PROFESSOR: All right. So today's lecture is going to be on Chapters 5 and 6. Pathogenic microorganisms, fungi, and animal parasites. There are going to be some areas in these -- this chapter, specifically Chapter 5, where you will not be responsible. I think it goes too much in depth for a Survey of Human Disease course. So I will let you know what you will not have to be responsible for.

So the general classification for pathogenic microorganisms includes bacteria, chlamydiae, rickettsiae, Ehrlichiae, mycoplasma, viruses, fungi. And we'll talk about these.

Now, first with bacteria. They can be classified, broken into groups, depending on certain characteristics. There is four characteristics that they use. One is the shape and the arrangement. Another one is the gram stain reaction. Another one can be biochemical and growth characteristics, and the forth is going to be antigenic structure.

Now, the shapes. As far as the shapes go, cocci refers to smears. They're round. And strep, all right, tends to be in chains of spheres. And staph tends to be in sheets of cocci. The cillus refers to a rod-shaped organism. Spiral shape refers pretty much to syphilis, and we'll talk about syphilis later on.

The gram stain reaction, very interesting. Basically, what a gram stain is, you collect the specimen. The specimen is going to be either a throat culture or pus from an abscess. It's rubbed on a glass slide. It's dried and then it's stained. It's stained with a purple dye. It then is washed with a solution. And then it's counterstained with a reddish-pink dye. If the bacteria hold on to the purple dye, which is called the gram stain, then they are considered gram positive. If they wash out and then take on the purple stain -- I'm sorry, the reddish-pinkish stain, they are considered gram negative. So staph and strep are gram negative. And significant gram negatives are the neisseria family.

Anybody know two of the bacteria that are in the neisseria family?

STUDENT: (Inaudible.)

PROFESSOR: Yep, neisseria gonorrhea. The other one neisseria meningitidis. We'll talk more about that at another time. But neisseria meningitidis is the bacteria responsible for what we call the meningococcal meningitis, which is the one that college age students are susceptible to or at risk for. We'll go into those characteristics later.

Then, of course, biochemical and growth characteristics include the aerobic and anaerobic. Aerobic means it requires oxygen to live. Anaerobic refers to the fact that it doesn't
require oxygen. When specimens are collected, sometimes aerobic and anaerobic specimens are collected. Sometimes when we say -- when we collect them, what happens is a sterile culturette, cotton tipped applicator gets rubbed into the abscess or the source of infection. It then gets put into a plastic tube. It's sealed at the bottom of the tube. There is a () that gets crushed that provides nutrients for the bacteria until it gets to the lab.

The anaerobic characteristics are interesting because when you culture for an anaerobic organism, you do the same thing. And there is a sleeve that the cotton tipped applicator goes into and gets sealed, but then that tube with the culturette gets also placed in a plastic narrow envelope and you seal it. You roll it down and seal it, and then you break a CO2 pellet so there is a source of CO2 and lack of oxygen. GI bacteria are characteristically anaerobic.

Spore formation. Anthrax is an example of an organism that has spores. And the last is going to be antigenic structure such as antigens of the cell body, capsule or flagella.

Anybody know any -- of course, flagella is the tail. It enables the bacteria to be motile. Does anybody know the name of any bacteria that have a flagella or tail? No one?

Anybody heard of trichomonas before? STD. That has a flagella.

Moving on. So, as I mentioned before, staphylococci are grouped in clusters or sheets. The streptococci are grouped in chains, long chains. Some organisms are grouped in pairs; those are diplococci. The bacillus, the rod-shaped, now, this you don't have to know. You don't have to know if this is a square end, round end, club shape, fusiform or common shape bacillus. Just know that bacillus are rod shaped, okay, and that anthrax falls into that category. Also mycobacterium tuberculosis falls in that category. The spiral shape is going to be treponema pallidum, which is syphilis.

Gram staining. I mentioned that already. Bacteria are classified as either gram positive or gram negative depending on ability to resist or retain certain dyes. So here they explain the process of gram staining. As I said before, the specimen is collected, dried on a glass slide, and then the dye is a purple dye called crystal violet is washed onto the slide. And then after that iodine is placed on the slide. And then alcohol or acetone, as a solvent, is applied. The idea is it will decolorize organisms that are not gram positive. Then the counterstain, safranin, which is a red dye is placed. So let's see. The gram positive cocci includes staph and strep, as I mentioned. The gram negative are going to be neisseria. You don't really have to know the gram negative rods, okay. And once again, you don't need to know this slide.

