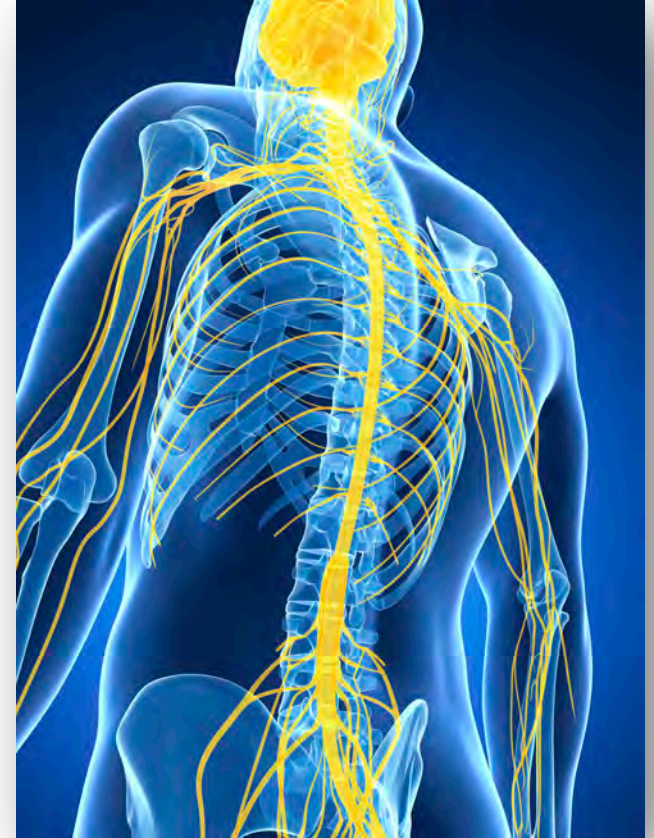


Z-Health Performance

Presents

Essentials of Elite Performance

Day 1



You ARE Your Brain!

"Everything you have ever felt or done in your life was due to brain function. At the most basic level, the intricate firing rates and patterns of your brain both determine who you have been and, more importantly, who you will become. All human change represents changes in that individual's nervous system.

All that we are is brain-derived."



So What Is Z-Health?

Z-Health is a scientifically designed system of exercise and applied neurology crafted to specifically target what matters most in human performance –

The Human Brain.

It developed out of the simple idea that all forms of training and rehabilitation specifically target the brain – whether we know it or not!



ZHEALTH
Performance Solutions



Why Is The Brain So Important?

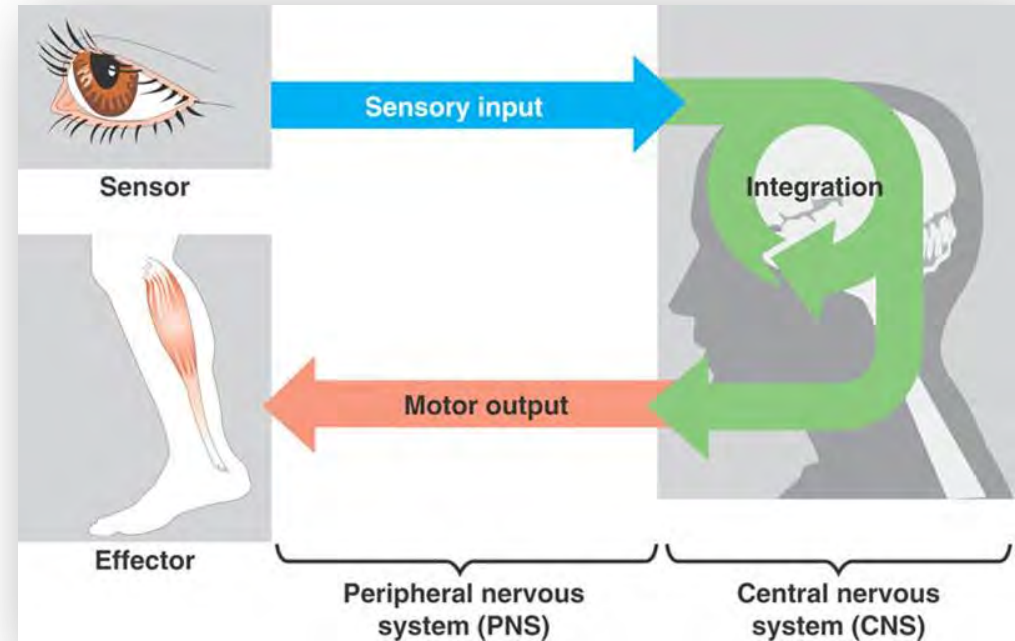
You can change the tires, improve the struts, work on the transmission, and change the decals on the outside of car. However, most of those changes will make little difference if the engine is malfunctioning. The same is true of the human body!



Let's Begin With Neurology Simplified

The Nervous System Does 3 Things

- 1.Receives Input (Afferent)
- 2.Decides What the Input Means and What to Do About It (Interpretation & Decision)
- 3.Creates Motor Output (Efferent)



Neurology Simplified: Inputs

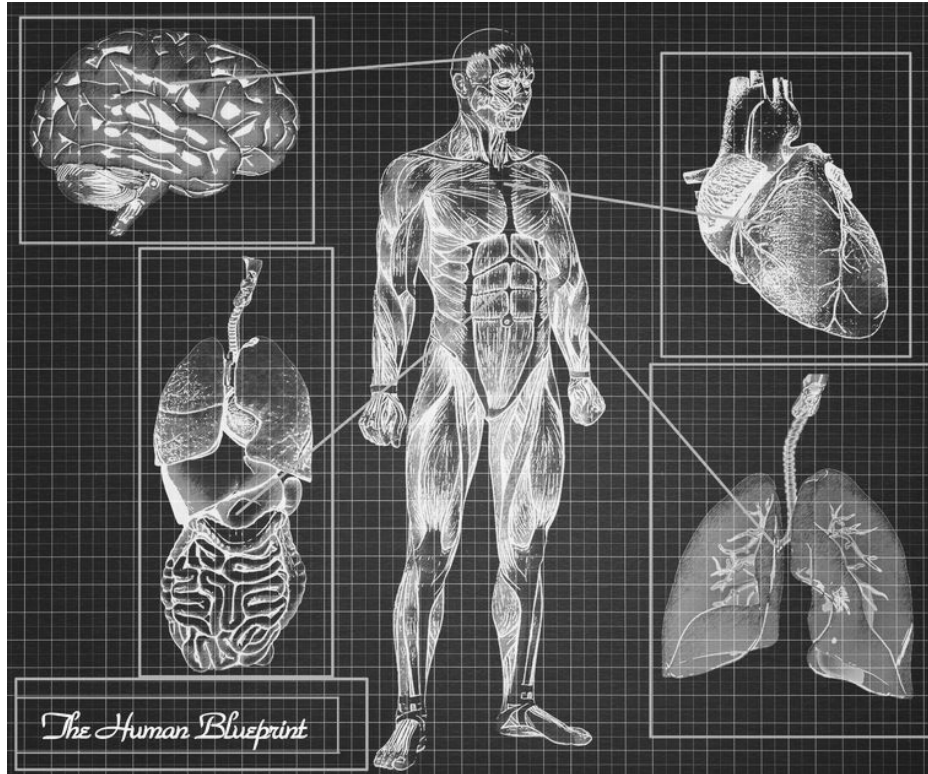
Exteroception:

Monitoring the external environment

1. Sight
2. Smell
3. Hearing
4. Taste
5. Touch



Neurology Simplified: Inputs



Interoception:

Awareness of bodily sensations & feelings

1. Heart Rate
2. Respiration
3. Visceral Organs
4. Thermoregulation
5. Sense of Ownership

Neurology Simplified: Inputs



Proprioception:

- Awareness of limb & body position in space

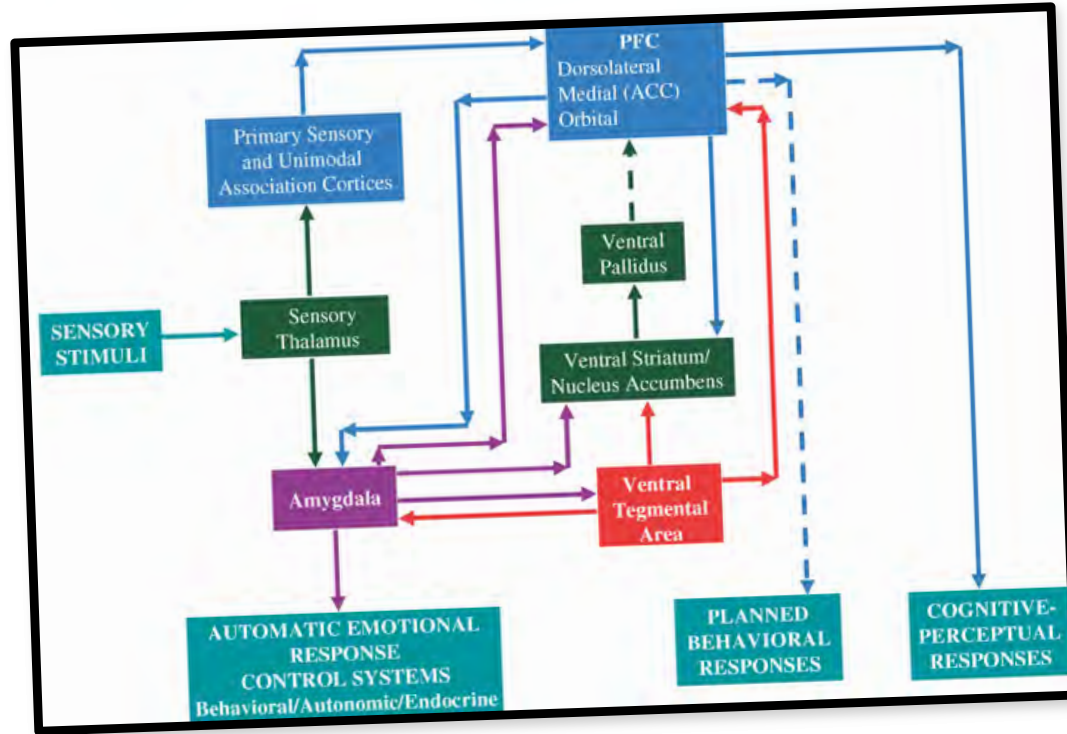
1. Mechanoreceptors
2. Baroreceptors
3. Thermoreceptors
4. Chemoreceptors
5. Electromagnetic Receptors
6. Nociceptors

Everything CAN Matter!



How Many of These
Inputs Do We Typically
Assess?

Neurology Simplified: Interpretation & Decision



Interpretation:

- Integration with other senses, memories, and predictive processes.

1.Old Brain First

2.THEN New Brain

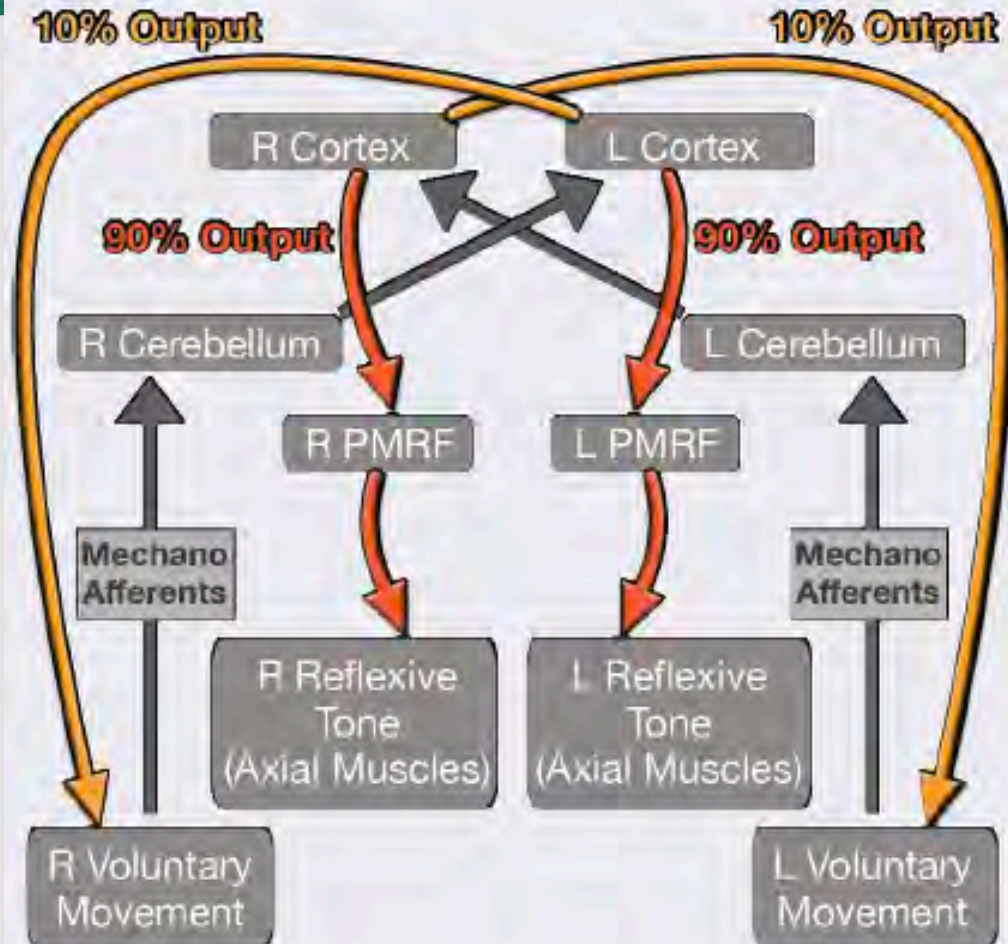
Decision:

- Can be made at either level.

Movement Neurology for Strength Training

1. Increased Neural Drive
2. Improved Reflexive Tone

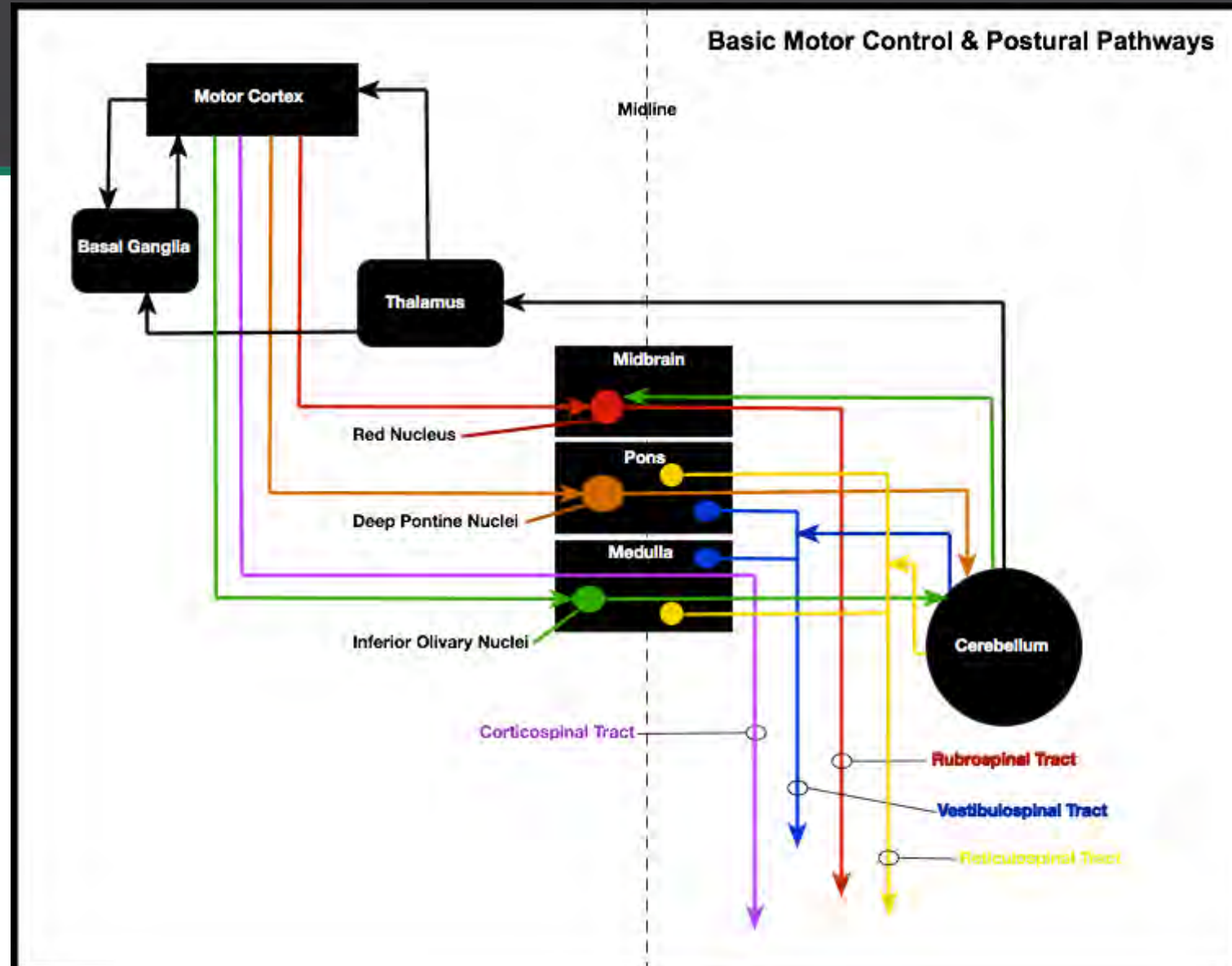
There are 2 Routes to Improve Voluntary Strength:
Increased Neural Drive and Improved Reflexive Tone

