Transmission and Growth of Microorganisms

Unit. Infection Control

Problem Area. Microorganisms and Disease

Lesson. Transmission and Growth of Microorganisms

Student Learning Objectives.

Instruction in this lesson should result in students achieving the following objectives:

1. **Identify the optimal growth environment for aerobic and anaerobic organisms.**
2. **Identify the classifications of infection and disease.**
3. **Identify the modes of transmission for microorganisms.**
4. **Identify the signs and symptoms of infection.**
5. **Describe the chain of infection.**
6. **Differentiate between the three levels of aseptic control.**

List of Resources.

The following resources may be useful in teaching this lesson:

Gerdin, J. (2003). *Health Careers Today,* 3rd ed. St. Louis: Mosby.

MedlinePlus: A service of the U.S. National Library of Medicine and the National Institutes of Health. <http://www.nlm.nih.gov/medlineplus/>

Simmers, L. (2004). *Diversified Health Occupations,* 6th ed. Clifton Park, NY: Delmar Learning.

Sorrentino, S. (2000). *Mosby's Textbook for Nursing Assistants,* 5th ed. St. Louis: Mosby.

List of Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with Internet access
- ✓ Classroom resource and reference materials

Terms. The following terms are presented in this lesson (shown in bold italics):

- aerobic
- anaerobic
- antisepsis
- asepsis
- causative agent
- chain of infection
- contamination
- disinfection
- endogenous
- exogenous
- fomites
- mode of transmission
- nosocomial
- opportunistic
- portal of entry
- portal of exit
- sterilization
- susceptible host

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situation. A possible approach is included here.

> *Infection control is a major safety concern as infection is a health hazard. Naturally, the human is an exceptional host and supplier of what microorganisms need to grow and flourish. Health care workers are responsible for understanding transmission of microorganisms and are responsible for training patients and families about transmission of organisms. The chain of*

infection can be broken, and health care workers are responsible for breaking the chain.

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Identify the optimal growth environment for aerobic and anaerobic organisms.

Anticipated Problem: What is the optimal growth environment for aerobic and anaerobic organisms?

I. Growth environment for aerobic and anaerobic microorganisms

A. Definition of aerobic microorganisms
   1. ***Aerobic*** microorganisms require oxygen to live.

B. Definition of anaerobic microorganisms
   1. ***Anaerobic*** microorganisms live and reproduce in the absence of oxygen.

C. Most microorganisms require the following elements to live and grow.
   1. All microorganisms require a reservoir (host).
   2. All microorganisms require water and nourishment from the reservoir.
   3. Most microorganisms require a warm and dark environment.
   4. Most microorganisms grow best at body temperature.
   5. Most microorganisms are destroyed by heat and light.

D. Asepsis and maintaining medical asepsis
   1. ***Asepsis*** is the absence of disease-producing microorganisms.
   2. ***Contamination*** is the process of becoming unclean.
   3. Aseptic techniques are directed toward maintaining cleanliness and eliminating or preventing contamination.
      a. Antiseptic is a substance that destroys or inhibits the growth of bacteria and other microorganisms on living tissue.
   4. Common aseptic techniques
      a. Hand washing
      b. Good personal hygiene
      c. Use of disposable gloves when contacting body secretions or contaminated objects
      d. Proper cleaning of instruments and equipment
      e. Thorough cleaning of the environment

5. Maintaining medical asepsis
    a. Avoid touching your clothing with soiled linen, table paper, supplies, or instruments. Roll used table paper or linens inward with the clean surface outward.
    b. Always consider the floor to be contaminated. Any item dropped onto the floor must be considered dirty and discarded or cleaned to its former level of asepsis before being used.
    c. Clean tables, counters, and other surfaces frequently and immediately after contamination. Clean areas are less likely than dirty ones to harbor microorganisms or encourage their growth.
    d. Always presume that blood and body fluids from any source are contaminated. Follow OSHA and CDC guidelines to protect yourself and to prevent the transmission of disease.

Many techniques can be used to help students master this objective. As an example, students could use Chapter 13 in Diversified Health Occupations. Use LS–A reinforce the vocabulary associated with medical asepsis and microorganisms.

