LESSON ASSIGNMENT

LESSON 5  
Cutaneous Fungi.

TEXT ASSIGNMENT  
Paragraphs 5-1 through 5-10.

TASK OBJECTIVES  
After completing this lesson, you should be able to:

5-1. Select the statement that correctly describes a morphologic characteristic of a specific superficial fungus.

5-2. Select the statement that correctly describes a characteristic of a specific dermatophytic fungus.

5-3. Select the statement that correctly describes the clinical aspects of the disease.

5-4. Select the fungus responsible for a specific dermatophytic disease.

SUGGESTION  
After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.
LESSON 5
CUTANEOUS FUNGI
Section I. SUPERFICIAL FUNGI

5-1. INTRODUCTION

Superficial fungi do not cause life-threatening infections in patients, but because the body area affected is the outer layer of the skin, the psychological problems of affected individuals usually require attention. Alleviation of psychological discomfort normally includes treatment of the infection.

5-2. MALASEZIA FURFUR

a. Malassezia furfur is found worldwide but is most prevalent in tropical areas. It causes tinea versicolor, a disease affecting smooth body skin areas. Tinea versicolor is a chronic infection usually affecting young adults. It is most often asymptomatic and is seen as scaly areas on the upper body. Early lesions are pink and appear irritated. Older lesions are hypopigmented (showing diminished pigmentation), particularly after exposure to the sun. When placed under a Wood's lamp (fluorescent light) in a dark room" most infected areas fluoresce dull-red to orange.

b. Laboratory identification of Malassezia furfur is usually made by direct examination of skin scrapings from the infected site. Microscopic examination shows clusters of small, thick-walled, round blastoconidia with mycelial fragments. The combination of round blastoconidia and mycelia gives an appearance called a "spaghetti and meatball" effect. Cultures are usually unsuccessful and not required to establish a diagnosis of tinea versicolor but sometimes isolation may be necessary or desirable. Since Malassezia furfur is a lipophilic organism, it requires the presence of a fatty material overlay for growth and inoculated media is commonly overlaid with sterile olive oil to enhance growth. When growth occurs, colonies are cream-colored, glossy, and raised, but later become dull, dry, and beige-colored. Microscopic morphology shows globose to ellipsoidal hyaline cells (3 to 7 mcm). Mycelia are not usually formed in culture but some cells may produce germ tubes. (Figure 5-1)

Figure 5-1. Microscopic morphology of Malassezia furfur.
5-3. **EXOPHIALA HERNECKII**

a. *Exophiala werneckii* (*Cladosporium werneckii*) is found worldwide but most commonly in the tropics and subtropics. It is the cause of *tinea nigra*, an infection that presents as black blotches on the palms of hands and, rarely, on other body areas. The disease is largely asymptomatic but can be confused with malignant melanoma.

b. Direct examination of skin scrapings from the suspected infection on site demonstrates light brown to dark-green branching septate hyphae and possibly chlamydospores. Colonial growth on isolation media is black and shiny, with a yeast-like surface and a black reverse. Microscopic morphology of colonies shows olive-colored, budding blastoconidia, and thick-walled septate hyphae. There are short conidiophores with 1- or 2-celled annelloconidia. Older cultures may show branching chains of annelloconidia.

5-4. **PIEDRAIA HORTAE**

a. *Piedrala hortae* is distributed worldwide but is most prevalent in tropical regions. It causes *black piedra* characterized by hard, brown, or black nodules on shafts of scalp hair. Although the patient feels no discomfort, the hair feels "gritty" and a metallic sound may be heard when combed.

b. Infected scalp hairs are examined directly for the presence of nodules that consist of tightly packed masses of wide, dark brown, septate, and branching hyphae. Crushed nodules release 2 to 8 single celled ascospores. Culture is not required for diagnosis. Colonies are dark brown to black, with a glabrous or smooth surface and an unremarkable reverse. Microscopic morphology includes thick-walled, brownish hyphae with chlamydospores. Asci and ascospores are not usually produced on routine media.

