

MICROBES AND MANKIND

A Lesson Plan to Augment the DVD of *2000 and Beyond: Confronting the Microbe Menace*

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Section A

Microbe Menace Lecture Questions

Lecture 1 Questions

“Microbe hunters tracking infectious agents.” by Dr. Donald Ganem

1. What caused the bubonic plague?
2. How do new epidemics arise?
3. How are microbial causes of epidemics identified?
4. Explain a single cycle of cell infection.
5. If a group of people who attended the same event got sick, how can you determine if the cause was infectious?
6. What is epidemiology?
7. Describe the molecular subtraction technique. Why would a researcher use this technique?
8. Distinguish between lytic and latent infection using the herpes virus as an example.
9. What are Koch’s postulates and the current day problems associated with them?
10. What is chromosome walking and why is it used?

Lecture 2 Questions

“The microbes fight back.” by Dr. B. Brett Finlay

1. Explain the statement, "we are more microbial than human".
2. How do normal flora protect the human body?
3. What are some common diseases caused by bacteria?
4. How are infectious diseases spread?
5. How do we combat infectious diseases?
6. What are some of the mechanisms of antibiotic protection?
7. What is antibiotic resistance and how does it occur?
8. What are the 3 major causes of antibiotic resistance?
9. Explain how conjugation, transduction, and transformation allow antibiotic resistance to occur.
10. Explain how vaccines work.
11. What are the ethical issues associated with vaccinations.

Lecture 3 Questions

"Outwitting bacteria's wiley ways." Dr. B. Brett Finlay

1. What is a pathogen?
2. Explain the multiplicity of infection.
3. What are virulence factors?
4. Explain what is meant by disease of mechanization.
5. What tools do bacteria use to infect a cell?
6. What is a toxin?
7. Where do pathogenic bacteria come from?
8. What is the role of viruses that attack bacteria in the acquisition of virulence factors?
9. How does salmonella avoid lysosomal fusion?
10. What are the advantages of quorum sensing?

Lecture 4 Questions

"Emerging Infections: How Epidemics Arise" Dr. Donald Ganem

1. What has to occur in order for new epidemics to arise?
2. Why do retroviruses have higher mutation rates?
3. What are silent mutations and how can they occur?
4. What are the consequences of elevated mutation rates in viruses?
5. Why do new flu epidemics occur each year?
6. Distinguish between antigenic drift and antigenic shift. Give a genetic basis for each.
7. What is the major repository of new strains of influenza?
8. How can whole viral mini subunits be swapped?
9. Why are pigs referred to as the mixing vessel for influenza?
10. Use the Hanta virus as an example to explain how genetically unaltered viruses can cause epidemics.
11. How was myxoma used to control rabbit populations in Australia, and what does the results of this experiment tell us about viral and host evolution?

Section B

Seminars on Microbes and Mankind

Q: What is a seminar?

A: A seminar is an organized discussion on a current (often "hot") topic in science.
*see the list at the end of the assignment outline

Q: Who leads the seminar?

A: You do. Each person picks of current topic of interest and finds 2 to 3 relevant papers. These papers are assigned readings for the group.

Q: How do I prepare for a seminar?

A: It depends on your role (leader or participant).

* Leader:

A seminar leader assigns readings, provides remedial information (videos, guest speakers, information charts, pictures, etc...). The seminar leader provides colleagues with the background information needed to understand and discuss the topic. Leading and facilitating the discussion are the main roles of the leader. A leader should be prepared to start the discussion and ask questions that will stimulate participation. Often (not required) the leader provides refreshments. *Groups will lead seminars. There will be more than one leader per topic.

* Participants:

Participants take an active role in the seminar. All participants read the assigned articles before the seminar and come with a list of questions, comments, and other pertinent notes. Be prepared to contribute to the discussion!

Evaluation:

Leading the seminar = 30 points

- provide a relevant current topic and 2 or 3 key papers
- provide remedial material if necessary
- be an informed leader...know the topic
- introduce the topic and provide relevant background information
- ask questions to generate discussion
- keep the discussion flowing
- summarize the discussion
- provide for a well-organized seminar (host duties are included)

Participating in the seminar = 5 points

- come prepared
- discuss the topic
- show common courtesy to the leader and guests

If you cannot attend a seminar, you may write a 1-page response. Included in this response should be a brief summary of the issue with key points highlighted. Opinions may be included in your response, however, you should present all sides of the issue.

Topics List:

- Biochemical warfare.
- The history of epidemics.
- Antibiotic resistance.
- Microorganisms used to make food.
- Cosmetic and medicinal uses of microorganism
- Prevention of epidemics in a global economy.
- Dangerous microbes used for research.
- The ecological role of microbes.
- The life that lives on man.
- Other related subtopics may be submitted for teacher approval.

