STERILE PROCESSING BASIC TRAINING: SPD BOOT CAMP®

Module #:5
Introductory Microbiology for Sterile Processing Professionals

by

The Central Sterile Processing Initiative

Sterile Processing Basic Training: SPD Boot Camp

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Message From The Central Sterile Processing Initiative Director

Thank you for purchasing this e-course, an introductory and review survey of the basics of sterile processing, *Sterile Processing Basic Training: SPD Boot Camp.* Thank you, enjoy the program, and I am always just an e-mail away if you have questions or need my assistance during the course of your studies. Sincerely, Shane Huey, Director	www.centralsterileprocessing.net

Preface

This e-course is neither the traditional textbook nor the typical student workbook. It is, rather, a combination of the best and most relevant of information related to the basics of sterile processing education and training presented much like a series of lecture notes with multimedia elements included for a more complete and well rounded educational experience for both sterile processing "newbies" and seasoned veterans simply seeking a comprehensive review alike.

The content is structured as a classroom lecture/text with all relevant points discussed and references provided for further information and investigation.

In this text one will be presented with material contained within the industry standard texts, current field relevant articles, and as well have workspace much like contained within the likewise standard workbooks. Herein, however, the student will find no superfluous material to bog one down unnecessarily. Covered within is only that which one needs to know as a sterile processing tech at the level 1 stage—the ESSENTIALS of sterile processing, that which every tech need know—the prerequisites of the field. References will be cited throughout the course, however, to point students in the right direction should they choose (and we are trusting that they will!) to pursue additional knowledge, training, and advancement in the field of sterile processing.

The course consists of multiple individual modules (at least 15 at the time of this printing). Please read through each module from beginning to end at least once before attempting to complete the assignments and then work your way back through the text completing the required coursework specified in the assignment directions at the end of the module (see contents).

Module 5

Module Objectives

- Define the science of microbiology
- Understanding of the major historical developments in microbiology
- Comprehension of the concepts of microbiology as related to sterile processing
- Microorganism identification
- Microbial transmission
- Microbial control and mortification

Introductory Microbiology for Sterile Processing Professionals

Introduction
The science of modern microbiology is both a fascinating and comprehensive science. *Microbiology*, as a branch of the larger trunk of the science of biology, is the study of microbial life and the impact of these microscopic organisms upon other biological entities (Chobin 54).

Most individuals hold at least a rudimentary concept of microbiology even if they do not in fact realize such directly. For example, most people wash their hands after using the restroom, don't eat food that has been dropped on the floor, avoid others who are sick, etc.

Microbes are microscopic entities invisible to the naked eye. It is in their size that the danger lies as microorganisms are so small and, simultaneously, invisible to the naked eye, the sterile processing technician must hold at least a basic conceptual understanding of microbial life, microbial transmission, and microbial mortification to fully perform his/her duties in the eradication of pathogenic microorganisms from items reprocessed in the sterile processing department for patient care.

***pathogenic**—disease causing*

Not all microbes are pathogenic. In fact, most bacteria are harmless and, in many cases, even beneficial as they function in integral life processes such as digestion, converting waste matter into life sustaining oxygen, photosynthesis (which contributes to the global food chain, e.g., as in the ocean with plankton), etc.

There are also applications for bacterial and microbial processes. E.g., in the food industry in the production of milk, cheese, vinegar, beer and wine, etc. (Chobin 55).

Historical Developments in Microbiology
For a more detailed account of key developments in microbiology,

refer to Module 2.

- 1665-Robert Hooke launches cell theory as he views "cells" with his makeshift microscope
- 1683-Leeuwenhoek observes *living* microscopic creatures (bacteria) and describes them as "animalcules"
- Late 1800s-Pasteur refutes spontaneous generation and demonstrates conclusively the airborne transmission of microbiological entities
- 1857-1914-"Golden Age of Microbiology"; many advancements in the field during this period
- 1860s-Lister applies understanding of germ theory of disease transmission to surgical technique
- 1876-Robert Koch demonstrates pathogenic behavior of certain bacteria (in this case via anthrax as found present in diseased cattle); Koch injected culture of the bacteria from diseased cattle into healthy cattle and the healthy cattle fell ill from the disease

Sterile Processing and Microbiology

There are two primary reasons for sterile processing technicians in the healthcare setting to be cognizant of the basics of microbiology:

1) The primary role of the sterile processing professional is that of infection control prevention. It is a primary duty of the sterile processor to protect patients from pathogenic microorganisms via the roles played in the sterile processing department.