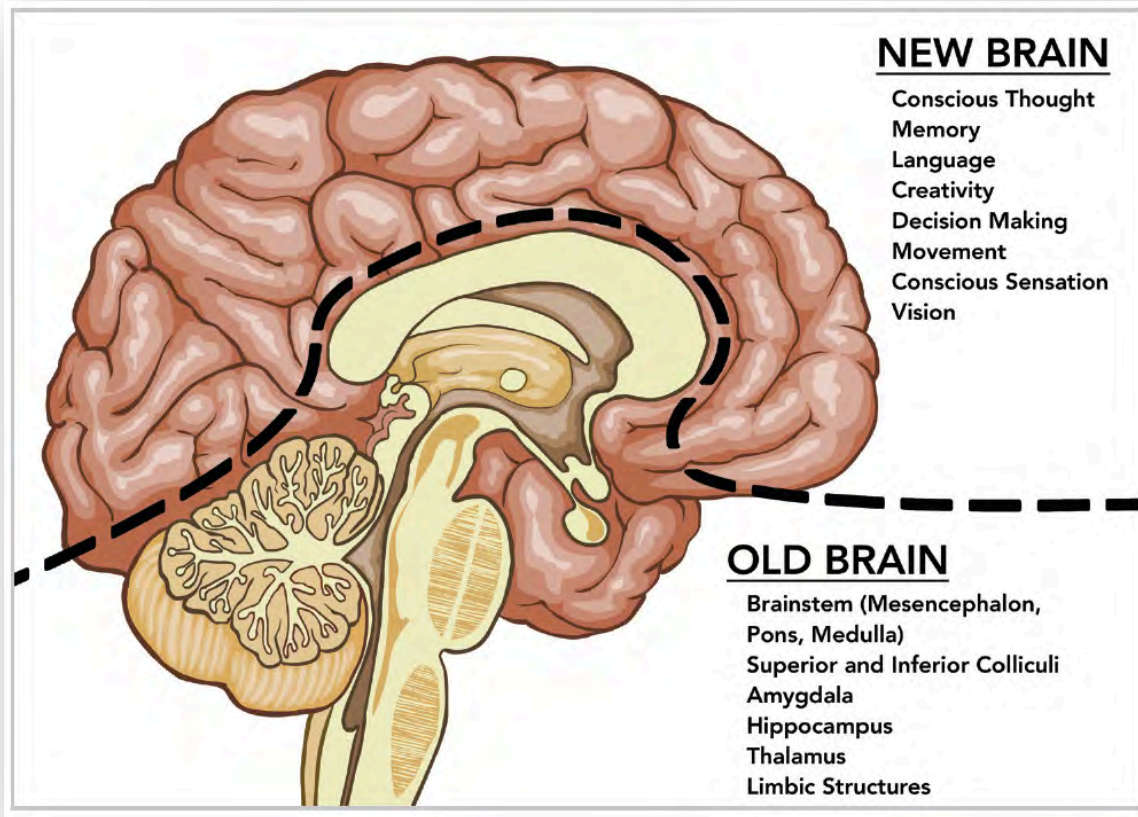


Neuro-Movement Pathways For Rehab

3 Key Players

1. Cortex
2. Basal Nuclei
3. Cerebellum





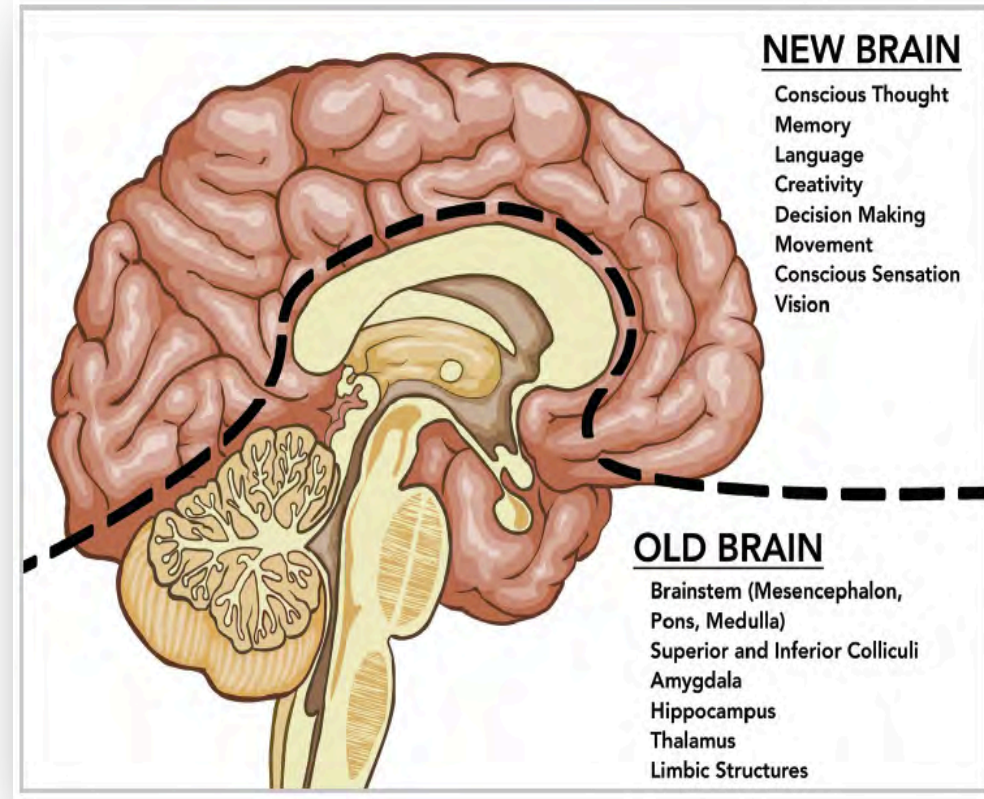
Your Brain Divided

Basic Brain “Functional” Divisions

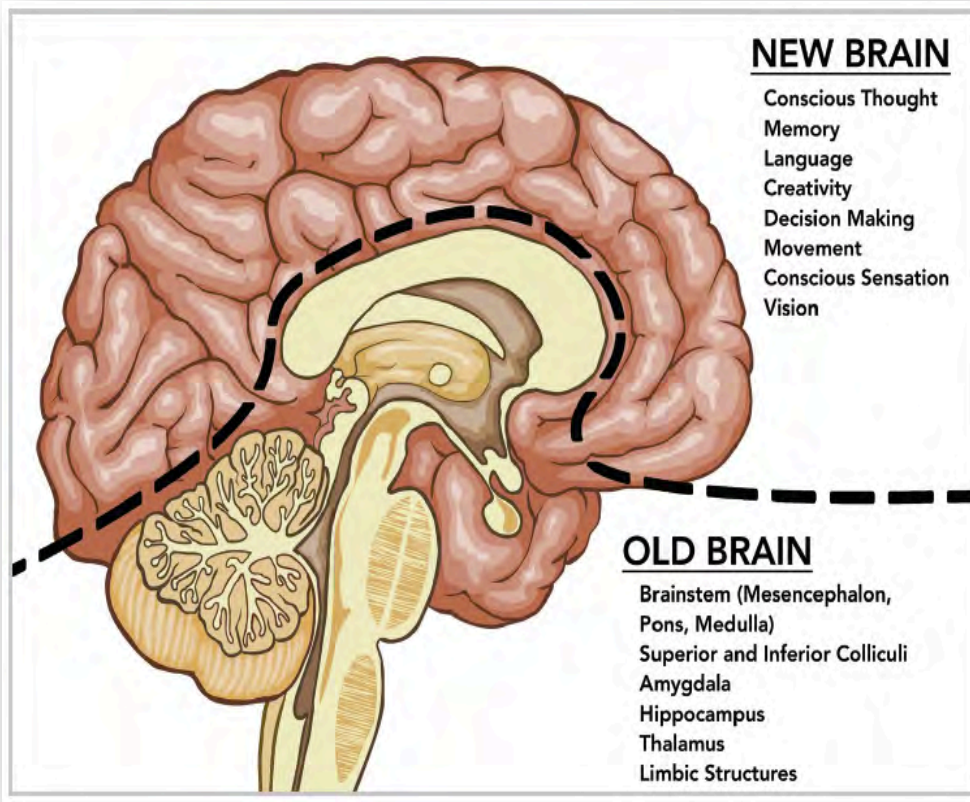
The Old 1st Brain

- Old Brain
- Non-Reasoning, Non-Rational
- Seat of Emotion
- Reviews and Judges All Incoming Stimulus
- Acts as GATEKEEPER to 2nd Brain
- Brainstem, Superior Colliculus, Inferior Colliculus, Limbic Lobe
- Only Interested in Answering 1 Question:

IS IT SAFE?



The New 2nd Brain



The New 2nd Brain

- New Brain – NeoCortex
- Conscious Thought
- Memory
- Language
- Creativity
- Decision Making
- Movement
- Conscious Sensation
- Vision
- Enacts Decisions

Neurology Simplified: Outputs



SURVIVAL

PERFORMANCE



PAIN
Fatigue
Inflexibility
Immobility

Dizziness
Poor Movement
Poor Balance
Migraines

Pain Free Movement
High Coordination
Strength
Speed
Great Balance
Endocrine Health
Immune Health

Your Expectation Creates Your Reality...

400,000,000,000 (400B)

Total Signals/sec.

2,000

Unconscious Awareness/sec.

40

Conscious Awareness/sec.

7 (+/-2)

Cognitive Thoughts/sec.

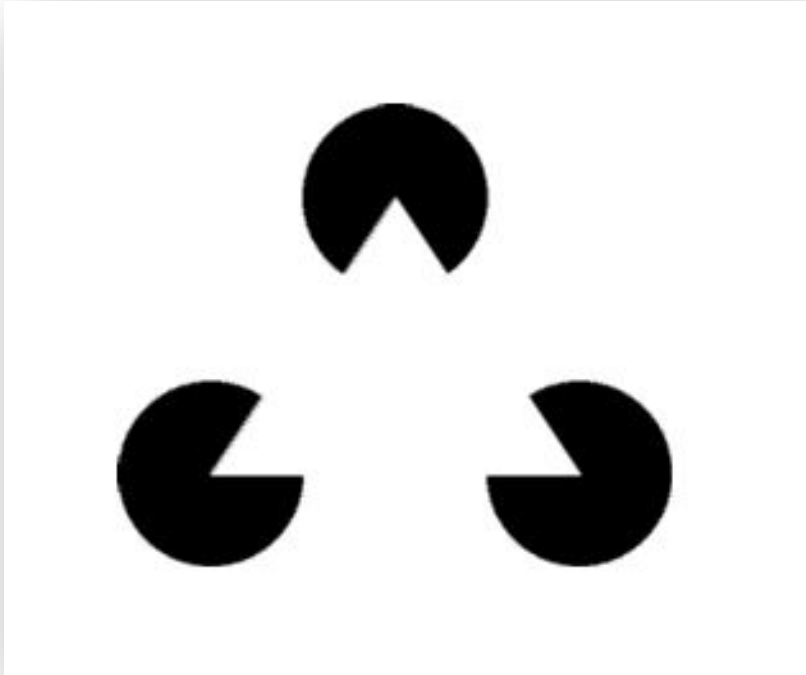


Job #1 – Survival!

Is The Body More
Oriented Toward
Survival or
Performance?



How Does The Brain Keep Us Alive?



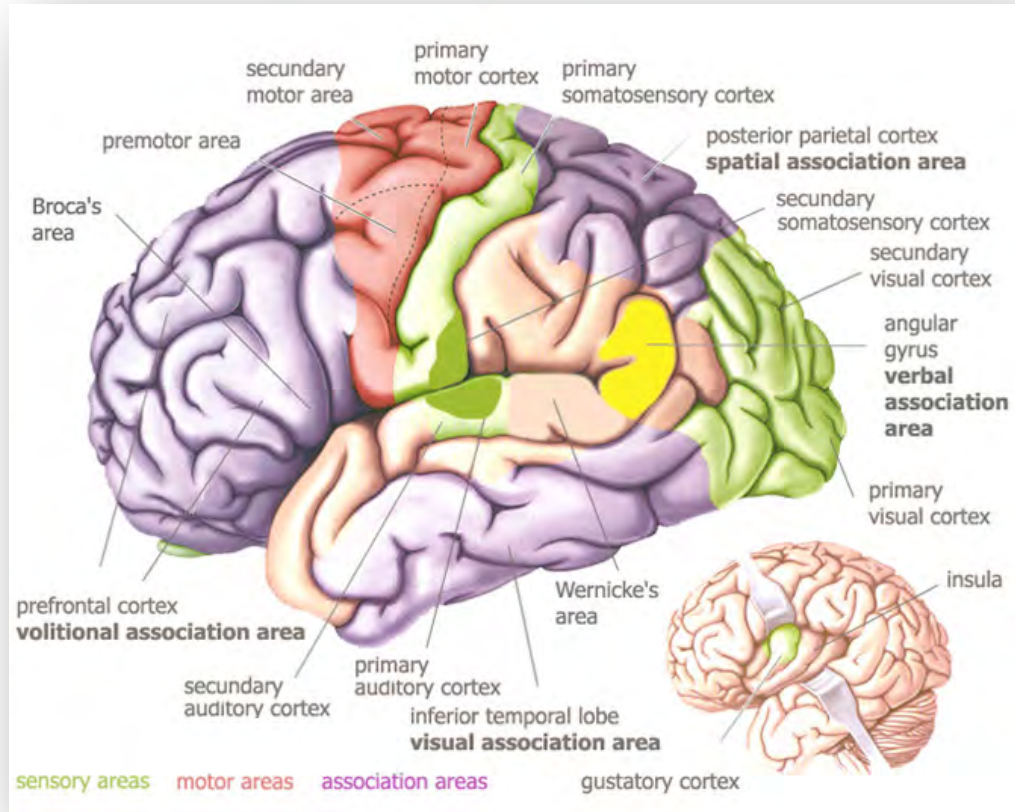
Survival processing in the human brain can be summed up in two words:

PATTERN RECOGNITION
(or more simply: **PREDICTION**)

How Does The Brain Keep Us Alive?



Foundational Brain Concepts



Two Things Your Brain Needs To Stay Alive:

1. Fuel (Oxygen, Glucose)

2. Activation (Use It or Lose It)

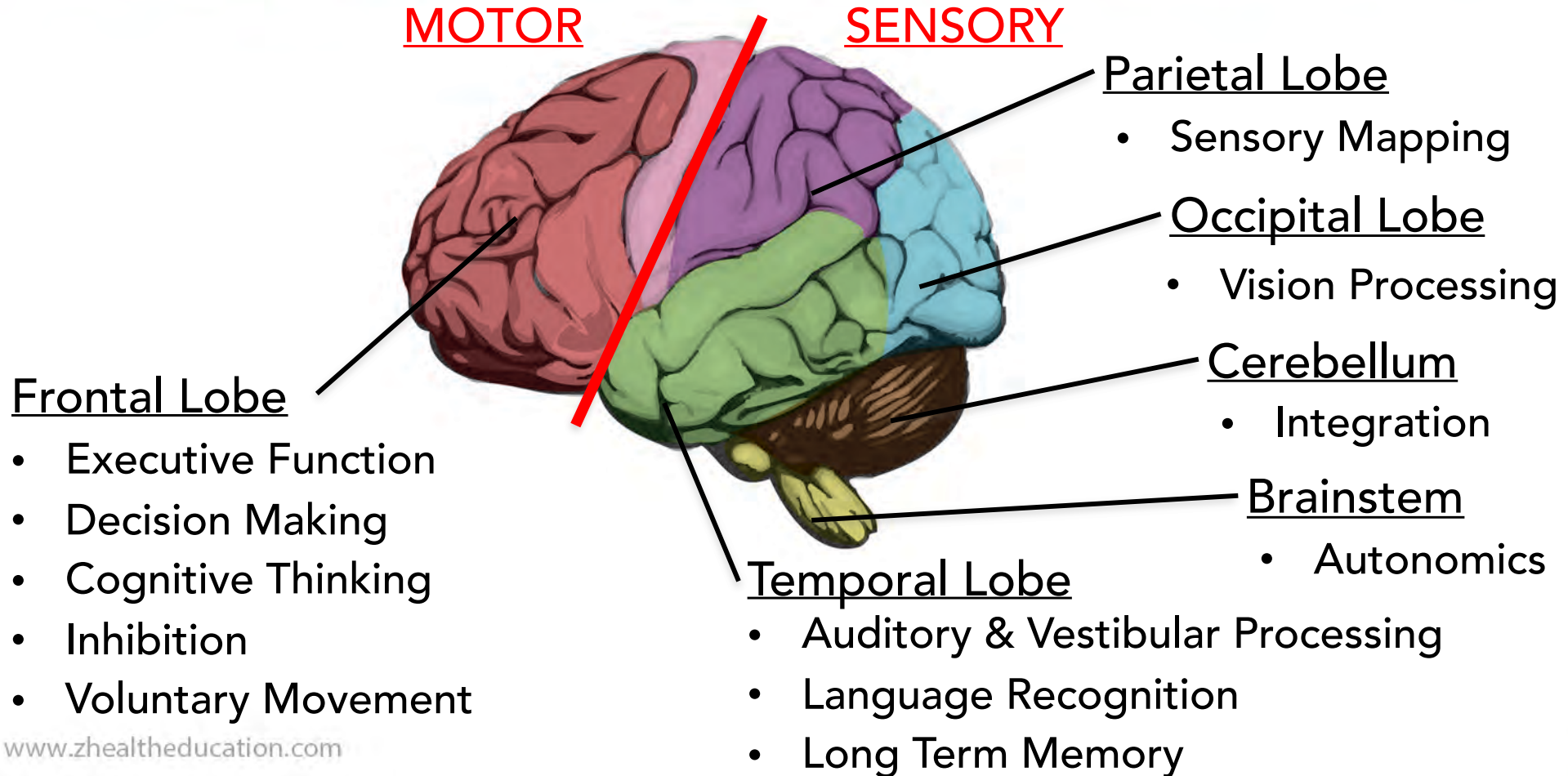
Foundational Brain Concepts

Your Brain's Basic Feeding Pattern

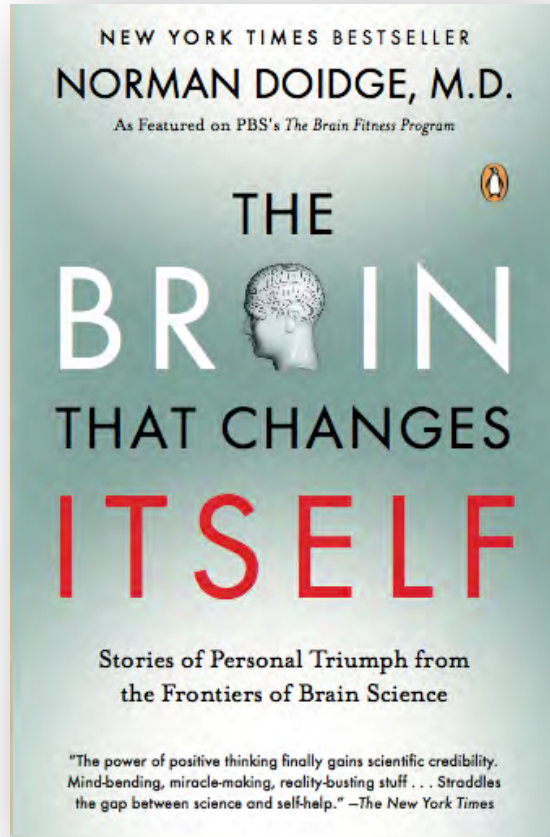
1. Bottom To Top
2. Back to Front



Foundational Brain Concepts



Neural Plasticity – The Science of Hope!

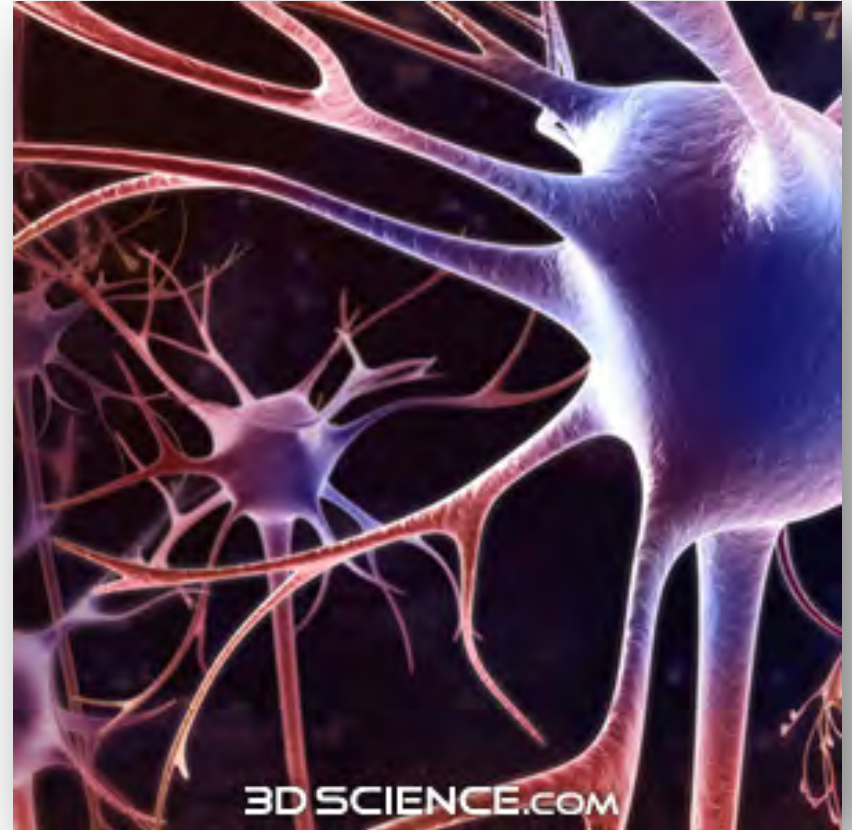


What is Neural Plasticity?