Objective 2: Identify the classifications of infection and disease.

Anticipated Problem: What are the four classes of infection and disease?

II. Four main classes of infection and disease (endogenous, exogenous, nosocomial, opportunistic)

A. ***Endogenous***
    1. Endogenous infections or disease originate within the body.
    2. Examples of endogenous infections or disease include metabolic disorders, congenital abnormalities, tumors, and microorganisms within the body.

B. ***Exogenous***
    1. Exogenous infections or disease originate outside the body.
    2. Examples of exogenous infections or disease include pathogenic organisms that invade the body, radiation, chemical agents, trauma, electric shock, and temperature extremes.

C. ***Nosocomial***
    1. Nosocomial infections are acquired during a stay in a health agency such as a hospital or long-term care facility.
    2. Nosocomial infections are usually present in the facility and transmitted by health care workers to the patient.
    3. Nosocomial infections are caused by normal flora or by microbes transmitted to the person from another source.

4. Many of the pathogens transmitted in this manner are antibiotic-resistant and can cause serious and even life-threatening infections in patients.
5. Some examples of nosocomial infections include staphylococcus, pseudomonas, and enterococci.

D. ***Opportunistic***

1. Opportunistic infections are those that occur when the body's defenses are weak.
2. Opportunistic infections normally do not occur in individuals with intact immune systems.
3. Examples of opportunistic infections include *Pneumocystis carinii* pneumonia or Kaposi's sarcoma in individuals with AIDS.

Many techniques can be used to help students master this objective. As an example, students could use Chapter 13 in Diversified Health Occupations. Use LS–B to reinforce the classification of disease.

Objective 3: Identify the modes of transmission for microorganisms.

Anticipated Problem: What are some normal modes of transmission for microorganisms?

III. Modes of transmission for microorganisms

A. Requirements for transmission (causative agent and reservoir)

1. A ***causative agent*** or pathogen is needed.
2. A reservoir (host) is required, which includes human body, animals, the environment and fomites.
3. ***Fomites*** are objects contaminated with infectious material that contains the pathogen.
4. Examples of fomites include doorknobs, bedpans, urinals, linens, instruments, and specimen containers.

B. Modes of transmission

1. Blood, body fluids, secretions, excretions
   a. Direct contact
2. Animals
   a. Bites
   b. Contact
3. Insects
   a. Bites
4. Wound dressings
   a. Non-frequent dressing changes
   b. Non-sterile practices during dressing changes

5. Direct contact
    a. Shaking hands
    b. Kissing
6. Personal items
    a. Toothbrush
    b. Comb
7. Eating and drinking utensils
    a. Silverware
    b. Drinking glassware
8. Water
9. Food
10. Air
11. Coughing, sneezing, talking, laughing, singing

C. Body defenses in fighting infection/disease
    1. Mucous membrane
        a. Mucous membranes line the respiratory, digestive, and reproductive tracts and trap pathogens.
    2. Cilia
        a. Cilia are tiny hair-like structures that line the respiratory tract and propel pathogens out of the body.
    3. Coughing and sneezing
    4. Hydrochloric acid
        a. It destroys pathogens in the stomach
    5. Tears in the eye
        a. Tears contain bacteriocidal chemicals.
    6. Fever
        a. Many organisms cannot survive at body temperatures above normal.
    7. Inflammation
        a. Leukocytes, or white blood cells, destroy pathogens.
    8. Immune response
        a. The body produces antibodies, which are protective proteins that combat pathogens.
        b. Interferon and complement are protective chemicals secreted by cells.

Many techniques can be used to help students master this objective. As an example, students could use Chapter 13 in Diversified Health Occupations. Use VM–A to visually describe various modes of transmission. Use LS–C to reinforce knowledge of the vocabulary.

Objective 4: Identify the signs and symptoms of infection.

Anticipated Problem: What are the signs and symptoms of infection?

IV. Signs and symptoms of infection

- A. Fever
- B. Increased pulse and respiratory rates
- C. Pain or tenderness
- D. Fatigue and loss of energy
- E. Loss of appetite
- F. Nausea
- G. Vomiting
- H. Diarrhea
- I. Rash
- J. Sores on mucous membranes
- K. Redness and swelling of a body part
- L. Discharge or drainage from the infected area

Many techniques can be used to help students master this objective. As an example, students could use Chapter 13 in Diversified Health Occupations. Use VM–B to reinforce signs and symptoms of infections.

