

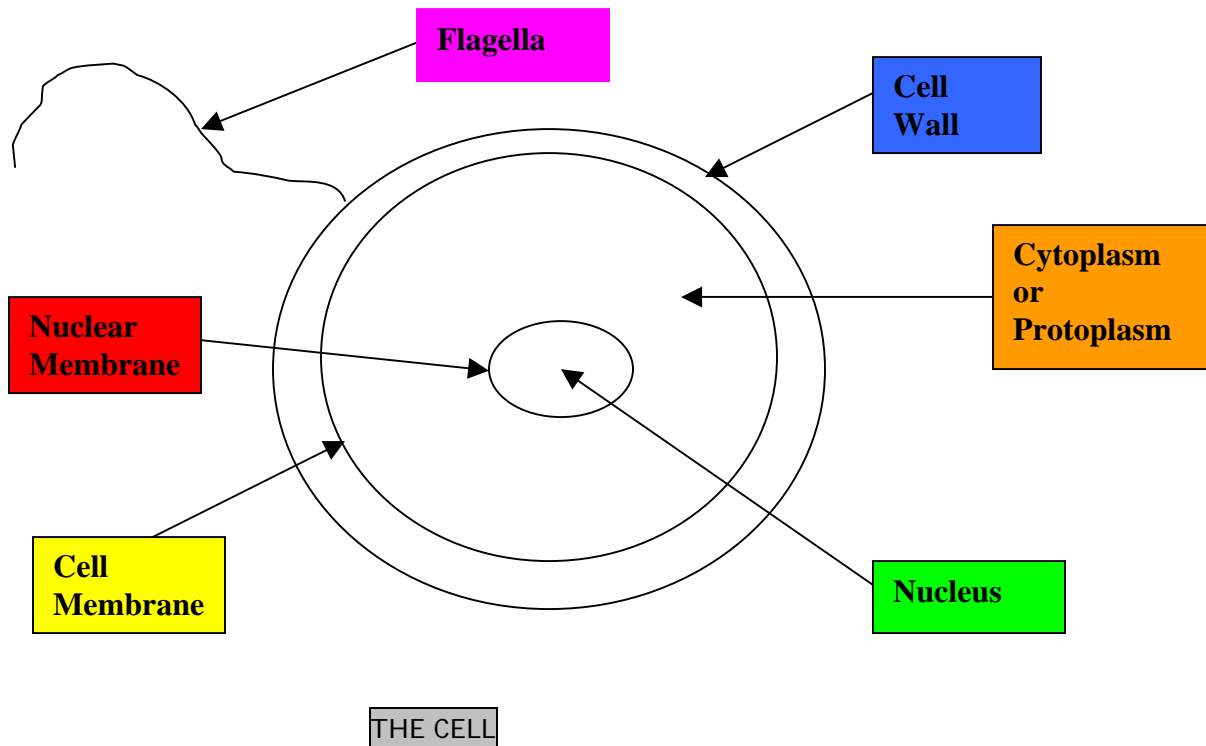
# Microbiology 101 - Part II

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**\*\*This in-service has been Approved by the CBSPD, Inc. for 1 CEU.**

In Part I we learned some basic information about microorganisms. In Part II we will learn more about them.

First let us learn more about microorganisms: Bacteria have many parts, which are identified in the diagram below.



Think of the cell like a boiled egg. The outer shell of the boiled egg serves to protect the egg and contain the inner contents. The cell wall plays the same part in the cell. Underneath the egg shell is a membrane that we peel off. In the cell this membrane is called the cell membrane and allows nutrients into and out of the cell. The white of the egg contains protein (this is why athletes eat egg white omelets); in the cell, this part of the cell is called the cytoplasm or protoplasm and contains mainly protein. The yolk of the egg is the core for reproduction; the nucleus of the cell contains the DNA for the cell to reproduce. If the nucleus dies the cell dies. Sometimes the nucleus is called the "brain" of the cell. The

flagellum is a whip like device that some cells have and it is used to propel the cell through fluids.