Any change in neuron structure or function that is observed either directly from measures of individual neurons or inferred from measures taken across populations of neurons.

Three Reasons To Focus On The Nervous System

1. **The Governing System**
2. **The Fastest System**
3. **The Most (Anatomically) Stable and (Functionally) Plastic System**



5 Types of Neural Plasticity

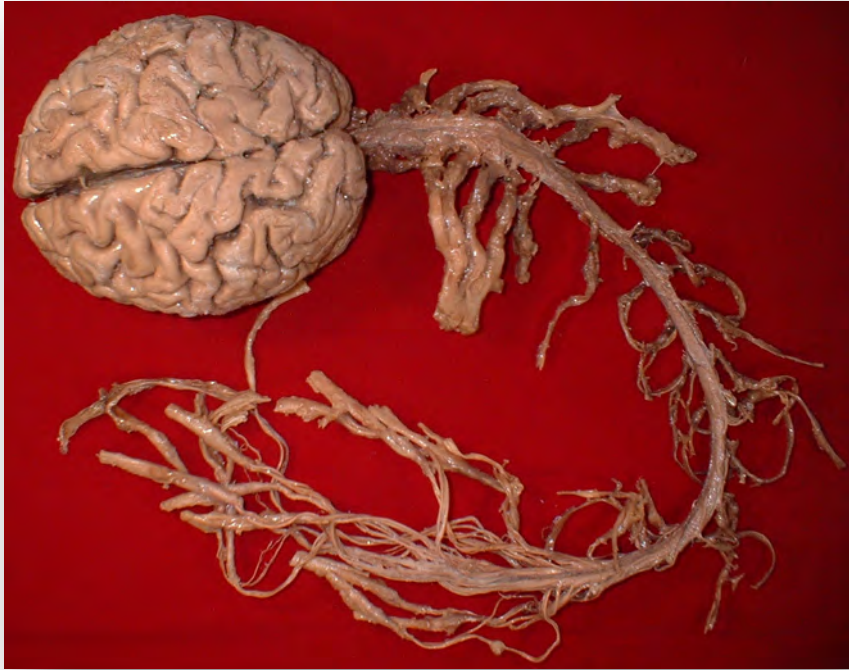
Neural Plasticity can change:

1. Neuron structure
2. Neuron function
3. Neuronal Pool structure
- 4. Neuronal Pool function**
5. Metaplasticity
(The plasticity of your plasticity)



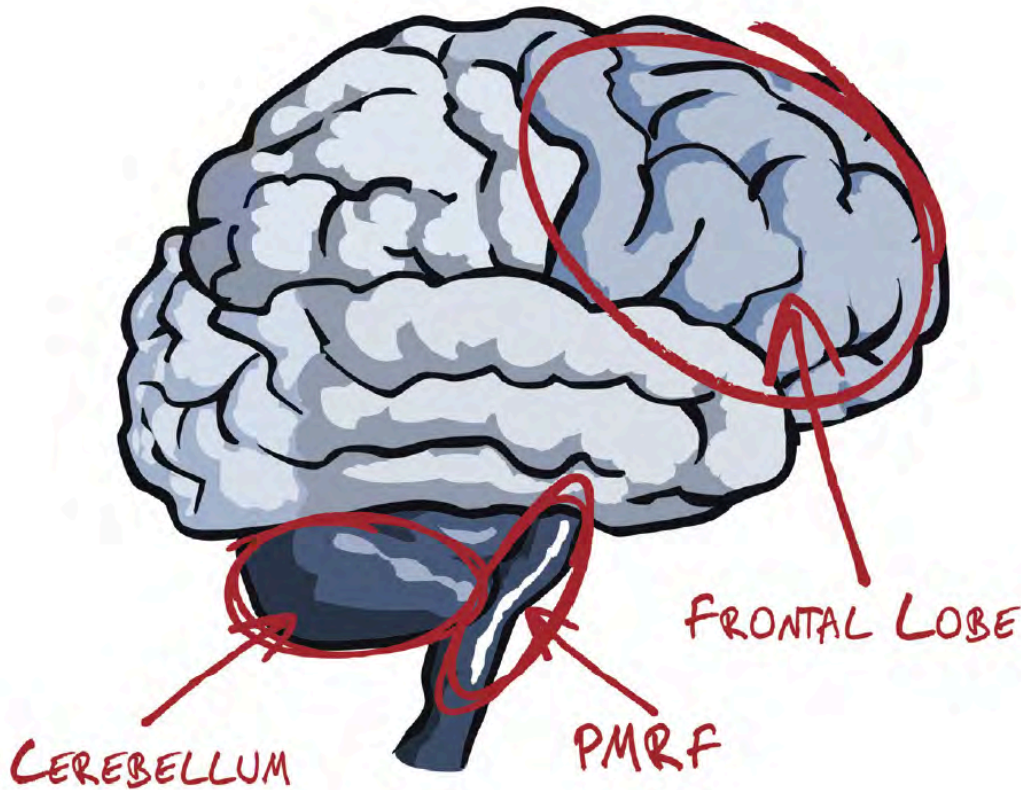
The Complexity of the Nervous System

The Human Nervous System



Latest estimates state that there are up to 120 billion neurons in the human brain. Each of those neurons connects to and works with between 10,000 and 80,000 other neurons. So, multiply 120 billion x 80,000 and you end up with 9,600,000,000,000,000 (9.6 quadrillion) potential connections. To put this in perspective, the milky way galaxy has about 200 million stars.

Movement Neuroanatomy



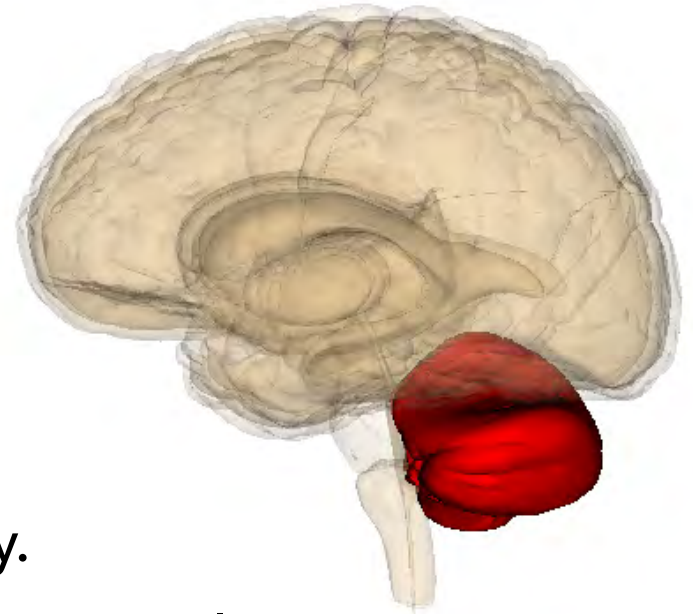
In terms of movement neurology in this course, we are primarily interested in 3 different brain regions:

1. Cerebellum – Coordinates and “Fixes” Movement Errors
2. Frontal Lobe (Cortex) – Initiates Movement
3. Pontomedullary Reticular Formation (PMRF) – Posture, Global Muscle Tone, and Autonomic Control

The Cerebellum

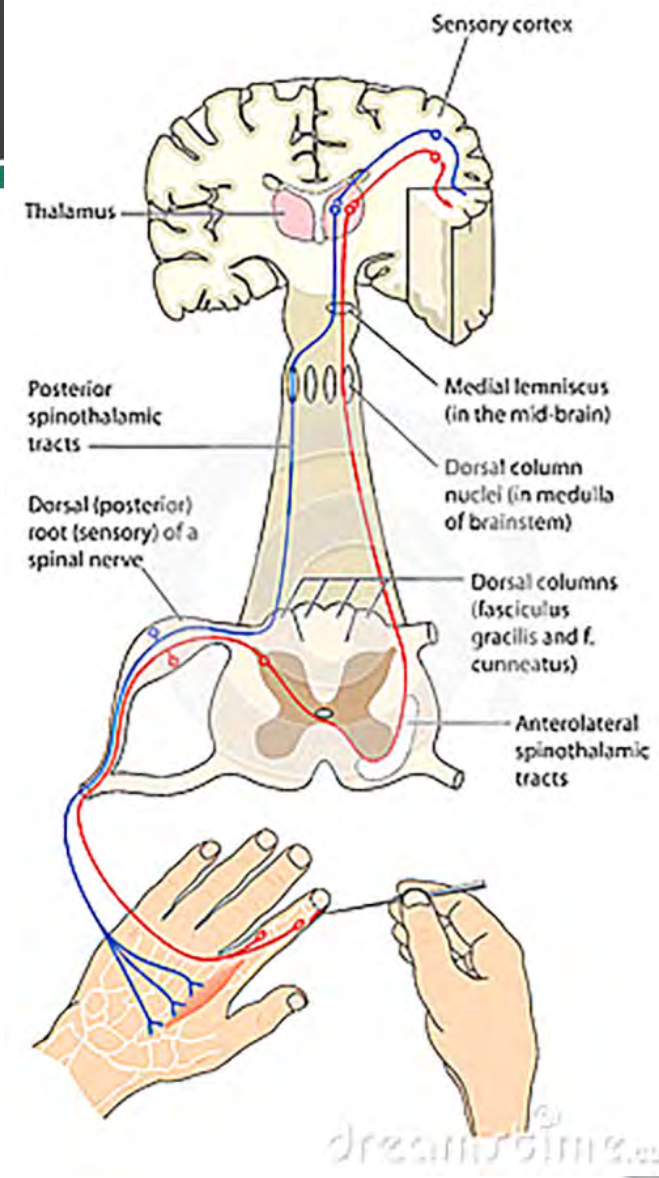
Cerebellum – Integrates (and simplifies) the complex data generated from all of our body systems and cognition. The cerebellum performs these tasks in movement:

1. Coordinates complex movements ipsilaterally.
2. Is responsible for the movement ABC's (Accuracy, Balance, Coordination)
3. Directly stimulates the contralateral cerebral cortex (frontal lobe)



R-Phase Neurology Rules:

1. All sensory input eventually goes to the contralateral cortex, except smell.
2. Voluntary movement is created by the contralateral cortex, and controlled by the ipsilateral cerebellum (remember Accuracy, Balance, Coordination).

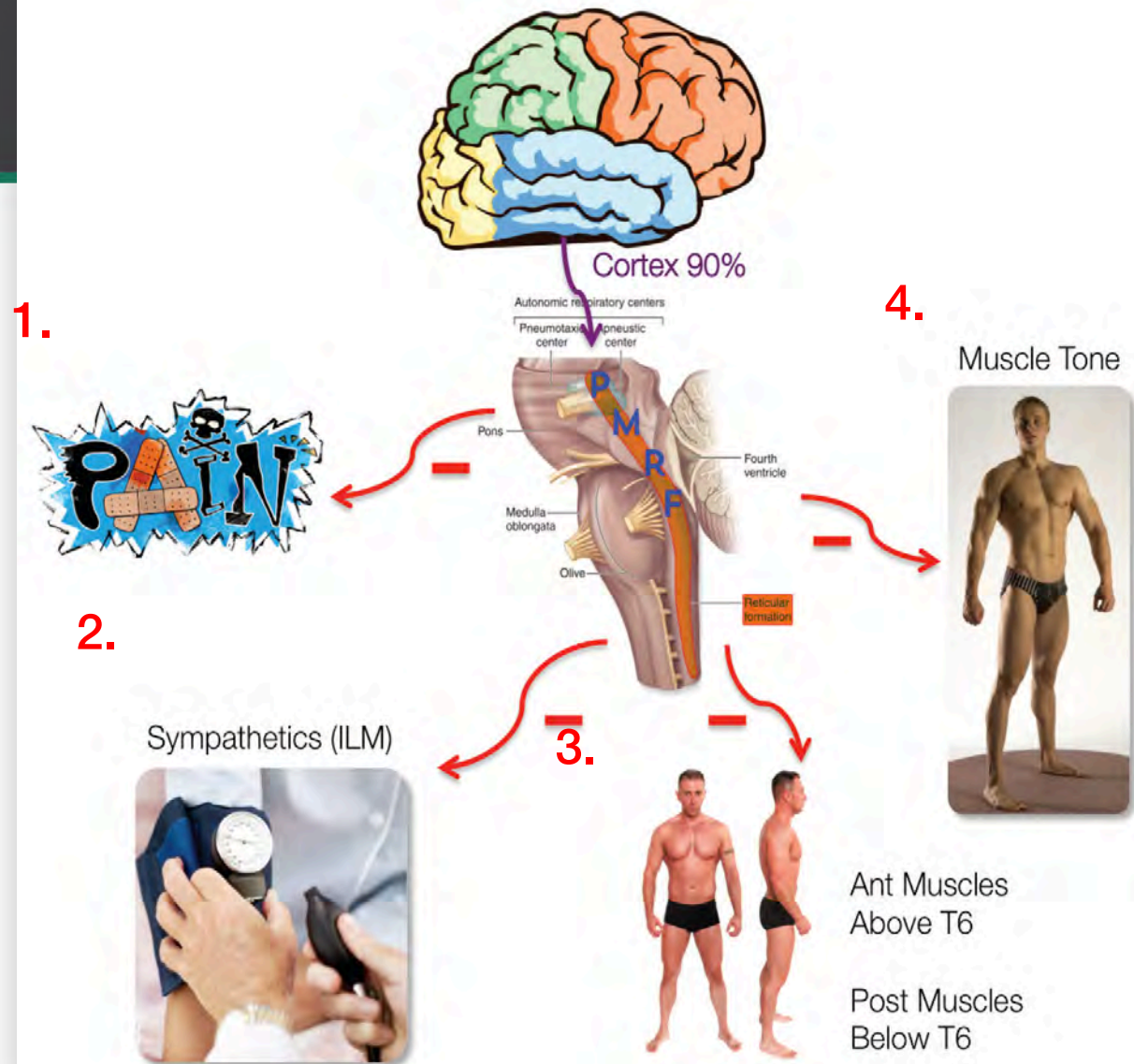


The PMRF

Pontomedullary Reticular Formation

Has 4 Responsibilities:
(All Ipsilateral)

1. Inhibit Pain
2. Inhibit Sympathetic Tone
3. Create Good, Upright Posture
4. Create Good Resting Muscle Tone



The PMRF

1. Inhibits pain on ipsilateral side of the body.

2. Inhibits the Sympathetics on ipsilateral side of the body (via the IML)

3. Creates good, upright posture.
(Inhibits the ipsilateral anterior muscles above T6 / Inhibits the posterior muscles below T6)

4. Creates good ipsilateral resting muscle tone (via Inhibition of Inhibitory Motor Interneurons).

1.



2.

Sympathetics (ILM)



Cortex 90%

Autonomic respiratory centers

Pneumotaxic center

Pneumotaxic center

Pons

Medulla oblongata

Olive

Fourth ventricle

Reticular formation

4.

Muscle Tone



Ant Muscles Above T6

Post Muscles Below T6

3.

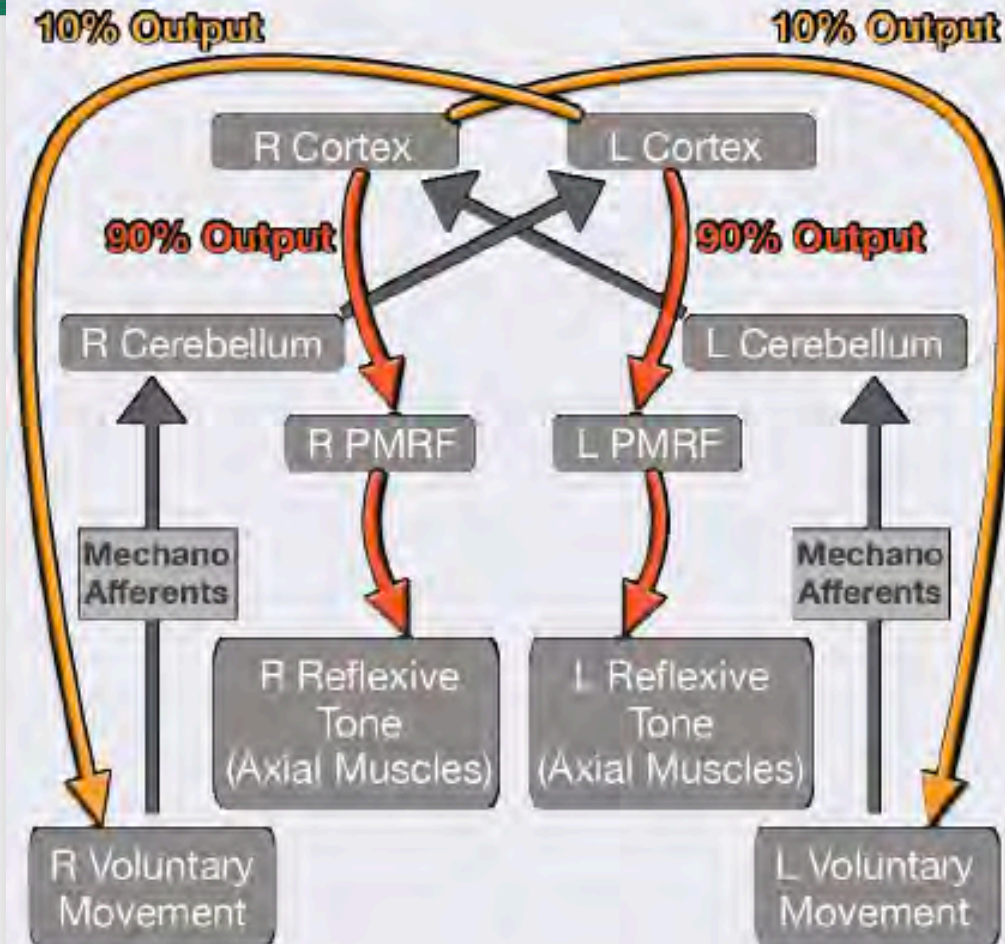


Improving Movement with Neurology

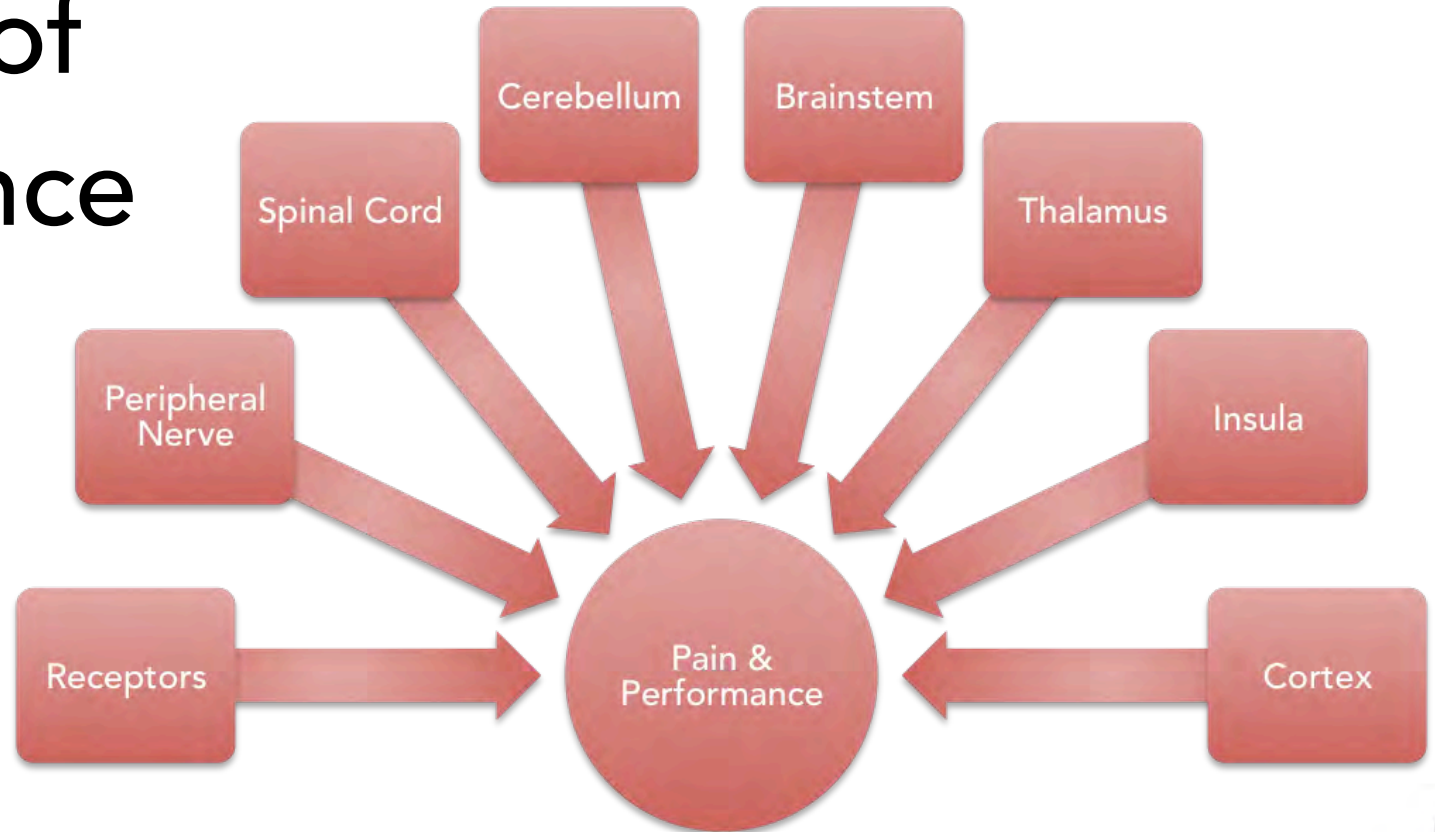
1. Increased Neural Drive for Voluntary Movement

