Chapter 1
Review of Basic Facts & Principles of Anatomy & Physiology

If you're like me, perhaps you spent your undergraduate years viewing the general anatomy and physiology courses as hurdles to be endured and passed rather than as a foundation for evidence-based practice. That's understandable, since the courses are usually so broad in scope that the clinically-relevant details seem to be lost somewhere in a vast abyss.

However, understanding basic anatomy and physiology will help you to better improve your journal-reading skills and your physical assessment skills. And, a sound understanding of anatomy and physiology terms will help improve your documentation skills, your communication with colleagues, and maybe figure out words on the IBLCE exam that you might otherwise have been clueless about!

The goal of this chapter is to help you review terminology and relate the 6 levels of anatomical structure and the 6 bodily processes to their clinical relevance in breastfeeding and lactation.

Objectives

- Correctly use terminology related to general anatomy including planes of the body, directional terms, terms of comparison, terms of movement and relevance.
- Use selected prefixes and suffixes to determine meaning of unfamiliar lactation-related words.
- Relate six bodily processes to breastfeeding and human milk.
- Relate six main levels of structural organization (chemical, cellular, tissue, organ, system, organism) to their clinical relevance in breastfeeding and lactation.

Topical Outline

- What is Anatomy?
- What is Physiology?
- Nervous system
- Endocrine system
- Muscular system
- Skeletal system
- Immune system
- Digestive System

Resources

- Flashcard set (electronic app): Anatomy Essentials
- Flashcard set (electronic app) Infant Anatomy & Physiology
- https://www.youtube.com/watch?v=wLrhYzdbbpE

Time Frame

- (based strongly on homework)

What is Anatomy? What is Physiology?

The word anatomy is from the Greek word *atome*, which means to cut up or to dissect, and *ology*, which means "the study of." Anatomy is the study of the structures of the body.

The Greek word *physis* means nature. The word *physiology* means the function of the body, and its Greek derivation reminds us that physiology is the study of how the body should naturally function. (*Pathology*, of course, means the study of illness.)

One who is embarking on the understanding and management of breastfeeding and lactation would be well-served by keeping in mind that the "nature" of breastfeeding is wellness and wholeness; gestation and lactation are natural processes, and therefore should be viewed as the norm.

Vocabulary

When discussing anatomy, it's helpful to use basic terms that pertain to the planes of the body, directional terms, terms of comparison, terms of movement, and terms of relation. This brief summary helps you to identify the terms; detailed flash cards would help you to memorize them.

Planes of body: axial, coronal, frontal, medial

Directional terms: Frontal, medial, sagittal, mid-sagittal, lateral, transverse, anterior, posterior, caudal, cranial, ventral, dorsal, lateral, medial, extrinsic, intrinsic, inferior, superior, deep.

Terms of comparison: superficial, distal, proximal, elevator, depressor, adduction, abduction.

Terms of movement: Extension, flexion, protraction, retraction, agonist, antagonist.

Terms of relation: antagonist, agonist.

Prefixes and suffixes. I can think of times when I've sat for the IBLCE exam and I didn't know the word in the question. (And I figured that if I didn't know that the word in the question meant, I didn't stand a good chance of getting the right answer!) I recommend that you know some very basic prefixes and suffixes, and, if you can, roots of words. About 90% of medical terms are derived from Latin or Greek. I will give you several examples as we go along in the course, but you also need to look for these yourself.

Levels of Body

The body has several levels. The chemical level _____, the etc.e tc. Get this from the homework.

Six Functions of the Human Body

The body has six functions: Responsiveness, etc. etc. get this from the homework.

Nervous System

The nervous system coordinates voluntary and involuntary actions, and transmits signals between different parts of the body.

