**Education & Training**

Anatomy and Physiology of the Sterile Processing Department

**THE HUMAN FACTOR IN STERILE PROCESSING**  
by Rose Seavey, RN, BS, MBA, CNOR, CRCST, CSPDT

**Objectives**

After completion of this self-study activity, the learner will be able to:

1. Define anatomy and physiology (A & P).
2. Describe the basic organization of the human body including the chemical, cellular, tissue, organ and system levels.
3. Discuss functional categories of support and movement, control systems, maintenance and continuity of the human body.
4. Compare the organization, principles of support and movement, control systems, maintenance, and continuity of the human body to that of a sterile processing department (SPD).

**Test Questions**

True or False

1. Physiology refers to the study of the structures (parts) of the body and the relationships of those structures.
   A. True   B. False

2. Tissues are made up of groups of specialized cells that perform specific functions.
   A. True   B. False

3. Bones are joined together and joints are created by sturdy connective tissue know as tendons and ligaments.
   A. True   B. False

4. Endocrine glands use ducts to secrete their products into body cavities or the body’s surface.
   A. True   B. False

5. Sensory organs are considered the body’s alarm system.
   A. True   B. False

6. Physical, chemical and biological sterilization monitors are the sterile processing department’s alarm systems.
   A. True   B. False

7. The circulatory system consists of two major parts, the cardiovascular system, consisting of the heart and blood vessels, and the lymphatic system.
   A. True   B. False

8. The lymphatic system consists of lymph nodes and lymph vessels and serves a vital role in fighting disease.
   A. True   B. False

9. The skin consists of several kinds of tissues that function together to create the largest organ in the body.
   A. True   B. False

10. Personal protective equipment consists of several items (general-purpose utility gloves, a liquid-resistant-covering with sleeves, fluid-resistant face mask and eye protection) that must function together to protect the staff.
    A. True   B. False
Introduction

How many times have you heard someone say something like “Sterile processing said …” or “Sterile processing did …” or “Let’s ask sterile processing”? When I hear a phrase like that my first response is that sterile processing is a department not a person. It can’t talk or make decisions. Of course, we know they are referring to the people or perhaps a specific person in charge of or representing the sterile processing department (SPD).

Let’s think about that for a moment. Humans are amazing, living, breathing beings. They can communicate, make decisions, generate products, move things, etc. The human body is made up of many complicated parts and systems that must work together to keep the body alive and healthy. In comparison, SPD is also made up of many complicated parts and systems that must work together to be successful.

This inservice will describe the basic anatomy and physiology (A&P) of the human body. We will discuss the organization of the human body; identify the various systems and examine the different structural levels by identifying the principles of:

1. support and movement;
2. control systems;
3. maintenance; and
4. continuity.

We will then compare those organizational principles of A&P of the human body with the organizational principles of A&P of a sterile processing department (SPD).

Anatomy and Physiology

Every sterile processing professional should have a basic understanding of the anatomy and physiology of the human body. Anatomy refers to the study of the structure (parts) and the relationships of those structures. Physiology refers to how the body parts function. In other words, the term A&P basically refers to the various parts of the body and how they work together.

For comparison, the A&P of an SPD refers to the various items, parts and structures that make up the department and how each piece must work together to create a functioning department.

Basic Organization of the Human Body

The human body consists of several structural levels of organization that are connected and dependent on each other in various ways.

Chemical level

The lowest level of organization is the chemical level. This chemical level includes all of the chemical substances essential to sustain life. These chemicals are made up of atoms connected together in different ways to form the next higher level of the organization: the cellular level.

Cellular level

The basic structural and functional units of the human body are cells. Many disease processes originate at the cellular level. A cell is the basic living, structural and functional unit of the body, and in fact, all organisms.

The body has many types of cells such as muscle, nerve and blood cells. Each cell has a different structure, and a different job to perform. Groups of specialized cells that perform specific functions make up the tissues which are the next higher level of organization in the body.