2. Improved Reflexive Tone for Stabilization

There are 2 Routes to Improve Voluntary Strength:
Increased Neural Drive and Improved Reflexive Tone

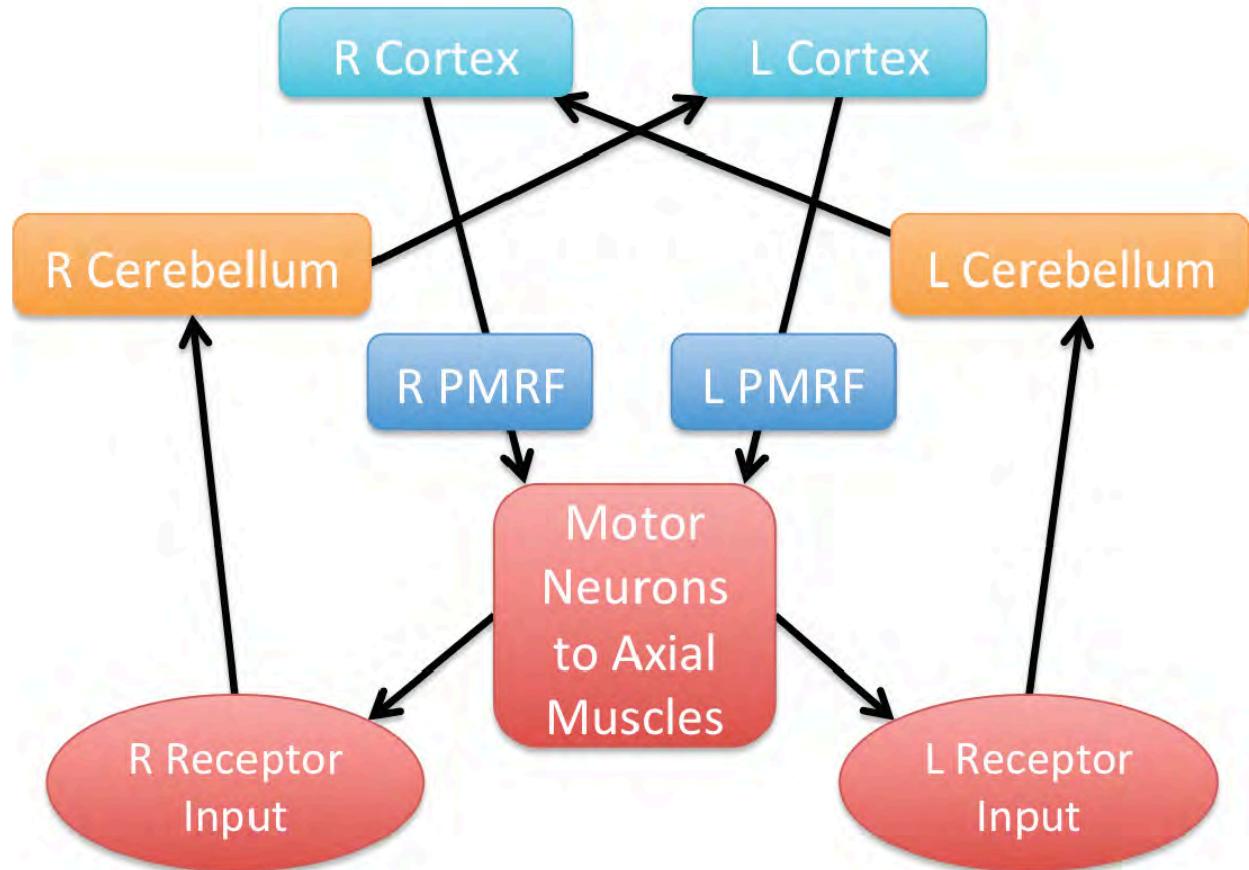


8 Levels of Performance Model



Understanding the Neurology of Movement

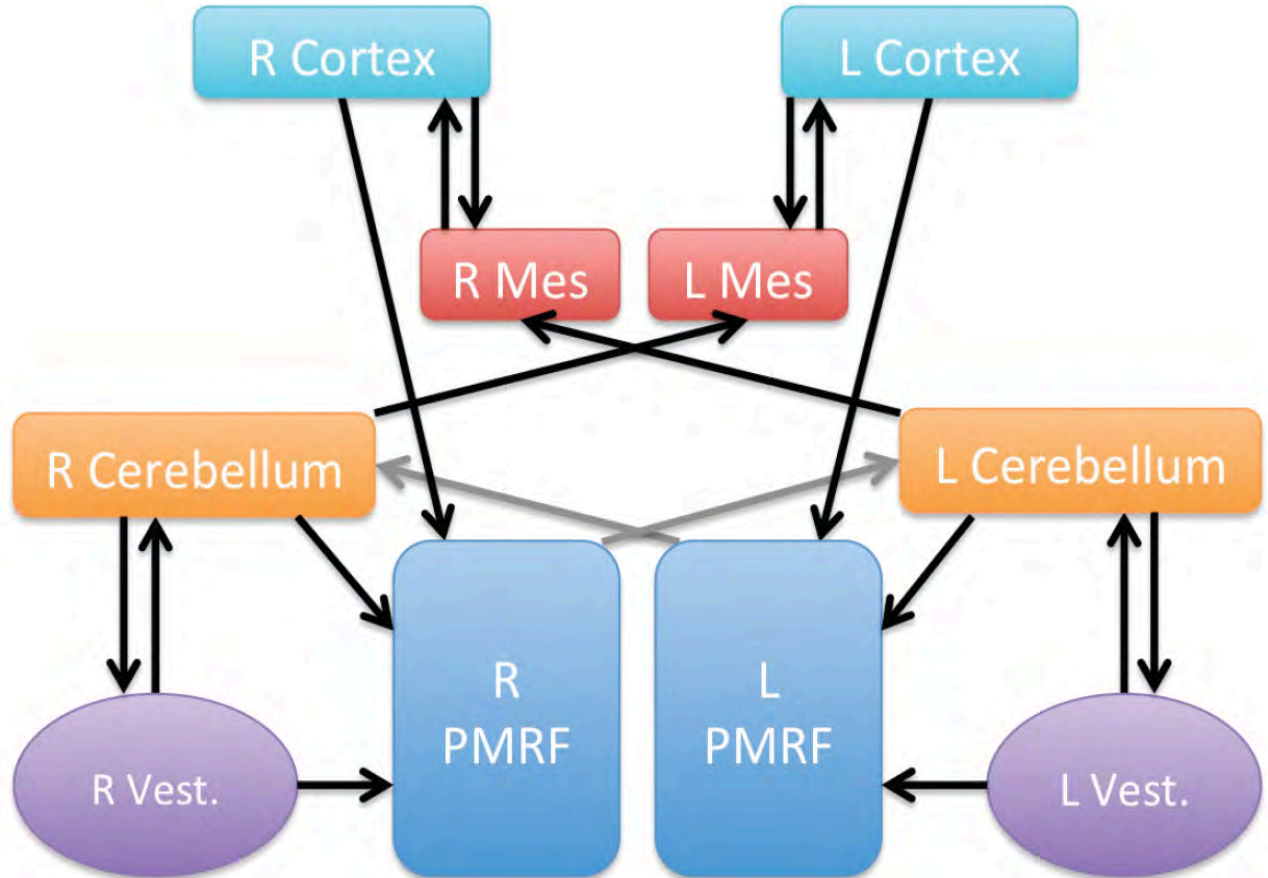
- If deficits exist in the Cerebellum, Cortex, or PMRF then movement and strength suffers!



Inputs to the PMRF

Increase activation of the PMRF by stimulating:

1. Ipsilateral Cortex
2. Ipsilateral Cerebellum
3. Ipsilateral Vestibular System



Nervous System Inputs... Expanded



Job #2 – Movement!

“Movement is the basic currency of health, fitness and performance. Great movement produces healthy, pain-free, high-level performance. Bad movement promotes pain, dysfunction, and progressive decreases in movement, which themselves lead to progressive decreases in brain function and health.”

Movement Is Life.



Movement Creates Structure



The body you have is the body you've earned by the way that you move.

Wolff's Law and Davis' Law



Bones and soft tissues remodel along lines of chronic stress.

Form Follows Function!

In most cases, WALKING is the single strongest, most chronic, full-body loading event our bodies undergo. So, if you want to fix both short and long-term problems, as well as increase performance and efficiency – fix their gait.

Ground Forces Math – Load in Kg

How Hard Do We Strike the Ground?

During Walking: 1.07-1.2x Bodyweight

During Running: 2.0-2.9x Bodyweight

During Sprinting: 4.6-5.5x Bodyweight

The Math

Average Male: 80kg

Danish Study 2011-2012 = 8,341 Steps/Day

$80\text{kg} \times 1.2 = 96\text{kg/Step}$

$96\text{kg} \times 8,400 = 806,400\text{kg per day}$

$806,400 \times 7 = 5,644,800\text{kg per week}$

$5,644,800 \times 52 = 293,529,600\text{ per year}$

Do you think a small joint issue could become a major problem?



Ground Forces Math – Load in lbs

How Hard Do We Strike the Ground?

During Walking: 1.07-1.2x Bodyweight

During Running: 2.0-2.9x Bodyweight

During Sprinting: 4.60-5.5x Bodyweight

The Math

Average Male: 200lbs

Average Steps Per Day = 8,341

$200\text{lb} \times 1.2 = 240\text{lb/Step}$

$240\text{lb} \times 8,400 = 2,016,000\text{lb per day}$

$2,016,000 \times 7 = 14,112,000\text{lb per week}$

$14,112,000 \times 52 = 733,824,000\text{lb per year}$

Do you think a small joint issue could become a major problem?



R-Phase Gait Assessment & Neurology

4 Common Functional Neurologic Presentations In Gait

1. Bobblehead
2. Loss of Arm Swing
3. PMRF Gait Pattern
4. Cerebellar Gait Pattern

R-Phase Gait Assessment & Neurology

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 during the gait cycle this is often indicative of either visual or vestibular issues

Possible Solutions:

- Cervical Mobility Drills
- TMJ Mobility Drills
- Gaze Stabilization
- Smooth Pursuits
- VOR
- VOR-C
- Otolith Drills

R-Phase Gait Assessment & Neurology

Possible Solutions:

- Complex mobility drills on the side of decreased arm swing.
- Use history findings and opposing joint/movement concepts as a guide.

Loss of Arm Swing -

Arm swing in gait is controlled (in part) by the **CONTRALATERAL HEMISPHERE.**

R-Phase Gait Assessment & Neurology

PMRF Gait Pattern – In this gait, you will see internal rotation of the UPPER EXTREMITY and external rotation of the LOWER EXTREMITY. This must be correlated with history findings.

Possible Solutions:

- Complex mobility drills on the side of the body CONTRALATERAL to the PMRF side.
- Consider unilateral strength training on the side of the body CONTRALATERAL to the PMRF side for 6-8 weeks.

R-Phase Gait Assessment & Neurology

Possible Solutions:

- Complex mobility drills on the IPSILATERAL side of the body.
- Remember, that the cerebellum responds to complexity so increase movement challenges with alterations in mobility drills:
 - Speed
 - Perturbation
 - External Loads
 - Bands
 - Eyes Closed

Cerebellar Gait Pattern – In this gait, you will see internal rotation of both the UPPER EXTREMITY and LOWER EXTREMITY. This will be ipsilateral to the side of the deficit. So, a right cerebellar issue will cause this pattern on the right side of the body.

Minimal Effective Dose



How many of you believe or have heard clients or friends say:

“At least they’re doing something”

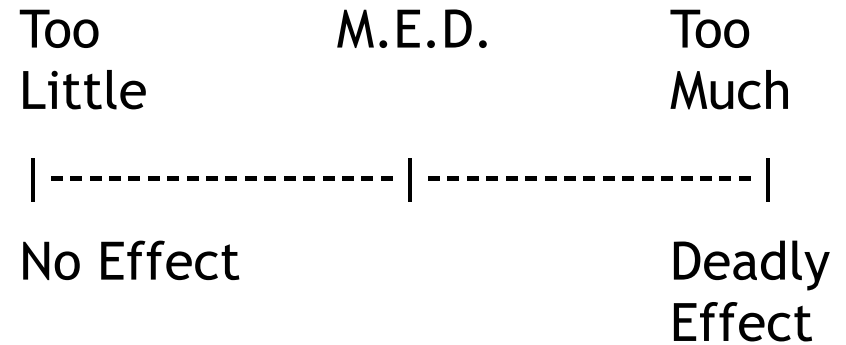
OR

“At least they’re out walking”

Minimal Effective Dose



For doctors prescribing medications, effective dosing is VITAL!



Minimal Effective Dose

Exercise is NOT
so easy
that you cannot
screw it up!



Genetic Non-Responders to Exercise?

Study Name:

Individual Responses to Combined Endurance & Strength Training

Study Parameters:

- 175 People for 21 weeks (5 months)
- VO2 Max & Maximum Isometric Strength
- Compliance > 95% to be Included in Results...
- 15% SUPER Responders (+42%)
- 65% NORMAL Responders (+20%)
- 20% NON Responders (-8%)

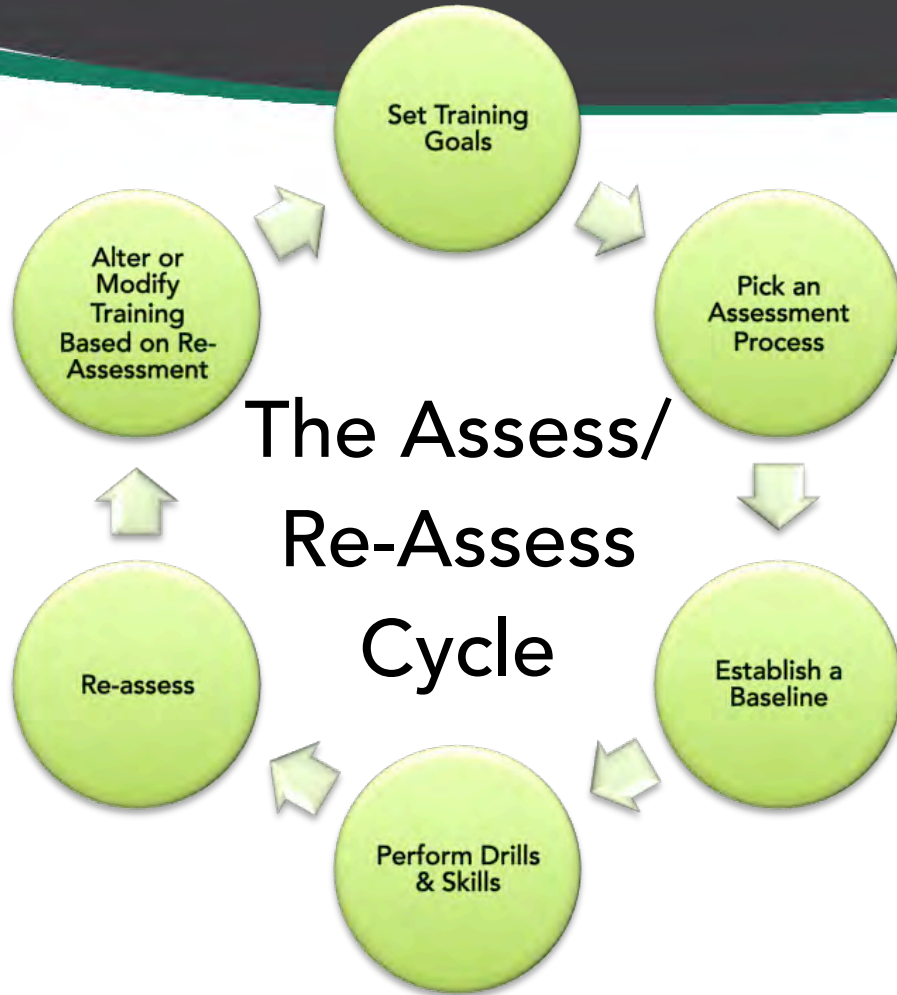


Minimal Effective Dose

Exercise is NOT
so easy
that you cannot
screw it up!



Two Vital Assessment Concepts

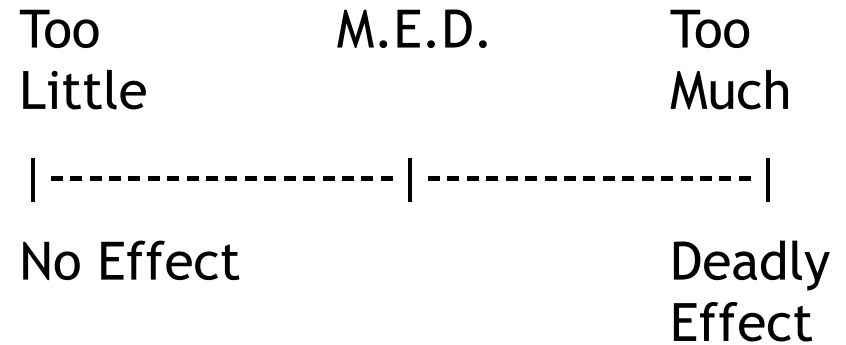


1. If you're not assessing, you're guessing.
2. Change occurs at the speed of the nervous system.

Minimal Effective Dose



For doctors prescribing medications, effective dosing is VITAL!