So the biochemical and growth characteristics. The type of culture media, the oxygen requirements, they are obligate and
facultative organisms.

Nutritional requirements. Some can be grown only under enriched mediums or carefully controlled conditions of temperature and pH. Some are hardy and can grow in relatively simple cultured mediums or a wide variety of conditions, such as staph and step. Easy to grow. It is true that most bacteria have distinctive biochemical characteristics.

The aerobic organisms, they grow best in the presence of oxygen. Aerobic organisms, as I mentioned before, these tend to be in the GI tract. They grow in the absence of oxygen or under extremely low oxygen tension. Neisseria falls into that category, possibly, but definitely the GI tract. Other bacteria grow equally well under either condition.

Spores, okay, they are dormant. They are extremely resistant. And that adds to the -- that adds to the use of spores or anthrax as a bacterial or bioterrorist weapon because the spores can lay dormant. They are resistant to moisture and heat for a long, long time. Then when they finally germinate, they give rise to actively growing bacteria under the favorable conditions.

So the antigenic structure. Basically they're talking about antigens that can be in the cell body, the capsule or the flagella. And they are going to be determined by special methods. So this is a graph which sort of summarizes what we said when the -- with the gram stains, cocci, bacilli.

Now, staph, I do want you to know about staph. We're going to staph. We're going to discuss strep. So staph is a gram positive cocci. It's arranged in clusters. It is a normal inhabitant of the skin. Different types of staph. The most commonly on the skin is going to be staph epidermitis. It's not really considered pathogenic. In the nasal cavity is going to be staph aureus. We can culture staph aureus. Probably 20 to 30 percent of the students in this class might have a positive culture of staph aureus, if we take culture from the nose. It's commonly found on skin, in the nose of patients and hospital staff. Normally not pathogenic.

Now, the disease it does cause, okay, food poisoning, vomiting, diarrhea, toxic shock, also tissue necrosis, meaning tissue death and destruction, and breakdown of red blood cells. These diseases -- these facts are produced by the toxins or occur because staph always produces toxins that can have this effect.

So skin infections, impetigo, common one. Staph is the most common organism to cause impetigo or skin infection. Boils, furuncles, carbuncles are going to be multi-type boils, but they don't have just one center. They have several centers. You can get a nail infection, skin infection. Staph.

At the very bottom here, we have MRSA. MRSA stands for methicillin-resistant staph aureus. And how many here know of someone who has had MRSA or MRSA infection? Okay. Anyway, it's...
become very common. And the origin of MRSA is basically due to the fact that we've given good medical care, and as a result MRSA has developed. Now, the reason why it has developed is due to the use of antibiotics.

When I was in practice, and if someone had an infection -- for example, they had surgery and say they got a wound infection. We'd culture the wound, all right, and determine what organism was growing in it, and we'd treat them with bacteria.

Now, it came out that the -- you know, when someone gets a wound infection, everybody gets unhappy, okay. The patient is unhappy because it's a complication and they have to stay longer. The hospital is unhappy because they have that bed tied up with a complication. They can't admit a new patient. The insurance company is unhappy because they have to pay a bigger bill. And the doctor is unhappy because he has to deal with unhappy people, insurance company, hospital and patient. So everybody is unhappy. So through studies it became -- they became aware of the fact that if patients were given a dose of antibiotics - what we call prophylactic antibiotics - before their surgery, if they had a complicated surgery, in the middle of the surgery they got another dose, and then if they got a dose a couple of hours after the surgery in the recovery room, those two to three doses of antibiotics reduced the risk of getting a wound infection or a post-op infection tremendously. So that seemed really easy. So people who had surgery then would get prophylactic antibiotics to prevent the wound infection. As a result the patients were happy because they went home when they expected to. Hospitals were happy because they could have new beds for admissions. Insurance companies were happy. Doctors were happy. Everybody was happy.

The problem is that with the use of antibiotics, a lot of bacteria were killed but not all of them, so that it encouraged the emergence of organisms that were resistant to antibiotics.

Staph, okay, is resistant to penicillin. Strep is not. Strep is what we call exquisitely sensitive to penicillin. And as a result, someone who has a strep infection, you give them penicillin if they are not allergic to penicillin and they respond great.

Staph has an enzyme called penicillinase that destroys penicillin. When it destroys penicillin, it therefore renders the penicillin ineffective in dealing with the staff.

