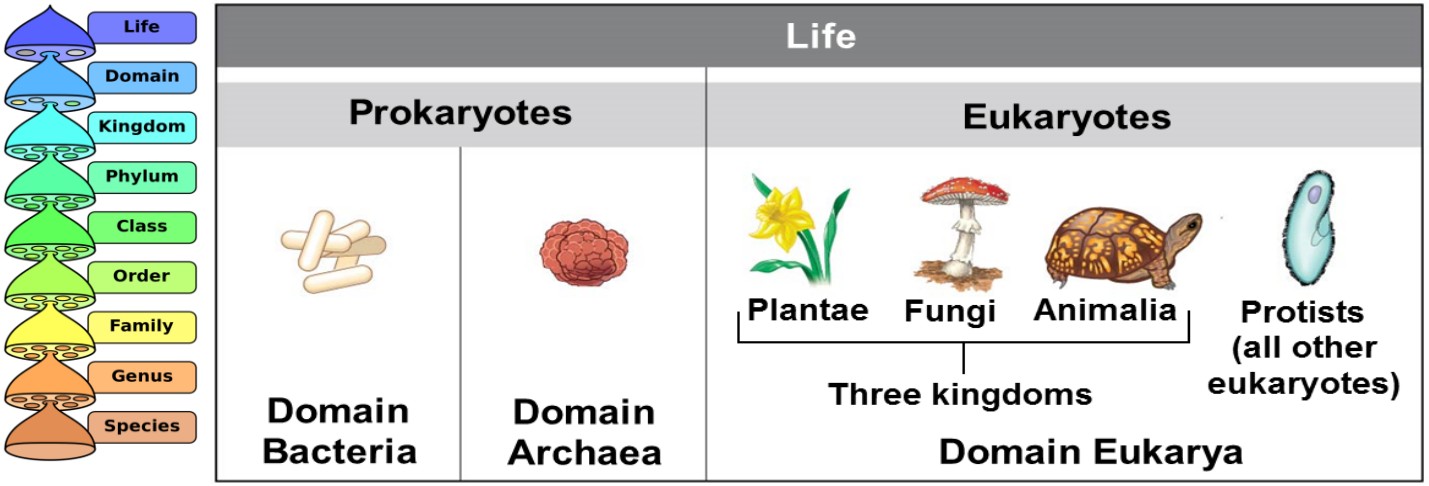
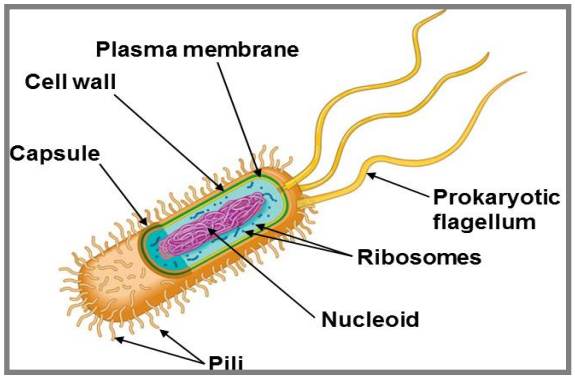
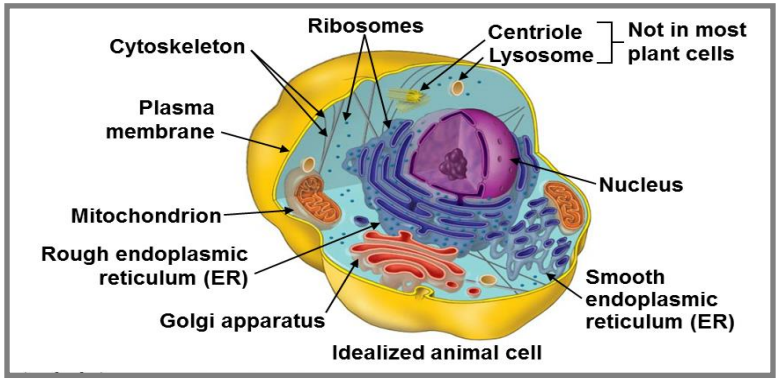
	BIOS 2015 ... CHAPTER 6 - INFECTION	
Page	**Note**	
89	**Review of Microbiology**	
	Microbiology refers to the **study of microorganisms** or microbes, very small living forms that are visible only with a microscope.	
	Microorganisms include **bacteria, fungi, protozoa, and viruses**.	
	Pathogens are the disease-causing microbes often referred to as "germs."	
	- but note that many microorganisms are classified as **nonpathogenic** because they do not usually cause disease.	