Minimal Effective Dose

Exercise is NOT
so easy
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Minimal Effective Dose

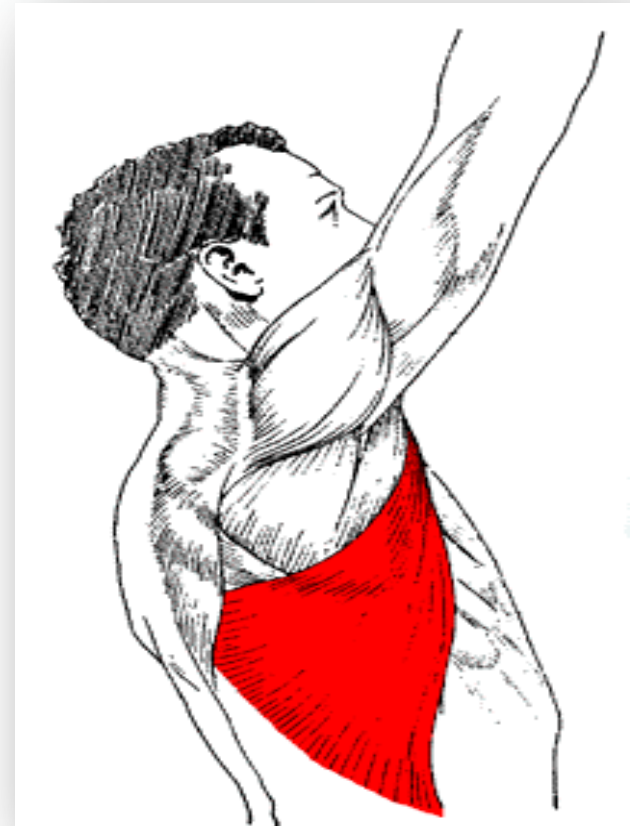
Exercise is NOT
so easy
that you cannot
screw it up!



Forms of Assessment #1

Active Range of Motion (AROM)

1. Shoulder Flexion (Arm To Front)
2. Shoulder Abduction (Arm To Side)
3. Shoulder Extension (Arm Behind)
4. Trunk Forward Bend
5. Trunk Rotation



Forms of Assessment #2



Strength

Rate of Perceived Exertion (RPE)

Grade the difficulty of the movement
using a 1-10 scale:

1 - - - - - 10

Extremely

Easy

Extremely

Hard



Forms of Assessment #3



Single-Leg Balance

Eyes Open

or

Eyes Closed

Forms of Assessment #4

Functional Activities

Improved quality of movement, decreased pain, and increased movement speed all indicate a positive adaptive response in the nervous system.



Input Drill #1 - Digit Span Testing

Sensory Input for Cortex & Cerebellum

1. Have the client hold their hands out, fingers spread, with eyes closed.
2. Trainer touches 2 fingers at the same time.
3. Client is asked to say how many fingers are in between the two that were touched.
4. Re-Assess after 10 attempts.

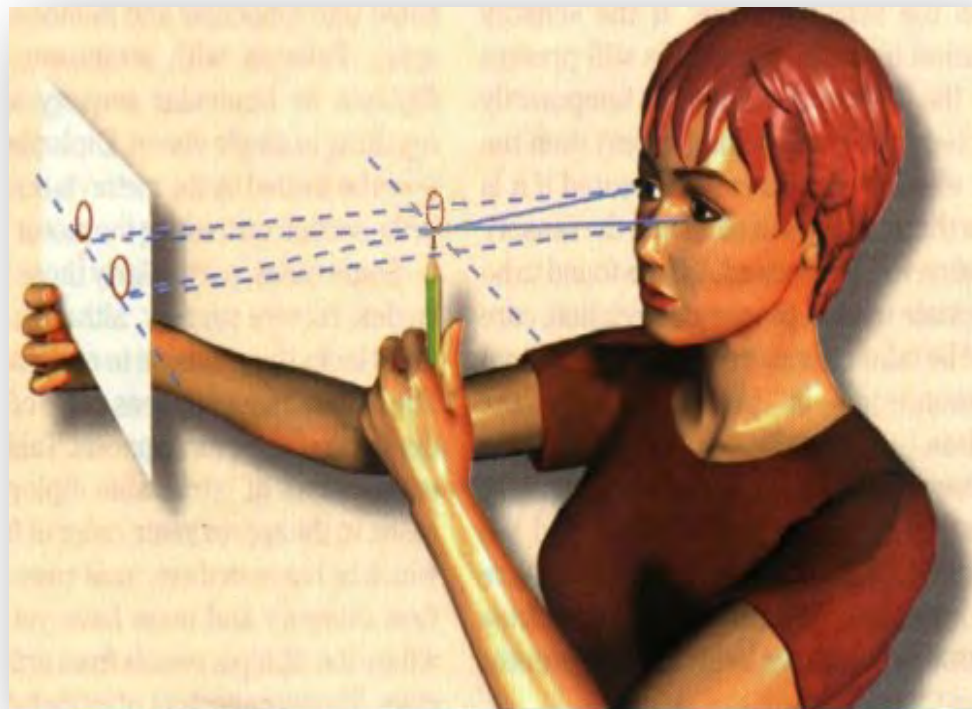


Input Drill #2 - Pencil Pushups

The Skill: Vergence

Vergence is the turning motion of the eyeballs toward or away from each other in order to focus on a target. It should be possible to perform high speed and highly accurate vergence tasks, even in highly stressful environments.

- Convergence = Eyes Toward Midline
- Divergence = Eyes Away from Midline

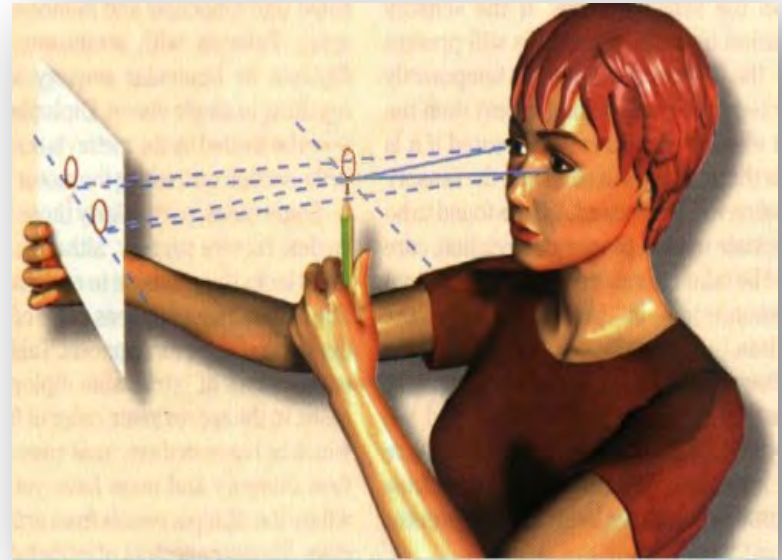


Input Drill #2 - Pencil Pushups

The Drill: Pencil Pushups

Training to maintain single focus from near to far, and far to near

1. Begin at arm's length, holding the pen directly in front of the eyes.
2. Slowly bring the pen toward the bridge of the nose, watching it with both eyes.
3. **STOP** moving the pen when the target doubles.
4. Slowly return to the starting position, watching the target with both eyes.
5. Re-Assess after 1-2 repetitions.



Input Drill #3 - Near/Far

The Skill: Near/Far Focusing

The ability to change focus quickly and accurately from one distance to another.



Input Drill #3 - Near/Far

The Drill: Pencil Pushups with Near/Far Switches

1. From a position of convergence (close to the face), change your visual focus to a target in the distance, both quickly and accurately, and then switch back to the pen.
2. Re-assess after 15-20 switches.



Respiration Drill #1 - Diaphragm Stretch 1

1. Supine, arms overhead.
2. Perform a posterior pelvic tilt.
3. Inhale fully.
4. Open your mouth and throat and create a forceful, deep exhale. When you think you have reached the end of your exhalation capacity, exhale even more deeply.
5. Feel for a deep stretch in your upper lumbar and low-to-mid thoracic spine.

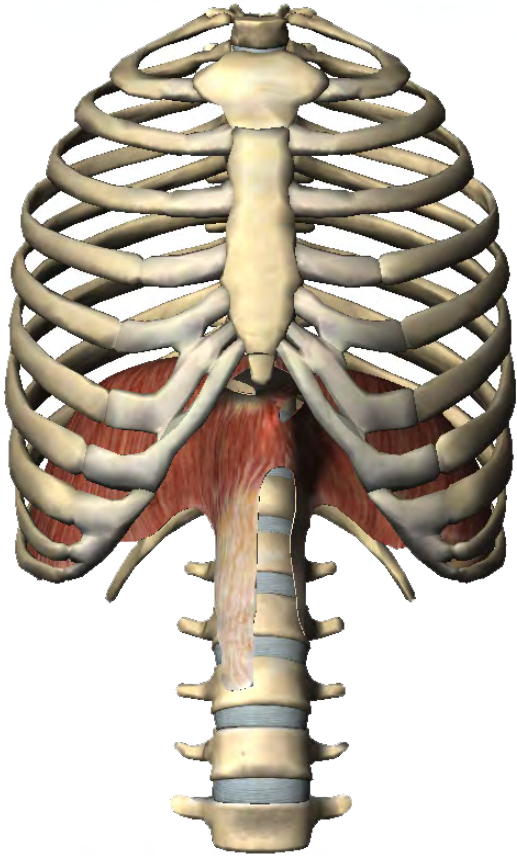


Respiration Drill #2 - Diaphragm Stretch 2

1. Supine, arms by your side.
2. Perform a posterior pelvic tilt.
3. Inhale fully as you raise arms to the overhead position and simultaneously perform a standard hip-bridge
4. In the top position, open your mouth and throat and exhale fully.
5. Hold this full exhale as you return to the ground while maintaining a posterior pelvic tilt. Try to widen your ribs laterally as you do this.
6. Feel for a deep stretch in your upper lumbar and low-to-mid thoracic spine.
7. When performed correctly, this will create a “vacuum” effect in the abdomen, deeply stretching the diaphragm while maintaining abdominal muscle relaxation.



Respiration Drill #2 - Diaphragm Stretch 2

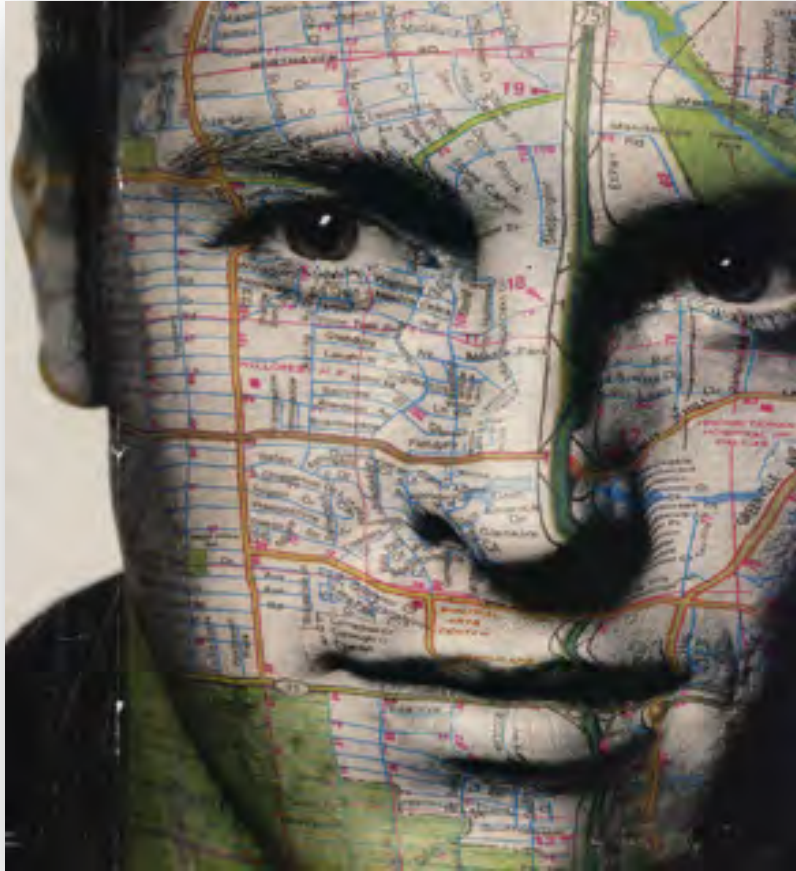


The Goals of R-Phase Training

1. Injury Rehabilitation
2. Neural Re-Education
3. Mobility Restoration



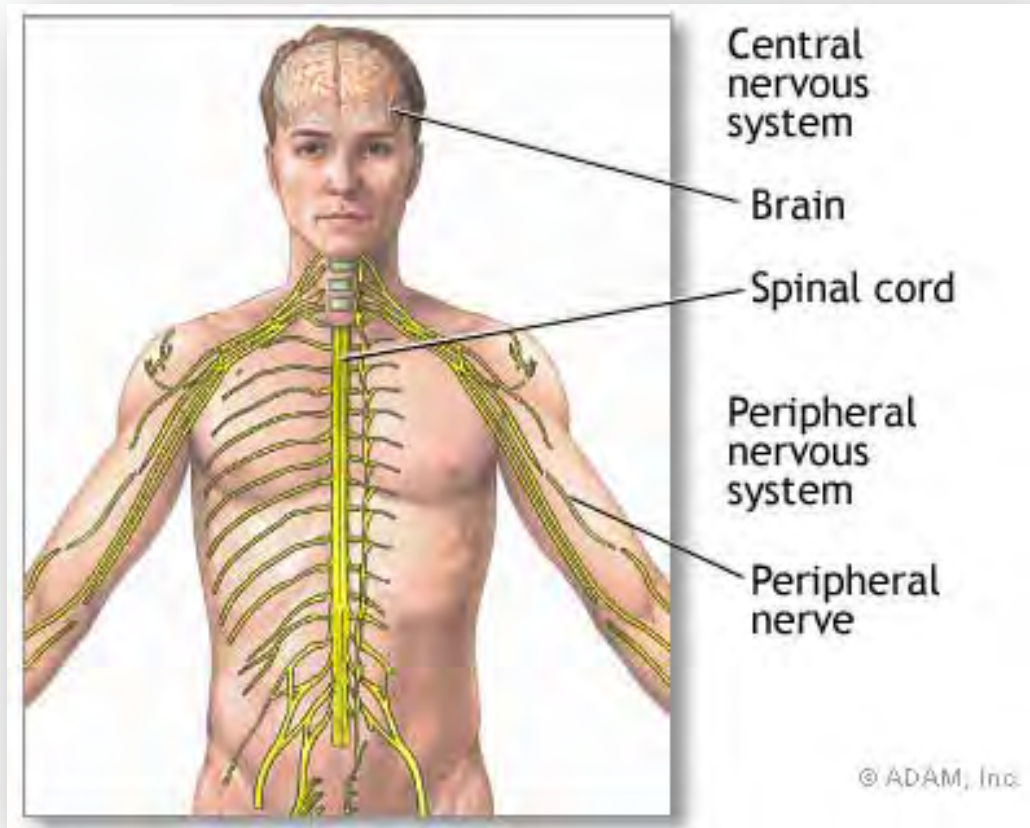
What is Proprioception?



The body's 3-D map of
itself in space and time.

AKA our movement &
awareness map.

The Proprioceptive System



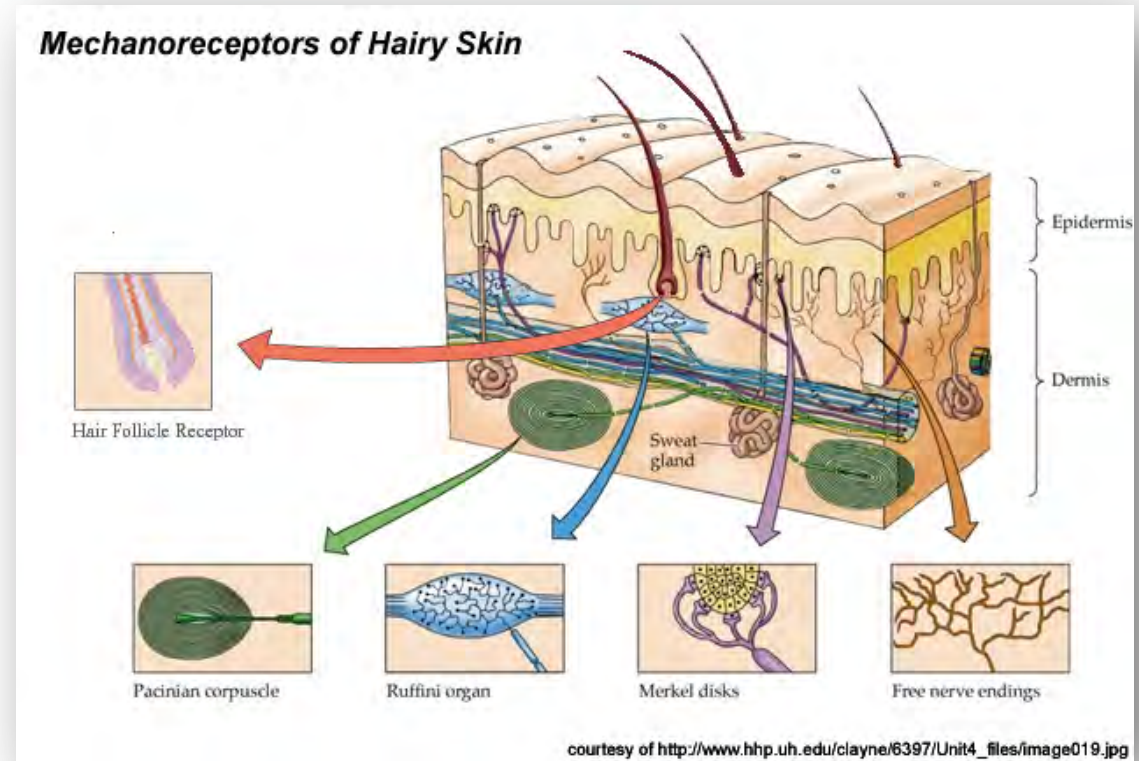
1. The Brain
2. The Spinal Cord
3. Peripheral Nerves
4. Many Different Types of Nerve Endings

Remember That
Proprioception LIVES In
The Brain!

