

SUPER SIMPLE

ANATOMY & PHYSIOLOGY

THE ULTIMATE LEARNING TOOL

MAKING LEARNING FUN & EASY



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NELSON H KRAUS

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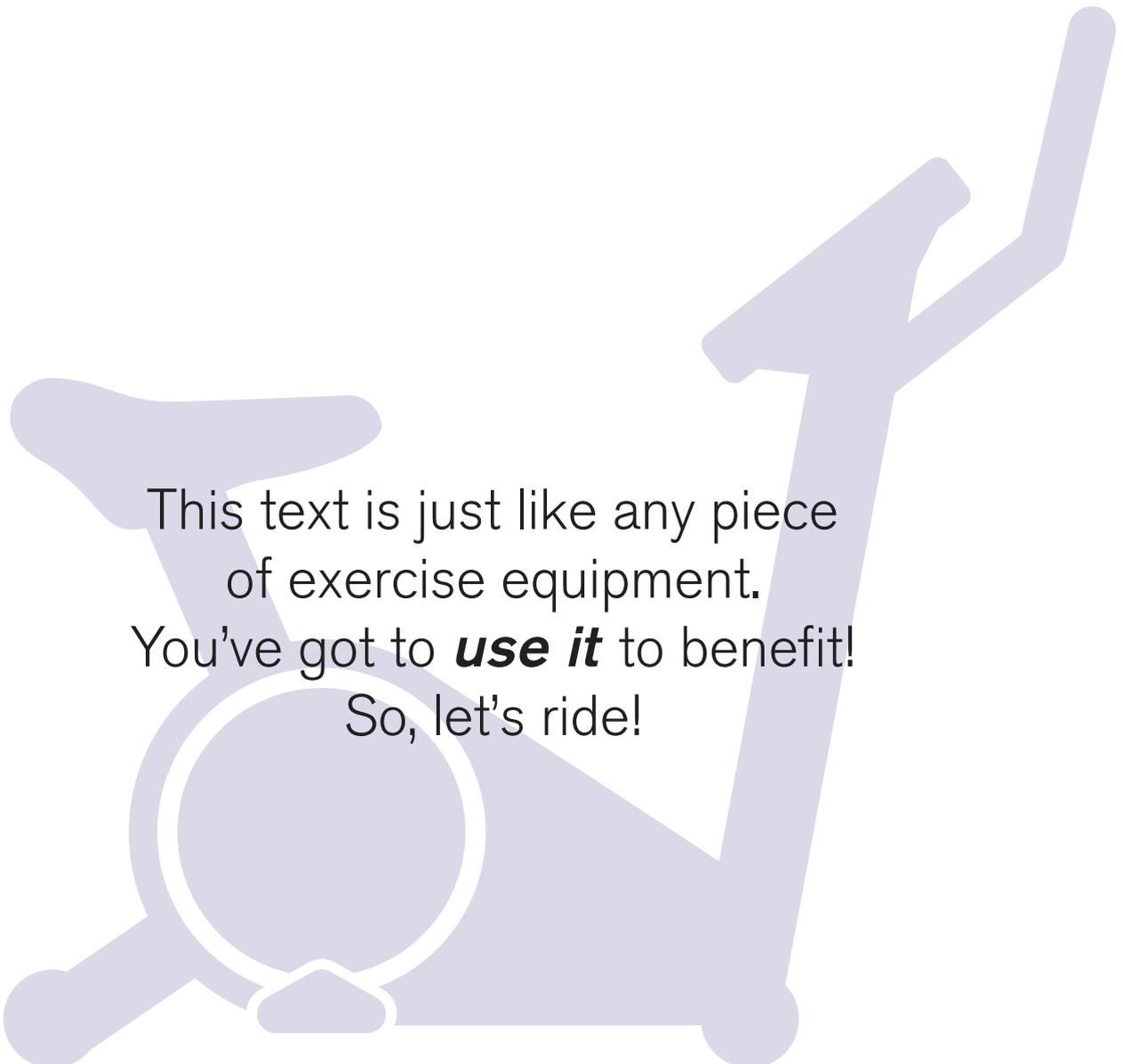
MAKING LEARNING FUN & EASY

NELSON H. KRAUS

FIRST EDITION



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This text is just like any piece
of exercise equipment.
You've got to ***use it*** to benefit!
So, let's ride!