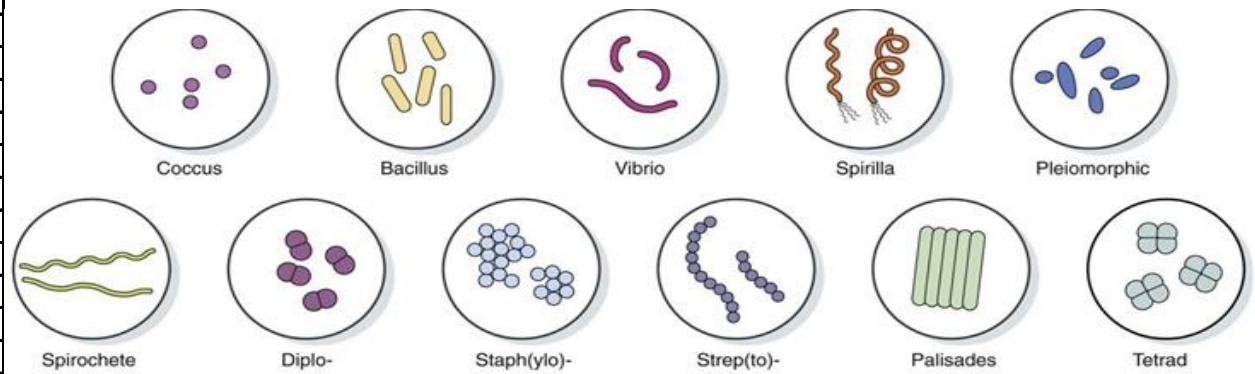
Prokaryotes

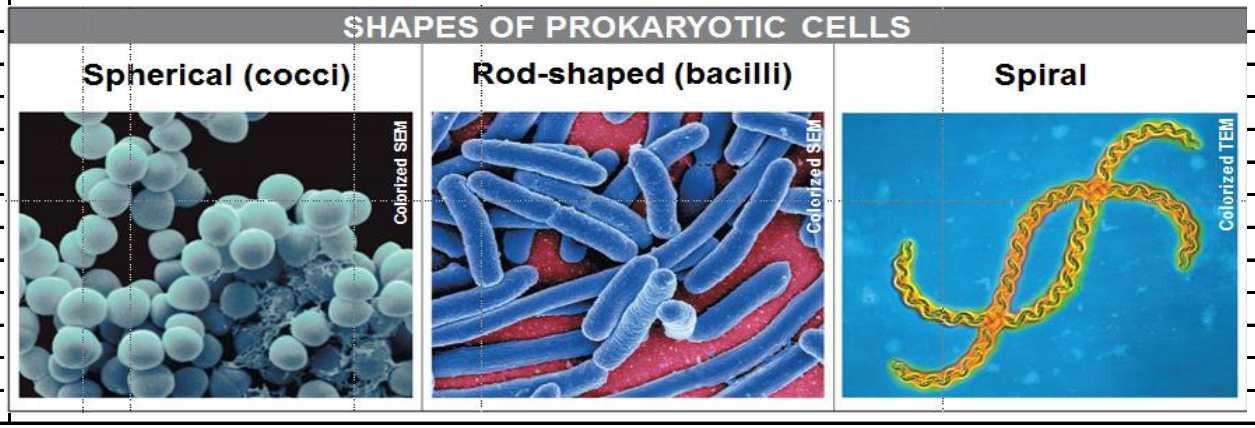


Eukaryotes

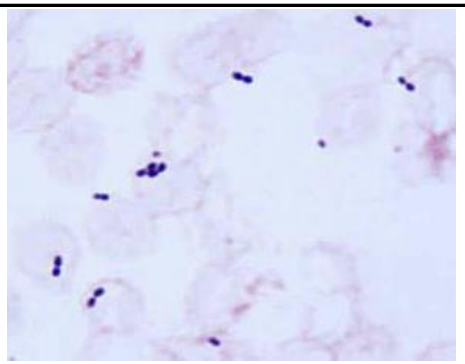
BACTERIA:

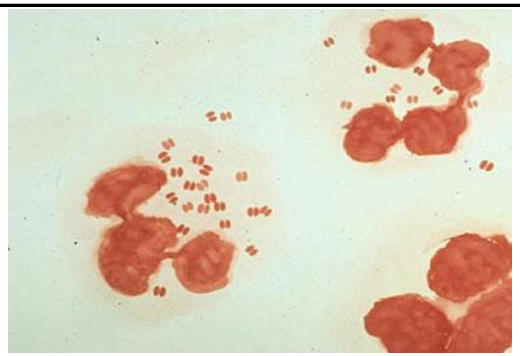
- are morphologically defined by their shape and clustering habits.
- some have special structures like flagellae that provides motility.
- some have hair like structures, **pili,** on the surface that aid in attachment to the host.
- special pili, "sex pili", allow exchange of genetic material between bacteria. Exchange of small pieces of DNA (plasmids) allows for transfer of drug resistence.