So then what happened is a drug company came up with a modification to penicillin. They modified a side chain and they called it methicillin because that modified side chain was resistant to penicillinase. So methicillin worked great against treating staph aureus.

So when I was in practice, if we did a culture and someone had staph, we wouldn't put them on penicillin. We put them on methicillin and they'd respond great. But then as time went on
through natural selection and mutation, the staph organism mutated and the penicillinase or enzyme mutated and a new one was formed that was able to inactivate methicillin. So we had the development of the methicillin-resistant staph aureus or what we call MRSA. So that's why I said that really MRSA has originated or developed because of the good healthcare that we have. We've reduced the risk of hospital infections and surgical infections, but now we have the emergence of an organism that is very difficult to treat. Basically, there's two types of MRSA. There's hospital acquired MRSA and there is community acquired MRSA. So that staph aureus.

So going back, what can staph do? We mentioned about impetigo, boils. Cellulitis refers to an infection of the skin. Surgical wound infection, eye infection, mastitis, breast infections for nursing mothers. Sepsis refers to wounds, okay, can cause wound infection. IV drug use. Since a lot of people will have staph on their skin, intravenous drug users on a regular basis are going to be introducing staph aureus into the system, their system. As a result they can get an infection. Osteomyelitis is an infection of the bone. Arthritis is an inflammation of the joint. Pneumonia, you guys know. And abscess is a collection of pus. So staph is a very virulent, pathogenic organism.

Now, streptococci, strep, as we call it, are based on -- there's several different types based on the type of hemolysis and differences in carbohydrate antigens in the cell wall. Now, hemolysis refers to the plate that it is plated on. The plate it's plated on has red blood cells, okay, in it. And if the strep breaks down the red blood cells, then it -- then we call that change or the breaking down of the red blood cells as hemolysis. Some will; some will not. Gamma hemolysis, they completely break up the red blood cells.

Group A is considered strep pyogenes causes pharyngitis. So I'm sure a lot of you in your years have at least one time been positive for strep in the throat. How many have been positive or had a positive strep culture in the throat? Yeah.

Group B strep is considered a normal habitant in the genital tract of women, okay, of the vagina. Probably maybe ten percent of pregnant women have a positive culture for Group B, depending on which study you read. And the concern about Group B strep is if the baby gets it, the baby can get sick. The baby can get meningitis.

And then there is Group D strep, which is basically enterococcus faecalis in the GI tract.

Now, then there is non beta hemolytic strep, which is alpha hemolysis which causes strep pneumoniea. You don't have to really know the gamma hemolysis.

So streptococci, they are gram positive arranged in chains or pairs. They're normal inhabitants of the skin, mouth, and nose. The thing, too, is that when I talk about infections from
strep or staph, some of those infections are what we call autoinfections. People can have strep in the nose, and then they can get a subsequent pharyngitis. They didn't catch the strep in the pharynx from anybody else but themselves. Pharynx refers to the back of the throat. Now, some of the diseases, I mentioned pharyngitis, the skin, the heart.

Later on in the lecture, we're going to talk about rheumatic fever and scarlet fever, toxic shock. Glomerulonephritis refers to an infection of the kidneys.

So antibiotics, one of the great discoveries and advances in medicine. We have the problem of antibiotic resistance. Why do we have the problem with antibiotic resistance? Because of overprescribing. You can argue that giving three doses of prophylactic antibiotics to reduce wound infections at the time of surgery is overprescribing, and I won't disagree with you.

Another example of overprescribing is two weeks before finals week, all right, and you don't feel well. You have got a cold, starting to kind of crummy. Your roommate went to the doctor and was diagnosed as having strep and treated with penicillin. You kind of had the early symptoms, but you don't feel as sick as your roommate did, so you kind of hang in there. And then the next week, right before exam week you really feel worse. You think, you know what, I really need an antibiotic. So you go see your doctor and he says, I really think you just have a viral infection. Viruses don't respond to antibiotics. Bacteria, they respond to antibiotics, and viruses don't.