CONTENTS

INTRODUCTION

XII

PART ONE—Basics—Forming the Foundation

2

Chapter 1 Excavating for Our A&P Foundation

5

Chapter 2 A&P Simplified/Conceptualized/Integrated

15

Chapter 3 How to Effectively Utilize the “H₂O” Sheet

19

PART TWO—Anatomy—Human Form or Structure

30

Chapter 4 Essential “Stuff” Needed for Our Foundation

33

Chapter 5 Cellular Biology Simplified

43

Chapter 6 Histology and Tissue Organization

51

Chapter 7 Integumentary System—Skin

63

Chapter 8 Skeletal System—“Dem” Bones!

73

Chapter 9 Skeletal Muscles—It’s All about Movement

107

Chapter 10 Nervous System—Body’s Means of Communication

121

Chapter 11 CVS Cardiovascular System—
The Heart of the Body!

141

Chapter 12 Respiratory System—Take a Deep Breath
and Let’s Churn On!

153

Chapter 13 Digestive System—Let’s Eat!

159

Chapter 14 Urinary System—Waste and Balance!

167

Chapter 15 Reproductive System—Reproduction PLUS

173

PART THREE	—Physiology—Human Function— Integration with Anatomy	178
Chapter 16	Basic Chemical Knowledge	181
Chapter 17	Utilizing Physiology on a Single Sheet (POSS) and Cellular Respiration	193
Chapter 18	Easily Explain Protein Synthesis	203
Chapter 19	Understanding Cellular Membrane Transport	207
Chapter 20	Bone Physiology and the Homeostasis of Calcium	217
Chapter 21	Muscle Physiology and the Sliding Filament “Theory” of Contraction	223
Chapter 22	Nervous System Physiology— Electrical Communication	235
Chapter 23	Sensory Nervous System and Special Senses— Eye and Ear	245
Chapter 24	Endocrine System—Chemical Communication	253
Chapter 25	Cardiovascular System (CVS)—The Heart of A&P	261
Chapter 26	Lymphatic and Immune System— It’s All about the D-Fence!	273
Chapter 27	Respiratory System—Gas Exchange	279
Chapter 28	Digestive System—Nutrition = Energy!	287
Chapter 29	Urinary System—Waste and Balance	295

Chapter 30	Reproductive Systems— Continuation of the Human Race	303
Chapter 31	Fluids and Electrolytes—Acid/Base Balance	309
Chapter 32	Nutrition and Metabolism—Who Doesn't Luv to Eat!	319
EPILOGUE		325

“If you can’t explain it simply,
you don’t understand it well enough.”

- Albert Einstein

SUPER SIMPLE A&P

THE ULTIMATE STUDY TOOL

Making learning fun and easy!

Nelson H. Kraus, M.Sc., M.D.

Before we start, let's do a *super simple summary* of why this Tool will make learning Anatomy and Physiology (A&P) much easier and more fun than you could imagine.

We've eliminated tons of content to focus on *Foundational Concepts*. Where you see , be alert, it indicates an essential concept. This focus on concepts lets us to do lots of repetition allowing us to build a true understanding of A&P rather than attempting to cover thousands of tiny, unnecessary details. Whew!

Our focus on concepts will foster a *real understanding* of A&P! Try it. You're going to luv it! And this Guide will introduce you to the wonderful world of *thinking*, which is necessary in the real world of medicine and healthcare. The number one,  is this:

Anatomical structures are shaped the way they are because of what they do!



We call this concept “**FFF**” for Form Follows Function. You'll see it *a lot* in this text highlighted by a FFF icon. This is the most helpful A&P concept to understand so you'll see it again and again! Our conceptual focus eliminates a ton of *memorization*. SUPER Simple A&P (SS A&P) provides specific tools so you can more efficiently accomplish necessary memorization. This Guide will help you *integrate* A&P, that is, pull all the pieces together into a usable *whole*, just like the human being! Remember, in *any* learning environment, *the ones doing the most work are the ones doing the most learning!* So, you'll need to do a significant amount of work to learn. But SS A&P is going to reduce the amount of your work, make it easier and more fun.

Although SS A&P can be used as a stand-alone text, it can also be utilized in conjunction with a standard A&P textbook as well as the Internet or anatomical models, preferably in a “hands-on” environment with an instructor or tutor. SS A&P is also a highly effective review guide for graduate students or practicing healthcare professionals who want to easily and efficiently review basic A&P concepts.

