

General Principles of Microbiology



micro = small

bio = life

logy = study (of) or science

Immunology = study of our protection from foreign macromolecules or invading organisms and our responses to them

Different classes of organisms...



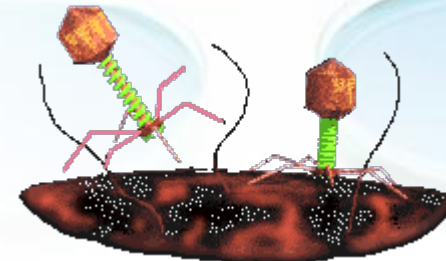
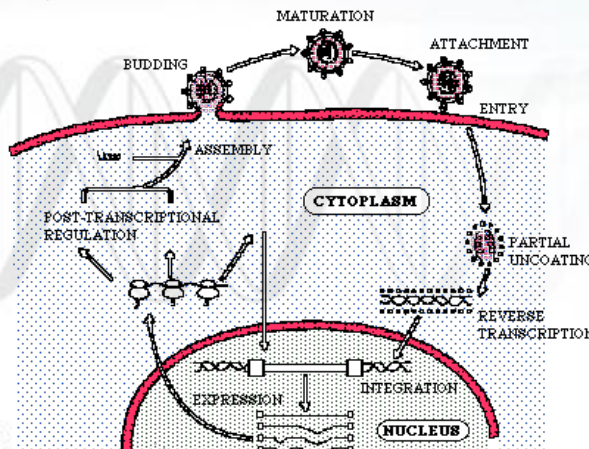
- ✓ Viruses / chlamydia (grow only in living cells)
- ✓ Mycoplasma (grow on non-living media)
- ✓ Bacteria (no separate nucleus; unicellular)
- ✓ Parasites
- ✓ Small (microscopic)
 - ❖ 1-2 microns (1 mm = 1000 microns)
 - ❖ Address them by their proper names !!!
 - (i.e., not "germs", "bugs")

What are they made of?



✓ Viruses

- Nucleic acid (either RNA or DNA...never both!)
- Surrounded by protein shell (capsid)
- Attach, inject nucleic acid (penetration), highjack synthetic processes inside cells to make more viruses, package, get out while going is good...



What are they made of?



✓ Bacteria

- Rigid cell wall to keep things in place
- Genetic material - circular chromosome
- No nucleus (nucleoid)
- Both DNA and RNA
- Binary fission



Some bacteria do not have a rigid cell wall and are more fragile (i.e., Mycoplasmas)



What are they made of?



✓ Eukaryotes

- Unicellular and multicellular animals and plants
- Genetic material is organized into a nucleus

✓ Are all bacteria bad?

Probiotics make sure all the space in the GI tract are occupied so that bad bacteria do not fill them.

- ✓ biotechnology, spoilage of foods, bioremediation, functional foods, etc...

✓ Can we live without bacteria?

No because they help with the physiology of the GI tract and they play a part in the innate immune system.





Good?



Health Canada Santé Canada

Canada

"Normal" flora...the good guys 😊



✓ Resident versus Transient

Resident - stay for a long time

Transient - come and go (do not stay for a long time)

✓ GI-tract: colon is inhabited by anaerobes and coliforms

✓ Skin: mostly coagulase negative staphylococci

✓ Where should there be NO bacteria?

ON MIDTERM: - urine, CSF, blood (circulatory system), CNS, lymphatic system, the eyes

What can they do for us?

- protection from invasive (bad) bacteria
- metabolism (vitamin K), immune stimulation

What protects us from the bad guys?



✓ Mechanical barriers

- skin, saliva, mucous, tears, hairs, etc.

✓ Other helpers include

- antibodies
- complement
- immune cells (T-cells, NK cells, macrophages)
- immune system (cell mediated; humoral)

Burn victims are extremely at risk because the skin is such an important protector.

How do the bad guys get in?



- ✓ Adherence
- ✓ Toxin production (destroys some of our defenses)
- ✓ Opportunism Normally do not cause a disease but under certain conditions they can (when the body is in a compromised state)
- ✓ Compromised host (how does this happen?)

- lack of sleep
- poor nutrition
- having a different disease

- ✓ **bacteraemia versus septicaemia? (aemia = blood)**

Bacteraemia - a type of blood poisoning where there is bacteria in the blood

Septicaemia - blood poisoning not caused by bacteria





Infectious disease and the human (immune) response



Microbial disease



STUFF IN RED IS IMPORTANT FOR EXAM!! (not my writing, the stuff in the slide)

- ✓ Interaction between microorganisms and the host (us) is continuous battle
 - They need to enter-live-multiply
- ✓ In order to enter, they need to **colonize** (establish and multiply) in/on body; **clinical infection** (disease) can result when damage occurs to host [**contamination** = deposition without multiplication]
- ✓ Clinical disease = easy to recognize
- ✓ Sub-clinical infection = hard to diagnose (no symptoms)

How do we measure how dangerous a bacteria/virus/parasite is?



- ✓ **Pathogenicity** = ability to produce disease
- ✓ **Virulence** = relative capacity to cause damage (i.e., the degree of pathogenicity)
- ✓ **Opportunistic** = do not normally cause disease but can do so when defense mechanism(s) breached or compromised

Pathogenesis of infectious diseases



- ✓ A pathogenic microorganism enters your body...two things happen:
 1. Microorganism (invader) tries to multiply / invade and cause disease (2^o event)
 2. Host tries to prevent #1

- ✓ Whether the invader wins or not is dependent on several factors

Pathogenesis of infectious diseases



✓ Transmission:



- inhalation, ingestion, break in protective barrier, direct deposit
- pathogenicity
- invasiveness (adherence, persistence, avoidance of immune system)
- toxigenicity (ability to make toxins)



How does a pathogen adhere to us?



- ✓ A bacteria needs to adhere, evade and invade the host
- ✓ Tools used to achieve these huge objectives:
 - ✓ surface structures (pili, fimbriae)
 - ✓ capsules
 - ✓ enzymes

Toxinogenicity



✓ Toxins are substances (usually proteins) secreted by bacteria with the hope to cause damage

✓ Two classes:

✓ Exotoxins

- excreted by **living** cells

Bacteria has to be alive

- specific affinities

- thermolabile

- means they're sensitive to temperature changes

- potent

Toxinogenicity



✓ Endotoxins

- liberated when cell wall disintegrates
 - less specific, causes fever, malaise, shock
 - thermostable
 - less potent than exotoxins
- worst nightmare in make-up industry
- reason why you feel worse before you feel better when you take antibiotics (because the antibiotics begin to break down the bacteria and expose the endotoxins.)





😊 Review of what we learned 😊

Things Discussed:

Difference between resident versus transient flora

Us vs Them

—> what do “they” need to do?

—> what do “they” have?

Endotoxins (inside bacteria, cell has to be dead) vs exotoxins (live cell)

—> what can “we” do?

