Mushroom Exam KEY
The Fungal Kingdom -- Fall 2006

	ID / Features	Short Answer	Combined
Points possible	200	90	290
Mean	130	61	190
Standard deviation	39	12	45
Median	136	61	196
Minimum	36	36	90
Maximum	184.5	83	265

PART I (200 pt; 10 pt per station)

Station 1 -- What species is this?

(a) *Laetiporus conifericola* ("*sulphureus*") (b) *Suillus lakei*
(c) *Russula xerampelina* (d) *Russula brevipes*

Station 2 -- Three genera of gilled mushrooms with no stipe or short lateral stipe.

Crepidotus, *Lentinus*, *Panellus*, *Panus*, *Pleurocybella*, *Pleurotus*, *Schizophyllum*, and others.

Station 3 -- What species is this?

(a) *Armillaria* "*mellea*" (b) *Lactarius* "*deliciosus*"
(c) *Hydnum* (*Dentinum*) *repandum* (d) *Amanita* "*vaginata*"

Station 4 -- (a) What is volva? (b) Describe type of volva. (c) What are warts on cap?

(a) Remnants of the universal veil that are left surrounding the base of the stipe.
(b) *A. muscaria*: zoned, or ringed; *A. pantherina*: collared, or circumsessile, bulb with a free rim of tissue; *A. phalloides*: membranous saccate (broad and cup-like); *A. vaginata*: membranous saccate (narrow and upright, may be constricted)
(c) Remnants of the universal veil.

Station 5 -- What species is this?

(a) *Aleuria aurantia* (b) *Amanita phalloides*
(c) *Ganoderma oregonense* (*tsugae*) (d) *Boletus edulis*

Station 6 -- Keep the Coop honest; distinguish golden chanterelle from false chanterelle.

Feature	Condition in *H. aurantiaca*	Condition in *C. formosus*
Nature of gills	Sharp, plate-like, regular "mushroom" gills	Blunt, fold- or vein-like
Color of hymenium	Bright true orange	Dull golden orange
Color of cap	Often dark brown, contrasting with hymenium	Usually ± same as hymenium
Stipe stature	Relatively slender relative to cap diameter	Often thick relative to cap diameter
Habitat evidence	Wood at base of stipes	Soil at base of stipes

Feature	Condition in *H. aurantiaca*	Condition in *C. formosus*
Context	Less fleshy, dry and stringy	Relatively fleshy
Odor	Not distinctive	Like apricots (sometimes)

Station 7 -- What species is this?

(a) *Helvella lacunosa* (b) *Hypholoma* (*Naematoloma*) *capnoides*
(c) "*Lepiota rachodes*" (*Chlorophyllum olivieri*) (d) *Amanita muscaria*

Station 8 -- (a) Draw cross-section showing free gills. (b) Four genera with free gills.

(a) Drawing must clearly show lack of connection between gills and stipe.
(b) *Agaricus*, *Amanita*, *Coprinus*, *Lepiota*, *Pluteus*, *Volvariella*, and others.

Station 9 -- What species is this?

(a) *Russula rosacea* (*sanguinea*) (b) *Tricholoma flavovirens*
(c) *Coprinus comatus* (d) *Cantharellus formosus*

Station 10 -- (a) What is cortina? (b) Three other genera often with cortina. (c) How tell Cortinarius from other cortinate genera?

(a) A partial veil with the texture of a spider web.
(b) *Hebeloma*, *Hygrophorus*, *Hypholoma* (*Naematoloma*), *Inocybe*, *Tricholoma*, *Tubaria*, some *Stropharia*, some *Pholiota*, and others.
(c) Check spore print color. If rusty brown, it's a *Cortinarius*; if not, it's one of the others.

Station 11 -- What species is this?

(a) *Hypholoma* (*Naematoloma*) *fasciculare* (b) *Coprinus atramentarius*
(c) *Sparassis crispa* (d) *Tricholoma magnivelare*

Station 12 -- Three lines of evidence that host of lobsters is *Russula brevipes*.