2) The secondary role (though equally important to the first) is that of protecting oneself from pathogenic microorganisms in the performance of one's duties.

Contamination is the presence of microorganisms. In sterile processing, items returned for reprocessing to the sterile processing depart must all be assumed contaminated and treated as if in fact infectious. Remember, contaminants such as microbes cannot be seen with the naked eye. Protect yourself and your patients by assuming

contamination until appropriate decontamination steps have been initiated, followed, and validated.

Things microbiological sterile processing technicians must know (Central Service Technical Manual, 61):

**Basic understanding of microbes*
**Classification of microbes*
**Growth and transmission of microbial life*
**Control and mortification of microorganisms*

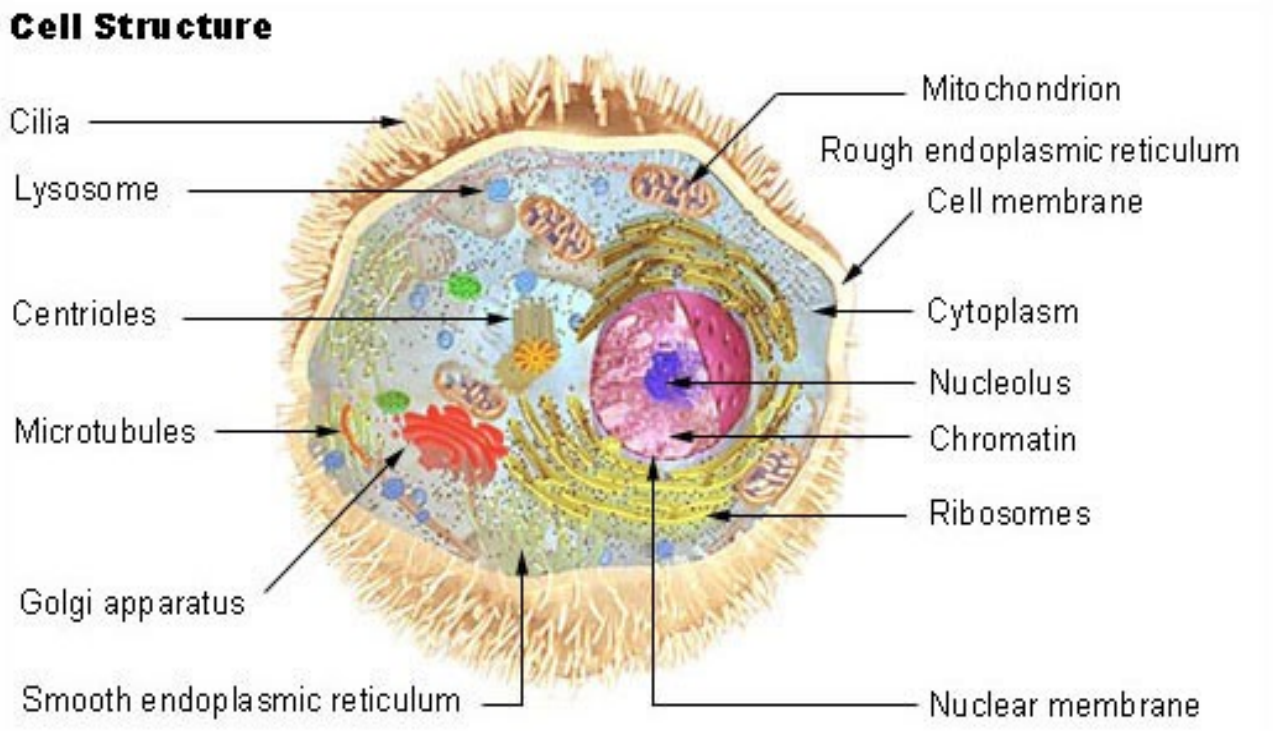
Microbiological Classification
The scientific name of an organism is provided in Latin. A given organism has two names, the first referring to the genus of the organism (always capitalized) and the second referring to the species of the organism.