3 Proprioceptive Nerve Endings

Nerve endings that provide many different types of information to the nervous system such as:

1. Mechanoreceptors
2. Baroreceptors
3. Chemoreceptors
4. Thermoreceptors
5. Nociceptors



Proprioception = All The Body, All The Time



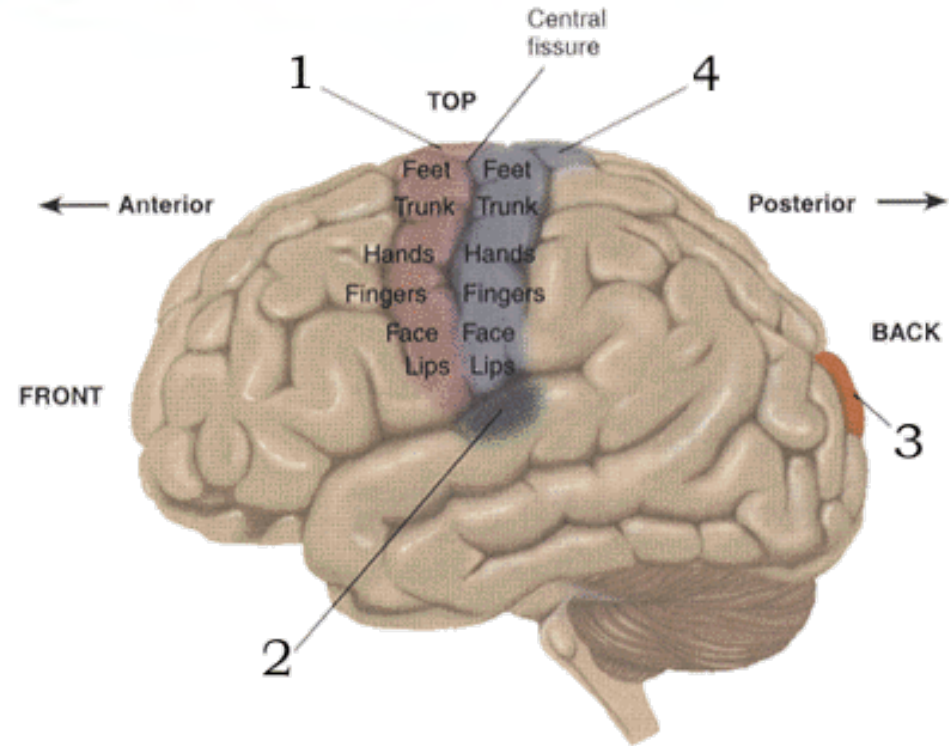
Two Most Critical Components of Proprioception



1. Mechanoreceptors (Fast)
2. Nociceptors (Slow)

Foundational Brain Concepts

The Sensory-Motor Cortex



Foundational Brain Concepts

The Sensory Homunculus



Foundational Brain Concepts



The Motor Homunculus

Side By Side



What Is The Startle Reflex?



Our genetically hard-wired
response to threat!

It is characterized by TWO
primary muscular actions:

Flexion & Adduction

The Elements of Startle



1. Head – The head moves forward and down to protect the throat.
2. Face – The startle reflex tenses all facial and jaw muscles and closes the airways.
3. Shoulders – The trapezius muscles contract bilaterally and raise shoulders up toward ears.
4. Chest – Anterior chest muscles contract and pull the shoulders forward and down.
5. Ribs – The intercostals muscles tighten and lock down the ribs.
6. Abdomen – All abdominal muscles, deep spinal muscles and pelvic floor muscles contract cooperatively to flex the body forward.
7. Gluteals – The gluteals also contract bilaterally to tip the pelvis forward.
8. Legs – The adductors, hips, and gastroc/soleus group contract to stabilize and balance the body.

The Arthrokinetic Reflex



1. A reflex based on joint movement and position.
2. One of the Missing Links in performance enhancement.
3. Remember this, "Jammed or immobile joints create weak muscles. Mobile joints create strength!"

Contraindications



1. Joint Hypermobility
2. Joint Effusion
3. Inflammation
4. Malignancy
5. Bone Disease
6. Fractures
7. Total Joint Replacements
8. Post-Surgical

Most of these are RELATIVE. If in doubt, always obtain doctor's approval prior to working with a client.

Job #2 – Movement!

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Movement Is Life.



Movement Creates Structure



The body you have is the body you've earned by the way that you move.

Wolff's Law and Davis' Law



Bones and soft tissues remodel along lines of chronic stress.

Form Follows Function!

In most cases, WALKING is the single strongest, most chronic, full-body loading event our bodies undergo. So, if you want to fix both short and long-term problems, as well as increase performance and efficiency – fix their gait.

Ground Forces Math – Load in Kg

How Hard Do We Strike the Ground?

During Walking: 1.07-1.2x Bodyweight

During Running: 2.0-2.9x Bodyweight

During Sprinting: 4.6-5.5x Bodyweight

The Math

Average Male: 80kg

Danish Study 2011-2012 = 8,341 Steps/Day

$80\text{kg} \times 1.2 = 96\text{kg/Step}$

$96\text{kg} \times 8,400 = 806,400\text{kg per day}$

$806,400 \times 7 = 5,644,800\text{kg per week}$

$5,644,800 \times 52 = 293,529,600\text{ per year}$

Do you think a small joint issue could become a major problem?





Essentials of Elite Performance

Day 2: I-Phase

What We Want

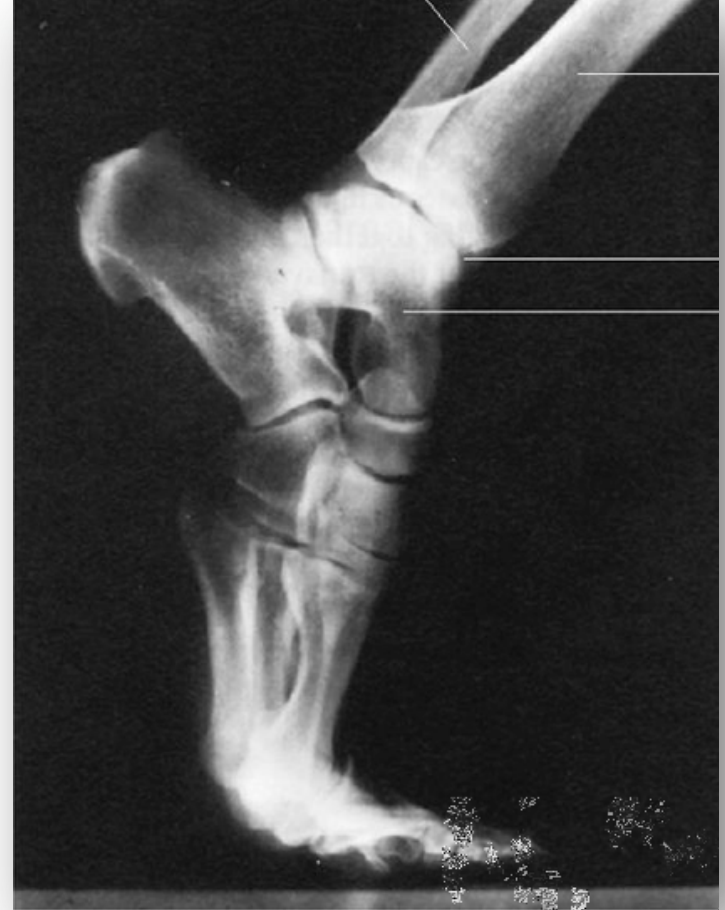


The Best Athletes Make
Everything
Look Easy. That Should Be
Our Goal!

"Success Leaves Clues"
-Anthony Robbins

Specific Adaptation To Imposed Demand (SAID)

- This is the **FUNDAMENTAL LAW** of human physiology.
- The classic definition: "The body adapts to whatever it does."
- The Z-Health definition: "The body ALWAYS adapts to EXACTLY what it does."
- The take home message here is that if you want a certain result, you must train with **PRECISION**.



The Training Rules

**PLEASE
OBSERVE
RULES
THANK YOU**

1. Never move into pain
2. If you have pain, slow down or decrease the range of motion
3. Long Spine/Long Body Position
4. Concentrate
5. Relax as much as possible

Big Ideas from Day 1

1. The Nervous System's #1 Job is Survival, via Prediction
2. Prediction = Current Information from ALL Inputs + Previous Experience
3. Prediction Occurs in the Old Brain, by Asking "Is It Safe?"
4. Unsafe or Unknown Predictions will INCREASE Threat
5. Increasing Threat will Result in Survival Outputs such as:

1. Pain
2. Tension
3. Startle Reflex
4. Sympathetic Nervous System
Wind Up / Up-Regulation

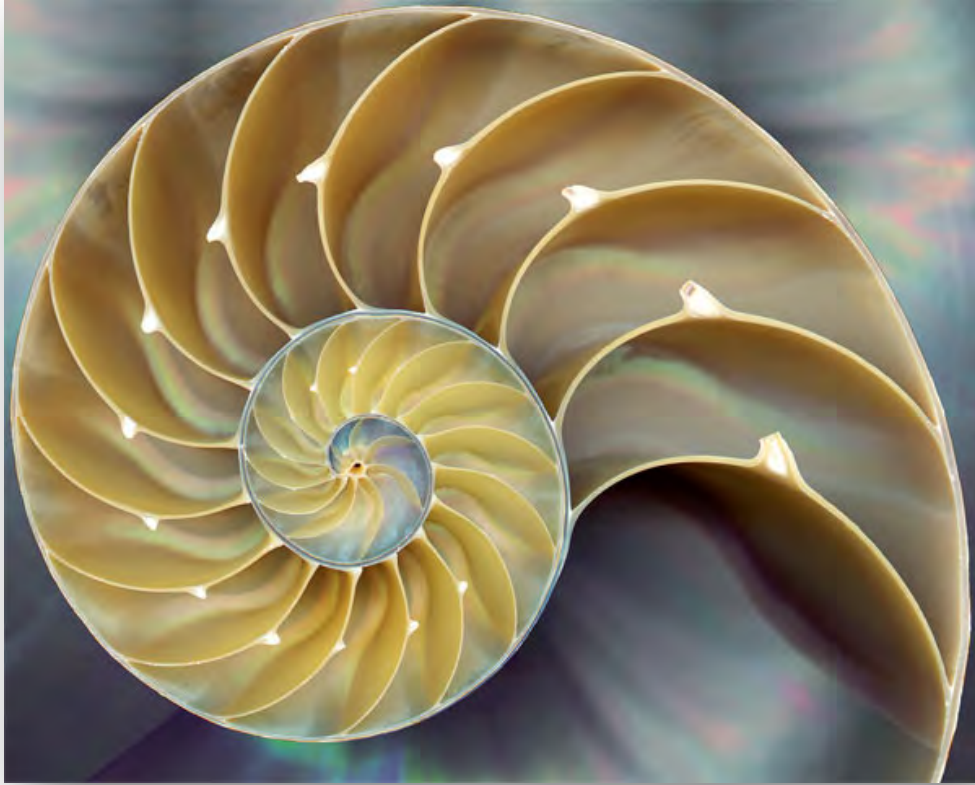
5. Adrenaline/Cortisol Release
6. Weakness
7. Poor Coordination
8. Inflexibility/Immobility
9. Motion Sickness
10. Anxiety/Depression



Big Ideas from Day 1

1. The Nervous System's #2 Job is Movement
2. To Improve Movement Outputs, We Must Minimize Survival Outputs AND Maximize Performance Outputs
3. These Come from the following:
 1. Appropriate Fuel & Activation Reaching the Frontal Lobe
(Where movement comes from)
 2. Clear Mapping of Sensory Inputs (Knowing Where The Body Is Before Trying to Move It)
 3. Efficient & Accurate Integration of ALL Inputs in the Old Brain
 4. High Level of Visual & Vestibular Skill
 5. Education & Practice of Movement Skills (Motor Learning)
(Remember 1,000-10,000 Repetitions)

Remember: Survival via Prediction



Pattern Recognition
Creates
Safe Prediction

Remember: Survival via Prediction



What happens when the brain can't predict accurately?

- Pain
- Weakness
- Fatigue
- Nausea
- Migraines
- Dizziness
- Tension/Inflexibility

Z-Health Is Built On How The Brain Works



Everything we do is to make us better at predicting.

- Movement Training
- Vestibular Training
- Vision Training
- Integration Training

The Neural Hierarchy



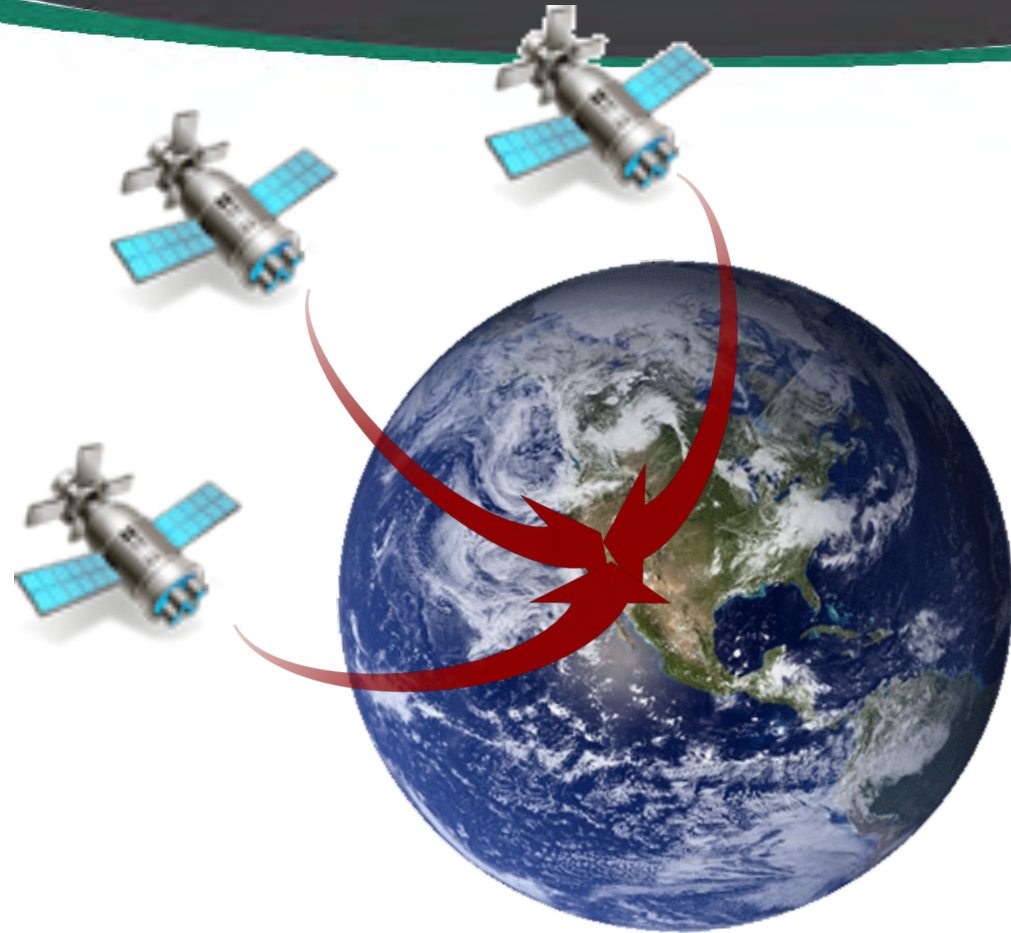
The Three Systems Used
for Prediction

1. Visual

2. Vestibular

3. Proprioceptive

Sensory MATCHING

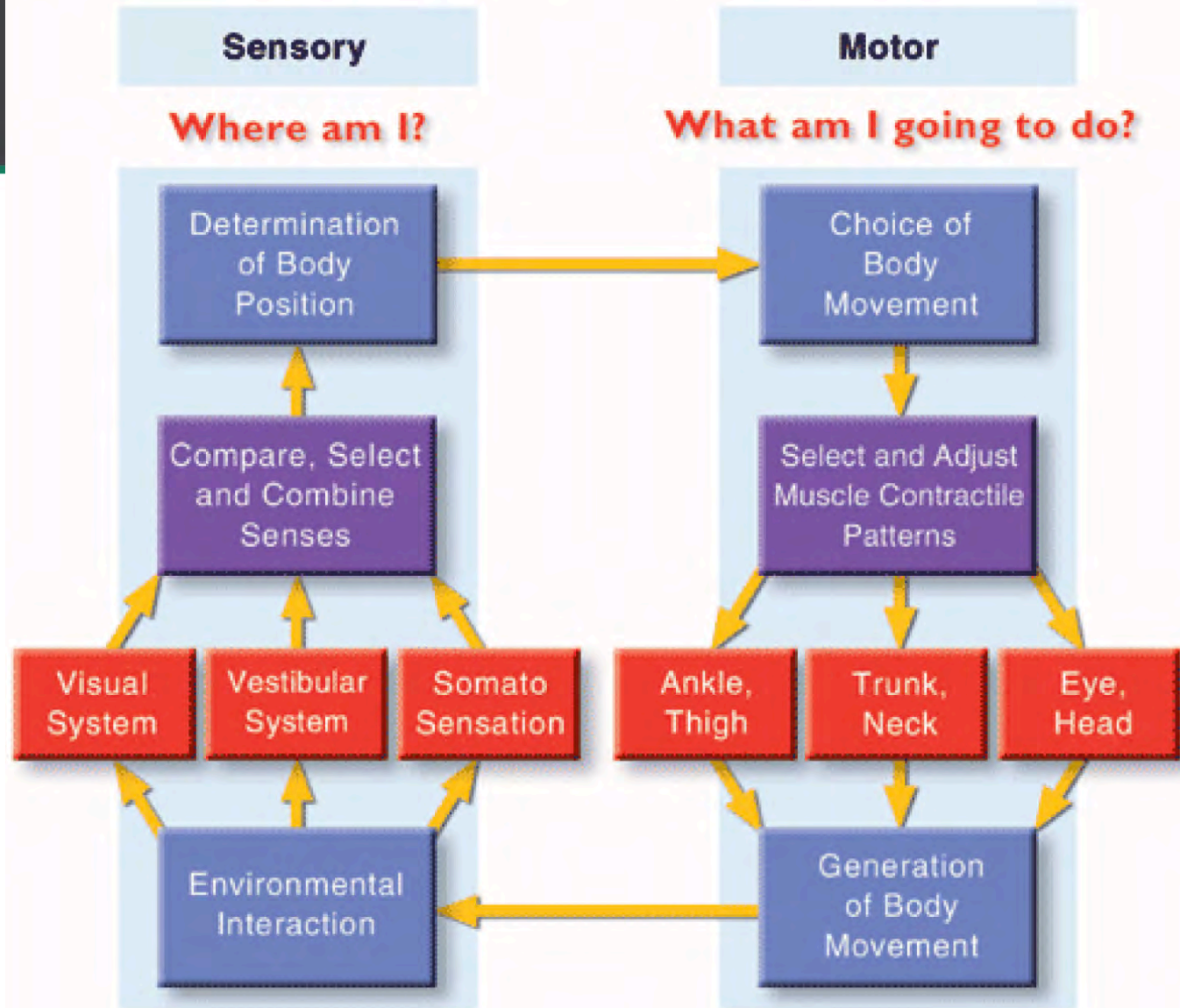


Two requirements for sensory matching:

1. Clear Information from the Three Systems
2. Correct Integration in the Brain

Movement & Postural Control

These are INTEGRATED tasks of the Visual, Vestibular, and Proprioceptive systems.