(1) Gather additional mushrooms from the area -- try to assemble a series from unaffected *R. brevipes*, to partially infected but still recognizable mushrooms, to fully lobsterized mushrooms.
(2) Use compound microscope to look for heteromerous trama (nests of sphaerocysts among typical filamentous hyphae), a key characteristic of the genus *Russula*. Shattering when thrown against a tree is a macroscopic manifestation of this.
(3) Use DNA sequencing or other molecular method to match the internal tissue of your lobsters with un-infected specimens of *R. brevipes*.

Station 13 -- What species is this?

(a) *Ganoderma applanatum* (b) *Boletus edulis*
(c) *Lepiota* (*Chlorophyllum*) *rachodes* (d) *Amanita pantherina*

Station 14 -- Two features *Agaricus* and *Lepiota* have in common. (b) One feature different.

(a) Free gills, ring. (Not things like "both are basidiomycetes." Not all have scaly caps.)
(b) Spore print color -- white in *Lepiota*, chocolate brown in *Agaricus*.

Station 15 -- What species is this?

(a) *Cantharellus subalbidus* (b) *Coprinus micaceus*
(c) *Pholiota aurivella* (d) *Boletus* (*Xerocomus*) *zelleri*

Station 16 -- Key to ascomycete, basidiomycete, and zygomycete cultures, using vegetative hyphae. *(So no asci, basidia,* etc*.!)*

The following features could be used to make a very short key: **hyphal diameter** (3-5 μm in ascomycetes and basidiomycetes vs. 10 μm in zygomycetes); presence of **septa** in ascomycetes and basidiomycetes, and absence in zygomycetes; nature of **septal pore** (simple in ascomycetes vs. complex in basidiomycetes; presence of **clamp connections** in basidiomycetes, but not in ascomycetes and zygomycetes. Clamps are not present in all basidiomycetes and are not present in monokaryons, but they are diagnostic when present so are a helpful feature (but if you use them you must include basidiomycetes twice, to allow for those in which the clamps are absent).

Station 17 -- What species is this?

(a) *Fomitopsis pinicola* (b) *Chroogomphus vinicolor*
(c) *Boletus* (*Xerocomus*) *chrysenteron* (d) *Pleurocybella porrigens*

Station 18 -- (a) Draw cross-section showing decurrent gills. (b) Four genera with decurrent gills.

(a) Drawing must clearly show gills running down stipe.
(b) *Clitocybe*, *Cantharellus*, *Gomphidius*, *Gomphus*, *Chroogomphus*, *Omphalina*, *Paxillus*, *Hygrophoropsis*, *Xeromphalina*, and others.

Station 19 -- What species is this?

(a) *Pleurotus* "*ostreatus*" (b) *Tricholoma magnivelare*
(c) *Gomphus floccosus* (d) *Hericium abietis*

Station 20 -- (a) What is a cystidium? (b) Where are different types found? (c-d) Draw one and name species in which you saw it.

(a) A sterile cell in the hymenium or cuticle of a sporocarp of a basidiomycete; distinguished from adjacent cells by its different shape, thicker walls, or larger size.
(b) Caulocystidium: stipe surface (stipe cuticle or stipitipellis); Cheilocystidium: edge (margin) of a gill or tube; Pileocystidium: cap surface (cap cuticle or pileipellis); Pleurocystidium: face of a gill.
(c-d) Many answers possible.

PART II (90 pt; 15 pt each)

Answer any six of the eight questions.

1. Describe three lines of evidence that mycorrhizas are an ancient phenomenon.

- Presence of mycorrhizal structures in earliest land plant fossils.
- Phylogenetically widespread occurrence throughout the plant kingdom.
- Molecular clock evidence on the time of origin of the fungus and plant groups involved in the mycorrhizal associations.
- Presence in ancient plant lineages.
- Earliest land plants were not well designed for the terrestrial environment.

2. **(a) Describe three fundamental things that Fungi have in common with plants and animals.**

   Eukaryotic cells (nucleus, chromosomes, other organelles, *etc.*); multicellular; characteristic DNA/RNA, aerobic respiration and other metabolic pathways, and others. Must have the first two. Features that all organisms share (such as "they are carbon-based life forms") generally did not receive credit.