SS A&P is your A&P “personal trainer” (PT). A PT instructs and encourages you, but if you want results, *you do the work*. Same deal with any academic endeavor. This Tool provides “TOEs,” which are focused “Topics of Emphasis.” These allow you to minimize memorization by developing true understanding of how the human body is structured and functions. This Guide lets go of the compulsion found in most introductory A&P classes where it's expected students can “*Learn it all!*”

Imagine we're building a four-story building. We'll be staying in the basement, building a really *solid foundation* of A&P understanding! ***Finally, if something (like this statement) is in italics, that's because it's essential for you to know! Italics = know it! (Bold italics = even more important!) Important terminology to remember is in bold.***

So, let's get started and have some fun, learning a ton of conceptual, foundational A&P "stuff"!

INTRODUCTION

This text/tutorial is designed to specifically target students who are taking an introductory level anatomy and physiology course at the undergraduate level. Most of these students have not had previous exposure to A&P and lack an ability to know how to efficiently study these challenging subjects.

To most effectively facilitate student learning, this text/tutorial is focused on *basic concepts* and *not the details of A&P*. We will be building a solid foundation of A&P insight and understanding. This foundation will then help students integrate more details of human structure and function as they progress through their academics and careers. But at an introductory level, *the foundation is essential!*

However, *Super Simple A&P (SS A&P)* is also highly effective when utilized as a tool to review basic conceptual understanding of A&P by more advanced students. This includes graduate, and professional students as well as practicing healthcare providers who need to refresh when preparing for CME (Continuing Medical Education) requirements. Many providers will also find *SS A&P* effective for patient education.

Learning A&P is like constructing that four-story building mentioned earlier. At the beginning of construction we're not concerned with the upper floors or even the first floor of our building. We're clearing land, excavating, driving pylons deep into the ground, and then pouring concrete to form the building's foundation. We'll spend some effort laying block for the basement walls but nothing beyond that part of our building. We want to end up with a solid foundation, so students can successfully build out the rest of the "structure." *So, in this text we'll spend our time and energy in the basement.*

This text/tutorial focuses on eliminating content not necessary to build a solid foundation of A&P understanding. Among the most common concerns and questions undergraduate students have are:

- "What do I really *need* to know?"
- "What's on the test?"
- "There's so much information in our twelve-hundred page text!"
- "I don't know what to focus on!"
- "What *do I really need* to focus on?"
- "Our text is *overwhelming* and I'm lost.

SS A&P answers those questions in an effective manner. *Introductory students need to know this entire Guide.* They need to gain insight into A&P and really *understand everything* in this text. It's all a student needs to build a solid foundation of human Anatomy and Physiology understanding. It will efficiently allow students to integrate A&P so they can more easily progress with their education and career.

ONE MORE THING

For administrative, logistical and financial reasons, some institutions separate Anatomy and Physiology into individual courses. Although the reasons for this “split” are valid and understandable and while Anatomy and Physiology can be separated administratively, they actually are *inseparable*.

Because many, if not most, colleges and universities teach A&P together, this SS A&P covers both Anatomy and Physiology. But material will be presented in a unique manner allowing the text to be easily and fluidly utilized whether the subjects are taught separately or together. Most importantly, the text will be easy for students to utilize as their *primary learning tool* in any introductory A&P course.

This Guide is divided into three parts. Part One covers the basics of how to effectively learn A&P. Part Two lays the foundation of understanding structure or Anatomy. Part Three deals with Physiology, the function of the human body. Because A&P are complimentary and inseparable, there is Physiology integrated into Part Two and Anatomy into Part Three. This integration or “blending” is accomplished by “bridging” between the parts utilizing a bridge “icon.” When students see the bridge icon, they’ll know it’s important to bounce to another section of SS A&P to clarify material. The “bridges” will make it easier to gain knowledge by seamlessly blending A&P together. Again, this format allows the text to be used effectively regardless of A&P course sequencing.

SS A&P is highly effective in a wide variety of learning environments. It can be utilized independently or in conjunction with an instructor in a “ground” campus situation. But whatever the learning situation, this Guide will minimize memorization while increasing understanding and retention.

SS A&P makes learning fun and easy!