So anyway, he said, I really think you have a viral infection, take some Tylenol and decongestant, and you should be better. Well, it's Friday and you really feel terrible. You've got a bad headache. You feel congested in the head. You go back to this guy and say, listen, I've got finals next week. I have to feel better. I don't -- I know that I have a bacterial infection. So the healthcare provider gives in and gives a prescription for antibiotics. When indeed it was a viral infection, okay, but it was -- it's overprescription. The symptoms look like it could be a bacterial infection. The patient doesn't feel well, so you get a prescription for antibiotics and you take them when you didn't really need them. Improper use of antibiotics, maybe that's an example of -- a better example of improper use is when you get a prescription for an antibiotic and you're supposed to take one pill four times a day for ten days. Then on the bottle, they put don't take with meals. Well, how do you take antibiotics four times a day for ten days and really not have it coincide with meals? And the problem with taking it with meals is it's not absorbed as well. So you take your antibiotics four times a day, that will happen for like two, three, four days. Then all of a sudden, you start to feel better. When you start to feel better, you're activity increases, you start doing stuff, and all of a sudden, you forgot that fourth dose. Then you are down
to three times a day. Couple of days later, you know what, you really feel good and you're away from your prescriptions or whatever, and you took it only twice a day. But you go, you know, I feel good. I guess I don't have to finish them. So that is improper use. So that is another example of how we have developed organisms that are resistant to antibiotics because of overprescribing, inappropriate prescribing, improper use.

So antibiotics, the mechanism of action. Now, I want you to have a general understanding of how antibiotics work. We're not going to be real specific about this. One way that it works is inhibits the synthesis of the bacterial cell wall and the cell membrane. And typical for that is going to be the penicillin family. For people who are allergic to penicillin, very often they are given cephalosporin. The most common cephalosporin they give is Keflex. How many of you have taken Keflex in the past? Okay. So that is -- that works well for people who are penicillin allergic. However, there is a slight cross-reactivity. So cephalosporin and penicillin act the same way.

Another way of mechanism of action is inhibiting the synthesis of proteins specific to microbes. ( ), which is not used that often. Tetracycline is. Tetracycline is commonly used for acne. Azithromycin works really well. How many of you have taken azithromycin before? Okay. What that does is inhibits the synthesis of microbial proteins. It comes in that dose pack. You take two pills right away, and then one pill a day for three to four days. You're done and usually you feel better. Works great for upper respiratory tract infections and nasal congestion.

Question?

STUDENT: Why don't those work with staph?

PROFESSOR: Why don't they? Because the microbial proteins that they inhibit, they don't inhibit the staph microbial proteins.

Now, also some of them inhibit bacterial metabolic functions. Folic acid synthesis, that's the sulfonamides and trimethoprim. Now, inhibiting the bacterial metabolic functions, sulfo drugs -- classically, sulfo drugs are used for urinary tract infections. They have minimal side effects. They are easy to take. They don't affect the stomach or anything else like that. The only thing you have to worry about is a very small percentage can develop an allergy and allergic reaction to it. Typically that's manifested as a skin rash. Other mechanisms of action, inhibiting bacterial DNA synthesis, ciprofloxacin. And of course, the one that I'm sure a lot of you have taken is cipro.

So here is a diagram that shows you the cell wall, the cell membrane, metabolic machinery, and essential substances and then the competing substances that you can administer. This diagram just shows you the areas of action for the antibiotics.
So what are some of the adverse effects of antibiotics? Well, toxicity. It can be toxic. That is a very general term. A more specific term is hypersensitivity. You develop an acute sensitivity to it. A concern also is alteration of the normal bacterial flora. When that really occurs is when people are given a broad spectrum antibiotic. Common broad spectrum is going to be penicillin or penicillin derivative drugs. Probably the most common affect of that is for women, if they get a sore throat, you or I, and they are given penicillin or ampicillin. That's a broad spectrum antibiotic. When I say broad spectrum, it kills the strep, right? But it also kills other bacteria that are in the body. So when you end up administering or giving a broad spectrum antibiotic, you kill a lot of bacteria. You then destroy or balance or the ecosystem in the body for awhile. That is why women who take penicillin or ampicillin are at increased risk for getting a vaginal infection caused by yeast. Yeast can be a normal inhabitant of the vagina and is kept in check by the bacteria that are present. When they take -- when patients take penicillin or ampicillin, it kills a lot of the bacteria in the throat, in the GI tract, in the vagina. As a result the balance is disturbed, and you get an increased number of yeasts and you get the symptoms of yeast vaginitis, which tends to be a vaginal discharge and vaginal itching and irritation.

Let's see. So adverse effects. Development of resistant strains. I've talked to you about MRSA. Also, there is mechanisms for circumventing effects of antibiotics such as penicillinase. They can mutate, change the cell wall structure or change the internal metabolic machinery.