5-5. **TRICHOSPORON BEIGELLI**

a. *Trichosporon beigelli* is distributed worldwide but is most prevalent in the tropics. It causes *white piedra*. This disease is characterized by the presence of hard white nodules on the hair shaft. The hairs on the scalp are generally affected, but occasionally the beard of upper lip may be involved. The nodes are thought to arise near the scalp. However, due to normal hair growth, they are commonly observed on the distal portion of the hair. The nodes may be just visible to the naked eye or felt as pinhead size, gritty masses adhering to one side, or surrounding the hair shaft. More than one nodule may be present on each infected hair. The intervening portions of the hair remain normal and the skin is not involved. There is no fluorescence under ultraviolet light.

b. Infected scalp hairs are examined directly for the presence of an ectothrix infection (defined below) with hyphae, arthroconidia, and blastoconidia. The fungus grows rapidly and in a few days produces a cream-colored yeast-like colony that becomes yellowish-gray, dry and wrinkled at 2 to 4 weeks of age. Microscopic
morphology shows branching hyphae with arthroconidia. Ovoid to ellipsoidal blastoconidia and pseudohyphae are also produced. The organism is commonly confused with the mold *Geotrichum* due to a similar colonial morphology and the presence of hyphae with arthroconidia. *Trichosporon*, however, additionally produces blastoconidia and pseudohyphae making this organism a true yeast.

c. There are two basic types of hair infection, ectothrix and endothrix. An ectothrix infection is characterized by arthroconidia on the outside of the hair and mycelium within the hair shaft. It therefore has fungal elements on both the outside and inside of the hair shaft. An endothrix infection is characterized by arthroconidia within the hair shaft only, with no elements on the outside of the shaft.

Section II. DERMATOPHYTES

5-6. INTRODUCTION

a. Dermatophytes commonly infect keratinaceous tissue such as hair, skin, and nails. This characteristic is thought to be due to an inhibitory agent in blood or serum that precludes establishment of infections at other body sites. While these organisms are pathogenic in man, they freely exist as soil saprophytes or zoopathogens. The infections are commonly referred to as "ringworm" due to round, serpentine lesions that appear to be caused by worms. The Latin word "tinea," which means "worm," is used to describe specific lesions.

b. The dermatophytes can be geophilic, zoophilic, or anthropophilic. The term geophilic is used for fungi whose natural habitat is in soil. Zoophilic refers to fungi that infect humans as well as lower animals. Anthropophilic means man-loving. Organisms in this category prefer to infect man.

5-7. *MICROSPORUM* SPP

a. Within the genus, 11 species have been recognized. Direct examination of hair usually reveals an ectothrix infection in which fungal elements are found both inside and outside the hair shaft. Additionally, when the hyphae break up into arthroconidia they may demonstrate a "mosaic" pattern. Infected tissue will show septate hyphae with occasional branching. The organisms within this genus usually do not infect the nails. The microconidia are not characteristic enough to allow identification, so organisms are identified by their characteristic macroconidia. All are echinulated, meaning they have a "spiny" wall. They are also spindle-shaped with a varying cell wall thickness.

b. One of the characteristics used to differentiate organisms is the thickness of the walls separating the cells of the macroconidia. If the separating walls are thicker than the outside wall of the cell then the wall is considered thick-walled. If the separating walls of the macroconidia are thinner than the outer wall, the wall is considered thin-walled.
c. *Microsporum audouinii.*

(1) This fungus is found in the United States, Africa, and Europe. Colonies are slow growing and flat with short aerial hyphae. The surface color is gray or cream to tan. Reverse color is delicate peach or flesh. There is a band of color where slant and butt of culture media meet. A diagnostic feature is loss of characteristic color on SDA media within 14 days.

(2) Macroconidia are rarely seen microscopically. Microconidia, while seen, are non-diagnostic. Presence of sterile hyphae are often observed. The sterile rice grain test is used to distinguish Microsporum species (growth on the grains of rice) and *Microsporum audouinii.* (No growth on the grains.) (Figure 5-2.)

![Microscopic morphology of Microsporum audouinii.](image)

d. *Microsporum canis.*

(1) This organism was originally isolated from dogs. Today, it is isolated as frequently from cats and is distributed worldwide. Colonies are fast growing, initially white and fluffy, but becoming silky, with bright yellow pigment showing through the periphery. After 2 to 4 weeks the aerial mycelium is dense, cottony, tan, and sometimes in irregular tufts of concentric rings. The reverse is initially bright yellow, becoming buff orange-brown. Rare isolates show no pigment on reverse.

(2) Microscopic morphology shows microconidia that are small and non-diagnostic. The macroconidia, which are diagnostic, are usually numerous. They are truncated, thick-walled, and spindle-shaped with a "snout." Seven to fifteen cells are present in the macroconidia. (Figure 5-3.) *Microsporum canis* may be confused with *Microsporum audouinii* but may be differentiated by the sterile rice grain test.