PART ONE

BASICS

Forming the Foundation

CHAPTER ONE

EXCAVATING FOR OUR A&P FOUNDATION

TOEs (Topics of Emphasis) for Chapter 1:



- Developing conceptual insight into how this Guide is structured
- Gaining insight into medical terminology
- Learning to grasp the necessity of repetition in the learning process
- The seven keys to learning
- The scientific method
- *Embracing* the term “FFF” (Form Follows Function)—*the primary concept of A&P*
- Defining and explaining “homeostasis”

Questions for Consideration:

- Are you able to explain the concept of “FFF” to someone else?
- What are the seven essential factors that facilitate human learning?
- What is the scientific method?
- What are the steps involved in the scientific method?
- Can you define and explain the term “Homeostasis”?
- Why is homeostasis referred to as the *big* “H” word?

Understanding medical terminology makes learning A&P easier and may be a prerequisite for some A&P courses. This Guide is not designed to provide the basics of medical terminology although medical terms are utilized throughout it as they are in any A&P text. Although not necessary to build your foundation of A&P insight, it is helpful to learn or review medical terminology.

There are online resources for learning medical terminology. Many of these online resources utilize the memory techniques of “absurd or illogical visual association” and “audionyms” to facilitate efficient understanding and retention. We’ll be utilizing those same techniques in *SS A&P* to make it easier, quicker and more fun when learning A&P! **The best of these programs is Medical Terminology 350 by Dean Vaughn.** This is a fun online course. Just plug “Medical Terminology 350 Dean Vaughn” into your browser to find the Dean Vaughn system.

There is an investment for the Dean Vaughn System, but remember, you are investing in your education which always requires some expense. The Dean Vaughn System is effective and efficient, so you’ll be able to move through it quickly. It will augment your abilities to grasp foundational A&P concepts. This will allow you to deepen your understanding and earn a higher grade.

Remember, becoming fluent in medical terminology is *essential* for anyone going into any healthcare profession.

You can also check with your college or university to see if they hold a license for the DVD Instructional Program (DVD IP) for Dean Vaughn. Some institutions may have it in their library or you might find it at some public libraries.

Learning how to apply the memory techniques utilized in Dean Vaughn can be used in anatomy and physiology as well as other science or non-science courses. Even though this Guide is focused on conceptual understanding, learning to more effectively use your memory is invaluable! *Let’s face it, memorization is an important part of learning anything!*

If you want to maximize your abilities to gain insight into A&P and utilize this Guide most efficiently, I believe it is essential for you to spend time building an understanding of medical terminology.

In addition to memorization and the application of memory techniques like the Dean Vaughn System utilizes, there are seven essential building blocks which facilitate human learning.

The first *absolute requirement* for effective human learning is *repetition*. It is the first key necessary to learn anything. Learning a language, playing a musical instrument or how to hit a golf ball, all require a ton of repetition or practice. Repetition is an essential key and this Guide provides an opportunity to do constant repetition. Content that is not necessary at an introductory level has been eliminated, so we can practice repetition. With this approach we’ll *Churn to Learn!* Because it’s easier for most people to remember a picture than words, Figure 1.1 shows a figure “churning” butter but also reading. She’s “churning to learn,” just like you will throughout *SS A&P*.

FIGURE 1.1



Emotions are the second key to human learning. These can be either positive or negative emotions unless they're carried to an extreme. Of course, it is better to be happy in a learning experience but there will be times of frustration, unhappiness and struggle. *But at all costs, avoid boredom by creating an environment that offers opportunities for emotions as well as lots of repetition. SS A&P will help create an environment of "emotional repetition."*

A third essential key to learning is voicing, vocalizing, or just plain talking about a topic like A&P. Talk to other students. Explain things. *Struggle to teach* someone else an aspect of A&P. You'll *always* learn more when teaching, than you will as a student. So, **teach to learn.**

A fourth essential key relates back to the visual memory techniques like those found in the Dean Vaughn System. It is easier for most of us to remember a picture than a

page of words. The old saying: "A picture is worth a thousand words" is absolutely on target. This is particularly true with a subject like Anatomy, especially gross anatomy (study of body parts you can see with the naked eye) and histology (the study of tissues). The "flow charts" (H₂O Sheet, Physiology on a Single Sheet and others yet to be introduced) which are found in this Guide are designed to help students get a picture in their "mind's eye" of some of the essential concepts of A&P.

A fifth essential key to learning is relating new information or concepts to existing knowledge. We'll do some relating throughout SS A&P but especially in Part Two which focuses on Physiology. We'll relate the circulatory system (CVS), which is the body's transportation system, to transportation systems in our communities. This involves vehicles, an engine providing energy, and highways where the vehicles travel. That relationship makes understanding the CVS easier and a little more fun.