So sensitivity tests. I'll go over this slide. I don't think it's that significant. You can do tube dilutions which measures the highest dilution inhibiting growth in a tube, test tube. Inhibiting the growth of the bacteria. They also use disks, all right, inhibit the growth around the disk. When, for example, someone has an infection, to diagnose the organism, they take a sterile cotton tipped applicator. They rub it on the source. For example, if it's the throat or tonsils, they'll do it on the tonsils. If it's a wound infection, they will take a cotton tipped applicator, insert it into the wound area that is draining, and then it gets put in a culturette and sent to the lab. In the lab what they do is they then take that culturette and they play it on a special media, all right, to encourage the organism to grow. They also will place antibiotic disks on the media. The idea is that if the organism is sensitive to the antibiotic disk, it will not grow near it. So as a result there is a clear halo around the antibiotic disk. So then what happens is the lab report that the lab generates, what they do is they diagnose the organism by looking at it under the microscope, gram staining it, and then they also will report the sensitivity. The sensitivity is what antibiotics the
bacteria is sensitive to and what it's resistant to. Staph will be sensitive maybe to methicillin. It will be resistant to penicillin.

Let's see. So chlamydiae. It's considered a gram negative, nonmotile bacteria. There's no flagella. Characteristically, it forms inclusion bodies in the infected cells. So it really needs to live intracellularly. It's got a rigid cell wall and it's reproduced by distinct intracellular cycle, as opposed to staph and strep which can live extracellularly. It's susceptible to tetracycline and erythromycin. No vaccine available. And what it does is it can cause pneumonia. Psittacosis is a pneumonia. And the primary source of the psittacosis is inhalation of dried bird feces.

I do have a story about that which we can digress on. When I was in med school, the senior year is ten months. You have to take a month in the emergency room, rotate through the emergency room. However, the rest of the time, you can take electives. And so one of the electives I took was an infectious disease elective. You are assigned to an infectious disease team, which is basically an infectious disease attending. And then there is a fellow. There is like one or two residents, an intern, and one or two med students. What it is is you work with the attending and the fellow. You go around and you see consults, and, you know, people in the hospital who their internists wants them to have an infectious disease consult because of difficulty in treating them or whatever.

Once a week we were in a group of hospitals, okay, in the New York metropolitan area where each week we'd got to a different hospital and they'd have ground rounds. Each hospital then would present interesting cases in the ground rounds, and then you were able to ask questions and try to diagnose the disease, how to treat it, and whatever of the presentation.

So they had this one case that struck me as very interesting and it's related to this. They had a woman who was admitted to the hospital very severely ill with psittacosis pneumonia. So the question is how did she get it? So they had all these questions. And first of all, what did she do? She didn't work in a pet store. She worked in a bank. She never had birds. No one in her family had birds. No parakeets, no parrots, whatever. Then they went to the neighborhood. Where did she live? Maybe someone had a loft of pigeons near there. Could that be it? Then it was how did she get to work? Did she walk through a park? You know how when people -- you walk through the park and there's pigeons on the benches. People feed pigeons. There's a whole flock of them. No, she didn't walk to work. She drove to work. She parked on the street near the bank and she went into the bank. So they exhausted all these areas of trying to figure out how she got this psittacosis pneumonia.

So then they did a study of her work. They went to the
bank, and she worked in an old bank building. High ceilings, you know that Greek kind of architecture with the columns. It didn't have central air, but did have air-conditioning vents in the top, the really high ceiling. So they looked at the air-conditioning vents. They went outside, and then they found -- the window air-conditioning vent, very high up was a pigeon's nest underneath the air-conditioning vent. That air-conditioning vent -- they went inside and the air-conditioning vent was directly over her desk. So basically, the psittacosis, which was in the pigeon feces, was just being blown on her desk tremendously. So she came in with overwhelming psittacosis pneumonia.

The moral of the story is basically extreme situations can cause illness. You can go to the park and feed pigeons, you're fine. But when you have tremendous exposure, all right, it can cause an infection.

Chlamydiae trachoma can cause conjunctivitis, infection of the eyes. Also, it causes urethritis in men and cervicitis and PID in women. And let's see. I'll discuss these now. I think they're in the next chapter also. Chlamydiae is considered an STD. And in men it causes what we call non-gonococcal urethritis. The urethra gets inflamed. When it gets inflamed, what happens is men have burning urination. They have a bloody, pus discharge from the penis. And obviously it's spread through sexual relations with someone else who has chlamydiae. The treatment is going to be antibiotics.

