General Principles of Microbiology

micro = small

bio = life

logy = study (of) or science

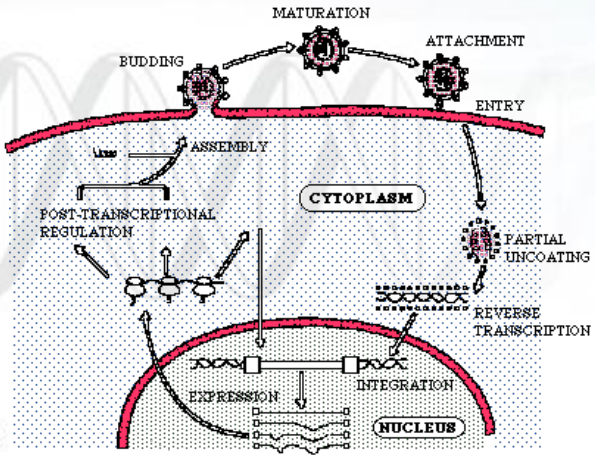
Immunology = study of our protection from foreign macromolecules or invading organisms and our responses to them

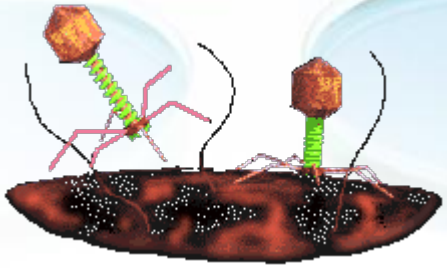
Different classes of organisms…

- ✓ 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 occurpied 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?

"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; humoural)

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° 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?