A sixth essential key to facilitate learning is to focus on concepts! Most A&P courses deliver, actually dump, an overwhelming amount of content on students. Students are

forced into memorization and regurgitation without real understanding. They do this to survive and obtain the grade needed to move on in their academic careers. But this mindless memorization and regurgitation doesn't allow students to retain much, if any, anatomy and physiology. As a result, they are forced to relearn A&P in future courses, clinical rotations or on the job after graduation. After all, an understanding of A&P is essential to allow medical personnel to deliver high quality care.

The seventh and final key to learning is movement! A growing amount of scientific evidence is showing movement and cognition are powerfully connected. Even something as simple as taking a walk while talking with a “study buddy” about A&P (or any other learning topic) helps learning. So, get off your gluteus maximus and stretch your legs on a regular basis while churning to learn!

By emphasizing basic concepts students are more likely to develop a real *understanding* of anatomy and physiology. This, of course, will require some memorization (remember all learning does) but gaining real insight into A&P minimizes memorization, improves retention and results in higher exam scores, better grades and easier admission into professional programs.

So. Let's do some repetition and review the *seven essential key* areas of learning in addition to memorization.

REPETITION—this is also *essential* for memorization

EMOTIONS—either positive or negative

VOCALIZING—talking about a subject (strive to teach it to someone else)

VISUALIZATION—“seeing” images of structures, processes and concepts in the mind's “eye”

ASSOCIATION—relating new knowledge to existing knowledge

CONCEPTS—facilitates and simplifies understanding especially at an introductory level

MOVEMENT—a moving body learns more effectively

FIGURE 1.2



Remember these *keys* with the “mnemonic” **REVVACM**. And because it's easier to remember pictures than words or seven letters strung together, we can apply illogical or absurd visual association as Dean Vaughn does. Visualize “**REVVACM**” by thinking about “sucking up” concepts, facts, and processes of A&P with a vacuum cleaner. *Silly* but it *works*. Figure 1.2 gives a picture which will help students remember the seven *keys* to learning. Now let's continue to **REVVACM** some A&P together.

REVIEW/REPETITION of THE Basic Concept of A&P (FFF) from Page 1

The primary basic concept of anatomy and physiology is “FFF” or *Form Follows Function*. A&P are inseparable and complimentary! They are interrelated and understanding the concept of FFF dramatically improves insight and understanding of A&P.

Anatomy is the study of human structure (form) and physiology is the study of human function. These two sciences are inseparably linked together. Organs and organ systems in the body are structured the way they are because of what they *do*. In other words, function (physiology) determines structure (anatomy). An understanding of one of these sciences is helpful, arguably essential, to understand the other science.

Because both anatomy and physiology are sciences, it is important for the novice A&P student to have basic insight into the *scientific method (SM)*.

The *scientific method (SM)* is the standard process of observation, experimentation and data collection which has allowed the development and evolution of modern day sciences like A&P. It goes all the way back to Aristotle and the Greeks. The *SM* allows scientists to confirm theories and build on existing knowledge. Many of the concepts discussed in physiology are theories developed using the scientific method.

The *SM* starts with simple observations and subsequent questions. An example would be: “how do cells make energy?” A hypothesis or explanation to the question is developed and experimentation designed to test the hypothesis. Data is collected from the experiment and analyzed. Scientists then determine if the data supports the hypothesis or not.

Depending on the conclusions drawn from the experiment, scientists either design additional experiments to support the hypothesis or develop a modified hypothesis. If the data supports the hypothesis, it will then be further tested by other scientists in distant locations. If the data from multiple independent experiments confirms the hypothesis it will become a theory answering the original question.

The steps of the *SM* can be summarized as:

- Observation
- Question
- Hypothesis
- Experimentation
- Data analysis
- Conclusion