In humans, the nervous system is made up of the central nervous system (CNS) and the peripheral nervous system (PNS.) The CNS contains the brain and spinal cord. The PNS consists mainly of nerves, which are long fibers that connect the CNS to every other part of the body. These nerves include motor neurons that enable voluntary movement, the autonomic nervous system (containing a sympathetic and a parasympathetic division), and also the enteric nervous system, a semi-independent part of the nervous system whose function is to control the gastrointestinal system. When we discuss gastrointestinal hormones, you'll see how this enteric nervous system is especially important because of their effect on breastfeeding

Cellular and Tissue Level

At the cellular level, a specialized type of cell called a neuron (also known as a nerve cell) sends signals to other cells through electrochemical waves traveling along thin fibers called axons. The axons cause chemicals called *neurotransmitters* to be released at junctions called *synapses*.

Neurotransmitters are endogenous chemicals that transmit signals from a neuron to a target cell across a synapse. Like hormones, neurotransmitters are involved in body responsiveness, but they are different. Table 1 describes each. Especially important neurotransmitters for breastfeeding include the endorphins, epinephrine and norepinephrine.

	Neurotransmitter	Hormone
Associated system	Nervous system	Endocrine system
Transmission	Across synaptic cleft	By blood
Produced by	Endocrine glands	Neurons
Target cells	Specific neurons or other cells	Can be located some distance away from endocrine gland
Speed of action	Extremely fast; up to a few milliseconds	Slower; a few seconds to a few days
Examples	Acetylcholine Dopamine Endorphins Norepinephrine	Oxytocin, prolactin, estrogen, progesterone, ADH, Growth hormone, Insulin Glycogen
What they do	Stimulate the postsynaptic membranes	Regulate their target organs

Table 1. Comparison of neurotransmitters and hormones.

Responsiveness

Responsiveness, especially reflexes and stimulus-response functions, are of prime importance for understanding events associated with infant feeding reflexes and the mother's milk ejection reflex.

The simplest type of neural circuit is a *reflex arc*, which begins with a sensory input and ends with a motor output, passing through a sequence of neurons in between. A simple neural reflex involves the occurrence of a *stimulus*, followed by a *response*. The stimulus sends an *afferent* signal to the spinal cord (where it meets interneurons) and an *efferent* neuron carries the message to the target organ.

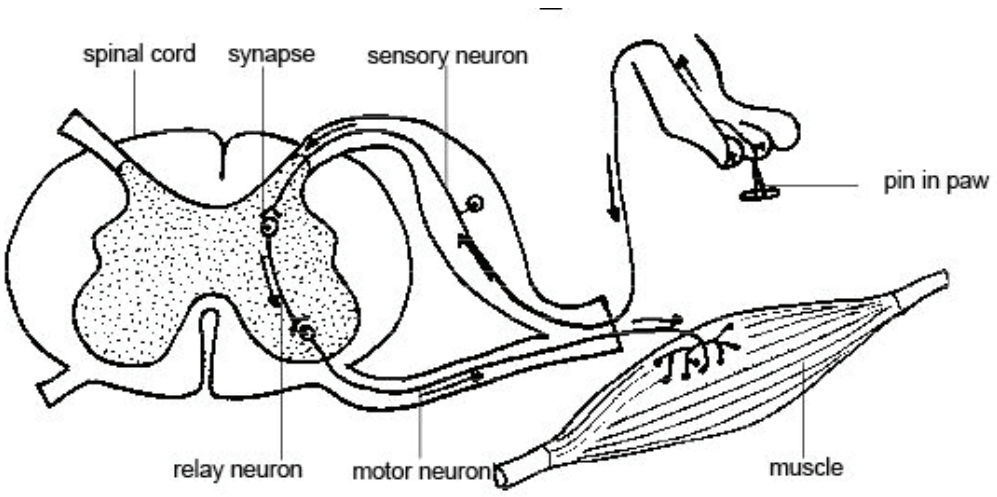
The classic example of a simple neural reflex is touching a hot pan (stimulus). The afferent neurons carry the message to the spinal cord; efferent neurons then cause the muscle to pull away (response) from the hot pain, as seen in Figure 1. This is the description of a simple neural reflex. However, the milk ejection reflex, although it is a process of stimulus and response, is not so simple; it will be discussed later.

Growth and Development

Cellular and Tissue Level

Organ Level

System Level



Endocrine System

The main function of the endocrine system is to signal the body to make changes. The endocrine system is made up of organs called endocrine glands and their hormones.