Microorganisms are so small that they cannot be measured via conventional metrics but rather are measured in terms of *microns*. A micron is a mere 1/25,000 of an inch with the average bacteria ranging in size from 1-10 microns. The notation for micron is the Greek letter µ.

To get a grasp on the size of an individual bacterium, if the tip of a ball point pen were covered entirely with bacteria, there could be up to trillions of bacteria present!

**Note: A single bacterium is not typically associated with "infection." Rather, it takes a sufficient number of bacteria (pathogenic) and ideal circumstances for an infection to emerge.*

Cells are the basic units of life and are constructed of several primary components similar across microbiological entities. Below is a diagram of the cell structures (animal cell).



Key Components of the Cell

cell wall-a rigid outer structure that functions to provide both structure and to allow for equilibrium between the inner and outer cell

cell membrane-located beneath cell wall, semi-permeable allowing for exchange between the inner and outer cell

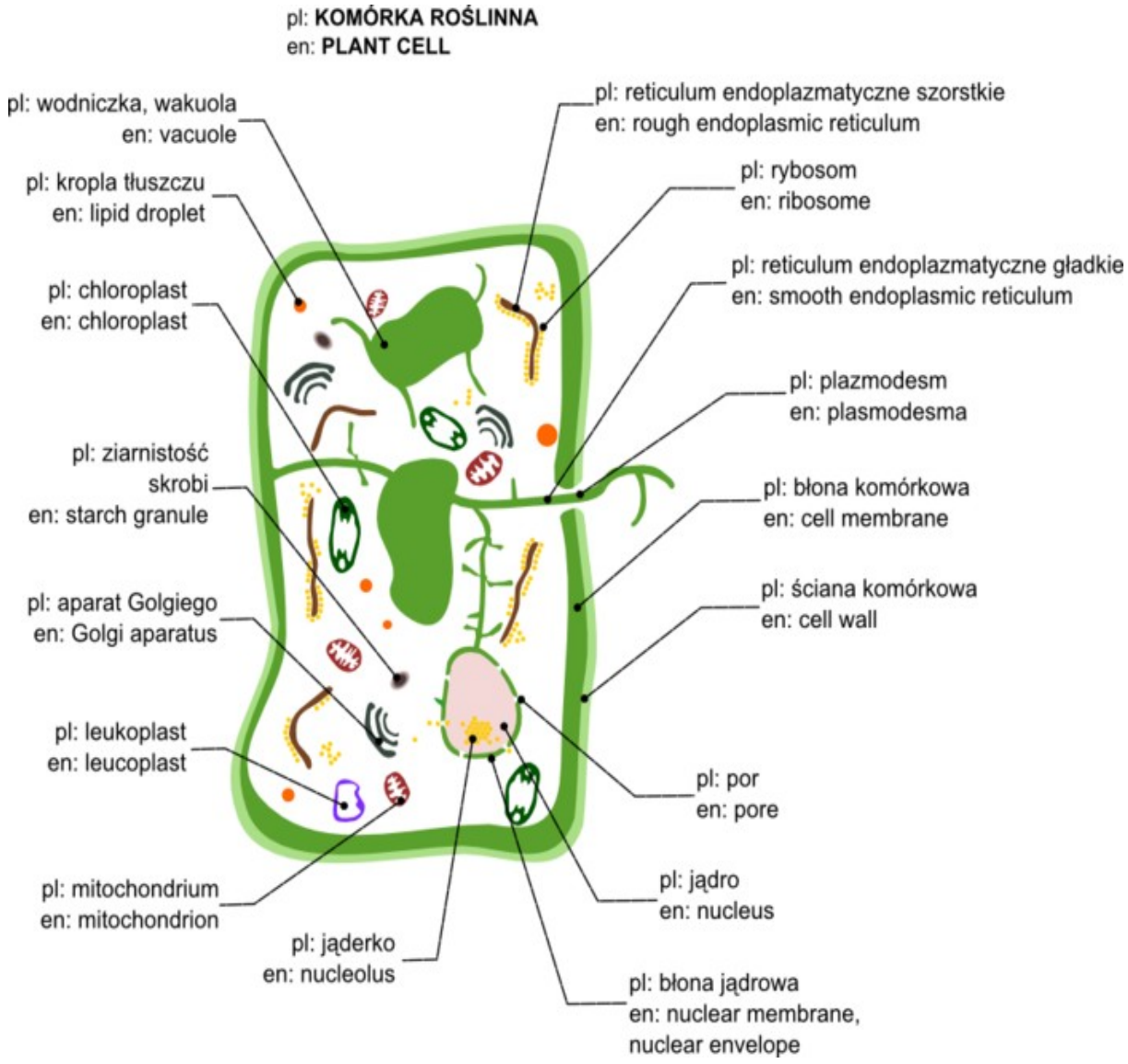
cytoplasm-gel-like protein-based protein substance in which cellular vital functions are performed or provided for