Some bacteria can react to adverse changes in their environment. Since they do not like the conditions they decide to “chill out”. There are two ways bacteria can react to adverse changes; forming a capsule or forming a spore.

When bacteria form a capsule it protects the bacterium by helping to prevent the cell from being killed. Encapsulated bacteria are more difficult to kill than bacteria without a capsule. All the bacteria that cause meningitis are encapsulated. Bacteria with capsules appear to have a halo around them. The capsule is a slime-like covering on the cell wall that makes penetration of heat or chemicals difficult. Mycobacterium tuberculosis is an encapsulated microorganism.

A few species of bacteria have the ability to produce highly resistant structures known as **endospores** (or simply spores). Spores are highly resistant to heat, chemicals and other forms of eradication. Diseases caused by endospores include botulism (*Clostridium botulinum*), gas gangrene (*Clostridium perfringens*), and tetanus (*Clostridium tetani*). The spore is a hard, shell-like covering on the cell and during the spore period, the cell is “resting” or hibernating. Literature has shown that spores have survived decades then started reproducing again when conditions improved. Because of the extreme difficulty killing spores, we use spores to test sterilizers.

Bacteria reproduce asexually by a process called binary fission. In this process one mother cell separates into two cells, two cells separate into four, four into eight and so on. Each of the daughter cells is an exact duplicate of the mother cell. Under ideal conditions bacteria can reproduce in as little as 20 minutes. It has been reported that small numbers of **microorganisms** can grow to over 250,000 in 6 hours! This is why it is so important to clean instruments as quickly as possible after they are used....the more bacteria the more difficult to clean. Sometimes the amount of bacterial load on devices is called **bioburden**.

Some microorganisms are capable of producing disease more rapidly than others. **Pathogenicity** is the ability of an organism to cause disease in another organism. Pathogens can destroy tissue or produce toxins. It is often used interchangeably with the term “virulence”. Virulence refers to the strength of a microbe to cause disease. For example, if there are a large number of pathogens that are non-virulent they will not have a large impact on the patient. However, if there are a small number of pathogens that are very virulent, they can cause serious disease in a short amount of time. In the winter we often hear “this flu strain is very virulent” meaning it is capable of causing disease quickly.

Some of the most common bacteria causing problems in healthcare facilities today are Escherichia Coli (E. Coli). This is a bacillus that lives in the intestine and is a normal part of the body. However, when E. coli gets out of the intestine and into another part of the body it becomes pathogenic and causes serious infections. Serratia marscens is a bacillus that was not pathogenic until it was used as research. It is usually found in soil so when you hear of a serratia infection, something was dirty (e.g. the hands/nails or the environment).

Staphylococcus aureus was a killer up until the 1950 when penicillin was discovered. Staph epidermitis was a cousin that was part of the normal flora of the hands however about 15 years ago staph "epi" became pathogenic and is now a leading cause of nosocomial infections. Pseudomonas Aeruginosa is a bacillus that loves to grow in standing water. It is particularly deadly microorganism because it is an opportunistic microbe-it will take over whenever the opportunity arises (e.g. decaying tissue). It will eventually get into the lungs of emphysema patients causing death. Pseudomonas is difficult to kill and is resistant to many antibiotics. Because of its love of standing water, plants and cut flowers are not permitted in Intensive Care Units of hospitals.

## **Viruses**

The viruses are smaller than bacteria. They cannot be seen with a microscope; a special microscope called an electron microscope is needed to see them. Viruses need living tissue to survive, outside living tissue they are inactive. This is important to remember because the HIV virus will not live once it leaves the body, it needs living tissue to survive. Of all the microorganisms, HIV is one of the easiest to inactivate once it is outside the body.

Viruses cause the common cold, polio, chicken pox, Herpes I, II, HIV, Hepatitis A, B, C, etc. Infections caused by viruses create a lasting immunity to re-infection; once you get the disease your body produces antibodies and you are protected from re-infection. Immunization based upon this principle because with an immunization you are given a small amount of the disease so your body can produce antibodies.

Because bacteria and viruses cause many of the diseases we're familiar with, people often confuse these two microbes. But they are very different. For one thing, they differ greatly in size. The biggest viruses are only as large as the tiniest bacteria.