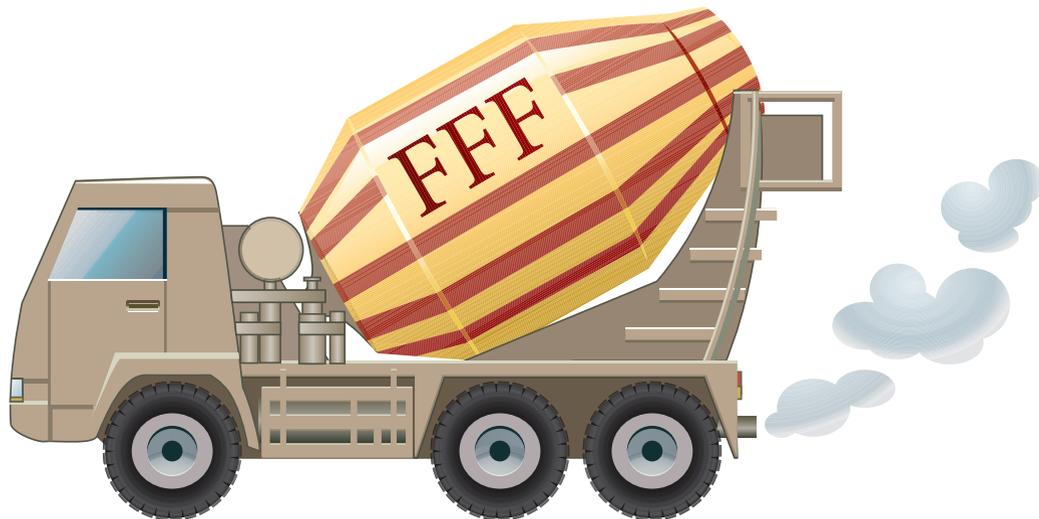
The *scientific method* is the “gold standard” which differentiates true scientific conclusions from just opinions and pseudoscience. The basic concepts of A&P have been derived using the *scientific method*. That’s how we know the cell makes energy through cellular respiration or metabolism (CR/CM) which involves four specific stages. We’ll discuss details of CR/CM in Part Three of SS A&P. Bridge to Chapter 17 for a detailed discussion of CR/CM or search the internet to learn more.



The concept of FFF (Form Follows Function) originated in architecture. What a building is used for determines how it's structured. Structure follows function. FFF was first coined by the American architect, Louis Sullivan in his article "The Tall Office Building Artistically Considered" in 1896.

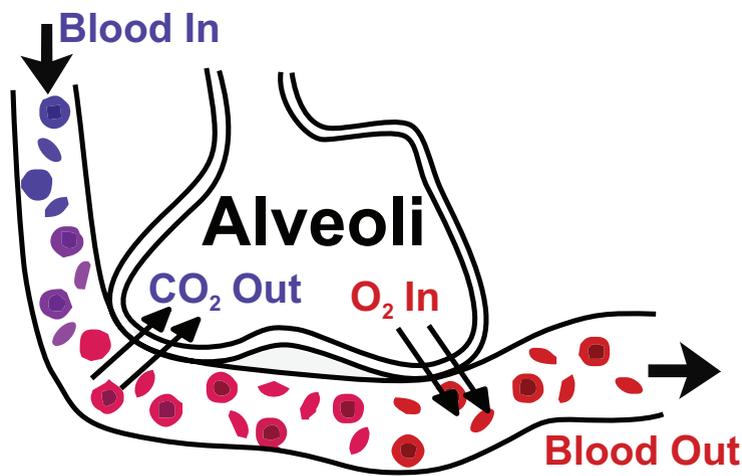
FFF could also be applied to the design of cars, trucks, military vehicles, etc. The cement truck in Fig 1.3 is a good example of FFF. It is structured the way it is because of what it DOES! Function determines form. Physiology determines anatomy. *Conceptually, how an organ is structured is determined by what it does! Form Follows Function! This concept will be constantly integrated into this text to help facilitate student understanding!*

FIGURE 1.3 FFF



How human organs and organ systems are structured is determined by what that structure does! As we're doing right now, we'll revisit FFF over and over again. Once a student gets her/his head "around" the concept of FFF, the more likely that student will be successful building a foundation of basic understanding of A&P.

Because form follows function, the structure of an organ will reveal something about what that organ does. For example, the lungs conceptual function is gas exchange; oxygen out of the lungs and into the blood stream and carbon dioxide out of the blood stream and into the lungs. This process takes place by simple diffusion, a passive process in gases and liquids where substances move from higher to lower concentration. To facilitate this process the lining of the gas exchanging sacs of the lungs (alveoli) are very thin. This is a great example of FFF.

FIGURE 1.4 Alveoli

If you grasp the concept of FFF and observed the ultrathin lining of the alveolar sacs, you can deduce there must be an exchange of substances across those thin sac walls. On the other hand, observing the thickness of the skin in the human, it is logical to deduce that skin offers a protective barrier.