Objective 5: Describe the chain of infection.

Anticipated Problem: What are the six factors involved in the chain of infection?

V. ***Chain of infection***

- A. Six factors are required in the chain of infection.
  1. Causative agent
  2. Reservoir
  3. ***Portal of exit*** (site where pathogen exits body)
  4. Mode of transmission
  5. ***Portal of entry*** (site where pathogen enters body)
  6. ***Susceptible host*** (a person at risk for infection)
- B. Factors that can break the chain of infection
  1. Causative agent
     a. Early recognition of signs of infection
     b. Rapid, accurate identification of organisms

2. Reservoir
    a. Medical asepsis
    b. Standard precautions
    c. Employee health
    d. Environmental sanitation
    e. Disinfection/sterilization
3. Portal of exit
    a. Medical asepsis
    b. Personal protective equipment
    c. Hand washing
    d. Control of excretions and secretions
    e. Trash and waste disposal
    f. Standard precautions
4. ***Mode of transmission***
    a. Transmission-based precautions
    b. Food handling
    c. Air flow control
    d. Medical asepsis
    e. Sterilization
    f. Hand washing
    g. Standard precautions
5. Portal of entry
    a. Wound care
    b. Catheter care
    c. Medical asepsis
    d. Standard precautions
6. Susceptible host
    a. Immunization to prevent disease
    b. Recognition of high-risk patients
    c. Treatment of underlying diseases

Many techniques can be used to help students master this objective. As an example, students could use Chapter 13 in Diversified Health Occupations. Use VM–C to illustrate the chain of infection. Use LS–D to apply the concepts of the chain of infection.

Objective 6: Differentiate between the three levels of aseptic control.

Anticipated Problem: How are the three levels of aseptic control similar and different?

VI. The three levels of aseptic control are antisepsis, disinfection, and sterilization.

A. ***Antisepsis***

1. Definition of antisepsis
   a. Antiseptics prevent or inhibit growth of pathogenic organisms but are not effective against spores and viruses.
   b. Antiseptics can usually be used on the skin.
   c. Examples of antiseptics include alcohol and betadine.

B. ***Disinfection***

1. Definition of disinfectants
   a. Disinfectants destroy or kill pathogenic organisms but are not always effective against spores and viruses.
   b. Chemical disinfectants are used in disinfection.
   c. Disinfectants can damage or irritate the skin and are mainly used on objects, not people.
   d. Examples of disinfectants include bleach solutions and zephirin.

C. ***Sterilization***

1. Definition of sterilization
   a. Sterilization is a process that destroys all microorganisms, both pathogenic and non-pathogenic, including spores and viruses.
   b. Examples of sterilization procedures include steam under pressure, gas, radiation, and chemicals.
   c. These procedures are used on equipment or objects, not on people.
   d. The autoclave is the most common piece of equipment used for sterilization.

Many techniques can be used to help students master this objective. As an example, students could use Chapter 13 in Diversified Health Occupations. Use LS–E to apply the concepts of aseptic control.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the ends of chapters in the textbook may also be used in the review/summary.

Application. Use the included visual master(s) and lab sheet(s) to apply the information presented in the lesson.

Evaluation.

Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

Answers to Sample Test:

Part One: Matching

1. h
2. e
3. a
4. j
5. g
6. i
7. b
8. f
9. k
10. c
11. d

Part Two: Matching

1. a
2. b
3. c
4. c
5. b
6. c
7. a
8. a
9. c
10. c
11. b

Part Three: Completion

Chain of Infection						
	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**	**Factor 6**
Factor Name	Causative Agent	Source or Reservoir	Portal of Exit	Mode of Transmission	Portal of Entry	Susceptible Host
Name two components for each factor that can break the chain of infection.						
Component 1	Early recognition of sign of infection	Medical asepsis or environmental sanitation	Medical asepsis or standard precautions	Transmission-based precautions or food handling	Wound care or catheter care	Treatment of underlying diseases or recognition of high-risk patients
Component 2	Rapid, accurate identification of organisms	Standard precautions or employee health or disinfection/sterilization	Personal protective equipment or hand washing or control of excretions and secretions or trash and waste disposal	Air flow control or hand washing or medical asepsis or standard precautions or sterilization	Medical asepsis or standard precautions	Immunization to prevent disease