Tissue level

A tissue is a group of similar cells and their intercellular substance functioning together to perform a specialized activity. Some tissues function to protect and support. Others move body parts or move food through body organs. There are four principle classifications of tissues according to their function and structure:

1. Epithelia tissue, which covers body surfaces or tissues, lines body cavities, and forms glands.
2. Connective tissue, which protects and supports the body and its organs and connects organs together.
3. Muscular tissue, which is responsible for movement.
4. Nervous tissue, which initiates and transmits nerve impulses that coordinate body activities.
Organ level

The organ level is the next higher level of the human body system. Organs are constructed from two or more different tissues that work together to perform a specific function. Organs have an identifiable shape such as the stomach, heart, liver, lungs, brain or skin.

System level

The next higher level of organization is the body’s system level. The systems consist of related organs that have a common function. For instance, the nervous system consists of the brain, spinal cord, nerves, and sense organs, such as the eye and ear. The function of the nervous system is to regulate body activities through nerve impulses. The human body has 11 major systems: the skeletal, muscular, nervous, endocrine, circulatory, lymphatic, respiratory, digestive, integumentary, urinary and reproductive systems.

All of the structural levels functioning together create the organization of the human body. We will examine how the systems function by grouping them into four categories: support and movement, control systems, maintenance, and continuity and compare them to SPD.

Support and Movement—Human Body

Skeletal system

The human skeletal system has five main functions:
1. shape and support;
2. allow for movement;
3. protect vital organs;
4. produce blood cells; and
5. store calcium.

The approximately 206 bones in the human body are connected by sturdy connective tissue know as tendons and ligaments.

There are many shapes of bones in the human body. The long bones, such as the humerus (upper arm bone), or the femur (thigh bone), act as levers to raise and lower. Short bones, such as the metacarpals of the hand and foot act as bridges. Some body parts are protected by flat bones, such as the ribs. There are also irregular shaped bones that help form framework and offer protection.

Besides holding the bones together, tendons and ligaments create joints which allow for movement or articulation. There are several types of joints: ball and socket joints such as the shoulder and hip; gliding joints in the spinal column allow us to lower our heads; and pivot joints or hinge joints allow rotation and backward and forward bending such as in the knee, knuckle, or elbow.

Muscular system

Bones and joints form the framework and provide leverage, but they are not capable of movement by themselves. Motion results from contraction and relaxation of muscles which produces energy. Muscles require energy from food and oxygen for power and strength.

Muscles perform three significant functions: motion, maintenance of posture and heat production. Movements such as walking or shaking your
Without muscle power, the SPD would not be able to function. The strength and energy provided either by humans or automatic machines can be considered the muscles of the department.

Skeletal muscle tissue is attached to bones and is considered voluntary muscle tissue because it can be consciously controlled. Muscle tissue located in the walls of hollow internal structures such as blood vessels, the stomach, and intestines are called smooth or visceral muscles. Smooth muscles are considered involuntary because their contraction is usually not under conscious control. Cardiac muscle tissue forms the walls of the heart and is considered involuntary muscle.

Support and Movement—SPD

Skeletal system
As with the human body SPD also requires supportive structures. The walls, floors and ceilings of the department can be considered the skeletal system. They support the department, give it shape, protect its contents and store items such as electrical and data wires and plumbing.

There are many types of walls, floors and ceilings in SPD. Some are structural, some are weight bearing and some are merely there as dividers, like the walls between clean and dirty areas. Walls, floors and ceilings also provide a place to support equipment, furniture or facilities.

Muscular system
Without muscle power, the SPD would not be able to function. The strength and energy provided either by humans or automatic machines can be considered the muscles of the department. As we know, human muscles require food and oxygen in order to perform the three significant functions; motion, maintenance of posture and heat production.

The other muscles of SPD are the mechanical equipment that allows the department to perform the required functions. These machines also require energy in order to perform. This energy that they need to run on is usually in the form of electricity, water or chemicals. There are many types of automatic “muscles” or equipment found in SPD. The machines are the instrument and cart washers, pasteurizers, decontaminators, disinfectors, sterilizers, peel pack heat sealers, drying cabinets, etc. Another form of mechanical muscle power is used in the elevators and lifts that allow people or products to be delivered to other floors.