SS *A&P* will focus on these types of basic concepts to build a foundational understanding of the human body, its structure and function.

Another fundamental concept is **homeostasis**, which is the body's ability to maintain a relatively constant internal environment despite a changing external environment. Our body maintains temperature, levels of electrolytes, blood glucose, and blood calcium through the process of homeostasis. This concept will recur frequently in Part Three, Physiology, of SS *A&P*. It is worth a mention now because understanding function can help a student learning anatomy anticipate or predict how organs are structured. The body makes perfect sense because things are structured the way they are because of their function.



Referral/BRIDGE to the basic concept of homeostasis in the Physiology Section of Guide (Chapter 20, pg 219).

Homeostasis can be most concisely defined as “**dynamic constancy**” or DC. Let's look conceptually at the DC of blood glucose levels. Our cells utilize glucose as the primary source of energy production. So, it is essential for our bodies to keep our blood glucose levels within a narrow range. When we lose our ability to maintain homeostasis of glucose or thousands of other substances, we become unhealthy, diseased or dysfunctional.

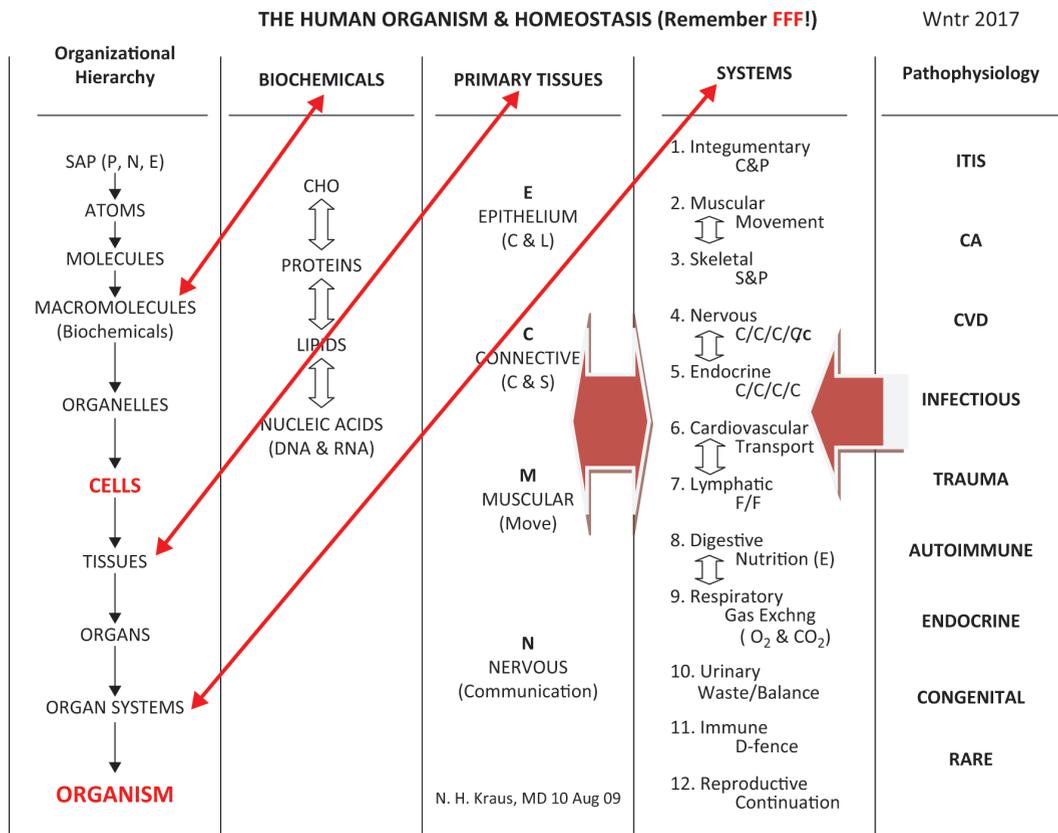
The homeostatic balance of glucose (sugar) and calcium are two of the most important concepts for students to understand. SS *A&P* will concentrate on developing a solid foundation of understanding the homeostatic processes for both substances.