Another difference is their structure; bacteria are complex compared to viruses.

The major difference between viruses and bacteria is the way they reproduce.

Bacteria contain the genetic blueprint (DNA) and all the tools they need to reproduce themselves. Viruses are moochers. They contain only a limited genetic blueprint and they don't have the necessary building tools. They have to invade other cells and hijack their cellular machinery to reproduce. Viruses invade by attaching to a cell and injecting their genes or by being swallowed up by the cell.

## **Rickettsiae**

This group of microorganisms can be spherical or rod shaped. They are parasites which live within the cells - need living tissue to survive. Only 6 types are pathogenic. Some examples of diseases caused by rickettsiae include Lyme disease and Rocky Mountain Spotted fever.

## Fungi

The fungi are larger than bacteria and more complex. They have more internal structures than bacteria. There are two types – yeasts and molds. They can be multi-celled (more than one cell) and grow best in a dark, moist environment (think of mushrooms). Some fungi are beneficial (e.g. the bread mold that creates penicillin, mushrooms) while others are pathogenic. Athlete's foot is a form of fungal infection and like most fungal infections they can be very resistant to treatment. One particular form, Aspergillus, is a mold that lives in ceiling tiles. It has an affinity for open heart patients. Whenever the ceiling tiles are being removed, the area around should be sealed off with plastic so any microorganisms (including Aspergillus) do not get into the work area.

## Handwashing

You carry millions of microbes on your hands. Most are harmless, but you can pick up some that cause illnesses, such as colds, flu, and diarrhea. When we forget to wash our hands, or don't wash them properly, we can spread these germs to other people, or give them to ourselves by touching our eyes, mouths, noses or cuts on our bodies.

We can also pick up germs from objects, such as doorknobs and stair railings, touched by other people who aren't good handwashers. Think about all the things you touch each day and how many people may have touched them before you.

Handwashing with warm water and soap can greatly reduce the chances of spreading or getting germs. The mechanical action of scrubbing loosens up the dirt and microbes on our hands and the soap picks them up and binds to them so that the water can wash them away.

### Handwashing should be performed

- Before you enter the work area
- Before and after eating
- After using the restroom
- After removing personal protective equipment in Decontam
- When ever changing tasks

## Others

■**Protozoa** – Simple animals some of which cause disease. Sometimes the human body is invaded by parasitic creatures that steal food from our guts or dine on our blood. Although many of these parasites are multi-celled creatures, microbiologists study them, too, because most species are too small to see easily without a microscope. However, some can get big—VERY big. The king of these parasites is the beef tapeworm, which can easily grow 7½ meters or 25 feet long! I imagine that living in your guts!

**Prions** – are Virus-like agents. While not a microorganism, their name is derived from “protein infectious materials = prions”. So a prion is actually a protein that has gone wrong. Prions cause Mad Cow disease and require special sterilization cycles to inactivate them. We will learn more about these later on in Microbiology Part III.

Now that we have learned about microorganisms we need to know how to stop them. The Sterile Processing Department plays a vital role in preventing disease transmission. This can occur several ways:

- Control the 4 factors of disease transmission – **BREAK THE CHAIN OF INFECTION**:
  - Block the portal of exit
  - Block the portal of entry
  - Avoid becoming susceptible host
  - Reduce microbial presence

**Block the portals of exit and pathways of transmission** – this is how microbes leave one host and travel to another. There are many ways for the portal of exit for surgical patients; surgical instruments and body fluids are the two most common exits. There are four primary pathways of disease transmission: Respiratory tract, Digestive tract, GU/Reproductive tract and the Skin. The Respiratory tract is the most common means of entry because we cannot control what we breathe in. The next most common is the digestive tract because we cannot always tell if food is bad before we eat it. Breaking the transmission cycle will stop the spread of the disease. Bacteria are hitchhikers-hands represent the most common means of disease transmission in the hospital setting So, handwashing is the single most important means to prevent infections.