Streptococcus pneumoniae





Pneumococcus - lance shaped **positive** diplococci

Neisseria gonorrhoeae - bean shaped **Gram negative** diplococci

90 - further defined by their growth requirements

culture no.	ONPG	ADH	LDC	ODC	CIT	H2S	URE	TDA	IND	VP	GEL	GLU	MAN	INO	SOR	RHA	SAC	MEL	AMY	ARA	identification
8101	+	–	+	+	–	–	–	–	+	–	–	+	+	–	+	+	+	+	–	+	*Escherichia coli*

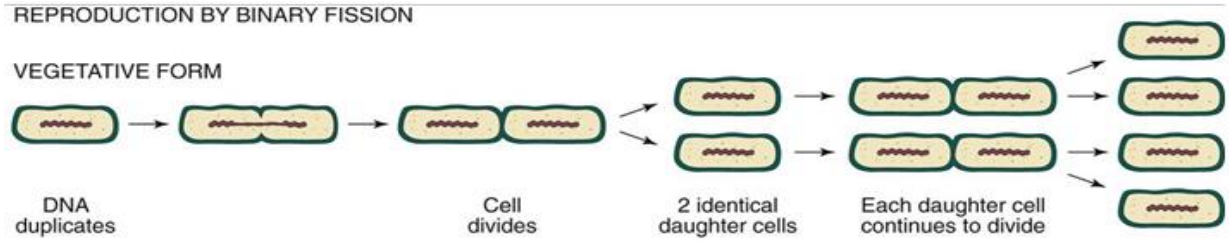
Different kinds of agar in petri dishes are inoculated as a first step.

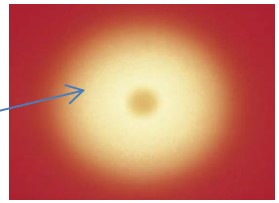
A series of substrates are inocculated to see which nutriens support the bacterium's growyh. These nutrients include different sugars, amino acids, and other nutrients. Growth results in a color change in the growth medium. The results produce a profile

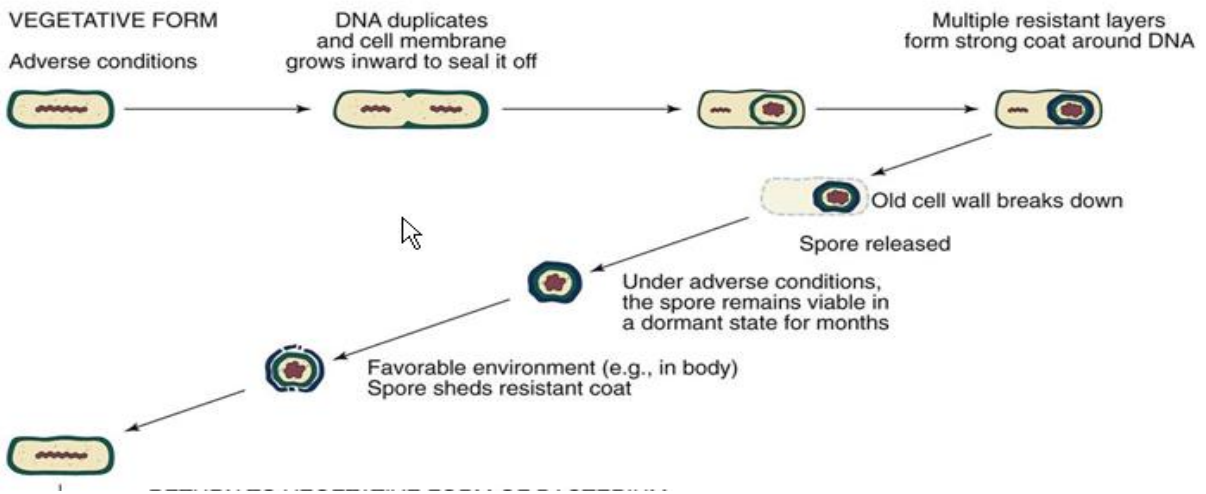
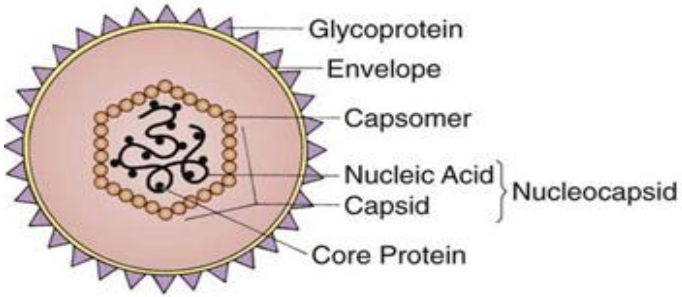
Other methods:

- DNA analysis

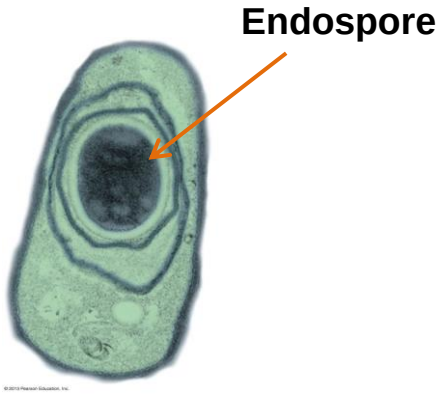
- **MALDI-TOF MS** , an elegant and very fast method in which a bit of a colony is spotted on a plate and mixed with a fluid to prepare it, after which it is vaporized by a laser and the vapor is analyzed to produce an electronic foot print that can be compared with a data base.