The concern is that the most common cause of urethritis used to be gonococcus, urethral gonorrhea. Now through treatment the incidents of gonococcal urethritis has decreased and chlamydia is more prevalent. Originally, when men would come in with the urethritis, he was diagnosed with gonococcal, and they would do cultures. They would come back as non-gonococcal. And the chlamydiae is an intracellular organism, and so they thought it was some type of viral thing. So it got to be labeled as a non-gonococcal urethritis. Then they realized it was chlamydiae.

As far as women goes, it's an STD, and initially the site of infection is going to be the cervix, the mucus-producing glands in the cervix. The organism proliferates. It then can move up the uterus through the tubes and cause an infection in the tubes and by the ovaries. Salpingitis -- remember "itis" means inflammation. So the term for infection of the tubes is salpingitis. PID refers pelvic inflammatory disease. The concern is that with chlamydiae, it causes an inflammation of the tubes and ovaries. They get a pelvic inflammatory disease. The pelvis gets inflamed. The peritonitis gets red and irritated. As a result of the organism, the infection, pus is present, scar tissue forms and then scar tissue on the tubes can reduce fertility.

The other thing is that women who get PID are at an
increased risk for getting a pregnancy in the tube as opposed to a fertilized egg implanting in the uterus. When there is scarring of the tube, it affects the motility of the tube. What happens is the egg is released from the ovary. In normal processes, it's fertilized in the tube. Then the tube moves it down to the uterus and implants in the uterus. Now, if you have scarring or infection within the tube, it may not function that well. After a certain time, it may not move the fertilized egg along quickly enough so that it attaches within the tube. Atopic refers to an abnormal location or position. So it doesn't refer just to pregnancy. So the medical term for atopic means in an unusual place, not the usual location. The concern about pregnancy in the tube is that it will attach. It will start to grow. Blood flow will be increased to the tube then it will rupture. It will rupture the tube. It will outgrow the tube. The tube will rupture, and there can be tremendous bleeding.

In Florida, women die of ruptured atopic pregnancies every year. Not many, just a couple. But one is too many. So it is a risk factor. LGV is not common at all. That's Lymphogranuloma venereum, and that is an STD, also. Rickettsiae and Ehrlichiae. We're not going to have to spend a lot of time on them. Basically, these are diseases where they affect the small blood vessels. Rocky mountain spotted fever is transmitted by ticks and organisms, transmitted by the tick, a tick bite. And it can present symptoms, and the symptoms will depend on which blood vessels it invades. For example, they may have liver symptoms if it invades the blood vessels that bring blood to the liver. You don't have to know really the rest of this slide.

Let's see. Mycoplasma. It's a little more significant. It's the smallest. It has -- it's wallless. It's a free-living bacteria. The significance of mycoplasma is it can cause pneumonia. It's called a mycoplasma pneumonia. It's an atypical pneumonia, and it's what we label as walking pneumonia. It's a walking pneumonia. Basically what happens is people have symptoms, okay, and they don't feel well, but they can -- they don't -- they will drag themselves to class. They don't feel like they need to stay in bed. The really typical pneumonia where people get really sick is caused by a gram positive cocci called pneumococcus. Pneumococcal pneumonia, people get really sick. Mycoplasma pneumonia, people -- it's walking pneumonia. They have a cough. They don't feel well, but they don't feel -- they don't get the shaking chills that people get with the pneumococcal pneumonia. Typically with mycoplasma, erythromycin works well. Penicillin doesn't work that well.

Then they get a cough, sore throat, headache, malaise. Malaise means lack of energy. Myalgia is going to be muscle aches. It resolves in ten to 14 days. Responds to antibiotics,
tetracycline and erythromycin.

Now, viruses. Viruses are organisms, and they do not have the ability to live outside the cell really, okay. They have to invade a cell and take over some of the host cell mechanisms to proliferate and produce additional viral organisms. Their DNA can -- their nucleic acid structure will be either DNA or RNA. Sometimes they carry very few genes. They are very small, insignificant. And they require a lot of help from the host. So they have a variation of size and complexity of the genome, and they cannot be seen under light microscope. With the development of the electron microscope, we finally were able to see viruses. Before that we were not able to see viruses.

The capsid refers to the protective protein membrane surrounding the genetic material. That's the capsid.

All right. And so it has to reproduce or replicate within cells. They lack the full compliment of metabolic enzymes to produce viral particles; therefore, they have to rely on the host's metabolic processes for survival. That includes the ribosomes, mitochondria, and lysosomes. They do not multiply by fission or mitosis. We talked about mitosis in another chapter.

