Z-HEALTH®
NEUROLOGY FOUNDATIONS
Study Guide

ZHEALTH
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Z-Health Foundations – Practical Neurology for Health and Fitness Professionals

Welcome to the fantastic world of practical neurology!

The Z-Health training curriculum is built on applied neuroscience. It is a fascinating field that is challenging, exciting and incredibly rewarding.

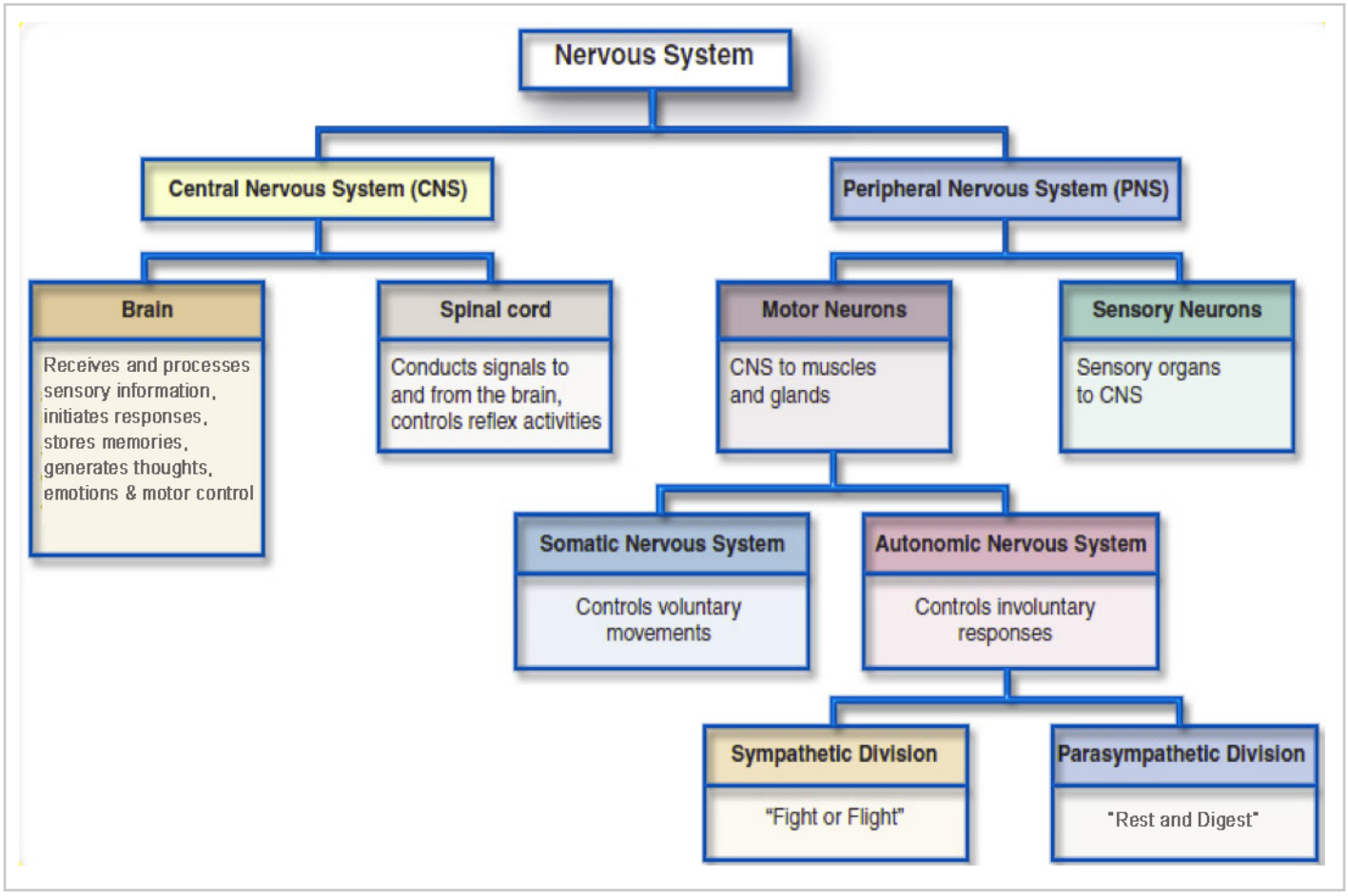
The primary goal of this study guide is to describe the fundamental neurological principles underlying all Z-Health education (and all forms of training, health & fitness). This will allow us to share a common language and understanding as you begin your journey through the Z-Health curriculum.