Chemical Level

Hormones are chemical messengers that regulate mood, growth and, tissue function, and metabolism. There are many, many hormones in the body. When one of the body's hormones is altered, others are affected. Hormones may be synthesized in one gland, but stored in another. For example, oxytocin and adrenocorticotropin (ADH) are synthesized in the hypothalamus, but stored (and secreted) by the pituitary gland. Hormones that are closely associated with lactation include oxytocin, prolactin, and others.

The endocrine system does indeed signal the body to make changes, but there are actually several types of endocrine signaling. To understand how lactation works, it's important to understand *endocrine* and *autocrine* signaling. In the early postpartum period, milk-production is regulated primarily by endocrine signaling. Later on, it is regulated primarily by autocrine signaling. (Note that multiple types of signaling may occur; these are the primary types used at these times.)

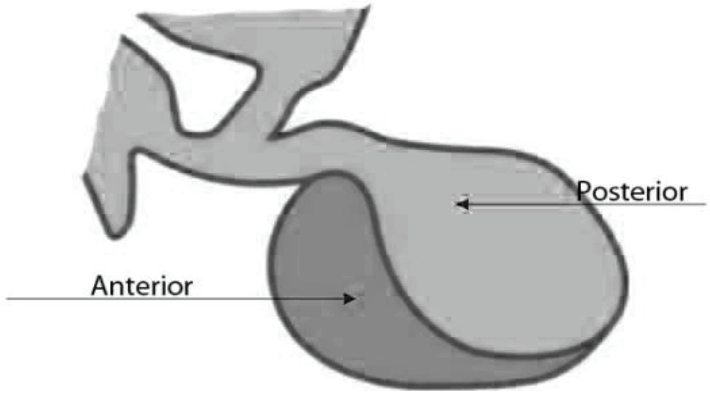
Organ Level

Organs in the endocrine gland are called glands. There are two types of glands in the human body: *exocrine* glands and *endocrine* glands.

Endocrine glands carry their secretions directly into the blood. Endocrine glands have no ducts; they are very vascular, and they store hormones. Examples of endocrine glands include the thymus, thyroid, pancreas, and the pituitary gland (seen in Figure 2) which is a key player in milk production and milk transfer.

Exocrine glands have ducts that carry their secretions to specific locations external to the gland (but the location may be inside or outside of the body). For example, the salivary glands carry saliva to the mouth; the ducts of the pancreas carry pancreatic fluid to the small intestine's duodenum. The mammary gland (breast) is an exocrine gland; it has ducts that carry milk to the nipple pores. The breast is really a modified sweat gland.

All endocrine processes must perform correctly pregnancy and lactation to be successful.



There are many examples of dysfunction that can affect lactation. A dramatic example is *Sheehan's Syndrome*, an

infarction of the pituitary gland that occurs after a massive hemorrhage. Women who are affected with Sheehan's syndrome do not produce any milk.[101]

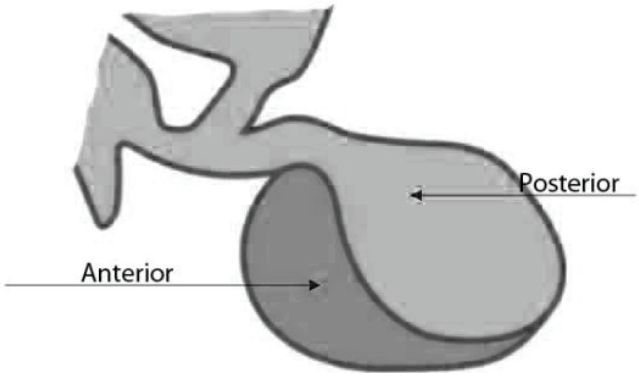


Figure 2. Anterior and posterior lobe of the pituitary gland.

Recalling, Reinforcing, and Expanding Your Knowledge

Matching Exercise

Match the term on the left to its definition or description on the right.

Answers are in the Appendices.