	Bruker Corporation Announces **FDA Clearance** to Market the MALDI Biotyper CA System BILLERICA, Mass.--(BUSINESS WIRE)--**Nov. 26, 2013**-- Bruker Corporation (NASDAQ: BRKR) today announced that it has been granted U.S. FDA clearance under Section 510(k) to market its MALDI Biotyper CA System in the United States for the identification of Gram negative bacterial colonies cultured.
	http://www.bruker.com/products/mass-spectrometry-and-separations/maldi-biotyper/overview.html
91	**Bacterial Toxins:**
	- **Exotoxin** is secreted (usually by Gram positive bacteria) and enters the blood stream to produce various effects. Examples: Neurotoxin from Tetanus bacillus; Enterotoxins that produce vomiting by effects on the brain. Their exposure can generate an antibody responseindicating that vacines may be effective as a preventative measure.
	- **Endotoxins** are present in the bacterial cell wall and are released from dead baceria. Systemic effects include fever, weakness, increased capillary permeability, loss of vascular fluid, and endotoxic shock.
	- **Bacterial enzymes** are released by some bacteria and result in tissue damage:
	Hemolysin, released by hemolyic streptococcus, lyses red blood cells (producing a clear zone in blood agar)
	Collagenase breaks down collagen
	Streptokinase breaks down blood clots.
92	**Bacterial Reproduction and Spore Formation:**
	- Reproduce by binary fission.
	



	- Environmental pressures drive the bacterium to form spores, a condensed coated form that protects the DNA until conditons are right to flourish.
	
	VIRUSES
	A **virus is an obligate intracellular parasite** that requires a living host cell for replication.
	- When it is extracellular, a virus particle is called a **virion.**
	- It consists of a protein coat, or capsid, and a core of either DNA or RNA
	- Some also have a protective envelope.
	

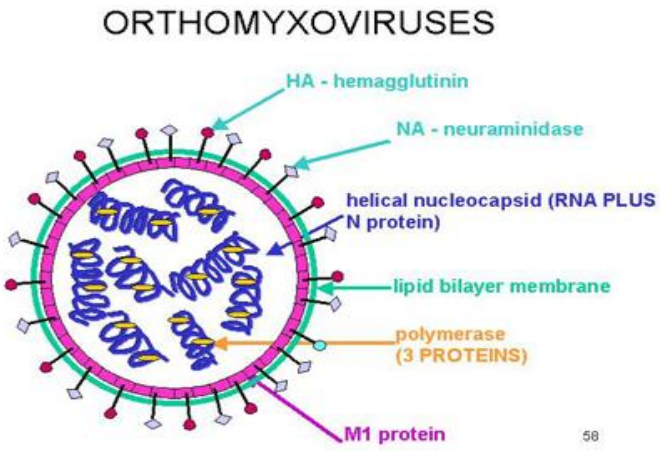
Life Cycle: When a virus infects a person, it attaches to a host cell, and the viral genetic material enters the cell. Viral DNA or RNA takes over control of the host cell, using the host's capacity for cell metabolism to synthesize protein, producing many new viral components . The new viruses are assembled, then released by lysis of the host cell or by budding from the host cell membrane usually with destruction of the host cell—and the new viruses in turn infect nearby cells. **Some viruses remain in a latent stage**; they enter host cells and replicate very slowly or not at all until sometime later.