One more form of SPD “muscle power” that creates movement is the various carts, trolleys or wheeled tables used for transporting. They generally require human energy to be able to move, but their function is to make moving items easier. Carts trolleys or wheeled tables could also be thought of as the tendons, ligaments and joints that help to create movement in the body.

Control Systems—Human Body

With the help of the sensory organs and the endocrine system, the nervous system is the control center of the human body. It detects changes in the environment, decides on a course of action, and responds to the change.
The network of nerves that branch out from the CNS connecting it to all the other parts of the body is called the peripheral nervous system. The peripheral nervous system is a two-way communication system between the brain and the body parts.

Endocrine system
There are two types of glands in the body: exocrine and endocrine. Exocrine glands use ducts to secrete their products into body cavities or onto the body’s surface. Endocrine glands (or ductless glands) secrete their products directly into the extracellular space around cells. The endocrine glands make up the endocrine system and consist of the pancreas, ovaries, and testes, as well as the pituitary, thyroid, parathyroid, adrenal, pancreas, ovaries, testes, pineal, and thymus glands. The endocrine system is the body’s method of chemical control. It affects bodily activities by releasing chemical messages, called hormones into the bloodstream. The endocrine glands and the chemical hormones they produce have a profound influence on bodily functions, metabolism, growth and personality.

Sensory organs
Sensory organs (eyes, ears, nose, tongue and skin) are accessory organs of the nervous system. These highly specialized organs have unique sensory receptors that carry messages to the brain. They respond to stimuli such as light, sound, smell, taste, heat and pressure and help keep track of the body’s internal environment. The sensory organs alert us to changes in the environment and can be considered the body’s alarm system.

Control Systems—SPD
Nervous system
Messages are coordinated and carried throughout the SPD by a vast communication network. This communication network is made up of data wires, computers, and paper. Information vital to the functions of SPD are warehoused either electronically via computers or in a written format. These documents are the control center for the entire department.

As with the human nervous system, SPD’s control center has two broad functions. It functions to convey communication and relay information which helps maintain and protect the department (much like the human endocrine system).

Endocrine system
Just as endocrine glands and hormones influence bodily activities, there are external and internal stimuli for SPD that have a profound influence on its functions, growth and personality. This could be considered the SPD’s endocrine system. These motivators are the regulations, standards, policies, procedures, guidelines and schedules that are found in the department. These documents help to protect the department by communicating and encouraging safe practices for the patient, staff, facility and environment.

If the department did not have an “endocrine system” it could not function effectively. There would be chaos and confusion.

Sensory organs
Sensory organs in the body respond to stimuli and send messages to the brain, and these unique sensory receptors help to monitor the body and its environment. SPD has many “senses” that it must rely on in order to monitor the internal environment of the department. The complexity of processing and sterilization technologies, as well as patient and employee safety requires adequate, safe and reliable monitors.

Temperature, humidity, ventilation, water quality, and electrical systems are some of the environmental concerns that require monitoring in SPD. Mechanical equipment, such as washers and sterilizers, has specific challenges requiring precise monitors that can alert the workers when things are not right. Other important monitors include sterilization process monitors. These can be categorized as physical monitors (displays, digital printouts or gauges), chemical indicators (external and internal package indicators or Bowie-Dick-type indicators), or biological indicators. These process monitors help detect failures in the sterilization process and keep patients safe. These monitors can be considered the SPD’s alarm systems.

Maintenance Systems—Human Body
In order for the body to maintain homeostasis (the body’s ability to have a balance within its internal environment, even when faced with external
changes, e.g., maintaining an internal temperature around 98.6°F, whatever the temperature is outside), it depends on the cardiovascular, lymphatic, respiratory, digestive and urinary systems. It is vital that these systems work together to maintain the human body.

**Circulatory and lymphatic system**

The circulatory system is responsible for transporting all vital substances necessary for cellular metabolism. It delivers oxygen and nutrients to the body’s cells, and removes carbon dioxide and harmful waste products from them. The circulatory system consists of two major parts: the cardiovascular system, consisting of the heart and blood vessels, and the lymphatic system.\(^6\)

The cardiovascular system consists of a network of blood vessels which allow blood to flow from the heart to all of the body’s cells and then back to the heart. The blood supplies oxygen and removes waste products from organs and tissues.

