

Biology 201
Introduction and Tropical Parasites I

Comprehensive Final Concepts

Infectious Diseases

Cause HALF worldwide deaths - 25 million/year
5-10% developed nations; 60-70% developing
Caused by biological agents, usually...
Microbial Pathogens: viruses, bacteria, parasites
Many transmitted by vectors - e.g. insects

Contrast non-infectious: genetic, environmental

Top 15 Infectious Diseases

12-15: Tropical Parasites - 0.13 million/year
11: Hepatitis B - 0.10 million/year*
10: Syphilis - 0.16 million/year
9: Meningitis - 0.17 million/year*
8: Tetanus - 0.21 million/year*
7: Pertussis - 0.30 million/year*
6: Measles - 0.60 million/year*
5: Malaria - 1.3 million/year
4: Tuberculosis/TB - 1.6 million/year
3: GI/Diarrheal Diseases - 1.8 million/year
2: HIV/AIDS - 2.8 million/year
1: Pneumonia/Influenza - 3.9 million/year

**Effective vaccines given in developed nations;
Some Emerging - New (e.g. SARS Pneumonia);
Some Re-Emerging - Old Problems (e.g. TB)*

Class Organized by Group - Big to Small

Unit 1: Parasites/Protozoa - Eukaryotic Cells
Unit 2: Bacteria - Prokaryotic Cells
Unit 3: Viruses - not cells, not living
Unit 4: GI, Respiratory - many agents above

For each, there are 1-2 homework/discussion activities and 1 exam with case-study essays.

Unit One Start - Introduction to Biology

Concept One: What Is Living?

Organization - made of cells, DNA information
Growth, development, reproduction
Evolution and adaptation - respond, regulate
Metabolizes and processes energy

Cells either eukaryotic (unit one) or prokaryotic (unit two) - compare/contrast for final!

Eukaryotic Cells

Cell membrane - fats/lipids, some proteins
Cytoplasm - between nucleus, cell membrane
Nucleus - command center, DNA information

Major Organelles - mitochondria, chloroplast...
Motility Proteins - flagella, cytoplasmic filaments
Hard Outer Wall (some) - e.g. cellulose, chitin

Think about - strong evidence that organelles = engulfed/enslaved prokaryotes...

Concept Two: Hierarchy of Biology

Molecules: carbohydrate, fat, protein, DNA/RNA
Cells: prokaryotes vs. eukaryotes
Multicellular Organization: tissues, organs
Ecology: interactions - organisms, environment

Concept Three: Classification

Domain, Kingdom - know for all agents
Phylum, Class, Order, Family - know if given
Genus species - know for all agents if given
Strains - sometimes used, differ by 1-5 genes

Challenge problem for next time: classify yourself using appropriate terms above.

Domain - New Term Since 1980's

3 Domains - uses DNA sequence data, genetics
Generally reflects cell structure, appearance
Eukaryotes - animals, plants, fungi, protozoa
Bacteria - prokaryote, moderate, 3% pathogens
Archaea - prokaryote, extreme, no pathogens

Traditional Kingdoms = animals, plants, fungi, protozoa, and monera (bacteria & archaea).

Introduction to Animal Kingdom

Home of the parasites - Unit One

Some Key, Relevant Features

Multicellular eukaryotes - so which domain?
Many show distinct tissue and organ structure
Metabolism: use chemicals for energy
Most reproduce sexually, some asexual/clone
About 16 phyla - only 1 includes vertebrates

Phylum Nematoda - a.k.a. Roundworms

From the Greek: nematos = thread; ode = like
20,000 known species, 15,000 parasitic
Diverse aquatic and soil habitats

Important biological control agents. Others will be described during GI diseases lectures.

Anatomy and Physiology

Pseudocoelom/simple body cavity, no segments
GI: simple mouth to gut tube
MS: outer cuticle, hydrostatic, simple muscles
BG: no vessels, simple diffusion
SL: cilia hairs, simple nerves, no central control

GI (gastrointestinal), MS (muscle/skeletal), BG (blood/gas), SL (sensory, locomotion).

Reproduction and Development

Reproduction: sexual, dimorphic
In host: female worms birth 1000+ embryo/day
Embryos to larvae that move through blood
Taken up by insect vectors, new larvae forms
Mature in new host - location varies with disease

Lymphatic Filariasis

First agent mosquito-linked - Bancroft, 1876
Mostly in tropical Anopheles mosquitoes
Human Tissues - lymphatic system, blockage

Larvae in pulmonary vessels most of day, peripheral most of night - significance?

Crash Course - Immune/Lymphatic System

Animals have varying levels of defense systems
Lymphatic system - vessels parallel blood...
At capillaries, lymph drains to lymphatic system
Lymph - defensive white cells, proteins (e.g. Ab)
Nodes/spleen - data processing, dump junctions

More during HIV; swollen nodes = infection.

Lymphatic Filariasis - Disease

High volume of molting larvae, dying adults
Acute lymph destruction/blockage, inflammation
Elephantiasis - constant untreated, skin necrosis
Wuchereria bancrofti - extremities, genitals
Brugia malayi - extremities, not genitals

Even without elephantiasis, filariasis usurps and destroys immune system - significance?

Lymphatic Filariasis - Epidemiology

120 million affected worldwide - total, current
75% Asia/Pacific; 25% Latin America, Africa
Last endemic US cases - S. Carolina, 1920s
15,000 US Servicemen contracted, WWII
7% Haitian refugees to US infected

Typically, short-term tourists don't contract; requires long-term exposure.

Onchocerciasis/Loa Loa Eyeworms

Major causes of blindness, carried by...
Tropical fast-water Simulium flies (Onchocerca)
Tropical Chrysops deer flies (Loa Loa)
Tissues affected - subcutaneous skin, 5% eye
Highly prolific - 15 years, 2000+ embryos/day

Eyeworm - Disease

From bite, larvae migrate through blood/lymph
5% cases result in blindness - agent in eyeball
Where worms mature, defenses make capsules
Tissue thickens/keratitis, loses pigment, itches...

Even without blindness, can infect lymph nodes and cause elephantiasis-like symptoms.

Eyeworm - Epidemiology

20 million affected worldwide - total, current
Majority - Africa: Nigeria, Sudan, Congo region
Others - Middle East, Latin America, Asia
Slave trade introduced to Americas 1500-1800
Napoleon - Sudanese troops in Mexico, 1862
Onchocerca (worldwide), L. loa (West Africa)

85% West African eye lesions, with 50% adult males blind; Typically, tourists don't contract.

Anti-Nematode Treatment - Avermectin Drugs

Similar in structure to GABA - neurotransmitter
Vertebrates - GABA only brain because of BBB
Nematodes lack CNS but use GABA as a...
Neuromuscular transmitter throughout body
If we take orally, BBB keeps out of brain - so?

Older drugs (DEC/diethylcarbamazine) similar effect but less specific (i.e. more side effects).