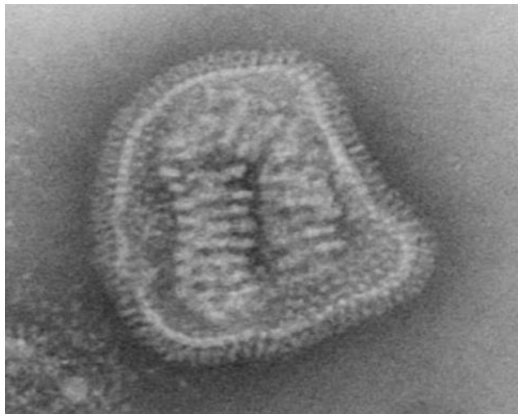


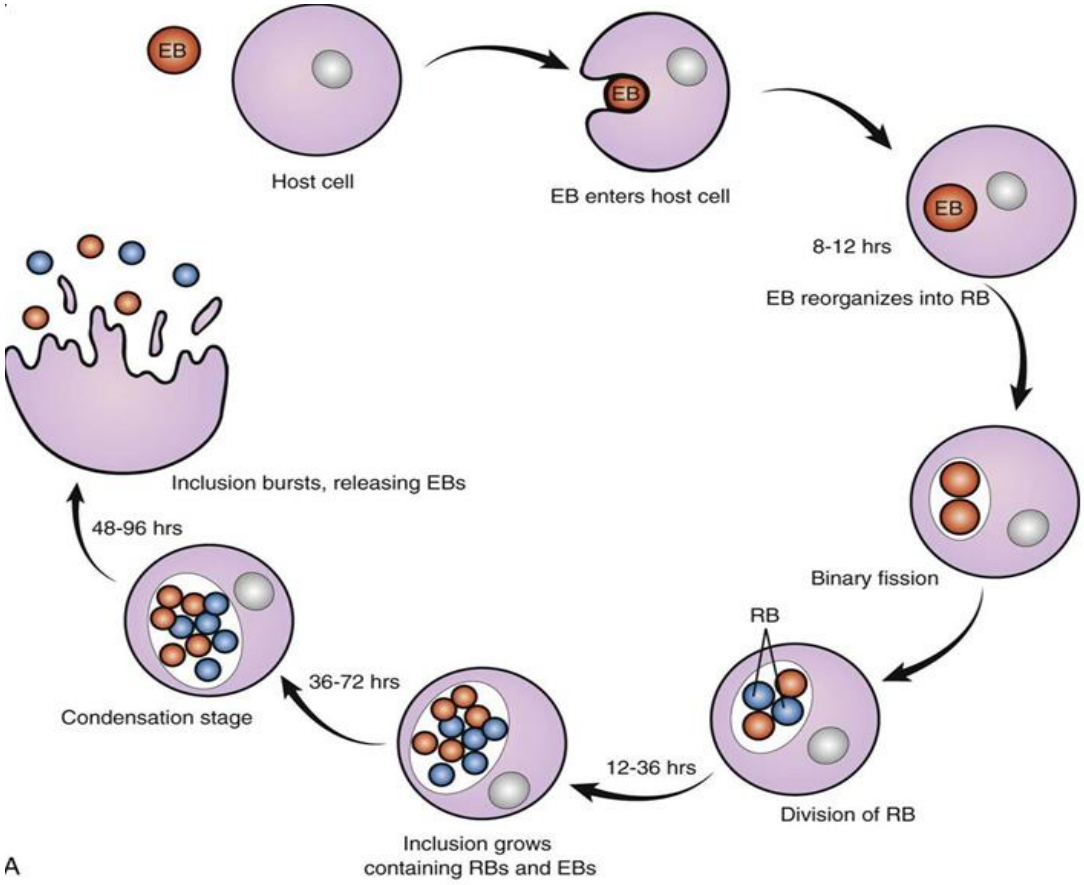
Viruses are difficult to treat:

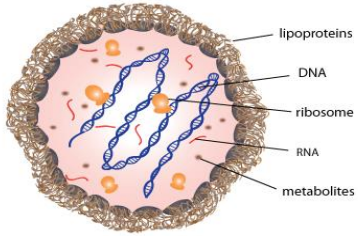
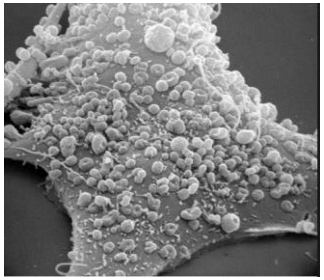
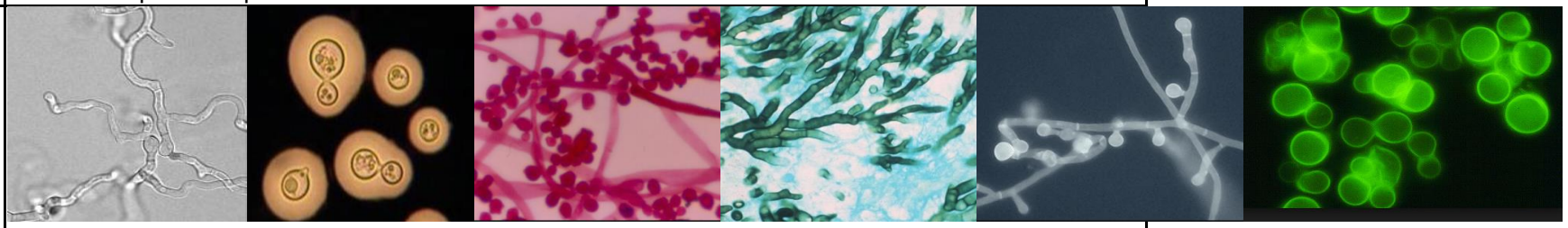
- some express protein on surface of host cell but many hide inside the host cell.
- use the host's metabolic machinery, so they are difficult to attack with drugs that target metabolism.
- they mutate.
- they combine with parts of other viruses (H1N1 has components from swine and human influenza.
- collectively this diversity makes it difficult to develop immunity to the virus.