Sensory MISMATCH



Results of sensory mismatch:

- Motion Sickness
- Nausea
- Vertigo
- Pain
- Movement Disturbances

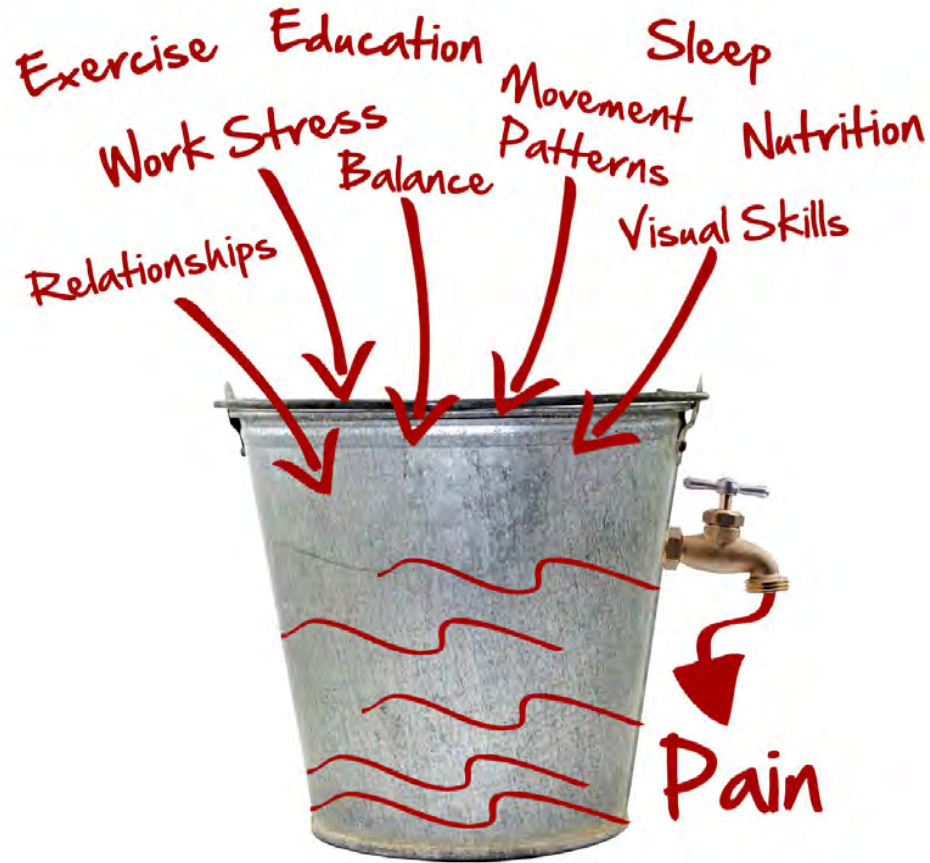
Sensory Mismatch – The Possible Consequences

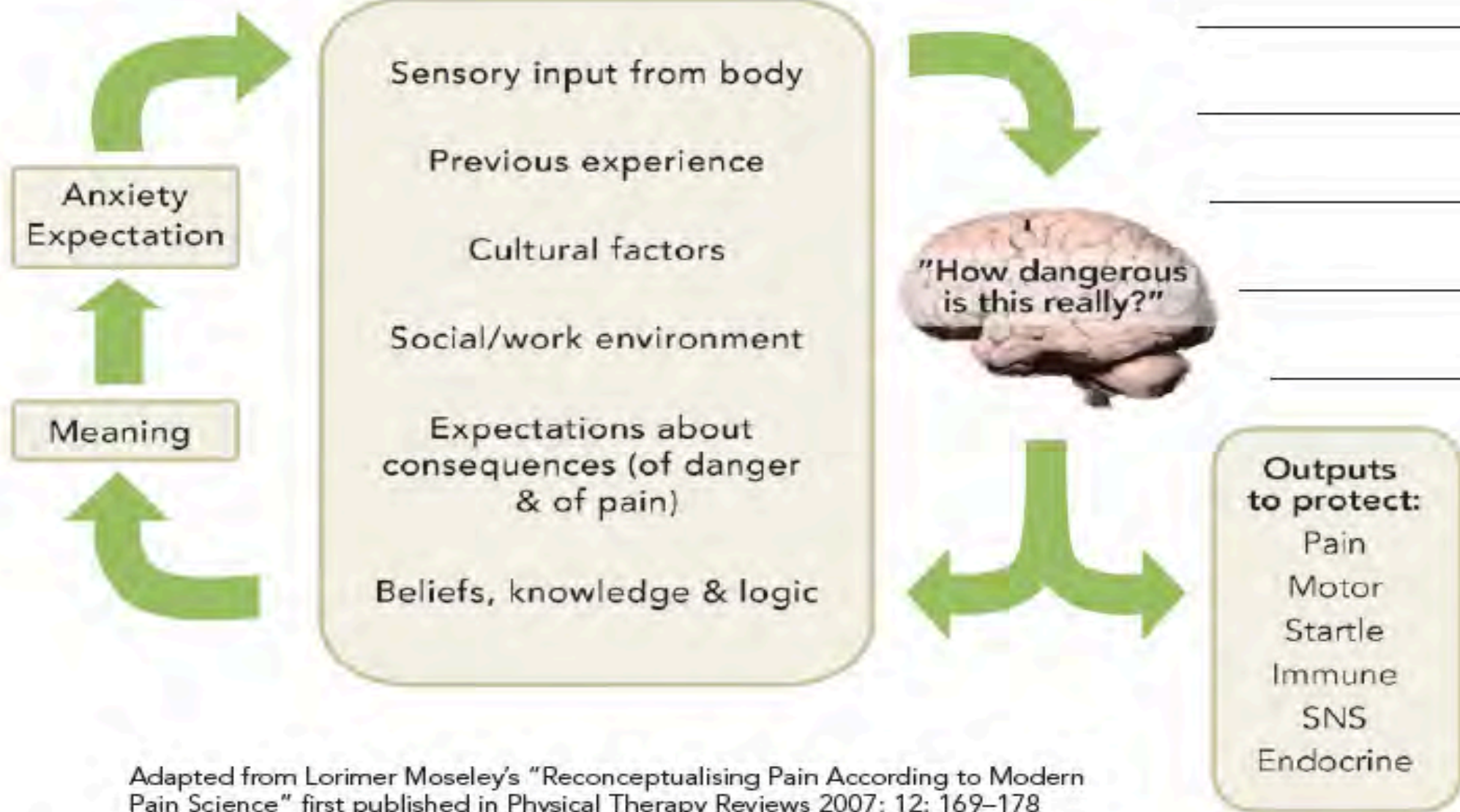
- | | |
|----------------------|-------------------|
| 1. Vertigo | 7. Anxiety |
| 2. Motion Sickness | 8. Depression |
| 3. Muscle Tension | 9. "Fibromyalgia" |
| 4. Pain | 10. Schizophrenia |
| 5. Weakness | 11. ADHD |
| 6. Poor Coordination | 12. Etc. |



Sensory Mismatch:
One of these things is not
like the others.

Z-Health's Threat Bucket





Adapted from Lorimer Moseley's "Reconceptualising Pain According to Modern Pain Science" first published in Physical Therapy Reviews 2007; 12: 169-178

Fundamentals of Movement Fluency

Template Training:

Every athletic skill can be broken down into six component parts.

1. Foot Position
2. Lunge Position
3. Spinal/Trunk Position
4. Head/Neck Position
5. Eye Position
6. Limb Position

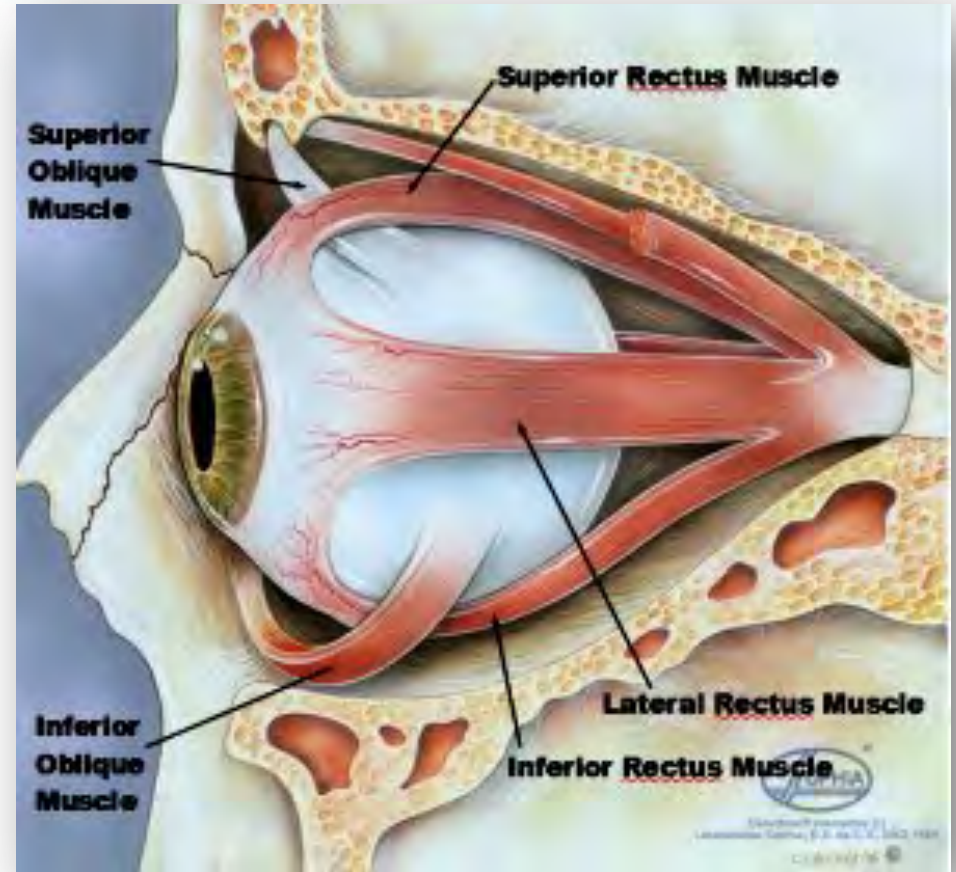
The template is used to make movement predictable for safety and performance!



The Visual System

Two Perspectives on the Visual System:

- Biomechanical
Muscle strength & flexibility
- Neurological
Visual reflexes & processing



The Visual System

1. Incredibly complex, high survival need system – largely based on muscular and reflexive activity.
2. Requires training and practice to use efficiently.
3. Controls up to 70% of postural activities.
4. Intimately connected to the vestibular system.

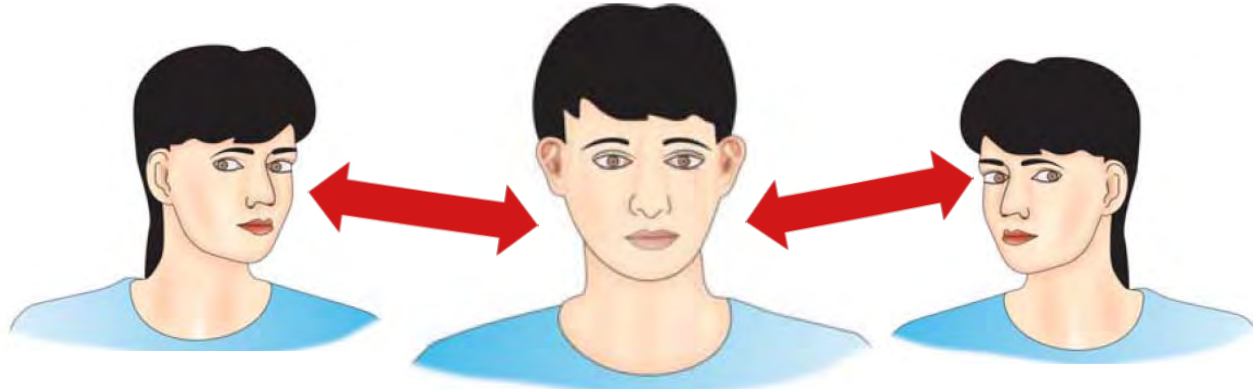


Eye Muscle Function

Two primary classifications of eye movement in humans:

1. Gaze Stabilization

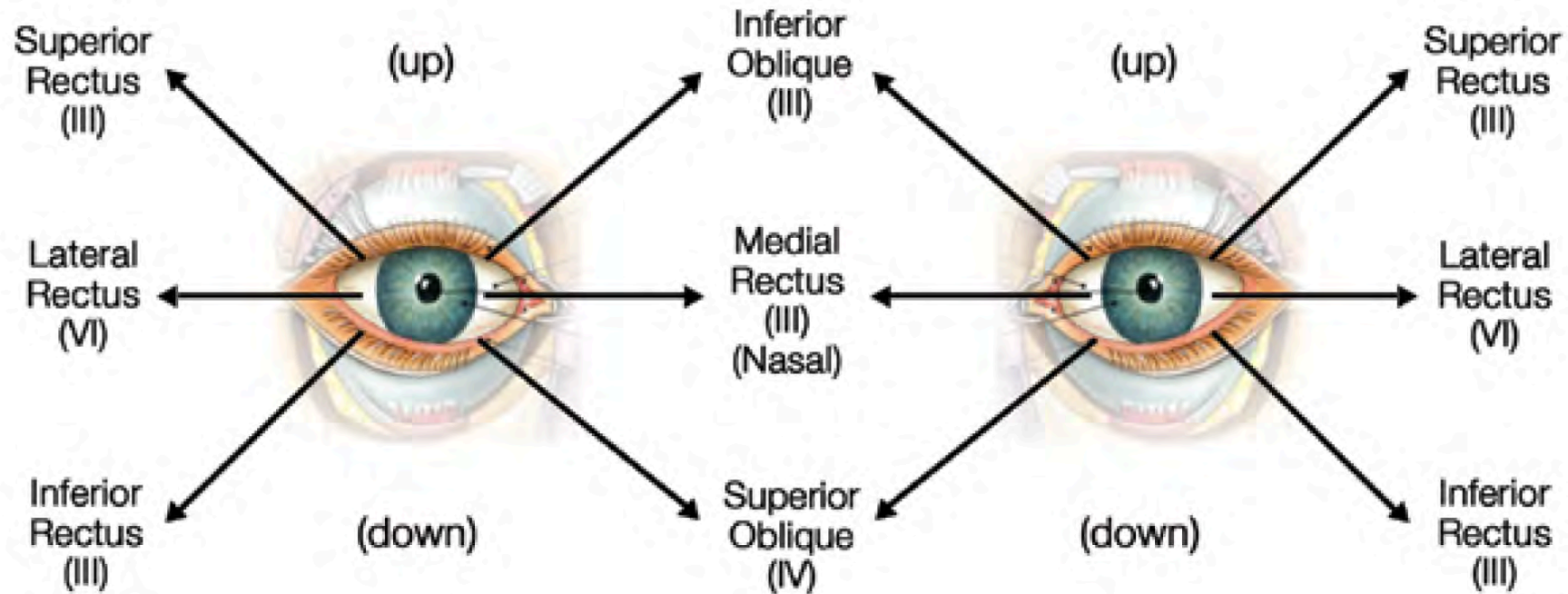
1. Gaze Shifting



Poor muscular function will cause problems
in both types of eye movements.

The Visual System Biomechanics - Extraocular Muscles

For each eye movement direction, a given extraocular muscle moves the pupil, at the front of the eye, as follows:



Eye Muscle Naming and Actions

The Eye Muscle & Eye Movement Rules:

Eye Muscles That Obey Their Names

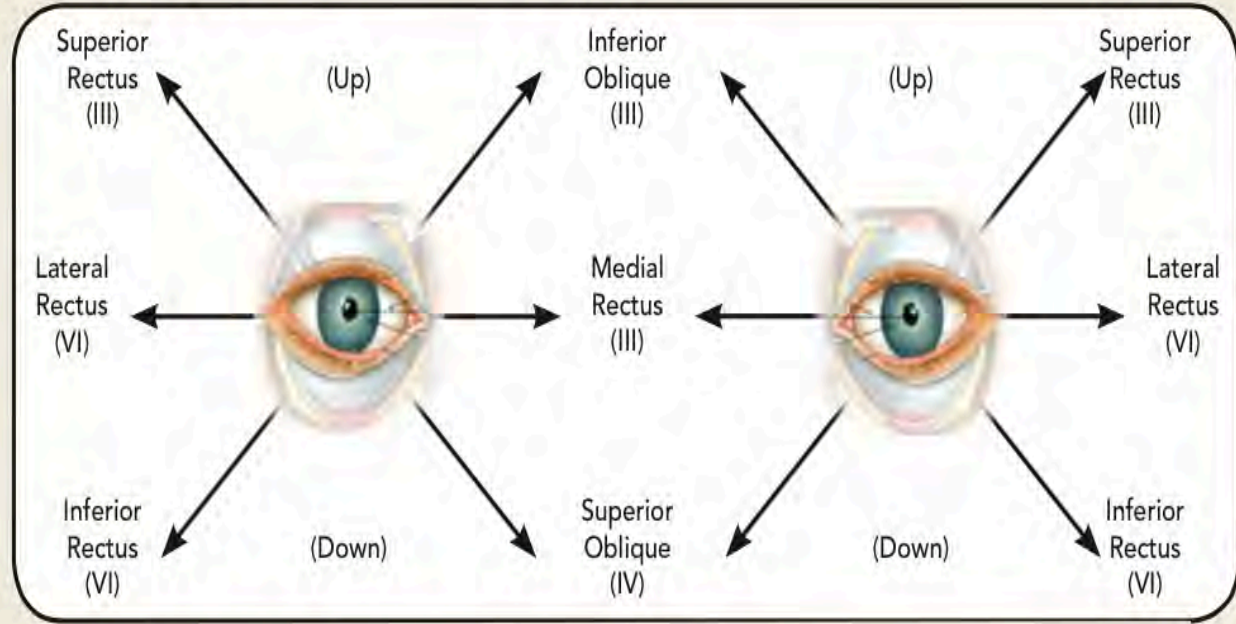
- Superior Rectus (Pulls Eye Up & Out)
- Inferior Rectus (Pulls Eye Down & Out)
- Medial Rectus (Pulls Eye Medially)
- Lateral Rectus (Pulls Eye Laterally)

Eye Muscles That DO NOT Obey Names

- Inferior Oblique (Pulls Eye Up & In)
- Superior Oblique (Pulls Eye Down & In)

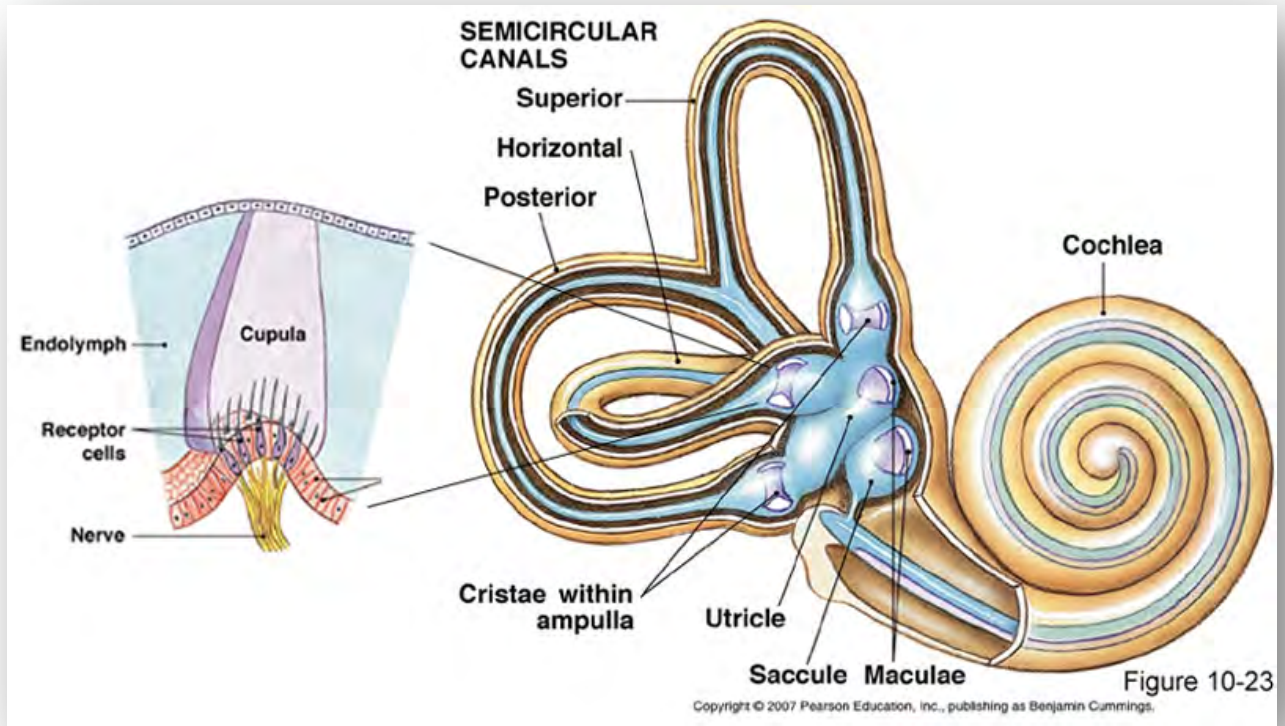
Mechanical Advantage in Movement

- When the eyes are ABDUCTED, the RECTUS muscles have mechanical advantage
- When the eyes are ADDUCTED, the OBLIQUE muscles have mechanical advantage



The Vestibular System

Your Neural Balancing System



The Vestibular System Answers Two Questions

1. Which way am I going?

2. Which way is up?



You Don't Have To Wobble to Train Balance

Modern “functional” training practices that utilize unstable surfaces often overlook the SAID Principle!