Let's get started!

Nervous System Organization

The first concept that we are always trying to get across is that neurology CAN be understood in a practical way. It is, in fact, a very orderly system – we just need to understand the organizational principles and basic anatomy.

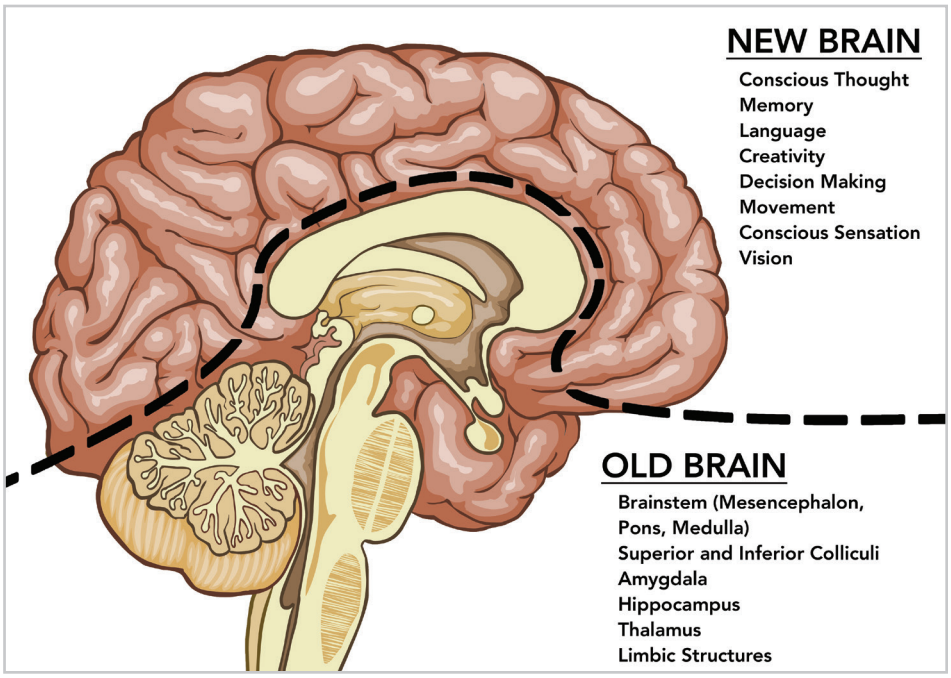
Here is a simple graph that explains the general nervous system organization and function.



Basic "Functional" Divisions

The next step in your learning process is to become comfortable with a very basic categorization of the brain itself, and its functional divisions. The easiest way to do this is to consider the human brain being composed of the:

- 1st Brain (Old Brain)
- 2nd Brain (New Brain)



The First Brain

Defined as older and non-reasoning, the first brain is primarily concerned with keeping you safe. It is, in essence, a gatekeeper of all information that will eventually flow upward to the 2nd brain. The 1st brain uses predictive analysis methods to look at all incoming signals and to answer one simple question:

"IS IT SAFE?"

The 1st Brain is composed of multiple anatomical structures that are primarily found deep inside and toward the posterior aspect of the brain. These structures include:

- Brainstem (Mesencephalon, Pons, Medulla)
- Superior and Inferior Colliculi
- Amygdala
- Hippocampus
- Thalamus
- Limbic Structures

The Second Brain

Contrary to what we just discussed regarding the first brain, the second brain is the home of the qualities that we believe make us most human. The second brain controls such diverse functions as:

- Conscious Thought
- Memory
- Language
- Creativity
- Decision Making
- Movement
- Conscious Sensation
- Vision

While most of us like to think that our second brain is primarily in charge, human functioning is really an ongoing dance between the first and second brains based on environmental contextual cues and high-priority brain drives, which are primarily survival-based actions.