nucleus-brain of the cell dictating and controlling cellular vital functions

flagellum-a typically thread-like cellular appendage functional in motility of the cell

Refer to above image for further cell structure.

For comparison, see below insert of plant cell.



Bacteria are single-celled organisms and produce by a means referred to as *binary fission*. Binary fission (also referred to as asexual reproduction) consists of a cell copying its DNA and essentially splitting into two separate and distinct cells.

Much like larger multicellular organisms (e.g., animals and humans), microorganisms need specific criteria met for survival:

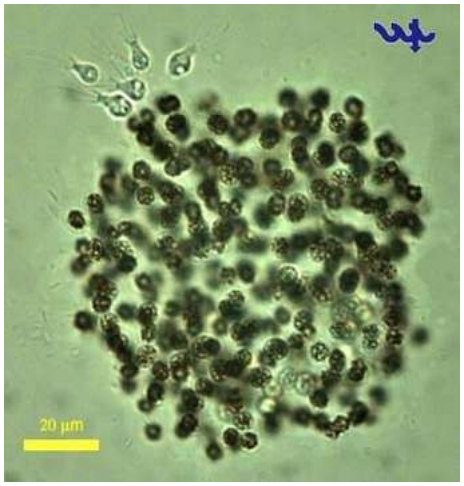
- Warmth and moisture (most bacterial populations thrive at around 98.6 deg F, which is human body temperature)
- Availability of nourishment (food)
- An alkaline pH
- Oxygen (bacteria requiring oxygen are referred to as *aerobes*; those not requiring oxygen for sustenance are *anaerobes*)
- Little to no light exposure

Control and mortification of microorganisms depends upon our ability to interfere with and disrupt one or more of the above needs of microbes.

Bacteria are classified along three primary parameters: shape of cell, color change with exposure to stain (e.g., Gram stain), and oxygen requirements.

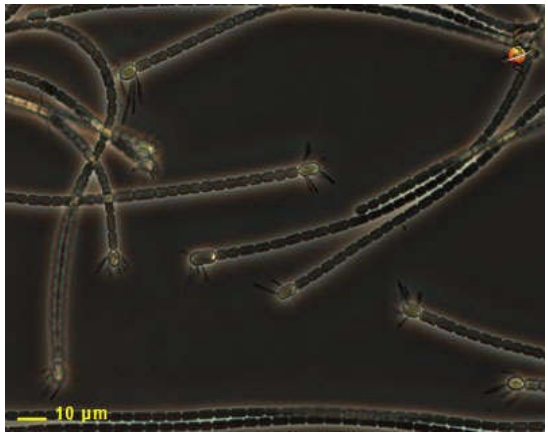
There are three basic bacterial cell shapes.