The heart is the pump that maintains the circulation of blood throughout the body. It is a hollow, muscular organ about the size of a fist. The heart is divided into four chambers. The upper two chambers are called the atria and they receive blood from the veins. The lower two chambers, called the ventricles, force blood from the heart into the arteries.\(^6\)

Blood that is low in oxygen and high in carbon dioxide is pumped into the lungs where carbon dioxide is removed and blood is oxygenated. The oxygen rich blood then gets pumped back into the body via the heart.

The lymphatic system serves a vital role in fighting disease. It consists of lymph nodes and lymph vessels. Lymph nodes act as filters against bacteria and other harmful materials. Lymph vessels carry lymph fluid back to the bloodstream.\(^3\)

**Respiratory system**

The respiratory system supplies the body with oxygen and removes carbon dioxide. In other words it acts as an oxygen distributor and a gas exchanger. The respiratory system also filters, warms, and humidifies the air we breathe. This system consists of the nose, mouth, pharynx (throat), trachea (windpipe) and lungs.

When we breathe and take air into our lungs it goes through a series of small tubes called bronchioles until it reaches small clusters of air sacks called alveoli. The oxygen and carbon dioxide exchange happens via diffusion between the alveolar air and the blood flowing through the capillaries of the lungs. This is the area where blood gets oxygen as we inhale and releases carbon dioxide as we exhale.\(^2\)

**Digestive system**

The human body needs food to sustain life. The digestive system prepares food for consumption by cells via chemical and mechanical means. The food we eat must go through several digestive steps before it can be used by cells for energy. There are five basic activities of digestion:

1. ingesting, or eating;
2. digestion, converting food to usable form by mechanical and chemical means;
3. peristalsis, the movement of food along the digestive tract;
4. absorption, the passage of digested food from the digestive tract into the circulatory and lymphatic system for distribution to cells; and
5. defecation, the elimination of indigestible substances from the body.\(^5\)

The 30-foot long food passageway of the digestive system is called the alimentary canal or digestive tract. It consists of the mouth, esophagus, stomach, small intestine, large intestine, rectum and anus. The digestive tract has accessory organs (teeth, liver, gallbladder, and pancreas) and glands (salivary, gastric, and intestinal) that aid in the digestive process. Ingested and broken down food is absorbed through the small and large intestines. Material that is not absorbed is eliminated as waste.\(^3\)

**Urinary system**

The metabolism of nutrients in the body results in the production of waste. The urinary system eliminates toxic and excess materials such as various salts and nitrogenous waste (ammonia and urea). It also helps maintain the normal concentrations of water and electrolytes, balance the pH and volume of body fluids, controls red blood cell production and blood pressure.\(^2\)

The two kidneys are the main organs of the urinary system. Their job is to process blood and form urine as liquid waste to be removed from the body. The accessory organs include: ureters, urinary bladder and the urethra. The tubes that drain urine from each kidney into the urinary bladder are the two ureters. The bladder is a hollow sac that stores urine until it is eliminated. The urethra is the tube that allows urine to pass from the bladder to outside the body.\(^2\)

**Integumentary system**

The integumentary system is composed of the skin and its derivatives such as hair, nails, glands and specialized receptors. The skin is an organ that consists of several kinds of tissues that function together.

The skin is considered the largest organ in the body and is designed to protect the body from the environment. The skin is a very complex structure that performs several necessary functions making it essential for survival. It covers the body to protect the underlying structures from bacterial invasion,
The skin is composed of two structural parts. The outer, thinner layer is called the epidermis. The inner, thicker layer consisting of connective tissues is called the dermis.  

Hair grows from the epidermis and is distributed all over the body. The primary function of hair is protection. Hair protects the scalp from injury and sun rays. Eyelashes guard the eyes from foreign particles. Nostril and external ear hair protects from insects and dust.

Nails are modified hardened epidermis cells covering the ends of fingers and toes. They help protect our fingers and toes.