**Block the portals of entry** – These are the routes by which microbes enter the body (needles, incisions, body openings). There are two ways microbes can enter; through **vectors and fomites**. A vector is a living organism/animal which transmits disease but may not be sick itself (e.g. the deer tick that causes Lyme Disease). A fomite is a non-living thing that spreads disease (i.e. contaminated IV solution, contaminated surgical instrument).

**Reduce the microbial presence** - This is also affected by SPD. How effectively we clean a device is important is reducing microbial presence. Cleaning's importance cannot be overemphasized!

By keeping health we **prevent becoming a susceptible host**.

There needs to be a sufficient numbers of microbes for disease to occur; the more microbes and the more virulent, the greater the probability of infection. The numbers needed depends on type of microorganism and virulence. Decontamination is the reduction of microbial presence and therefore paramount to all we do in SPD.

Barriers to Contamination – Some of the control mechanisms we use to keep microbes at bay include:

- Separation of clean and dirty
- Proper Air flow
- Traffic control limiting access to the department

This means keeping the doors and windows between Decontam and Prep and Packaging closed at all times. Keeping traffic into the department at a minimum and when visitors do come, they must wear a cover gown, hair cover and shoe covers.

We will learn more about Microbiology in Part III.

### POST TEST QUESTIONS: Microbiology 101 – Part II

This in-service is Approved by the CBSPD for 1 CEU. Complete this post test and follow the directions at the end of the test for payment and results.

1. A microorganism that likes to grow in standing water is known as
  - A) Staph Aureus
  - B) Staph Epidermitis
  - C) Pseudomonas Aeruginosa
  - D) Serratis Marscens
  
2. The part of the cell that permits nutrients to enter the cell is known as
  - A) nucleus
  - B) flagellum
  - C) protoplasm
  - D) cell membrane
  
3. A capsule is
  - A) a slime like covering on the cell wall
  - B) a hard, shell like covering on the cell wall
  - C) a dead bacteria
  - D) a hibernating bacteria
  
4. Microorganisms can reproduce in as little as
  - A) 2 minutes
  - B) 5 minutes
  - C) 10 minutes
  - D) 20 minutes
  
5. An important fact about viruses is that they
  - A) require living tissue to survive and grow
  - B) require dead tissue to survive and grow
  - C) reproduce quickly
  - D) reproduce slowly

6. Lyme disease is caused by
    - A) staphylococcus
    - B) rickettsiae
    - C) pseudomonas
    - D) streptococcus
  
  7. Prions are
    - A) spores
    - B) encapsulated microbes
    - C) infectious proteins
    - D) viruses
  
  8. The most common portal of entry for diseases in the human body is the
    - A) Digestive tract
    - B) Skin
    - C) Respiratory Tract
    - D) GU Tract
  
  9. A vector is
    - A) a non-living thing that transmits infection
    - B) a living thing that transmits infection
    - C) a spore
    - D) a capsule
  
  10. One of the **major** ways to prevent contamination in SPD is to:
    - A) Wear clean scrubs each day
    - B) Keep all hair covered
    - C) Separate clean and dirty functions
    - D) Stay home when sick
- 

### Directions for Payment and Results

This in-service = \$10

Re-do's = \$10 each

**No refunds (all sales are FINAL), prices subject to change.**

Payment is accepted in the form of a Credit Card, Facility Check, or Money Order only.

Sorry, no personal checks.

Please see the form on the following page.

Upon passing this in-service, your certificate will be mailed to you within 7-10 business days.

Please fill out the form below and submit it with your payment and the quiz to:

**Sterile Processing University, 59 Allerton Road, Lebanon, NJ 08833.**

Name: \_\_\_\_\_

Mail to:  Home  Work

Full Address: \_\_\_\_\_

\_\_\_\_\_

Phone: \_\_\_\_\_

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For Credit Card Orders Only:  Visa  MasterCard  Discover

Credit Card Number: \_\_\_\_\_ Exp. Date: \_\_\_\_\_

Person's Name on Card: \_\_\_\_\_

Card Billing Address: \_\_\_\_\_

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If you have any questions, please email [heidi@spdceus.com](mailto:heidi@spdceus.com)

Thank you!