Cocci
Cocci are round or spherically shaped bacteria.
Example: staphylococcus



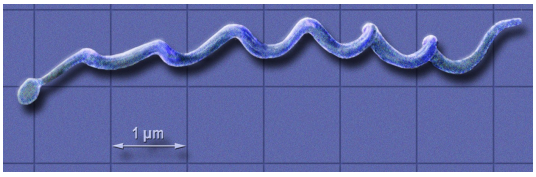
Cocci Bacteria

Rod Bacteria (Bacilli)
Rods, as the name implies, are shaped like a rod. May also be shaped such as a rectangular brick or even thread-like.
Example: geobacillus thermophilus



Rod Bacteria (Bacilli)

Spiral Bacteria (Spirochetes)
Vary in shape from mild curvatures to pretzel-like twists.
Example: Helicobacter pylori



Spirochete

Bacteria may also be classified according to color change when exposed to a staining medium. As they occur in nature, microorganisms are typically lacking in color or pigmentation and must be stained with a coloring agent such that the organism and organism component structures can be viewed clearly via microscopy.

There are two primary stains for bacterial identification and observation: *the Gram stain* and *Ziehl-Neilson stain*.

With the Gram stain (developed by Christian Gram in 1884), bacteria that stain purple when exposed to a certain dye are said to be *gram positive* and those that do not *gram negative*.

Microorganisms are also classified on their consumption of or lack of requirement for oxygen. Microbes that require oxygen are said to

be *aerobic* bacteria and those able to thrive in absence of oxygen are *anaerobic*.

Spore*-a resistant form of bacteria created when a microbe encases itself in a thick wall of protective matter allowing for it to survive for extended periods of time in unfavorable conditions.*

Conditions for Microbiological Growth and Success

Just as other forms of life require ideal conditions and environments for life, growth, development and perpetuation, so to do microbes. These conditions and environments vary from one form of microbial life to another.

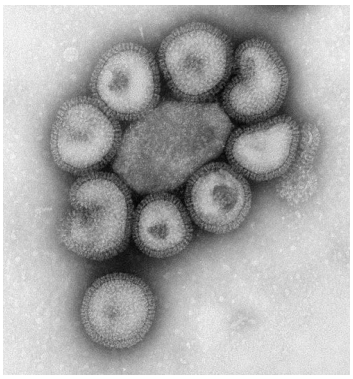
Bacteria referred to as *psychrophiles* prefer colder temperatures ranging from between 59 deg F to 68 deg F. *Mesophiles* prefer average temperatures and as such thrive in the human body (68 deg F to 113 deg F). Finally, *thermophiles* (the name literally means lovers of heat) prefer the warmer temperature range (122 deg F to 158 deg F).

Much like humans, over the ages microbes have evolved and continue to do so in response to their environment and conditions in which they find themselves in an effort to survive and to continue to perpetuate the species. A classic example of this in the healthcare setting is MRSE (methycillin resistant staphylococcus aureus), a staph bacteria that is no highly resistant to the strongest of antibiotics.

Other (Non-Bacterial) Organisms

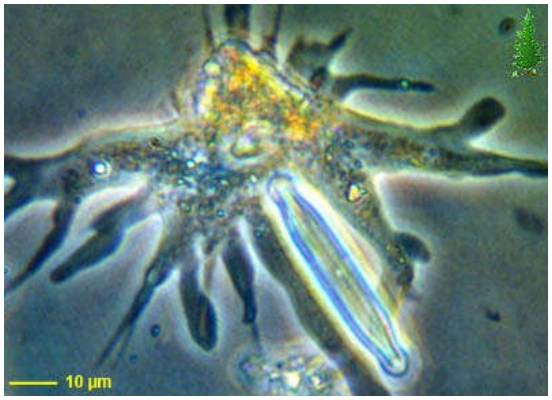
Viruses-Viruses are not themselves truly living creatures (are not cellular organisms as are bacteria) but rather depend upon other living cells for their success and reproduction. Viruses are typically 1000 times smaller than the smallest of bacteria. The word "virus" stems from the Latin referring to "poison."

Examples of viruses include: HIV/AIDS, smallpox, rabies, polio, hepatitis, etc.



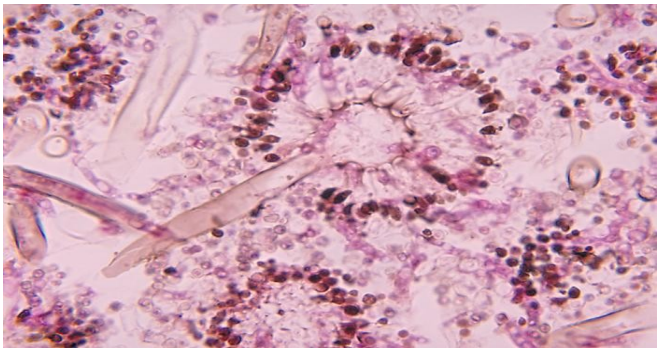
Influenza Virus

Protozoa-Are single-celled animal microorganisms. An example is the amoeba.