![Microscopic morphology of Microsporum canis.](image)
e. *Microsporum gypseum*

(1) *Microsporum gypseum* is a geophilic organism with worldwide distribution. The colonies grow rapidly with a flat, powdery surface colored various shades of tan. The reverse color ranges from yellow to slightly red.

(2) Microscopic morphology shows rare microconidia that are non-diagnostic. Macroconidia are numerous and diagnostic. They are wide, spindle-shaped with rounded ends. They contain three to six cells, with one end cut off and the other end rounded. (Figure 5-4.)

![Microscopic morphology of *Microsporum gypseum*.](image)

f. *Microsporum nanum.*

(1) *Microsporum nanum* is a zoophilic organism with worldwide distribution. The colonies are rapid growing and flat, with color ranging from cream to buff to cinnamon. Reverse color is splotchy brown.

(2) Microscopic morphology includes few microconidia that resemble an egg with the bottom cut off. Macroconidia are numerous and diagnostic. They are pear-shaped with thick, rough outer walls, and contain one to three cells, most commonly two. (Figure 5-5.)

![Microscopic morphology of *Microsporum nanum*.](image)
5-8. **EPIDERMOPHYTON FLOCCOSUM**

a. *Epidermophyton floccosum* is the only pathogen within this genus. It is an anthropophilic organism with worldwide distribution. It infects skin and nails but does not infect hair. Colonial growth is slow, initially white and fluffy, becoming velvety and powdery. Color is khaki-green with a yellow border. Reverse color is non-characteristic. Surface is flat or radially folded.

b. Microscopic morphology shows no microconidia. Macroconidia are numerous and may be borne singly or in clusters of 2 or 3 on the same conidiophore. They have a blunt, "snow-shoe" shape with smooth, thin walls, and generally, three to four cells. (Figure 5-6.)

![Figure 5-6. Microscopic morphology of *Epidermophyton floccosum*.](image)

5-9. **TRICHOPHYTON**

a. There are 24 species within the genus. They can infect hair, skin, and nails. In this genus, the microconidia are diagnostic while the macroconidia are not.

b. There are two characteristic arrangements of the microconidia that will help distinguish this organism from similarly appearing genera: the "en thyrse" and "en grappe" arrangements. En grape refers to microconidia in clumps at the ends of the hyphae. En thyrse refers to microconidia that form along the sides of the hyphae.

c. *Trichophyton mentagrophytes* var. *mentagrophytes*.

(1) This organism is zoophilic with a worldwide geographic distribution. It infects hair, skin, and nails. Colonies are flat and granular with suede and red to tan granules. The reverse is buff to reddish-brown.

(2) Microscopic morphology shows macroconidia that are non-diagnostic. They may be club or pencil-shaped with thin, smooth walls. Micro-conidia are clavate (club-shaped) or globose, arranged "en thyrse" or "en grappe." Hyphae may form spirals. (Figure 5-7.) Spiral hyphae, when present, are an identifying characteristic of this species. This organism produces a positive urease test within 4 days. The in vitro hair test is also positive. Microscopic observation of the in vitro hair test shows perpendicular invasion of the hair by this organism.
Figure 5-7. Microscopic morphology of *Trichophyton mentagrophytes*.

d. *Trichophyton rubrum*.

(1) This organism usually does not invade hair. Of many possible variants, seven are known in the United States (US). Infection by this organism serves as a marker for underlying diseases such as undiagnosed diabetes or leukemia. It is anthropophilic and found worldwide. Colonies are slow growing, flat or heaped at the center with a white, fluffy surface turning pink-tan. Reverse is wine-red.

(2) Microscopic morphology shows fragile, pencil-shaped macroconidia with smooth, thin walls. The microconidia are clavate, or globose, and "en thyrse". Microconidia are usually present in large numbers. The macroconidia are narrow with thin-walled parallel sides and contain two to eight cells. The confirmation tests, urease and in vitro hair tests, are both negative for this organism.

e. *Trichophyton tonsurans*.

(1) *Trichophyton tonsurans* is an anthropophilic organism that is distributed throughout the US and Europe. It is a common cause of tinea capitis in both children and adults. Colonial growth is slow and may be of several types. All are markedly folded and appear as suede or granular. Colonies may be red, yellow, white, or other colors, with a deep orange to mahogany reverse.