Normal blood fasting glucose levels range from 70–100 mg/dl. The body maintains this range through “negative feedback loops.” These can be easily understood by comparing them with an (HVAC Heating, Ventilation, and Air Conditioning) system in a building. The thermostat is set at 70 degrees. When the temperature drops to 69°, the system turns on the heat to raise the temperature. Once it reaches 71° the heat turns off. This maintains a constant temperature even though there is some fluctuation between 69 and 71 degrees. The HVAC system provides a *dynamic constancy*. Human homeostasis does the same. We’ll look at homeostasis in more detail in many of the chapters in Part Three of SS A&P. And we’ll constantly refer to homeostatic balance as we build our foundation of A&P understanding.

Finally, SS A&P provides a variety of flow charts to help simplify and conceptualize A&P. These are designed to summarize ideas, minimize memorization and facilitate insight. Flow charts are one type of learning “tool” helping students gain insight into A&P.

The Human Organization and Homeostasis Sheet (H₂O Sheet) is the first of these flow charts. We’ll be “dissecting” the H₂O Sheet in Chapter 3 and then utilizing it throughout our learning process.

FIGURE 1.5

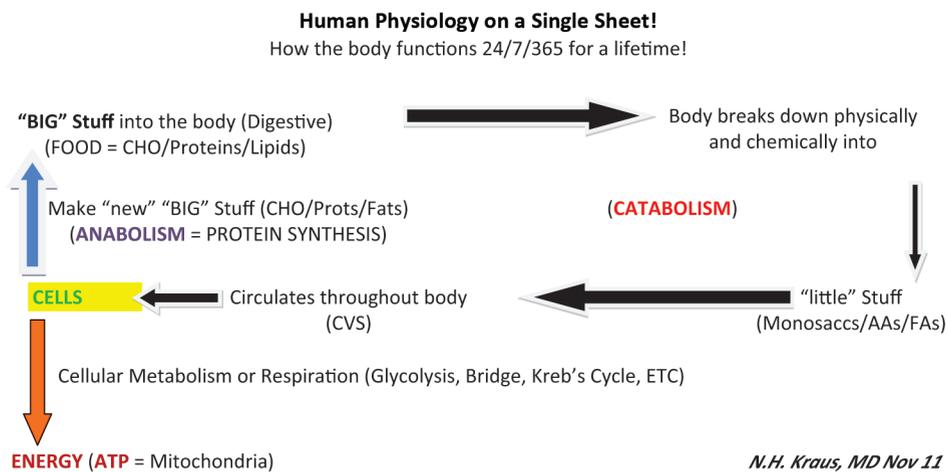


Another fun and effective resource that can help the novice A&P student “*Churn to Learn*” is “Crash Course” with Hank Green on YouTube. Check it out, Hank is entertaining and informative. There are dozens of courses covering all the topics in A&P in 10- to 15-minute sessions. Just put “Crash Course Anatomy and Physiology” into your browser, surf around, find a course covering an A&P topic you want to review and *churn* away with Hank. He goes at a fast pace so it’s helpful to stop the video to absorb what is being discussed. I’d also suggest repeat viewings of Crash Course lessons. Remember REVVACM!

Human Physiology on a Single Sheet (POSS) is another helpful flow chart. Again, we’ll be utilizing this flow chart as we continue our learning process. It will be explained in more detail in the Physiology section (Part Three) of this Guide. If you want to gain some insight into POSS right now, bridge to Chapter 17.



FIGURE 1.6



Review Questions

- What is homeostasis, the “*big H word*”?
- Why is it essential for students to “*Churn to Learn*” when studying A&P?
- Why is the scientific method important?
- Why is the H₂O Sheet an effective means of facilitating *real* Anatomy & Physiology understanding and insight?
- What is a “negative feedback loop”?

Activity

- Explain why the comparison of DC (dynamic constancy) or homeostasis with an HVAC unit is an effective means of gaining insight into Physiology.
- Review and discuss (with another student) the seven *keys* to learning.
- Explain the concept of an audionym.
- Explain the scientific method to a ten-year old.
- Struggle to write out a list of six **good** examples of FFF. Explain why your examples demonstrate FFF.

Notes

FIGURE CREDITS

Fig. 1.1: Source: [https://commons.wikimedia.org/wiki/File:Churn_\(PSF\).jpg](https://commons.wikimedia.org/wiki/File:Churn_(PSF).jpg).

Fig. 1.2: Source: https://commons.wikimedia.org/wiki/File:Blue_vacuum_cleaner.svg.

Fig. 1.4: Copyright © Helix84 (CC BY-SA 3.0) at <https://commons.wikimedia.org/wiki/File:Alveoli.svg>.