Sample Test

Name _____

Transmission and Growth of Microorganisms

Part One: Matching

Instructions: **Match the term with the correct definition.**

a. aerobic
b. anaerobic
c. asepsis
d. disinfection
e. endogenous
f. exogenous
g. fomites
h. nosocomial
i. opportunistic
j. sterilization
k. susceptible host

_____1. This infection is acquired during a stay in a health care facility.

_____2. This infection or disease originates within the body.

_____3. This microorganism requires oxygen to live and grow.

_____4. This is the process of destroying all microorganisms.

_____5. These objects are contaminated with infectious material that contain the pathogens.

_____6. These infections occur when the body's defenses are weak.

_____7. The microorganism flourishes in the absence of oxygen.

_____8. This infection or disease originates outside the body.

_____9. This individual is likely to get an infection or disease.

____10. This is the absence of diseases producing microorganisms or pathogens.

____11. This process destroys or kills pathogenic organisms except spores and viruses and can cause skin irritation or skin damage.

Part Two: Matching

Instructions: **Match each term with the correct statements.**

a. antisepsis
b. disinfection
c. sterilization

_____1. use of alcohol
_____2. use of bleach solution
_____3. use of gas
_____4. use of radiation
_____5. use of zephirin
_____6. kills spores and viruses
_____7. use of betadine
_____8. can usually be used on skin
_____9. use of an autoclave
____10. uses steam under pressure
____11. does not kill spores and viruses and can cause irritation or damage to the skin

Part Three: Completion

Instructions: **Provide the factors and components to complete the following chart.**

Chain of Infection						
	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**	**Factor 6**
Factor Name						
Name two components for each factor that can break the chain of infection.						
Component 1						
Component 2						