So the mode of action, they invade a susceptible cell. Now, what happens when they invade? Well, you can have an asymptomatic, latent viral infection. They can cause cell necrosis and degeneration of tissue. They can cause hyperplasia. What does the term hyperplasia mean, guys?

STUDENT: Increase in growth.

PROFESSOR: Good. Increase in cell number. That's a little more specific than increase in growth. Increase in cell number. So you can get cellular hyperplasia and proliferation. You can get progressive cell injury, and you get neoplasia.

Now, can you think of any virus that causes cellular hyperplasia? Increase in cell number. Okay. So no one. If I say the word virus, what virus comes to your mind right away?

STUDENT: HIV.

PROFESSOR: Okay, HIV. Great. What next after HIV?

STUDENT: HPV.

PROFESSOR: HPV affects the cell and causes cellular hyperplasia. How does it do that? What are warts? HPV can cause cellular warts. Why does it cause the warts? Because it invades the cell and causes hyperplasia, increase in number. Increase in number, you get that raised area and that's the wart.

So asymptomatic. What's an example of an asymptomatic, latent viral infection? I really don't want to use HIV. HIV does invade the cell and starts having an effect because it destroys the helper T cells. You may not have symptoms, but still the cell count is going down.

Anybody give me an example of another virus that causes a latent viral infection?
STUDENT: (Inaudible.)
PROFESSOR: Totally. That was what I'm thinking. Herpes. The initial herpes infection causes blisters and outbreak. And then what happens is it goes dormant. The only question is how long does it stay dormant? Does it stay dormant for a month? Does it stay dormant for six months? A year? Ten years? That's an example of it.

Another one is with chicken pox. The (), when you get chicken pox, it then is dormant. You always have it. And it can come out many years later as what?
STUDENT: Shingles.
PROFESSOR: Shingles, right.

Also, the HPV virus, we know strains 16 and 18 causes cervical cancer. Gardasil. What strains -- does anybody know the strains of HPV that it confers ()? No one wants to take a stab at it? It's four strains. Anybody? Six, 11, 16, and 18. Sixteen and 18 causes cervical CI. Six and 11 are for the venereal warts.

So let's see. Body defenses against viral infections. They can produce -- the body can produce interferon, which is a protein. It's an antiviral agent. It's a protein. It's one of the cytokines, and it will interfere with viral replication. Then, as mentioned before, we have the cell-mediated immunity, humoral defenses.

Now, treatment with antiviral agents. They can block viral multiplication. They actually can prevent the virus from invading the cell. Unfortunately, they have limited application. Some of them are toxic and not that effective. There are medications that you can take to reduce the symptoms of a herpetic outbreak. And also for people who get repetitive outbreaks every month, you can put them on medications. Zovirax is an example of the medication. And you put them on that for several months, and then take them off it. And what that does is usually it breaks that cycle of them getting a herpetic outbreak every month.

Here we have an example, picture of the left, of German measles. We have the herpes zoster shingles. What I want to point out on the herpes zoster shingles, what happens is -- it's really hard to tell, but I believe that that is the side of a person. You are looking at the side. Definitely the picture on the right, you see the back and the scapula at the top. What happens is the virus gets activated in a dermatome. It's a dorsal root ganglion. They live in the ganglia, and then what happens when they get activated is they present along the path of the nerve that supplies sensation to the skin. So when you look at that picture, you will see that basically it's in a band. Going from the spine, the band kind of goes diagonally downward, and that is the path of the dermatome. So people don't get it randomly. It's specific dermatomes where the shingles present.
Someone with multiple warts. Then you have got mumps. This boy has mumps. And basically mumps is a virus. He has swelling of the parotid glands. The parotid glands are located right in front of the ear. The duct enters the mouth. And as a result, when they swell -- you see the swelling in the face there.

Okay. We have condylomas or venereal warts caused by HPV, a perfect example of cellular hyperplasia. You have the herpetic blisters associated with herpes. The herpes virus is categorized or classified as Type I and Type II. There's different names for it. Sometimes herpes Type I is also known as herpes oralis. And herpes Type II is known as genitalis and/or labialis. And basically the strict or classic understanding is Type I affects the mouth and Type II affects the genitals. Now, there is cross-reactivity. Sometimes you can do a culture from a herpetic sore and you can have Type I on the genitals and Type II orally, but not usually. And the organism -- what happens is the outbreak occurs, and then it goes away. It goes away. With herpes of the genitals, Type II, to get herpes Type II, you have to have relations with someone who has the herpes virus. We used to think that the herpes virus could really only be transmitted when relations occurred with someone who had active sores. We then realized that there was a small percentage of the population that if they had herpes and it resolved, and they didn't have active sores at the time of relations, that they can still transmit the virus. We thought it was a small percentage.