Generally, what we want you to remember about these functional divisions is quite simple:

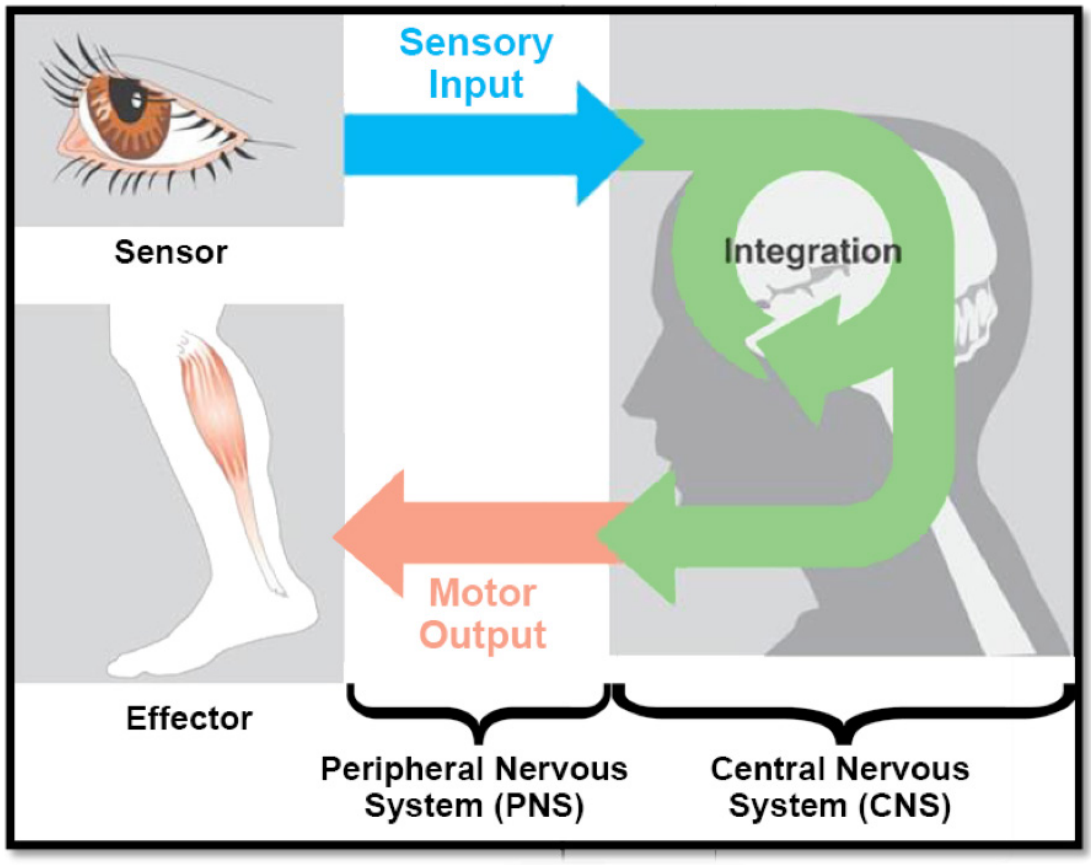
1. The first brain is only concerned with survival and safety. As a result, it is faster and less "conscious" in its work.
2. The primary job of the second brain is to INHIBIT the first brain! This is what allows us to function in normal societal contexts and work with other individuals safely and constructively.

Neurology 101 – How the Nervous System Works

In order to readily utilize the brain-based lens of Z-Health training, it is vital to understand that the human nervous system does three primary things:

1. Receives information from the internal and external environments using a wide array of senses.
2. Interprets those signals and decides what to do about them.
3. Creates motor output based on the decision that was made.

Represented graphically, it looks like this:



Why Does This Matter? The Neuro-Centric Rationale

As a Z-Health practitioner, you should recognize that the ultimate OUTPUT of your client's nervous system (whether that be pain, immobility and weakness, OR elite athletic performance) is the sum total of everything occuring in this loop. Most health & fitness training or therapy systems tend to be highly OUTPUT-CENTRIC with an intense focus on the "end" of the loop. In Z-Health we take a NEURO-CENTRIC approach that requires us to be experts in assessing and training all portions of this loop. The first step in this is to become an Input expert.