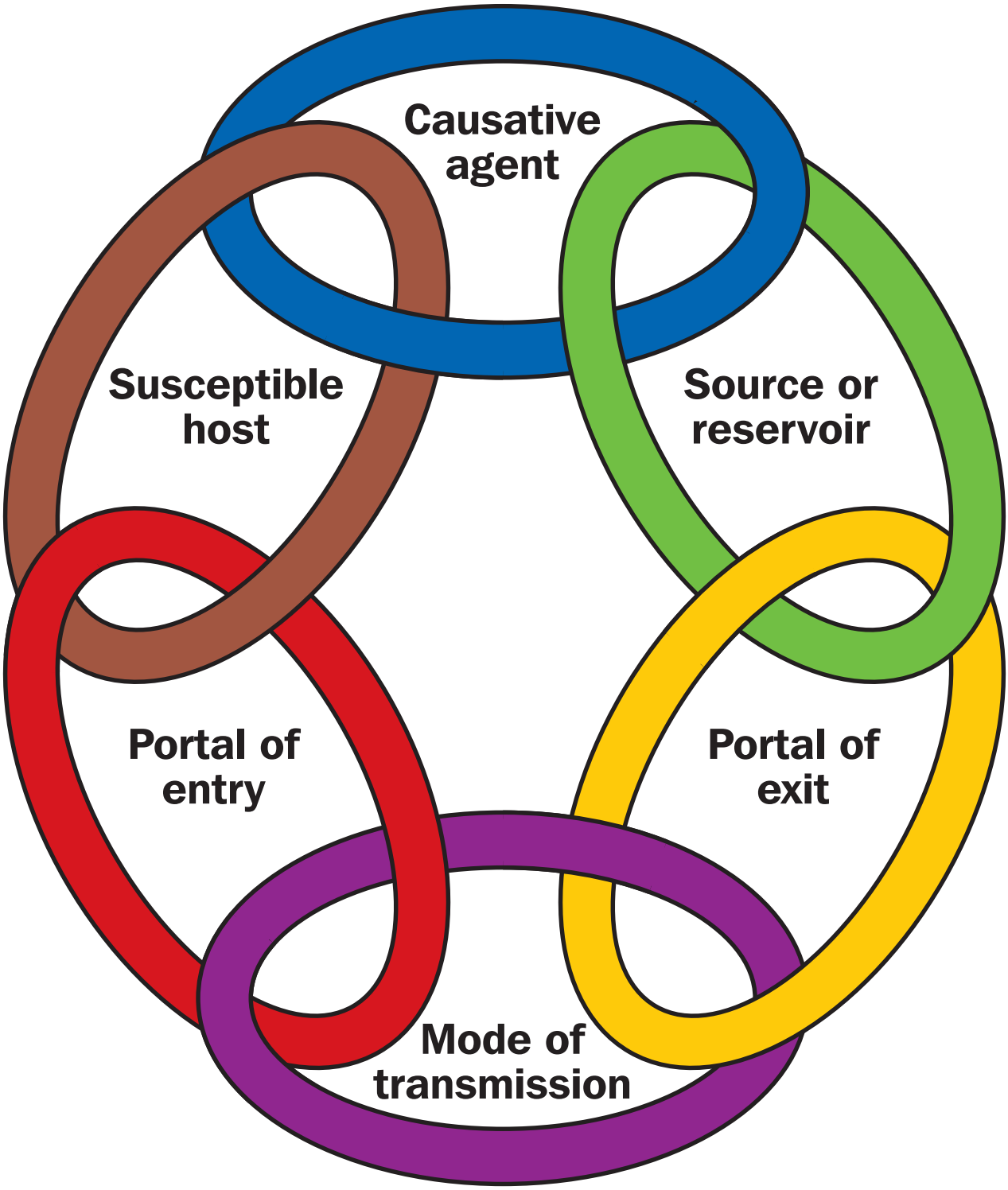
METHODS OF TRANSMITTING MICROBES

- Blood, body fluids, secretions, excretions
- Animals
- Insects
- Wound dressings
- Direct contact
- Personal items
- Eating and drinking utensils
- Water
- Food
- Air
- Coughing, sneezing, talking, laughing, singing

SIGNS AND SYMPTOMS OF INFECTION

- Fever
- Increased pulse and respiratory rates
- Pain or tenderness
- Fatigue and loss of energy
- Loss of appetite
- Nausea
- Vomiting
- Diarrhea
- Rash
- Sores on mucous membranes
- Redness and swelling of a body part
- Discharge or drainage from the infected area

CHAIN OF INFECTION



Transmission of Disease Exercise 1

Purpose

The purpose of this activity to allow students to practice basic terminology associated with transmission of disease.

Objective

1. Prepare tools that will enable students to practice basic terminology associated with transmission of disease.

Materials

- lab sheet
- 4 × 6 index cards
- writing utensil (best if using a felt tip marker)

Procedure

1. Using the terminology list below create index cards in the following manner.
2. Write the word(s)/question on one side of the 4 × 6 index card.
3. Flip the card over and write the definition or response to the associated statement.
4. Have students use flash cards to study concepts.
5. Students can work with a partner to study.