Section C

Teacher Directed Experiment

Controlling Bacterial Growth:

1. Use a marker to divide your agar plate into 4th's and number each quadrant. In your notebook write down the name of the disinfectant that you are going to test in each quadrant.
2. Obtain a sterile swab, collect your bacteria, slightly open your Petri dish, streak the agar starting at the top, turn the dish 90 degrees and do it again and close the Petri dish.
3. Flame the swab and then quickly plunge it into the water.
4. Light the Bunsen burner
5. Use sterile forceps to pick up a sterilized disk of filter paper.
6. Choose the three disinfectants that you want to use. Insert the disk into the first disinfectant, shake off any liquid, slightly open the Petri dish, and gently press the disk against the agar in the center of quadrant # 1 until it sticks, close the dish.
7. Flame the forceps to sterilize, and allow them to cool before picking up the next disk.
8. Repeat steps 5-7.
9. In quadrant 4, place a disk that was soaked in water.
10. Tape the Petri dish closed, turn it upside down, write your name on it, and put it on the tray.

Clean up:

Put Petri dishes upside down on the tray. Throw swabs in the garbage and pour the water down the sink. Use the disinfectant to spray down lab counters and wipe them down, dispose of the other disinfectants down the sink.

Each Day:

Observe the Petri dish. White or cloudy areas of the agar indicate bacterial growth. Clear areas, called zones of inhibition, surrounding the filter-paper disks indicate that the disinfectant inhibited bacterial growth. A lightly cloudy area indicates that the bacterial growth was slowed down. Record your observations in your notebook. With a ruler, measure to the nearest mm. The size of the clear zone surrounding each disk and record

this in your notebook. Also count any distinct colonies you can see and record any other notable changes. Remember to keep a neat and complete record of your observations! These will need to be included in your final write-up!!

Section D

Student Directed Experiment

You will have from tomorrow until the end of the quarter to conduct your own experiment related to bacteria. The **written report 70 pts** of your bacteria experiment will be due next Friday.

You will be given one petrel-dish each.

Information regarding sterile technique and resources available will be given through lecture during class. These notes and all data collected during this experiment should be kept in your laboratory notebook. **See handout regarding notebook criteria.*

Proposal Format

INTRODUCTION (5 pts):

-Gives general background information about your topic that is necessary in order for the reader to understand the experiment.

-Explains the significance, in other words, tells why the experiment is important.

-Explains your question, hypothesis, and what evidence will support your hypothesis.

Materials (5 pts):

-What specifically will you need? Only 3 petri-dishes per person.

Methods (5 pts):

-Include the specific steps you will take to complete the project.

Resources (5pts):

Books

Articles

Agencies

People

Laboratory Report Format

DESCRIPTIVE TITLE (5 pts): The title describes the topic of the experiment. Complete sentences are good.

INTRODUCTION (15 pts):

- Provides background information and explains the relevance of your experiment.
 - *In other words, tells why the experiment is important.
 - *Cite your sources using APA format!
- Explains the purpose of your experiment.
- Explains your question and hypothesis.

MATERIALS (10 pts):

- What did you use?
- How much/many did you use?

METHODS (10 pts):

- Explains the procedure you used.
- Another person should be able to follow your instructions and perform the same experiment. *Write this section in paragraph form. Do not make a list of steps.*

DATA/RESULTS (15 pts):

- A written explanation of what happened.
- Include observations, Data Tables, Graphs. Refer to these in the written explanation.
- Label the units and make the data as easy to interpret as possible.

CONCLUSION (15 pts):

- Interpretation of your results. What do they mean?
- Did your results support your hypothesis?
- What improvements, if any, could be made to your experimental design?
- Given the results of your experiment, what would be the next experiment to conduct?

*Writing should be clear and concise. Be specific.

A separate writing score will be given according to the CIM writing criteria. This is worth 10 points.

With this assignment you may earn CIM writing and scientific inquiry. See the handouts for criteria.

Section E

Bacteria Study Guide

Answer the following questions on a separate sheet of paper and staple it to this sheet.

1. What is the relationship between the structure of the cell wall and whether a bacteria is gram+ or gram -?
2. What are the different methods of bacterial reproduction?
3. What are the names of the different shapes and arrangements that bacteria can be found?
4. What are the four types of bacteria and their characteristics?
5. What is the general structure of the typical bacteria?
6. What disease is caused by each of the different bacteria that were presented in class?
7. What is antibiotic resistance? How does it occur? How can it be slowed down? Should you take antibiotics for a viral infection? Why or why not?
8. What is conjugation?
9. What do we call bacteria that cause disease?
10. What are the different methods and products that we use to control bacteria?
11. What are the two ways that bacteria cause disease?
12. What is the difference between an exotoxin and an endotoxin?
13. What is an obligate aerobe? An obligate anaerobe? A facultative anaerobe?
14. What are the two ways that bacteria can break down food to obtain energy?
15. What is a heterotroph? An autotrophy? Chemotrophic autotrophy? Phototrophic heterotroph?
16. What are the different ways in which bacteria are beneficial to us? To the environment?
17. What is symbiosis?