Brain-based practitioners recognize that many of the problems preventing clients from excelling begin as input problems. The real issue here is very few educational models offer deep insight into all types of different inputs that can create issues.

As an example, take a look at this graphic:

This is a chart of many different inputs that reach the brain. As brain-based practitioners we must be able to assess the various INPUTS and then work with a client to re-train them as necessary.

Eventually, this assessment and training will include the following:

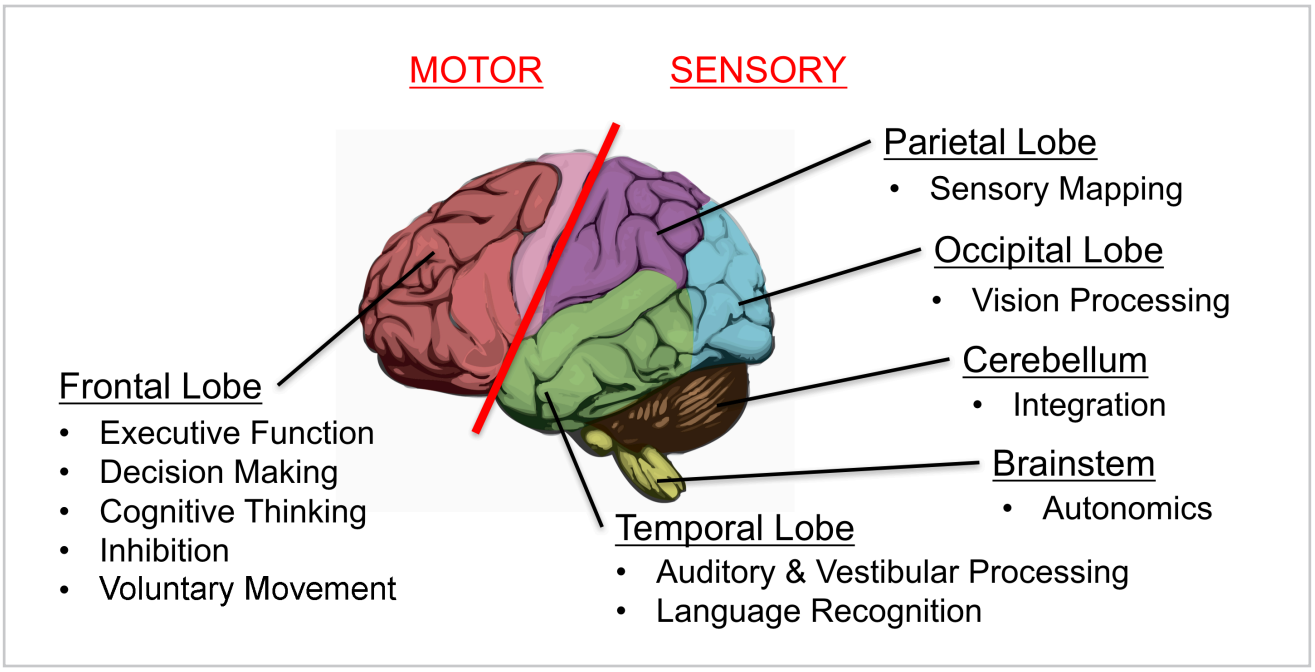
1. Sensory receptor: The nerve ending or sensory organ that receives the input from the environment and creates a signal for the nervous system.
2. Peripheral/cranial nerve: The nerve carrying signals to the central nervous system.
3. Spine/brainstem: The central nervous system structure carrying sensory signals to the brain area(s) where it will be interpreted.

Interpretation/Decision

Next on the list of skills we need to develop is understanding the different areas of the brain that govern the interpretation & decision portion of the loop.

We must realize that Interpretation and Decision happen in both the Old Brain and the New Brain. Because it's the job of the Old Brain to decide "Is it safe?", each sensory input that is received is interpreted and evaluated for threats before a decision is made to: A) respond immediately with protective action, B) process the input pre-cognitively, or C) pass it on to the new brain for cognitive processing.

Once the inputs are passed on and reach the New Brain, we need to understand where and how the interpretation takes place, and how decisions are made. This begins with an understanding of the names and basic functions of the cortex as shown here:



We can summarize this image by saying that sensory information is processed (interpreted) in the back of the brain, and our responses (decision) are created in the front.