We now realize that the percentage of people who can transmit the herpes virus, even if they don't have an active sore is much greater, maybe 40 or 50 percent. It's really hard to quantitate that. There is different studies that suggest different numbers. It's much more infectious than we originally thought. So that's the Type II.

Typically the herpetic sore of the genitals, it presents initially with a lot of ulcers. It can be very painful. A herpetic sore also is painful. Then after a couple of days it goes away, and then the only question is when does the next outbreak occur? Does it occur a month later? Ten years later? It's really hard to predict.

The other thing I want to say is as the population ages, more and more people are positive for herpes antibodies. Basically, positive for Type I antibodies, even though these people will deny being aware of having herpetic outbreak. So as people get older -- and when I say older, I mean 50s and 60s, a greater, greater percentage of that age group are positive for antibodies, which means they've been exposed to the virus and fought it off, fended it off. So we don't really have an understanding, a good understanding as to why that happens.

Fungi are plant-like organisms, and they don't have chlorophyll. There's two types: yeasts and molds. Most of them
are aerobes. They're opportunistic. They like a special opportunity. Let's see. Here's an example of a yeast form hyphae in the vaginal smear in the vagina. Those are vaginal epithelial cells with nuclei, but they're stratified squamous cells. Blastomycosis is a fungus; you don't need to know that.

All right. As far as parasite and host, animal parasites, the organisms are adapted to living within or on the body of another animal. We call that the host. They cannot live freely or have a free-living existence. They have a complex life cycle. For example, they can live within the intestinal tract and discharge their eggs in the feces. That's how they get transmitted. So transmission will occur because of poor sanitation. Very common in tropical climates. Less frequent in cold or temperate climates.

Protozoa are one-celled parasites. Metazoa are multi-cellular structures, okay. And then also there's the arthropod, small insects.

Guys, let me finish this. It won't take that long. Malaria is caused by various species of plasmodium. There's amebic dysentery caused by the organism entamoeba histolytica. The trichomonas vaginalis is the one I mentioned with the flagella. Giardiasis caused by giardia lamblia. It affects the small intestine, causes cramping, abdominal pain. Toxo caused by toxoplasma gondii. The concern with toxo is that it can cause an infection in the fetus. So woman who are pregnant should stay away from cat feces since it's cat feces that contain toxo. They can have a cat, they can pet a cat, but they just can't change the litter box. It can cause malformations within the brain. It can cause neurologic deficits.

Cryptosporidiosis, you guys don't have to know. Pneumocystis pneumonia. Interesting. It's caused by pneumocystis jiroveci, and it is an opportunistic infection. It's an opportunistic infection in that it requires a special opportunity. What is the opportunity? The opportunity is decreased helper T cell count. We'll talk about AIDS and HIV in the next chapter.

Roundworm. Three types of worms here: ascaris, pinworms and trichinella. The ascaris is a large worm that lives in the intestines. The pinworms are interesting in that the pinworms typically occur in the pediatric age group. The symptoms are little kids have perianal itching at night. The reason why we have that at night is because the female worm comes out and lays her eggs on the skin. The way to diagnose it is take a piece of Scotch tape, the pediatrician does, they just apply the tape to the perirectal area, take it off, put it on a glass slide, look at it underneath the microscope and you can see the eggs on the Scotch tape.

Trichinella, small roundworm. Parasitizes small animals and humans. You get that from eating improperly cooked pork.
There is some pictures.
  Tapeworm, they are longer, ribbon-like worms. They can
grow to a length of several feet. They live in the intestinal
tract. You get them by eating the flesh of an infected animal.
  Flukes are thick, fleshy short worms. They can suck. They
have a suction. They attach to the host.
  Trichonosis, that's a muscle biopsy.
  Arthropods transmit by close physical contact. Scabies and
  crab louse. The scabies organisms, they are a small parasite.
They burrow underneath the skin where they lay their eggs that
hatch in a few days. You are diagnosed because you actually can
see the furrow lines underneath the skin.
  Crab louse lives in the anal and genital area. They lay
their eggs attached to the hair. I think there's a picture. I
know there's a picture of them.
(End of class.)

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I hereby certify that the foregoing transcription is a true
and accurate verbatim record of the recorded proceedings.

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