There are two kinds of glands associated with the skin: sebaceous glands and sweat glands. Sebaceous glands secrete an oily substance called sebum. They help keep hair from drying out, form a protective film that prevents excessive evaporation of water and help to keep the skin soft and pliable. Sweat glands produce perspiration as needed to regulate body temperature and assists in the elimination of waste.

**Maintenance Systems—SPD**

**Circulatory and lymphatic system**

The circulatory system is responsible for transporting all vital substances for life. The vital substances for SPD are the items necessary to be able to function, and the products it produces for the customers. Therefore, the transportation system, which is necessary to deliver the products for usage in specific areas, can be considered the “circulatory” system for SPD.

Like the human circulatory system, moving substances in the department consists of two major components, manual transportation and automatic transportation. Manual transportation includes delivery of items either by hand or with the use of carts, trolleys or wheeled tables. Automatic transportation consists of a mechanical means to deliver products. Examples of automatic transportation devices include elevators, pneumatic tube systems or vehicles.

Like the lymphatic system, decontamination, disinfection and sterilization serves vital roles in fighting disease by acting as a filter against bacteria and other harmful materials.

**Respiratory system**

The respiratory system of SPD is the air handling system. Like the human respiratory system, it acts as an oxygen distributor and a gas exchanger making it vital to the air we breathe. It filters, warms and humidifies the air. The system consists of many parts, such as vents, thermostats and humidifiers.

The department depends on the air handling system to keep the environment safe and comfortable with temperature and humidity controls. It functions also to help protect the integrity of the clean and sterile products within the department. It has the capability to filter, exchange and direct air currents. For instance, we know the clean and sterile storage areas of SPD must be under positive air pressure while the dirty or decontamination areas need to be under negative air pressure.

**Digestive system**

A sterile processing department is a complex machine, which requires many sources of energy and fuel to give it the ability to function. The main function of the department is to reprocess and produce products such as sterile packages and instrument trays. The food or fuel SPD “ingests” are the products (reusable and disposable) necessary to perform the vital functions of the department. SPD “consumes” these necessary products. The five basic activities of digesting these products are:

1. cleaning or decontaminating;
2. assembling trays or kits into a more usable form;
3. wrapping packages;
4. sterilizing or disinfecting devices; and
5. picking case carts.

Materials that are not able to be reused or “absorbed” are eliminated in the waste stream.

**Urinary system**

The plumbing system is more or less the fluid handling system in SPD. Just like in the human body, water is vital to life in SPD. It is necessary for many daily activities such as cleaning, mixing concentrated chemicals and, sterilizing. The plumbing system facilitates the regulation of water temperature and volume necessary for the activities.

The main “organs” of the plumbing system would be the holding tanks and various filters. Their job is to provide processed water for use in the various activities of the department. The access organs of the plumbing system are the pipes, sinks and drains. Like the ureters, the pipes direct water to the sink or piece of equipment that holds the water (the bladder). After the activities are performed and the water
is no longer needed it is eliminated as waste water down the drain pipe (the urethra) and out of the department.

**Integumentary system**

The integumentary system is the first line of defense to protect the underlying tissues of the body. In SPD, one of the most important underlying “tissues” that requires protecting is the personnel.

Due to the potential environmental hazards staff may encounter, the Occupational Safety and Health Administration (OSHA) bloodborne pathogen regulations requires that each facility have an exposure control plan in place. Like the integumentary system, the plan is composed of many protective parts. These are the engineering controls, work-practice controls (e.g. dress codes, handwashing, etc.), and preventive and post-exposure medical care procedures that are necessary to maintain the safety and health of employees.7

Like the skin, the protective attire consists of two layers. The inner layer consists of a uniform (sometimes referred to as scrubs), non-skid, sturdy shoes, and a surgical-type hair covering. The outer layer would be provided by the personal protective equipment (PPE). This layer of extra protection is worn in addition to a uniform whenever personnel are working in a decontamination area. The PPE consists of several items (or “tissues”) that function together to protect the staff. PPE includes general-purpose heavy-duty, water proof utility gloves, a liquid-resistant covering with sleeves and, if there is any risk of splash or splatter, PPE should include a fluid-resistant face mask (which is covering the nose) and eye protection such as goggles or a full-length face shield.7

**Continuity System—Human Body**

**Reproductive system**

The reproductive system is the biological focus of the body. It is the means by which life is continued. The male and female reproductive systems are specialized to produce offspring. The organs of the male and female reproductive system produce sex cells, sustain them and transport them to a location where fertilization can occur.