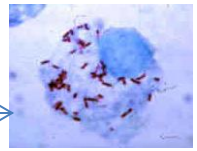
Type of Virus	RNA or DNA	Example of Disease
Orthomyxoviruses	RNA	Influenza A, B, and C
Paramyxoviruses	RNA	Mumps, measles
Togavirus	RNA	Rubella virus (German measles), Hepatitis C virus
Herpesvirus	DNA	Herpes simplex, Infectious mononucleosis, Varicella (chickenpox)
Flaviviruses	RNA	West Nile virus, Encephalitis
Picornaviruses	RNA	Poliovirus, Hepatitis A virus
Hepadnaviruses	DNA	Hepatitis B virus
Papovaviruses	DNA	Warts, cancer (human papillomavirus/HPV)

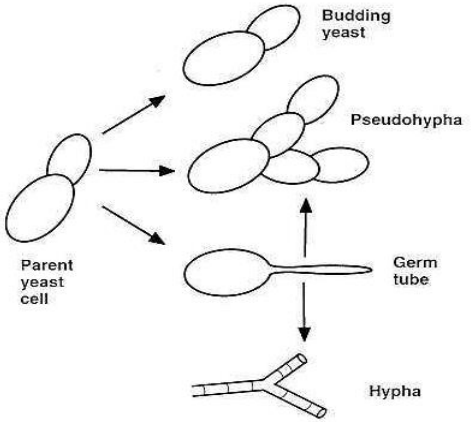




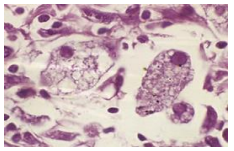
93	**Chlamydiae, Rickettsiae, and Mycoplasmas**
	replicate by binary fission, but they lack some basic component; therefore they require the presence of living cells for reproduction
	Chlamydiae are considered very primitive forms related to bacteria:
95	- They exist in two forms. One, the elementary body (EB) is infectious, possessing a cell wall and the ability to bind to epithelial cells. The other form, the reticulate body (RB) is noninfectious, but uses the host cell to make ATP and reproduce as an obligate intracellular organism. After large numbers of new microbes are produced inside the host cells, the new RBs change into EBs, rupturing the host cells' membranes and dispersing to infect more cells.
	

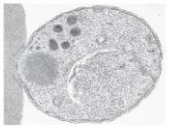
	Rickettsiae are **tiny gram-negative bacteria** that live inside a host cell (obligate intracellular parasites). They are transmitted by insect vectors, such as lice or ticks, and cause diseases such as typhus fever and Rocky Mountain spotted fever. They attack blood vessel walls, causing a typical rash and small hemorrhages.
	Mycoplasmal infection is a common cause of pneumonia. These microbes **lack cell walls**—therefore are not affected by many antimicrobial drugs—and they can appear in many shapes. They are the **smallest cellular microbe.**
	  Mycoplasma on the surface of a cell.
96	**FUNGI**
	Classified as **eukaryotic**
	Fungal or mycotic infection results from single-celled yeasts or multicellular molds.
	Frequently considered beneficial because they are important in the production of yogurt, beer, and other foods, as well as serving as a source of antibiotic drugs.
	Hyphae - long filaments or strands of fungal cells.
	Mycelium - a mass of filaments visable as a solid object (like a mushroom).
	Reproduce by budding, extension of hyphae, and spores.
	Tenia pedis - foot fungus
	Candida - a yeast normally on the skin, but someimes it causes infection of the oral cavit in infants (thrush) or vaginal yeast infections. In an immunocompromized person, it can spread as a systemic infection.
	Histoplasmosis - inhaled and may infect lungs of a normal person or may spread systemically in an immunocompromized patient.
	



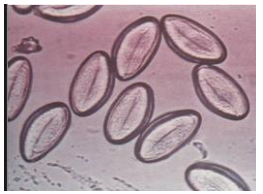


97	**Protozoa**
	Protozoa are eukaryotic or more complex organisms. They are unicellular, usually motile, and lack a cell wall, but occur in a number of shapes.
	Examples:
	Trichomonas vaginalis - a flagellate that casues a sexually transmitted disease.
	Entamoeba histolytica - an ameba that causes diarrhea (spread by fecal-oral route).
	- amebas move by using "pseudopods" (false feet).
	Plasmodium - causes malaria (spread by mosquito).
	Giardia lamblia - a flagellate that causes "explosive diarrhea".
98	**Helminths**
	Parasitic worms that infect humans.
	Their life cycle consists of at least **three stages, ovum (egg), larva, and adult**. The ova or larvae may be ingested in contaminated food or water, or may enter through the skin or be transmitted by infected insects. They are often found in the intestine but can inhabit the lung or blood vessels during parts of their life cycle.
	Helminths are usually diagnosed by observation of ova or eggs in stool specimens.
	In North America include pinworms, hookworms, tapeworms (Fig. 6-10), and Ascaris or giant roundworms.
	Prions - infectious proteins
	A prion is an abnormal molecule that is transmissible in tissues or blood of animals or humans. It induces proteins within the brain of the recipient to undergo abnormal folding and change of shape. This renders the protein molecule non-functional and causes degenerative disease of the nervous system. Prion diseases in humans include Creutzfeldt-Jakob disease and variant Creutzfeldt-Jakob disease.These are rapidly progressive and fatal. It is thought that variant Creutzfeldt-Jakob disease is caused by consumption of meat that has been contaminated with nervous tissue from an infected animal such as beef cattle. In areas where bovine spongiform encephalopathy (BSE), the animal prion infection, is prevalent, consumption of ground meats, sausages, or offal should be avoided.