____	1. epinephrine	A. Stored in the anterior pituitary gland
____	2. estrogen	B. Growth of lobules and alveoli results from this hormone
____	3. oxytocin	C. Stored in the posterior pituitary gland.
____	4. progesterone	D. released in response to stress
____	5. prolactin	E. Growth of ducts, nipples and increased fat during pregnancy is largely due to this hormone's influence

Learning Exercise 1. Classical hormones

Applying Your Knowledge to Clinical Practice

- A woman is 35 weeks pregnant, and comes to you saying that her milk supply has recently dwindled to almost nothing, even though she is breastfeeding her 20-month old baby very frequently. The low milk supply that she is experiencing could be attributed to what hormone?

- A woman had a vaginal birth 2 days ago. Her milk still has not come in, and she has more vaginal bleeding at this time than would be expected. What hormone is responsible for this situation?

Chemical Level: Gut Hormones

Gut Hormones and Their Description

Matching Exercise

Match the term on the left to its definition or description on the right.

Answers are in the Appendices.

____	1. cholecystokinin (CCK)	A. Controls levels of glucose in the blood.
____	2. cortisol	B. Mobilizes fatty acids
____	3. gastrin	C. Palou's study showed that this hormone appears to protect against obesity.
____	4. insulin	D. Stimulates secretion of the parietal cells
____	5. leptin	E. Shuts down the gut
	6. secretin	F. Releases hydrochloric acid, influences growth of mucosal cells, gastric motility
____	7. somatostatin	G. Promotes glucose-induced insulin release, and promotes growth in the gut; also promotes satiety and the desire for rest or sleep

Learning Exercise 2. Matching selected gut hormone names and descriptions

Muscular System

When we think of the muscular system, we often think of how it interacts with the skeletal system, and we even use the word musculoskeletal. Certainly, a major part of the muscular system is locomotion of the entire body. However, there are more than 600 muscles in the human body, and they perform many functions, including assisting with lactation, the act of breastfeeding, and digestion. Nearly all movement in the body—with the exception of movements by cilia, flagellum on sperm cells and amoeboid movement of some white blood cells—is attributable to muscles. When we think of the musculoskeletal system, we think of how it gives us the ability to sit, stand, walk and generally stay in motion. What we may not think of is the much smaller movements that occur in facial expressions or other movement. When we think of examples in breastfeeding and lactation, we might think of the infant's mandible (chin) as a hinged bone in the face which—in conjunction with the masseter and others—is critical for suckling.

Cellular Level

The main unit of structure for the muscular system is the specialized cell called the *muscle fiber*. The primary function of the muscle fiber is to contract. (And, when not contracting, muscle cells are relaxing.) Movement of bones, internal organs or blood vessels occurs because of the process of contraction and relaxation of muscles.

Tissue Level

There are three types of muscle tissue in the body: skeletal muscle (striated) muscle, smooth muscle, and cardiac muscle. Skeletal muscle, as you might imagine, is attached to the skeleton. It produces skeletal movement, maintains posture, stabilizes joints, and generates heat. (About 85% of the body's heat is generated from muscular activity.) Skeletal muscle is voluntary, because it is under conscious control. Smooth muscle regulates arterial blood flow, moves food through the digestive tract, expels urine from the bladder, propels a fetus from the uterus, and regulates flow of air through the lungs. Cardiac muscle is found only in the heart.

Intrinsic refers to the muscles fully contained (origin, belly, and insertion) within the structure, e.g., those that are within the tongue.

To understand much of the terminology used later, it's helpful to remember that the prefix *myo* means muscle. *Intrinsic* refers to the muscles fully contained (origin, belly, and insertion) within the structure, e.g., those muscles that are within the tongue. *Extrinsic* refers to those muscles outside of the structure.

Problems in breastfeeding can occur when the musculoskeletal system has congenital structural defects or birth injuries. For example, the infant may be born with *micrognathia* (small chin) which affects the ability to suckle. Weak muscles, as are seen with some neurological conditions or even preterm birth, affect breastfeeding.

Applying Your Knowledge to Clinical Practice

- What congenital condition is associated with micrognathia?

Vocabulary

Cellular and Tissue Level

Organ Level

System Level