(2) Microscopic morphology shows rare macroconidia that are cylindrical to clavate, slightly curved at the tops, and two to three-celled. Microconidia are extremely pleomorphic. Small microconidia tend to be globose to clavate and elongate, while large microconidia are globose resembling a balloon. A variety of shapes and sizes may be seen in the same culture. Growth is enhanced in a tube of medium containing thiamine.

f. *Trichophyton verrucosum*.

(1) *Trichophyton verrucosum* is a zoophilic organism with a worldwide distribution. Colonies are very slow growing. Initially they are small, heaped, glabrous, tough, and leathery. They appear white to yellowish tan, with a nonpigmented reverse.
Microscopic morphology shows a typical absence of both microconidia and macroconidia. Chlamydo spores produced form chains. This organism requires thiamine. Growth is enhanced in the presence of thiamine and inositol.

5-10. DISEASES CAUSED BY DERMATOPHYTES

a. **Tinea Pedis (Athlete's Foot)**. This is probably the most common and widely known dermatophytosis. It usually produces lesions between the toes, but may involve the entire foot. Lesions present as itchy, scaly, reddened areas in which dead epidermis and debris collect. Advanced lesions may develop purulent fluid and/or secondary bacterial infections. Causative agents: *Trichophyton rubrum*, *Trichophyton mentagrophytes*; and *Epidermophyton floccosum*.

b. **Tinea Manuum (Ringworm of the Hands)**. This is a dermatophytosis similar to tinea pedis but involving the hands. Infected areas are primarily the interdigital and palmar surfaces of the hands. Causative agents: Same as tinea pedis.

c. **Tinea Cruris (Jock Itch)**. This dermatophytosis involves the groin, perineal, and perianal areas. Cause is usually due to sharing of contaminated clothing and/or towels. Lesions are dry, scaly, and itchy, with secondary infections possible. Causative agents: *Microsporum canis*, *Trichophyton rubrum*, *Epidermophyton floccosum*.

d. **Tinea Corporis (Ringworm of the Body)**. This disease involves chiefly the glabrous skin, usually of the face, arms, and shoulders. It presents the classical "ringworm" type of lesion. The fungus is usually zoophilic or may be transmitted from an animal source. *Trichophyton rubrum* usually causes the most significant infections and, in diabetics, may cause a very resistant chronic infection. Causative agents: *Microsporum canis*, *Trichophyton mentagrophytes*, *Trichophyton rubrum*.

e. **Tinea Barbae (Ringworm of the Beard)**. This disease is usually contracted from an animal vector and involves mainly the area of the face normally covered by facial hair (that is, eyebrows, beard). *Trichophyton verrucosum* is the leading cause of ringworm in cattle in the United States and is commonly acquired by dairymen. Infections of farmers due to *Trichophyton mentagrophytes* have been attributed to exposure to infected horses and dogs. Severe infections may produce serious or purulent discharges. Causative agents: *Trichophyton verrucosum*, *Trichophyton mentagrophytes*, and *Trichophyton schoenleinii*.

f. **Tinea Unguim (Ringworm of the Nails)**. This infection causes nails to become split, discolored, thickened, or crumbly and spongy. The disease is commonly found in conjunction with tinea pedis. Many so-called saprophytic fungi as well as *candida albicans* can also be agents of this disease. Causative Agents: *Trichophyton rubrum* and *Trichophyton mentagrophytes*.

f. **Tinea Capitis (Ringworm of the Scalp)**. This is a dermatophytosis of the scalp that usually presents as a dry, scaly lesion. The infection is most common in
children with *Trichophyton tonsurans* as the most common etiological agent. While differentiation of the etiological agents requires expertise, all *Microsporum* spp., except *Microsporum gypseum*, are readily diagnosed by the production of a yellow/green fluorescence of infected hairs when illuminated by a Wood's lamp. Causative agents: *Microsporum canis, Microsporum audouinii, Microsporum distortum, Trichophyton schoenleinii, Trichophyton tonsurans, Trichophyton violaceum.*

Continue with Exercises
EXERCISES, LESSON 5

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the exercise, by completing the incomplete statement, or by writing the answer in the space provided at the end of the exercise.

After you have completed all the exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. What disease is caused by *Malassezia furfur*?
   ______________________________

2. Laboratory identification of *Malassezia furfur* is most often made by:
   a. Direct examination of infected hairs.
   b. Observation of colonial growth.
   c. Direct examination of skin scrapings.
   d. Examination of microscopic colonial morphology.