Adult Pin Worm



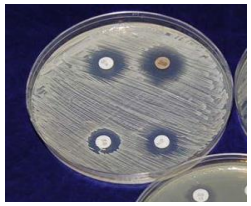
Pin worm Egg

Tape Worm

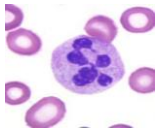
	Algae
	- usually not a concern for human disease
	- Medical concerns involving algae include: human consumption of marine animals that have fed on algae and accumulated toxins produced by the algae and recent disorders attributed to the algae Pfiesteria piscicida.
99	**Infection**
	Flora - microbes that normally inhabit a part of the body.
	Infection - when a microbe or parasite is able o reproduce on or in a tissue.
	Endemic - a disease that consistently occurs in a given geographic region.
	Reservoir - where the disease can reside awaiting the opportunity to infect. Can be a person, water, doil, food, equipment, etc…
	Infections spread by:
	Direct route - physical contact or by passing across the placenta to the fetus.
	Indirect route - through an intermediary like infected food.
	Droplet - like in a sneeze can be directly inhaled or contacted on a contaminated object.
	Aerosol - transmitted by small particles from the respiratory tract passing in the air.
	Vector borne - like a mosquito borne disease.
	Nosocomial infections - occur in health care facillities. HAND WASHING - very important to control.
102	**Control of Transmission and Infection**
	Universal precautions: treat all blood, body fluid and waste as if it is infected.
	- use gloves, masks, gowns, etc as needed to produce a barrier.
	- dispose of needles and sharps in special containers.
	- manage biohazard waste.
	Control spread by **identifying and targeting reservoirs** and using epidemiology and invesigators to track down sources of epidemics.
	Sanitation is important:
103	**Disinfectants:** chemical solutions that are known to destroy microorganisms or their toxins on inanimate objects (vary on what they kill - read the label).
104	**Antiseptic:** chemicals applied to the body that reduce the number of organisms on the surface. They often wash away naturally by body fluids or have a limited effective time on the site applied.

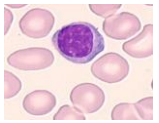
	Physiology of Infecion
	The microorganisms must gain entry to the body, choose a hospitable site, establish a colony, and begin reproducing. Only if the host defenses are insufficient to destroy all the pathogens during this process will infection be established.
	Incubation period refers to the time between entry of the organism into the body and appearance of clinical signs of the disease. Incubation periods vary considerably, depending on the characteristics of the organism, and may last days or months.
	Prodromal period, which is more evident in some infections than others, follows. This is the time when the infected person may feel fatigued, lose appetite, or have a headache, and usually senses that "I am coming down with something."
	Acute period, when the infectious disease develops fully, and the clinical manifestations reach a peak.
	Progression of disease:
	- may be short lived and quickly resolve, completely cured (like a 24 hour flu).
	- may produce a prolonged illness that eventually resolves (or not).
	- may proceed rapidly to death.
105	**Patterns of Infection:**
	Local infections - organism enters the body and remains confined to a specific location.
	Focal infections - pathogen spreads from a local infection to other tissues.
	Systemic infections - infection spreads to several sites and tissue fluids, typically through the circulatory system.
	Septicemia - pathogens in the blood
	Bacteremia - bacteria in the blood.
	Toxemia - toxins in the blood.
	Viremia - viruses in the blood.
106	**Methods of Diagnosis**
	Stain specimen:
	- Gram stain, fungal stain, mycobacterial stain.
	Culture the specimen to grow and identify the pathogen and its drug sensitivity.
	Blood tests - CBC and diff

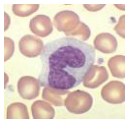
Clear zone of no growth around antibiotic disk shows sensitivity of the bacterium.