We can also infer that decisions and responses of appropriate speed, accuracy, and efficiency depend on the quality and accuracy of the sensory interpretations that are happening in the back of the brain. If any of the areas in the sensory part of the cortex aren't interpreting information accurately, outputs from the motor area of the cortex will be affected, and generally speaking, the back of the brain will attempt to use more fuel/activation to "correct" the interpretation problems if possible. Many times, improving a motor issue will require training areas in the back of the cortex first.

Output – The Final Frontier

The more we learn about the human nervous system, the more we recognize the ultimate control of outputs is incredibly complex and multi-factorial. However, there are some foundational concepts and structures that will make this portion of the total neuro-centric approach much easier to understand.

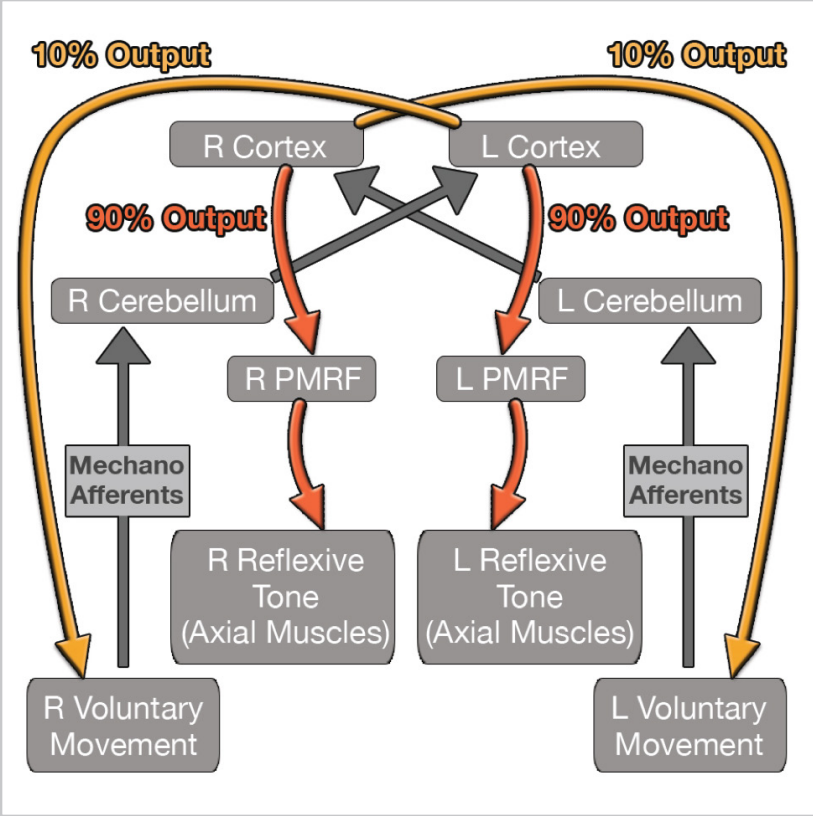
To begin, it is essential to understand that output control has two primary components:

1. Voluntary Motor Activity
2. Reflexive Stability

Regardless of what you are asking a client to do, BOTH components ultimately matter a great deal. Let's look at a basic graphic that describes how this is achieved.

What you see in the diagram teaches several important things:

1. Voluntary movement is controlled by the CONTRALATERAL (opposite) cortical hemisphere.
2. Approximately 10% of the total output of the cortical hemisphere is dedicated to VOLUNTARY movement (while the movement is happening).
3. The other 90% of cortical hemispheric output is dedicated to creating reflexive stability and control IPSILATERALLY (same side) through activation of a portion of the first brain called the PMRF (pontomedullary reticular formation).
    A. This PMRF area actually has four significant responsibilities in training:
        i. Ipsilateral postural control
        ii. Ipsilateral muscle tone
        iii. Ipsilateral sympathetic tone inhibition
        iv. Ipsilateral pain inhibition
4. Finally, you can see that every movement OUTPUT creates INPUTS that return to the brain for error detection and correction.