Terminology

a. Aerobic

b. Anaerobic

c. Antisepsis

d. Asepsis

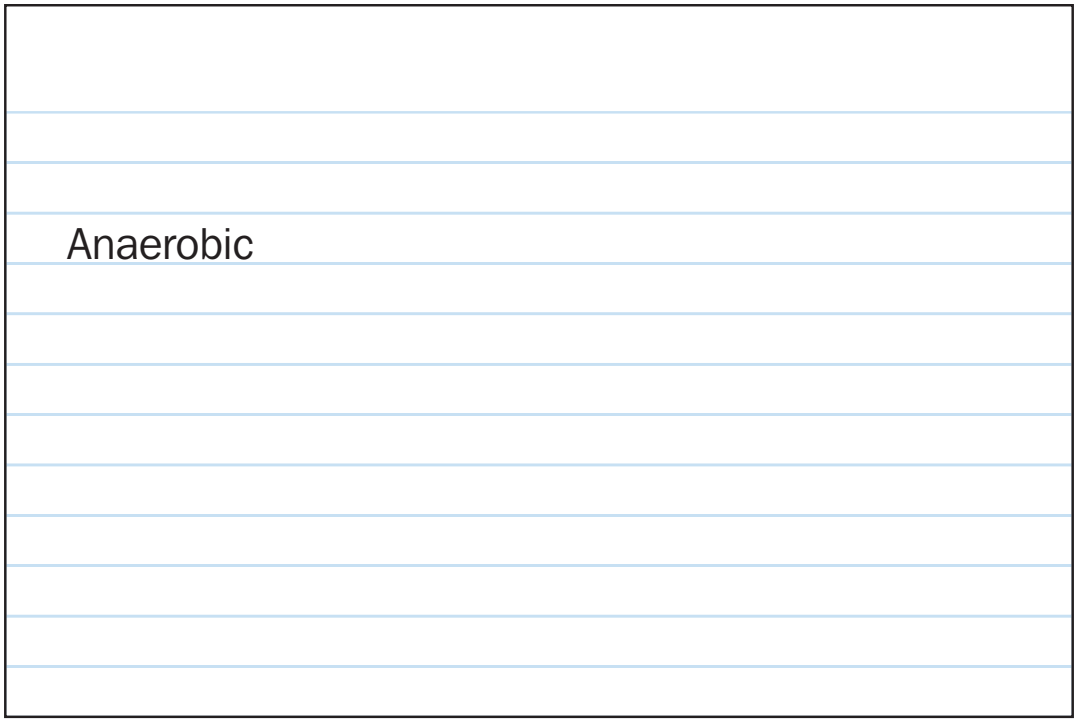
e. Contamination

f. Identify the optimal growth environment for microorganisms

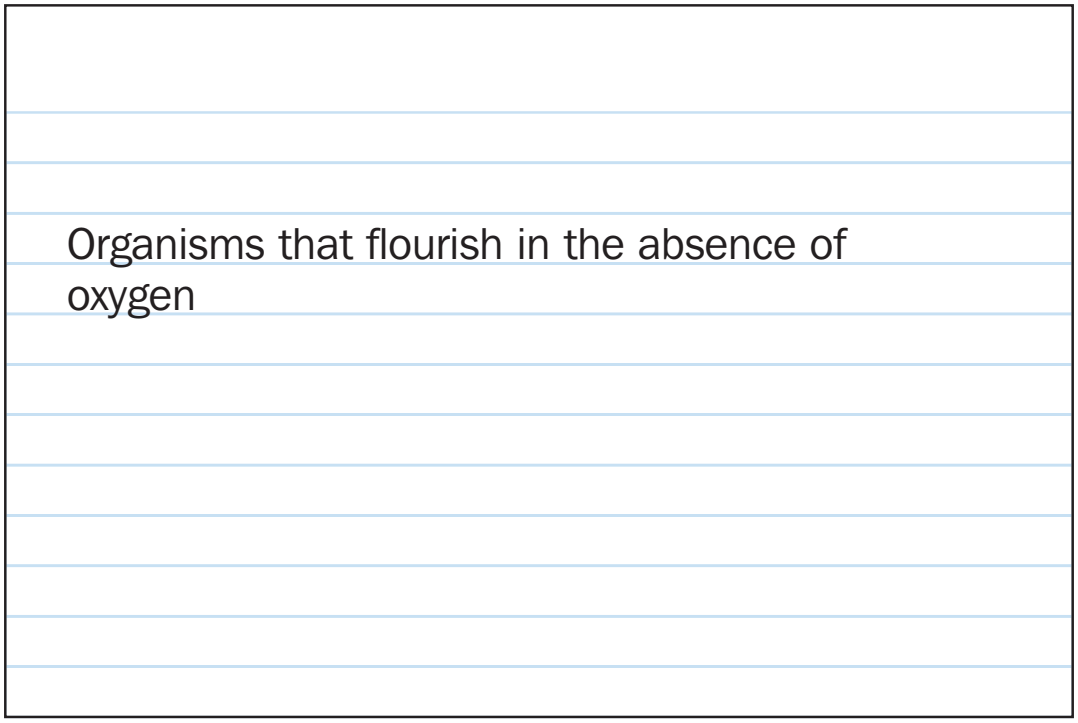
g. List guidelines for maintaining medical asepsis.