Amoeba

Fungi-Fungi are plant-like microorganisms consisting of molds and macroscopic relatives (e.g., the mushrooms). Examples of fungi include: Histoplasma capsulatum, Tinea pedis (athlete's foot), and Crytococcus neoformans.



Fungal Infection

Prions-Prions are a class of infectious agents similar in structure and action to viruses though substantially smaller than viruses and most resembling protein structures. Prional infections attack the nervous tissues such as brain and other nerve structures and most often result in the death of the host.

*Surgical instruments exposed to prional matter prove a daunting challenge to sterile processing and, in most instances, results in the disposal of such instrumentation.

Examples of diseases caused by infection with prions: CJD (mad cow disease) and kuru.

Prion Structures

Microbial Transmission and Infection Control

Microbes, though indeed mobile, are nature's proverbial hitchhikers, hitching ride via air, dust, fluids, objects, and other living organisms (Central Service Technical Manual, 70).

As hitchhikers, the role of the sterile processing technician is to ensure that there are minimal to no hitchhikers on patient care equipment and instrumentation!

Despite the continual bombardment with microbes (people are exposed to over 1000 types of microorganisms on a daily basis), it must be stated that only approximately 1 percent of microbes are detrimental to human health (are pathogenic). Regardless this fact, that 1% can wreak much havoc if not dealt with appropriately in the healthcare setting. This is YOUR job #1 sterile processing professional!

For further information on disease transmission and infection

control, refer to Module 4 (material from Module 4 will be included once again in Module 5 quiz).

Conclusion

Microbiology is a vast field encompassing a host of areas not covered within this module. For those who have sought full-time, lifelong career in healthcare (whether as sterile processing technician or otherwise) it would behoove you to pursue a formal, academic course of study in microbiology. This module does not pretend to be comprehensive in this area, only focusing on the basics for the sterile processing professional. Other sciences of interest and relevance include biology and chemistry. Such courses of study can only aid you in your career in sterile processing. Pursue them if you can.

Required Readings, Recommended Readings,and Other Resources

Required Reading
Module 5

*Read each of the following article(s) in its entirety.

http://www.mansfield.ohio-state.edu/~sabedon/biol2005.htm

http://www.broward.edu/faculty/ghauer/ghauer/Microbiology2010/IntroductiontoMicroSummer2008.ppt
* The above is a PowerPoint presentation.

Recommended Reading
Central Service Technical Manual, Seventh Edition. Chapter 4.

Chobin, Nancy, Ed. The Basics of Sterile Processing, Third Edition. Chapter 3.

Recommended Links
http://www.sciencedaily.com/news/plants_animals/microbiology/
http://www.asm.org/

Module Assignments

Module 5 Assignments

1) Read the module in its entirety from cover to cover at least once.

2) Read the assigned required reading and review the Power Point presentation.

3) Provide a brief but detailed summary (2-3 paragraphs minimum) of the role of microbiology in the day to day operations of sterile processing.

4) Independently, find 3 additional articles online related to the module and summarize (provide web link).

5) Find at least one online video on microbiology. Summarize content and provide link to video content for verification.

6) Locate an article relevant to the module at http://www.sciencedaily.com/news/plants_animals/microbiology/ and write a brief review.

7) Go to the following site and download one of the basic versions of Darwin's Pond. Follow the instructions and create a world with microbial life. Play with the conditions and note how the environmental factors impact the advancement (or detract from) the development of life. Write a brief one page summary of your findings. http://www.ventrella.com/Darwin/darwin.html

8) Complete the module quiz (posted online separately 3-5 days after posting of this module). Submit with above documents to info@centralsterileprocessing.net. In subject line, type "Module 5 Assignments." In body of e-mail, submit full name.

END MODULE 5