These systems are unique because their functions are not necessary for the survival of the individual, but are vital to the continuation of the human species.2

Reproduction is also the means by which genetic material is passed from generation to generation; therefore, reproduction maintains the species.

**Continuity System—SPD**

**Reproductive system**

The future stability of SPD is dependent on the “reproduction” of qualified individuals who have demonstrated competence in all aspects of sterile processing: decontamination, preparation, packaging, sterilization, sterile storage, and distribution of sterile medical devices. Like genetics in the human body, this “material” or knowledge must be passed on from others through orientation, training, education, and certification in the sterile processing profession.

There is one big difference, unlike human genetics we can choose what we will pass on to our “offspring.” To ensure a healthy department we must pass on the best “genes” to our “young” in SPD. We should teach only best practices, those that have been publically documented and proven by validation, research and expert opinions. We must mentor the new staff and give them the knowledge to be able to be critical thinkers, for they are the future of our species, the SPD professionals.

**Reference**

The human body is amazing. It is made up of many complicated parts and systems that must work together to keep the body alive and healthy. The human body is organized into many structures consisting of chemical, cellular, tissue, organ and systems levels. The systems level can be grouped into four distinct functional categories: support and movement, control, maintenance and continuity.

SPD is also made of many complicated systems that must function together for the department to be successful. There are many comparative distinct functions in support and movement, control, maintenance, and continuity that are necessary for survival of the department.

Sterile processing is truly an amazing department! So the next time you hear someone say “Sterile processing said ...” or “Sterile processing did ...” or “Let’s ask sterile processing” you can imagine this department as being lifelike and almost human!

Rose Seavey RN, BS, MBA, CNOR, CRCST, CSPTD is the president/CEO of Seavey Healthcare Consulting Inc., and formerly the director of the sterile processing department at The Children’s Hospital of Denver. Ms. Seavey was elected to the Association of periOperative Registered Nurses (AORN) Board of Directors for 2008-2010. She was honored with AORN’s award for Outstanding Achievement in Clinical Nurse Education in 2001. She served as the president of the American Society of Healthcare Central Service Professionals (ASHCSP) in 2003 and is the 2002 recipient of ASHCSP National Educator of the Year award. Ms. Seavey was selected as one of the Who’s Who in Infection Prevention in 2006 by Infection Control Today. She is a member of several AAMI working group committees that are developing recommended practices and is currently a co-chair for the ANSI/AAMI Working Group for Hospital Steam Sterilizers performance standards. In addition she has lectured and authored many articles on various topics relating to perioperative services and sterile processing, locally, nationally and internationally.

ANSWERS

1. B 6. A
2. A 7. A
3. A 8. A
4. B 9. A
5. A 10. A

Sterile Process and Distribution CEU Information

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The CBSPD (Certification Board for Sterile Processing and Distribution) has pre-approved this inservice for one (1) contact hour for a period of five (5) years from the date of publication. Successful completion of the lesson and post test must be documented by facility management and those records maintained by the individuals until recertification is required. DO NOT SEND LESSON OR TEST TO CBSPD.

For additional information regarding Certification contact: CBSPD, 148 Main St., Lebanon, NJ, 08833 or call 908-236-0530 or 800-555-9765 or visit the Web site at www.sterileprocessing.org.

IAHCSMM has awarded one (1) Contact Point for completion of this continuing education lesson toward IAHCSMM recertification.

Nursing CE Application Form

This inservice is approved by the California Board of Registered Nurses, CEP 5770 for one (1) contact hour. This form is valid up to five (5) years from the date of publication.

1. Make a photocopy of this form.
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4. Date the application and sign.
5. Answer the true/false CE questions. KEEP A COPY FOR YOUR RECORDS.
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