   (b) Describe three fundamental things that set Fungi apart from plants and animals.

   Hyphal (mycelial) body type; absorbotrophic nutrition; reproduction by spores; commonly multinucleate cells; relatively few cell types (plants and animals have many differentiated types).

3. **(a) Explain how introduction of a pathogenic fungus into an area could lead to a decrease in plant diversity.** *Note: pathogenic organisms usually are quite specific to their hosts -- rarely does a single fungus (or other pathogen) affect a wide range of plants. (But nonetheless I gave credit for most answers involving kill-lots-of-things fungi.)*

   Plant community with many species of roughly equal abundance. Pathogenic fungus specific to one of the species eliminates it. Each of the remaining species increases in abundance only slightly. Loss of the one species reduces richness and, thus, diversity because evenness is not affected.

   (b) Explain how introduction of a pathogenic fungus into an area could lead to an increase in plant diversity.

   Plant community with single dominant species and many subordinate species. Pathogenic fungus specific to the dominant plant species greatly reduces its abundance. Demise of the dominant leads to increases by the subordinate species, which increases evenness and, thus, diversity.

4. **Describe three benefits of having a hyphal / mycelial body type.** *(Everyone answered this question!)*
   - Hyphae are small and can access places (and thus resources) that larger organisms can't.
   - Increased surface area : volume ratio. Important for an absorbotrophic organism.
   - Allows resources to be gathered simultaneously from diverse locations in a heterogeneous environment and allocated to where they are needed.
   - Allows exploration across "inhospitable terrain" to be supported by other hyphae in resource-rich areas.
   - Allows recycling of cellular components from senescing to growing portions.

5. **Describe two basic differences between the life cycle of a long-cycle, heteroecious rust and those of the other fungi whose life cycles we reviewed. Think beyond haploid-fertilization-diploid-meiosis, and be sure to show you know what long-cycle and heteroecious mean.**
   - Life cycle requires two different host plants to be completed (heteroecious).
   - Life cycle involves all five different types of spore found in rusts (long-cycle).

6. **(a) What features do the different types of mycorrhiza all have in common?**
   - Symbiosis of a fungus with roots (or root-like organs) of plants.

- Fungus receives photosynthates from plant.
- Plant receives nutrients such as P and N from fungus.

(b) Mycorrhizas are very diverse. Describe three major *types of diversity* within mycorrhizas and give examples of each.

- Taxonomic diversity: Many different fungi involved from Glomeromycota, Ascomycota, and Basidiomycota. Many different plants involved from all major groups. Many different combinations of fungi and plants within the different types.
- Morphological / anatomical diversity: AM with arbuscules and vesicles inside plant cells. EcM with external sheath / mantle and internal Hartig net, but no entry of plant cells. Dichotomous branching in pine EcM, different patterns in other plants.
- Functional diversity: Many AM involved with phosphate (inorganic) uptake; many EcM involved with N uptake, some inorganic (*e.g.*, NH_4^+), others organic (amino acids, peptides, etc.). Many ErM offer protection from high metal concentrations.
- Ecological / biogeographical diversity: AM dominant in tropical forests, grasslands, and deserts; EcM dominant in temperate and boreal forests; ErM in bogs and heathlands.

7. (a) What is anastomosis?

The somatic (vegetative) fusion of two hyphae -- especially when it occurs at multiple sites within a mycelium to make a network.

(b) Give three reasons why it is important for fungi.

- Necessary part of sexual reproduction for many.
- Allows for damage control -- "wall off" the damaged area (such as caused by grazing mini-critters) to minimize loss of resources. Also provides alternate transport routes around the damaged area.
- Allows for more efficient integration of mycelium.
- Allows for greater proliferation in nutrient-rich patches.

8. Describe three reasons that the scientific names of fungi change.

- As more is learned about the different fungi and their evolutionary relationships names are changed to reflect the new understanding. (Most answers given were specific examples of this general reason.)
- Mistakes were made in the past that need to be corrected (same fungus named twice, *etc.*).
- Taxonomists have different opinions about evolutionary relationships and how things should be classified, and change names to reflect their particular classification schemes.