In our courses, we'll be examining each part of this diagram, and each neurological structure involved to be sure they are all doing their jobs appropriately and integrating correctly into the larger pattern.

Gait Assessment & Neurology – Getting Practical

In the Z-Health system gait assessment is one of our greatest tools, particularly when it is viewed through a neurological, rather than biomechanical, lens. We teach gait assessment beginning at R-Phase and will generally add more "findings" in each certification. While there are many things you can learn about your client from gait assessment there are some fundamental concepts that you can quickly apply. Here are the basic neurologic patterns:

1. "Bobblehead" – When your client is walking, the head and neck should remain relatively still and fixed. If your client displays a significant amount of head and neck movement, spinal destabilization, or excessive rigidity that results in this bobblehead during the gait cycle this is often indicative of either visual or vestibular issues:
   A. If you are approaching this from an R-Phase perspective, you would use this finding as indication of the need to work on:
      i. Cervical spine mobility drills, and
      ii. Temporomandibular Joint drills
   B. If you have been through I-Phase or beyond you should immediately assess your client's ability to do:
      i. Gaze Stabilization
      ii. Smooth Pursuits
      iii. VOR
      iv. VOR-C
      v. Otolith Organ activations

2. Loss of Arm Swing – Arm swing in gait is, in part, controlled by the CONTRALATERAL HEMISPHERE. So, if you see a loss of RIGHT arm swing you would be concerned about poor function of the LEFT hemisphere.
   A. If you are approaching this from an R-Phase perspective, you would use this finding as indication of the need to work on:
      i. Mobility drills on the side of decreased arm swing, particularly complex coordination drills. This complex, voluntary movement will cause activation of the contralateral hemisphere.
   B. After I-Phase, you would also include:
      i. Visual drills to activate the problematic hemisphere. In our example above of a loss of RIGHT arm swing indicating problems of the LEFT hemisphere, you could practice Smooth Pursuits to the LEFT (from I-Phase), or Saccades to the RIGHT (from S-Phase).
      ii. Vestibular Drills for the cerebellum on the IPSILATERAL side of the decreased arm swing. In our example, this would be VOR drills for the RIGHT vestibular canals. This can be a useful tool because the ipsilateral cerebellum will send a great deal of communication and information to the contralateral cortical hemisphere.

3. Cerebellar Gait Pattern – When you have an UNDERACTIVE cerebellum, you will often see the following presentations in gait:

   Internal rotation of BOTH the upper and lower extremities IPSILATERAL to the side of dysfunction. So, if you have a right cerebellum issue you would see both upper and lower extremity internal rotation on the RIGHT.

   A. At an R-Phase level:
      i. Your client likely needs extensive mobility training on the IPSILATERAL side of the dysfunctional cerebellum.
   B. At an I-Phase level you can also consider adding in:
      i. VOR drills on the IPSILATERAL side of the dysfunctional cerebellum.
      ii. Gaze stabilization drills to activate the dysfunctional cerebellum. In the I-Phase manual, there is a specific Gaze Stabilization pattern that connects the direction of eye movement to a single side cerebellum activation.
   C. This is a client who may benefit significantly from 4-6 weeks of primarily unilateral work.

4. PMRF Gait Pattern – This is something you will see frequently in gait assessment with your clients. The basic pattern typically shows:

   Internal rotation of the UPPER EXTREMITY and external rotation of the LOWER EXTREMITY.
   * Remember from our diagram above that the PMRF is controlled/activated by the IPSILATERAL CORTICAL HEMISPHERE.

   A. To approach this from an R-Phase perspective:
      i. Perform drills on the CONTRALATERAL side of the body – especially if your client is complaining of pain.
      ii. Use "opposing joints" as a guide for where to begin.
   B. From an I-Phase and beyond perspective:
      i. Activate the IPSILATERAL cortex to the dysfunctional PMRF via:
         a. Smooth Pursuits to the IPSILATERAL side (I-Phase)
         b. Saccades to the CONTRALATERAL side (S-Phase)
         c. VOR or VOR-C for the CONTRALATERAL side vestibular canals (I-Phase)
   C. This is a client who may benefit significantly from 4-6 weeks of primarily unilateral work.