

PowerLecture:

Chapter 21

Prokaryotes and Viruses

Section 21.0: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online

Videos: CNN

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➤ Anatomy and Physiology, 2003, Vol. 7, *West Nile Virus* (2:26)

➤ Environmental Science, 2003, Vol. 6, *West Nile Virus* (1:57)

Impacts, Issues: **West Nile Virus Takes Off**

➤ Alexander the Great, 336 B.C., conquered a vast empire

➤ It's speculated that his demise was due to West Nile encephalitis

Impacts, Issues: **West Nile Virus Takes Off**

➤ West Nile Virus is pathogenic, it invades its host and multiplies, causing disease

➤ It's a flavivirus, traveling inside mosquitoes which act as the transferring agent from host to host

Impacts, Issues Video

Section 21.1: Weblinks and InfoTrac

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Microorganisms

➤ Single-celled organisms that are too small to be seen without a microscope

➤ Bacteria are the smallest living organisms

➤ Viruses are smaller but are not alive

The Prokaryotes

➤ Only two groups

➤ Archaeobacteria and Eubacteria

➤ Arose before the eukaryotes

Prokaryotic Characteristics

➤ No membrane-bound nucleus

➤ Single chromosome

➤ Cell wall (in most species)

➤ Prokaryotic fission

➤ Metabolic diversity

Prokaryotic Body Plan

Prokaryotic Body Plan
Prokaryotic body plan
Bacterial Shapes

Metabolic Diversity

- Photoautotrophs
- Chemoautotrophs
- Chemoheterotrophs

Gram Stain

Gram stain

Section 21.2: Weblinks and InfoTrac

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Bacterial Genes

- Bacteria have a single chromosome
 - Circular molecule of DNA
- Many bacteria also have plasmids
 - Self-replicating circle of DNA that has a few genes
 - Can be passed from one cell to another

Prokaryotic Fission - 3

Prokaryotic fission

Conjugation

Prokaryotic conjugation

Section 21.3: Weblinks and InfoTrac

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Videos: CNN

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- Genetics, 2003, Vol. 1, *Fingerprinting E. Coli* (3:04)

Prokaryotic Classification

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Videos: CNN

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- Biology, 2002, Vol. 6, *Natural Anthrax* (2:20)
- Biology, 2002, Vol. 6, *Anthrax Bioterror* (3:04)
- Genetics, 2004, Vol. 2, *The Anthrax Genome* (3:05)

Eubacteria

- Includes most familiar bacteria
- Have fatty acids in plasma membrane
- Most have cell wall; always includes peptidoglycan
- Classification based largely on metabolism

Eubacterial Diversity

- Photoautotrophic
 - Aerobic (Cyanobacteria)
 - Anaerobic (Green bacteria)
- Chemoautotrophic
 - Important in nitrogen cycle
- Chemoheterotrophic
 - Largest group

Eubacteria

Examples of eubacteria

Some Pathogenic Eubacteria

- Most are chemoheterotrophs
 - *E. coli* strains
 - *Clostridium botulinum*
 - *Clostridium tetanus*
 - *Borrelia burgdorferi*
 - *Rickettsia rickettsii*

Some Pathogenic Eubacteria

Bacterial Behavior

- Bacteria move toward nutrient-rich regions
- Aerobes move toward oxygen; anaerobes avoid it
- Photosynthetic types move toward light
- Magnetotactic bacteria swim downward
- Myobacteria show collective behavior

Section 21.5: Weblinks and InfoTrac

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Archaeobacteria

Methanogens

Extreme halophiles

Extreme thermophiles

Section 21.6: Weblinks and InfoTrac

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Videos: CNN

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➤ Biology, 2002, Vol. 6, *Smallpox Threat* (5:12)

➤ Biology, 2004, Vol. 8, *Monkeypox* (2:33)

➤ Anatomy and Physiology, 2002, Vol. 6, *AIDS Update* (2:10)

Virus

➤ Noncellular infectious agent

➤ Protein wrapped around a nucleic acid core

➤ Cannot reproduce itself; can only be reproduced using a host cell

Viral Body Plans

➤ Genetic material is DNA or RNA

➤ Coat is protein

Enveloped Virus (HIV)

Viral Body Plans

Body plans of viruses

Section 21.7: Weblinks and InfoTrac

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Videos: CNN

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➤ Biology, 2002, Vol. 6, *Preventing HIV Entry* (1:48)

Viral Multiplication - Basic Steps

- Attach to host cell
- Enter host (virus or just genetic material)
- Direct host to make viral genetic material and protein
- Assemble viral nucleic acids and proteins
- Release new viral particles

Viral Replication

Bacteriophage multiplication cycles

Lytic

Pathway

Lytic Pathway

Lytic pathway

Lysogenic Pathway

Lysogenic Pathway

Lysogenic pathway

Replication of an

Enveloped

Virus

Replication of an Enveloped Virus

Enveloped DNA virus replication

Section 21.8: Weblinks and InfoTrac

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Videos: CNN

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➤ Biology, 2003, Vol. 7, *Salon Infections* (2:05)

➤ Biology, 2003, Vol. 7, *Global AIDS* (2:18)

➤ Biology, 2001, Vol. 5, *Mad Cow Update* (2:13)

➤ Anatomy and Physiology, 2003, Vol. 7, *Mad Cow Victim* (3:25)

Nature of Disease

- Contagious disease pathogens must directly contact a new host
- Epidemic
- Pandemic (AIDS)
- Sporadic
- Endemic

Evolution and Disease

- Host and pathogen are coevolving
- If a pathogen kills too quickly, it might disappear along with the individual host
- Most dangerous if pathogen
 - Is overwhelming in numbers
 - Is in a novel host
 - Is a mutant strain

New Threats

- Emerging Pathogens
 - *Ebola* virus
 - Monkeypox virus
 - SARS virus
- Drug-resistant strains
- Food poisoning
 - *E. coli*
 - *Salmonella*

Viroids

- Smaller than viruses
- Strands or circles of RNA
- No protein-coding genes
- No protein coat
- Cause many plant diseases

Prions

- Small proteins
- Linked to human diseases
 - Kuru
 - Creutzfeldt-Jakob disease (CJD)
- Animal diseases
 - Scrapie in sheep
 - Bovine spongiform encephalopathy (mad cow disease)