3. Which organism is the cause of tinea nigra?
   a. Piedraia *hortae*.
   b. *Exophiala werneckii*.
   c. *Malassezia furfur*.
   d. *Trichophyton rubrum*.

4. What color are colonies of *Exophiala werneckii*?
   a. Beige.
   b. Dark green.
   c. Light brown.
   d. Black.
5. If a patient reports a metallic sound upon combing hair, what organism might be the infective agent?
   a. *Piedraia hortae.*
   b. *Trichosporon beigelli.*
   c. *Exophiala werneckii.*
   d. *Malassezia furfur.*

6. What two characteristics aid in discriminating *Trichosporon beigelli* from *Geotrichum candidum?*
   ____________________________
   ____________________________

7. Infections by dermatophytes are erroneously called _______________________ infections
   a. Cutaneous.
   b. Keratinaceous.
   c. Ringworm.
   d. Ectothrix.

8. Hyphae which break up into a mosaic pattern of arthroconidia are characteristic of:
   a. *Trichosporon beigelli.*
   b. *Microsporum* spp.
   c. *Trichophyton* spp.
   d. *Tinea capitis.*
9. List the identifying characteristics of *Microsporum macroconidia*.

__________________________.

__________________________.

__________________________.

10. *Microsporum audouinii* differs from other *Microsporum* spp. in:

   a. The microscopic appearance of its macroconidia.
   
   b. The results of the sterile rice grain test.
   
   c. The appearance of domed terminal vesicles.
   
   d. None of the above.

11. The presence of macroconidia which are numerous and spindle-shaped with a "snout" suggests infection with:

   a. *Microsporum canis*.
   
   b. *Microsporum nanum*.
   
   c. *Epidermophyton floccosum*.
   
   d. *Trichophyton* spp.

12. Colonies of *Microsporum gypseum* have a reverse color that is:

   
   b. Black.
   
   c. Peach.
   
   d. Yellow.
13. *Epidermophyton floccosum* is likely to be isolated from specimens.
   a. Hair or nails.
   b. Skin, hair, or nails.
   c. Skin or nails.
   d. Skin or hair.

14. Laboratory indicators of the presence of *Trichophyton mentagrophytes* include:
   ________________________________.
   ________________________________.
   ________________________________.
   ________________________________.

15. An organism that can serve as a marker for other underlying disease is:
   a. *Trichophyton tonsurans*.
   b. *Trichophyton rubrum*.
   c. *Trichophyton mentagrophytes*.
   d. *Epidermophyton floccosum*.

16. An anthropophilic organism commonly found in tinea capitis infections is:
   a. *Trichophyton tonsurans*.
   b. *Trichophyton rubrum*.
   c. *Trichophyton verrocosum*.
   d. *Trichophyton mentagrophytes*. 
17. Dermatophytes that commonly cause athlete’s foot include:
   a. *Trichophyton verrucosum*.
   b. *Trichosporon beigelli*.
   c. *Epidermophyton floccosum*.
   d. *Microsporum canis*.

18. Fungi that cause "ringworm" infections are frequently transmitted by:
   a. Contaminated soil.
   b. Air droplets.
   c. Animals.
   d. Human carriers.

19. If a hair specimen taken from a patient with scalp ringworm displays a yellow-green fluorescence under a Wood's lamp, it is likely to be:
   a. Any member of *Microsporum* spp.
   b. Any member of *Trichophyton* spp.
   c. A member of *Trichosporon* spp.
   d. A member of *Microsporum* spp.
SOLUTIONS TO EXERCISES, LESSON 5

1. Tinea versicolor (para 5-2a).
2. c (para 5-2b)
3. b (para 5-3a)
4. d (para 5-3b)
5. a (para 5-4a)
6. Blastocconidia
   Pseudohyphae (para 5-2a)
7. c (para 5-5a)
8. b (para 5-6)
9. Echinulated
   Spindle-shaped
   Varying cell wall thickness. (para 5-7a)
10. b (para 5-7b(2))
11. a (para 5-7c(2))
12. d (para 5-7d(1))
13. c (para 5-8a)
14. Spiral hyphae
    Positive urease test
    Perpendicular invasion of hair. (para 5-9c(2))
15. b (para 5-9c(1))
16. a (para 5-9d(1))
17. a (para 5-10a)
18. c (paras 5-10d, e)
19. d (para 5-10g)

End of Lesson 5