia

nonconidiogenous hyphal fungi that reproduce only by fragmentation

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#### Majority of Medically-Important Fungi

Hyphomycetes (conidial hyphal fungi) that have known or suspected Ascomycota affinities.

In general, these Ascomycota are Plectomycetes (cleistothecial ascomycetes), although a large number that cause relatively few infections are Loculoascomycetes (loculostromatic ascomycetes) of order Chaetothyriales..

Most are also heterothallic.

#### Topic 4: Conidia and Other Spores

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##### Generalized Fungi Imperfecti Rules

1. Form-generic names apply only to the state/morph represented by their type-species and not to any other of its morphs.
2. Form-genera are not mutually exclusive
3. Form-genera are not directly assignable to taxa of sexual/telomophic fungi
4. The nomenclature of the "higher fungi" is independent of the nomenclature of the form-gene
5. Although not a rule, it is most informative in today's world to refer to fungi according to their taxonomic or morph affinities: i. e. the anamorphic name of ascomycete/plectomycete *Ajellomyces capsulatus* is *Histoplasma capsulatum*.

##### Generalized Fungal Life Cycle