Example

Side A:



Side B:



Transmission of Disease Exercise 2

Purpose

The purpose of this activity to allow students to practice basic terminology associated with transmission of disease.

Objective

1. Prepare tools that will enable students to practice basic terminology associated with transmission of disease.

Materials

- lab sheet
- 4 × 6 index cards
- writing utensil (best if using a felt tip marker)

Procedure

1. Using the terminology list below create index cards in the following manner.
2. Write the word(s)/question on one side of the 4 × 6 index card.
3. Flip the card over and write the definition or response to the associated statement.
4. Have students use flash cards to study concepts.
5. Students can work with a partner to study.

Terminology

a. Causative agent
b. Endogenous
c. Exogenous
d. Fomites
e. Mode of transmission
f. Nosocomial
g. Opportunistic

Example

Side A:

Endogenous

Side B:

An infection or disease that originates within the body

Transmission of Disease Exercise 3

Purpose

The purpose of this activity to allow students to practice basic terminology associated with transmission of disease.

Objective

1. To prepare tools that will enable students to practice basic terminology associated with transmission of disease.

Materials

- lab sheet
- 4 × 6 index cards
- writing utensil (best if using a felt tip marker)

Procedure

1. Using the terminology list below create index cards in the following manner.
2. Write the word(s)/question on one side of the 4 × 6 index card.
3. Flip the card over and write the definition or response to the associated statement.
4. Have students use flash cards to study concepts.
5. Students can work with a partner to study.

Terminology/Concepts

a. Name three levels of aseptic control

b. Identify the six factors of the chain of infection

c. Identify 8 body defenses that contribute to the removal of pathogens in the body

d. For each level of aseptic control identify their unique characteristics (make 3 cards)

e. For each of the six factors of the chain of infection list 2–3 components that can break the chain of infection (make 6 cards)

f. Name 7 signs and symptoms of infection

Example

Side A:

Identify the six factors of the chain of infection

Side B:

1. Causative agent
2. Reservoir
3. Portal of exit
4. Mode of transmission
5. Portal of entry
6. Susceptible host

Transmission of Disease Exercise 4

Purpose

The purpose of this activity to allow students to associate transmission of diseases with their activities of day living.

Objective

1. To identify potential opportunities to break the chain of infection.

Materials

- lab sheet
- writing utensil
- textbook

Procedure

1. Using the information learned in this lesson, have students complete the lab sheet as a homework assignment.
2. During a 24-hour period, have them identify all potential activities that could potentially trigger the chain of infection. They should complete the lab sheet with the appropriate corresponding information and provide a minimum of five activities.
3. Answers will vary by student.

Name _____

Transmission of Disease Exercise 4

Incidence Number	Causative Agent (Source)	Reservoir (Host)	Portal of Exit	Method of Transmission	Portal of Entry	Your actions to break the chain of infection or what you should have done
Example	Nasal drainage	Brother's nose	Blew nose on tissue	Picked up tissue to dispose	Rubbed nose with exposed hand	Tell brother to throw away or pick up tissue without direct contact
1						
2						
3						
4						

Incidence Number	Causative Agent (Source)	Reservoir (Host)	Portal of Exit	Method of Transmission	Portal of Entry	Your actions to break the chain of infection or what you should have done
5						
6						
7						
8						
9						

Possible 30 points.

Transmission of Disease Exercise 5

Purpose

The purpose of this activity to allow students to associate products identified in the levels of aseptic control.

Objective

1. To identify potential products for use in medical asepsis techniques.

Materials

- lab sheet
- writing utensil
- resources: textbook, internet, household products, grocery store

Procedure

1. Using the information learned in this lesson, have students complete the lab sheet as a homework assignment.
2. Using resources at hand (household products, grocery store, internet), students should identify products that are considered antiseptics and disinfectants.
3. Have them identify 6 products for each type of aseptic control listed.
4. Answers will vary by student.

Name _____

Transmission of Disease Exercise 5

Products Identified as Antiseptics	Products Identified as Disinfectants