18. What is a saprophyte?

Section F

Microbe Exam

1. Spherical bacteria are called
 - a. spirally
 - b. coccid
 - c. bacilli
 - d. streptococci

2. Prokaryotes are unlike all other organisms in that their cells
 - a. lack nuclei
 - b. are small
 - c. have a cell wall
 - d. lack nucleic acids

3. Cells carry out energy production in the absence of oxygen by
 - a. anaerobic respiration
 - b. symbiosis
 - c. respiration
 - d. parasitism

4. A structure that forms when a bacterium produces a thick internal wall that encloses its DNA and part of its cytoplasm is called a (an)
 - a. capsid
 - b. endospore
 - c. spirillum
 - d. prophage

5. Organisms that require a constant supply of oxygen to live are
 - a. obligate anaerobes
 - b. obligate aerobes
 - c. facultative anaerobes
 - d. facultative aerobes

6. Bacteria that live in oxygen-free, very salty, or very hot environments are in the phylum
 - a. Eubacteria
 - b. Archaeobacteria
 - c. Cyanobacteria
 - d. Prochlorobacteria

7. The term that is least closely related to the others is
 - a. moneran

- b. bacteria
 - c. prokaryote
 - d. eukaryote
8. A form of sexual reproduction that occurs in some bacteria is known as
- a. binary fission
 - b. endospores
 - c. capsids
 - d. conjugation
9. Substances that can attack and destroy bacteria within the body are
- a. antibiotics
 - b. disinfectants
 - c. vaccines
 - d. interferons
10. Bacteria cause disease by damaging cells and by releasing
- a. symbionts
 - b. toxins
 - c. antibiotics
 - d. interferons
11. A beneficial symbiotic relationship occurs between humans and bacteria is
- a. bacteria whose enzymes break down cellulose
 - b. *Nitrosomonas* that produce ammonia
 - c. *Salmonella* in our stomachs
 - d. *E. coli* in our large intestine
12. Bacteria that use sunlight for energy and organic compounds for nutrition are
- a. phototrophic autotrophs
 - b. chemotrophic autotrophs
 - c. phototrophic heterotrophs
 - d. chemotrophic heterotrophs
13. The process in which monerans take nitrogen from the air and convert it to a form plants can use it
- a. sterilization
 - b. the nutrient flow
 - c. nitrogen fixation
 - d. sewage decomposition
14. Bacteria reproduce asexually through
- a. binary fission
 - b. endospores
 - c. capsids
 - d. conjugation

15. The blue-green bacteria, once known as blue-green algae, are
- eubacteria
 - prochlorobacteria
 - archaebacteria
 - cyanobacteria
16. Rod-shaped bacteria are called
- cocci
 - bacilli
 - spirilla
 - diplococci
17. Organisms that can survive with or without oxygen are
- obligate aerobes
 - obligate anaerobes
 - facultative aerobes
 - facultative bannanaerobes
18. Bacteria that recycle and break down dead trees are
- parasites
 - methanogens
 - saprophytes
 - symbionts
19. Cyanobacteria might impact the earth's atmospheric temperature by
- utilizing carbon dioxide, thereby increasing the temperature
 - utilizing carbon dioxide, thereby decreasing the temperature
 - adding more carbon dioxide to the air
 - using up more oxygen than originally believed
20. The gram stain can indicate
- the shape of the bacteria
 - the number of cell walls
 - neither a nor b
 - both a and b

Section G

Related Websites

http://www.fda.gov/oc/opacom/hottopics/anti_resist.html

US FDA description of antibiotic resistance

<http://www.cspinet.org/ar/>

Center for Science in the Public Interest website on antibiotic resistance

<http://biosafety.ihe.be/AR/ARmenu.html>

A discussion of the genetic causes for antibiotic resistance (from the Belgian Biosafety Server)

<http://www.aegis.com/news/ads/2001/AD012160.html>

A discussion of how viral mutations have affected the search for the AIDS virus

<http://www.emersonanimalhospital.com/flue.html>

An explanation of how a chicken virus mutated into a deadly human influenza virus

<http://www.cacmid.ca/abstracts/a73.html>

Abstract describing an experiment that detected a viral mutation