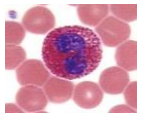


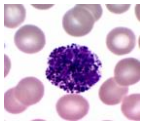
	CBC - complete blood count (gives the number of red and white blood cells and platelets per unit of blood volume as well as information about their size and shape).
	Leuko**cytosis** - **increase** in white cells, often in bacterial infections.
	Leuko**penia** - **decrease** in white cells, often seen in a viral infection.
	Monocytosis - increaeed monocytes.
	Neutropenia - decreased neutrophils.
	Bacteria - often elevate neutropils.
	Viruses - often elevate lymphocytes and monocytes.
	Diff - "differential count" gives the percentages of the different white blood cells.
	Serology - blood tests that look for an increase in an antibody to a specific organism to indicate exposure or infection.
107	**Treatment**
	Designed so that drug resistence does not develop.
	Antibiotic - kills bacteria and will not kill virus.
	Bacteriostatic - slows bacterial growth
	Bacteriocidal - kills bacteria.
	Broad Spectrum - kills wide range of bacteria (Gram negative and positive).
	Narrow Spectrum - kills a more focused population, preferred as less disruptive to flora.
108	Modes of action:
	- interfere with bacterial cell wall synthesis. (example - penicillin).
	- destabilizes cell membrane and allows contents to leak out.
	- interfere with protein synthesis.
	- interfere with synthesis of essential metabolites.
109	Antiviral - decrease the reproduction of viruses inside the host cell but cannot destroy the virus.
	INFLUENZA
	The influenza viruses are classified as RNA viruses of the myxovirus group. There are three subgroups of the influenza virus—type A, the most prevalent pathogen, type B, and type C. Types A and B cause epidemics and pandemics that tend to occur in cycles. The influenza virus, particularly type A, is difficult to control because it undergoes frequent mutations.

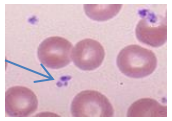

Neutrophil


Lymphocyte


Monocyte


Eosinophil


Basophil


Platelet

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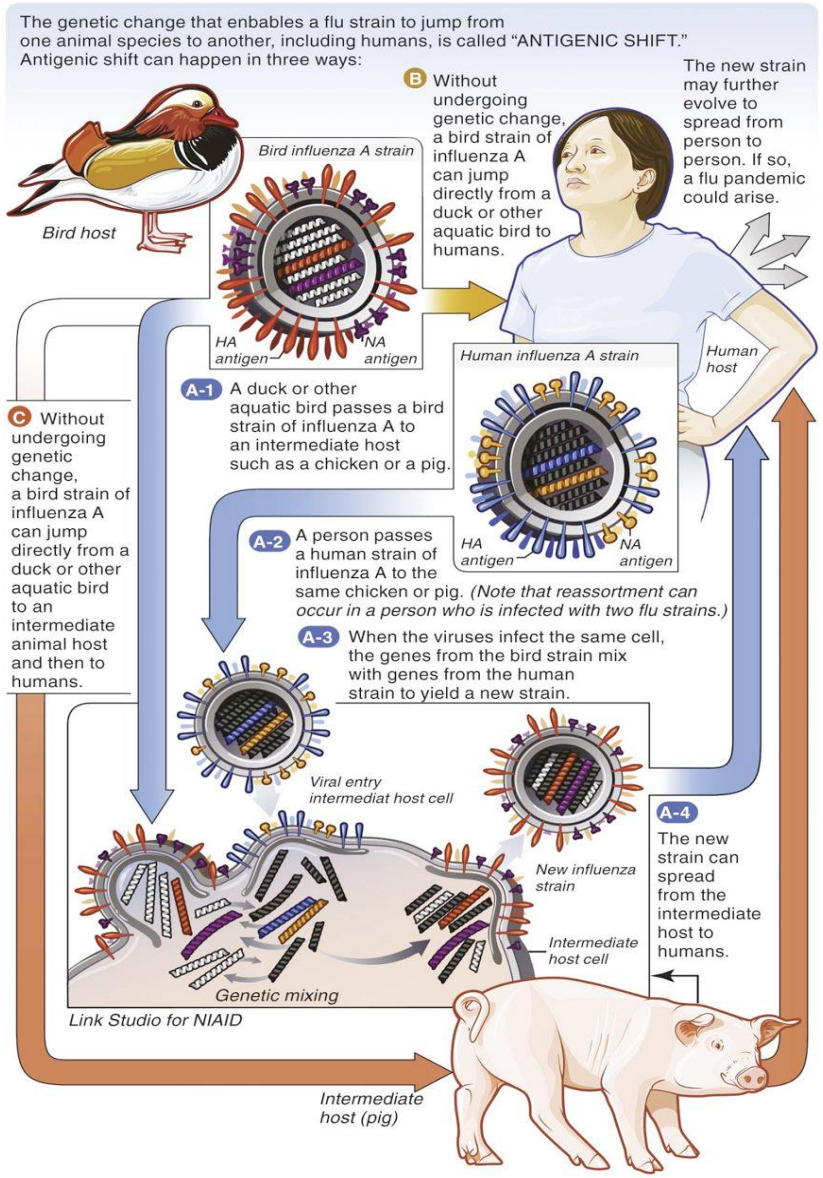

Antigenic Shift: Three ways depected above.