1. Stabilizing the head DECREASES vestibular activation
2. The brain uses different movement patterns to balance on unstable surfaces and stable surfaces



Balance Training Progression Drills



1. Head Movement

- A. Rotations
- B. Tilts
- C. Flexion/Extension

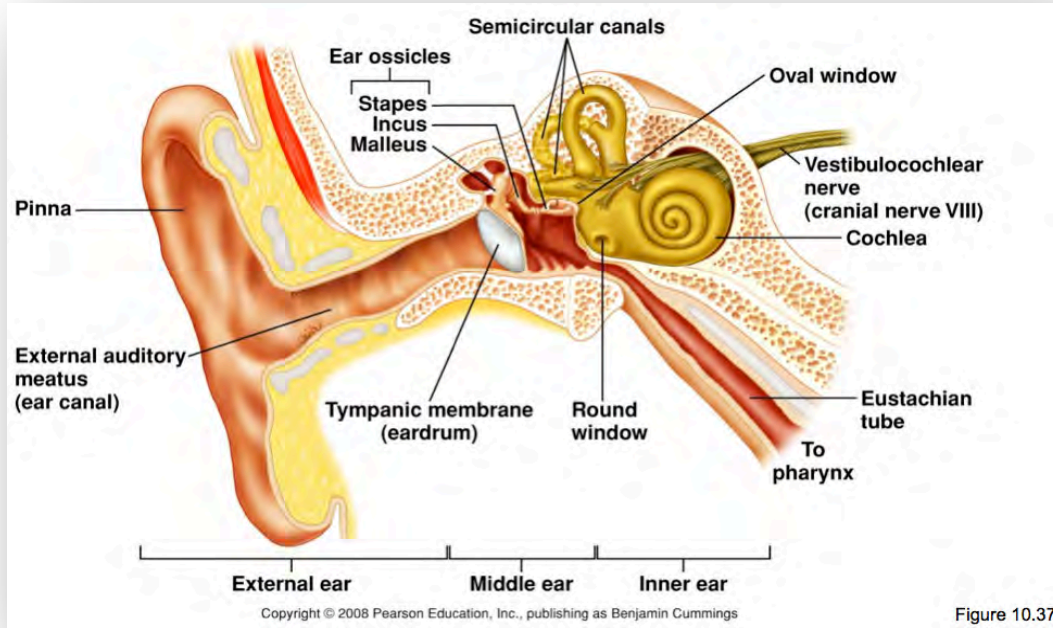
Combined with:

2. Stances

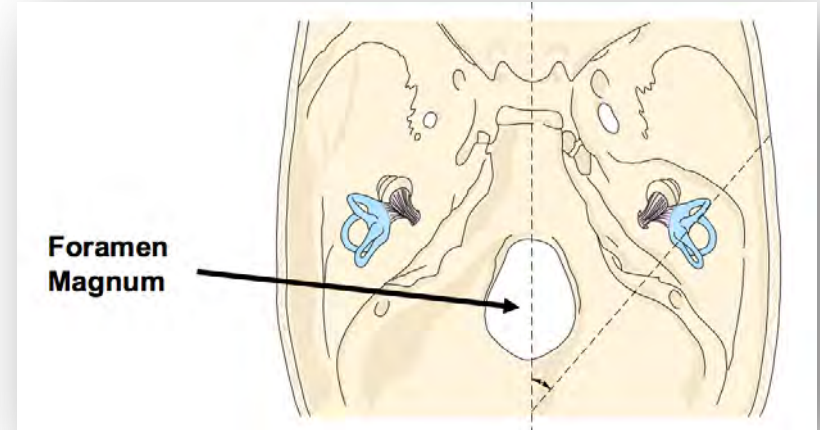
- 2 Legs, Eyes Open
- 2 Leg, Eyes Closed
- 1 Leg, Eyes Open
- 1 Leg, Eyes Closed

Remember you can include other “template” pieces in your balance training. (e.g. walking, speed work, loaded, etc)

The Vestibular System – Where It Lives

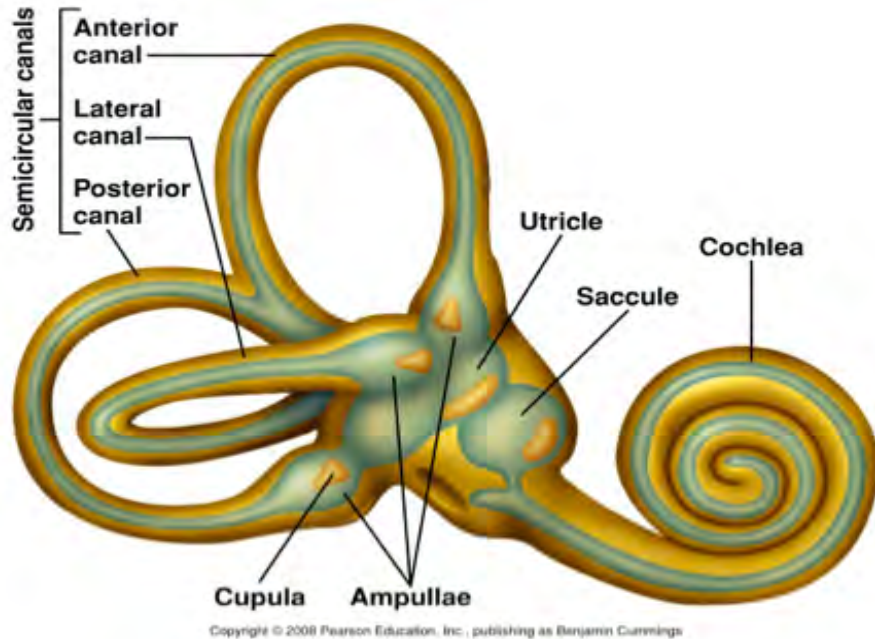


View From Front



View From Top

The Vestibular System Parts

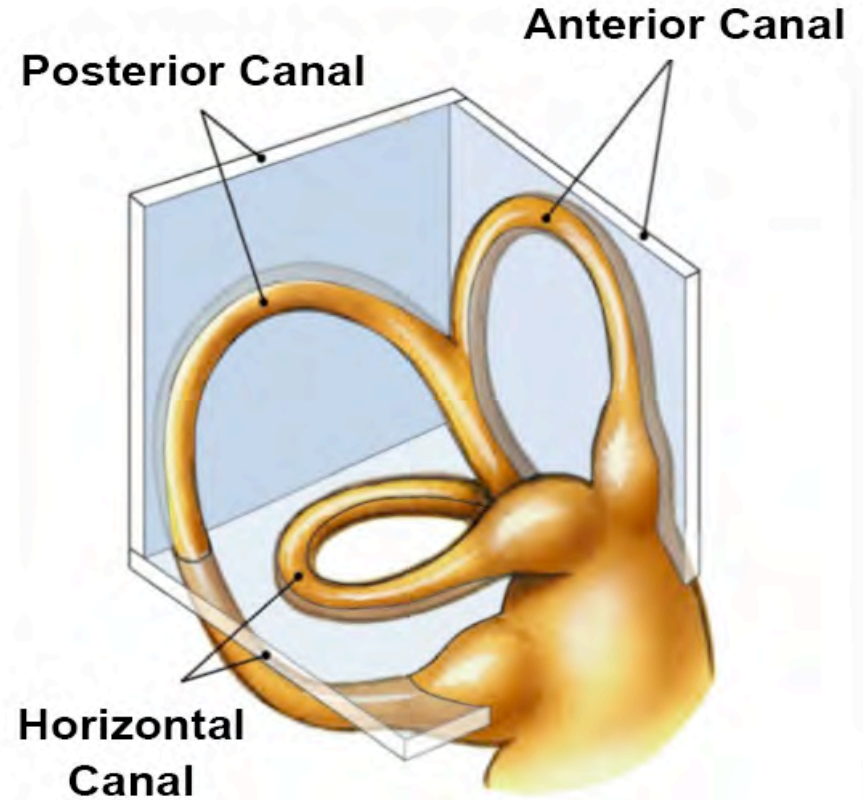


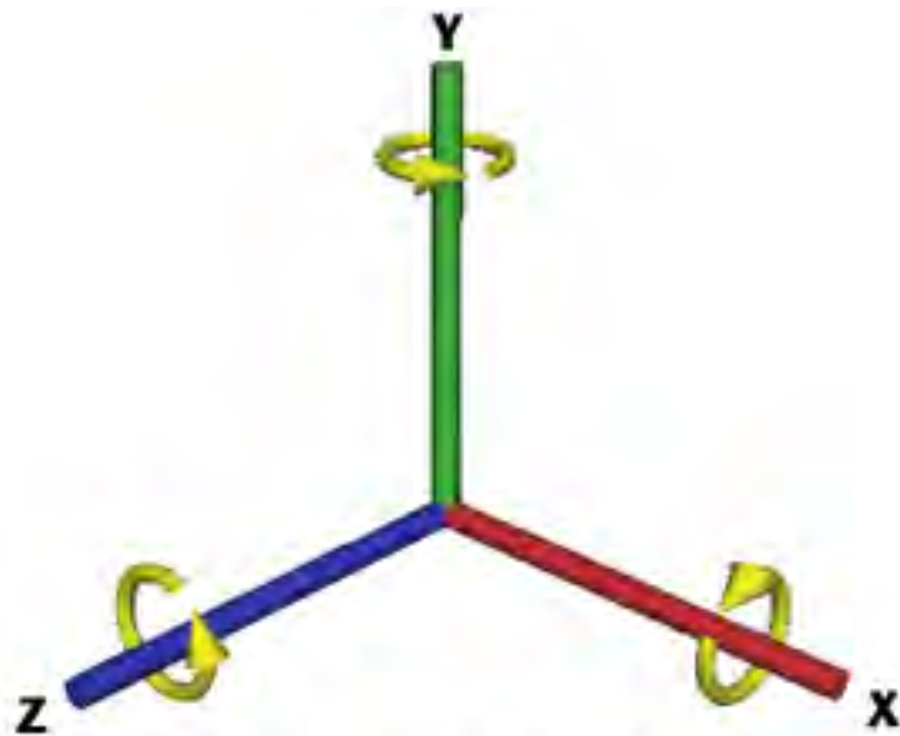
- 3 Semicircular Canals
 - Anterior, AKA Superior
 - Lateral, AKA Horizontal
 - Posterior
- 2 Otolith Organs
 - Utricle
 - Saccule

The Semicircular Canals

The Semicircular Canals:

1. Sense Head Motion and Movement Velocity
2. Enable the VOR (Vestibulo-Ocular Reflex)
3. Create an environment for good visual acuity by ensuring that head movement is opposed by equal and opposite eye movement.

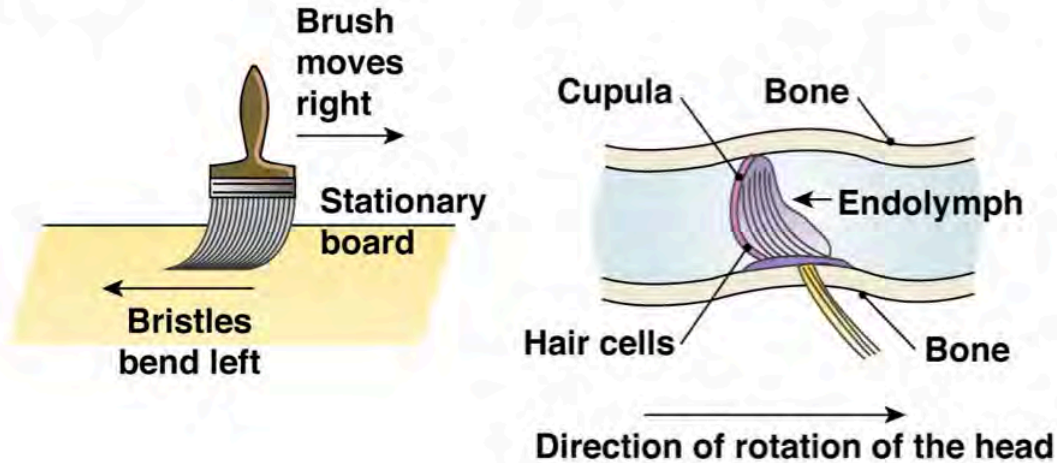




Euler rotation interpolation

The Semicircular Canals – How They Work

When the head turns right, endolymph pushes the cupula to the left.



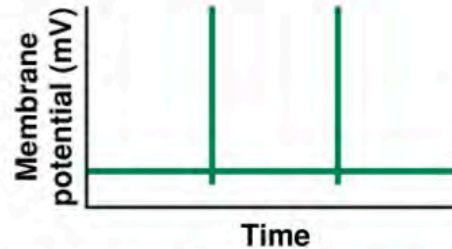
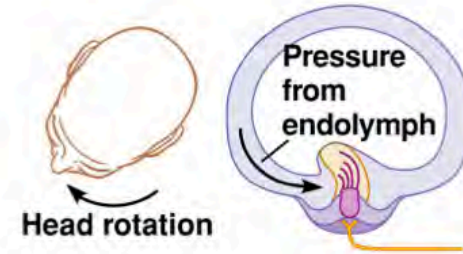
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Figure 10-24

It is movement of the Cupula, being pushed by the endolymph, that triggers hair cells to send a neural signal to the brain.

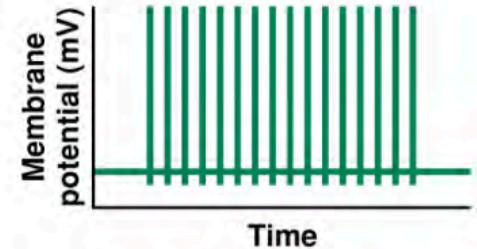
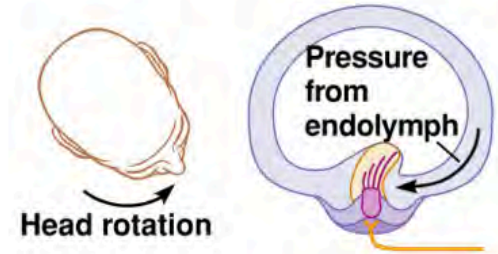
The Semicircular Canals – A Push Pull System

This is an illustration of the LEFT horizontal semicircular canal. Notice that in right rotation, the firing rate goes DOWN, while in left rotation it goes UP. The reverse is happening in the horizontal canal on the right.



(d) Acceleration

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(e) Acceleration

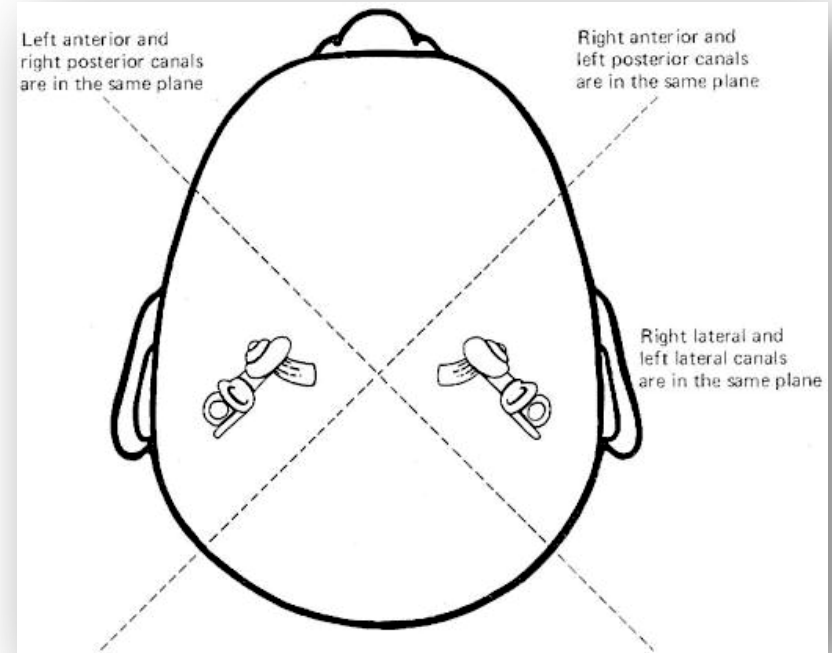
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The Semicircular Canals and Eye Muscles

The semicircular canals lie in roughly the same planes as the extraocular muscles:

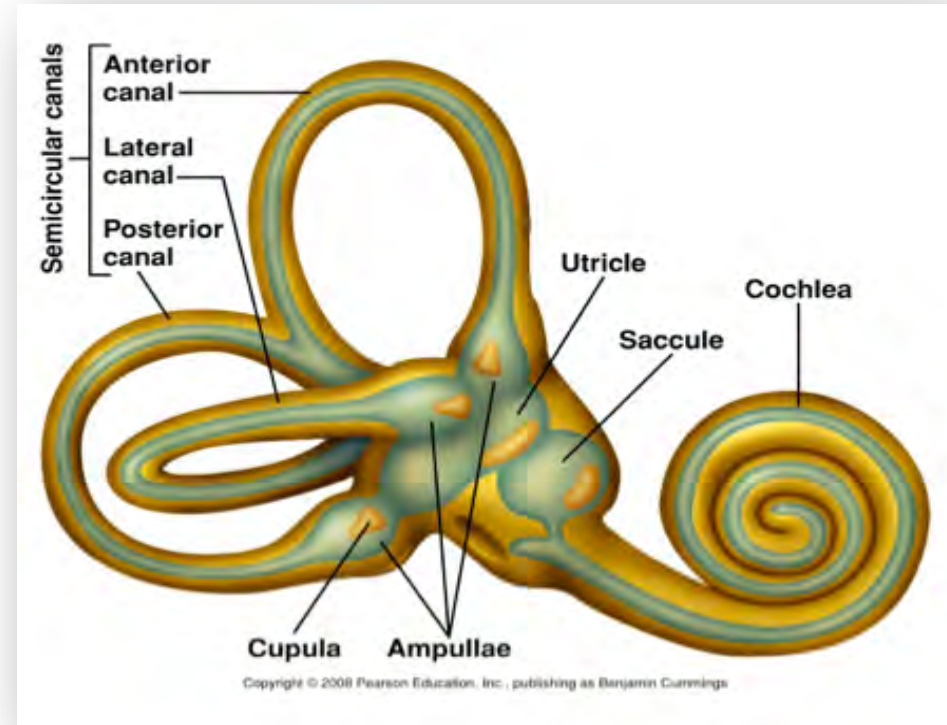
- Horizontal Canals: lateral and medial recti.
- LARP: left vertical recti, right obliques.
- RALP: right vertical recti, left obliques.
- Each canal excites a pair of muscles and inhibits a pair of muscles in its plane.
- Its partner excites the muscles it inhibits, and vice versa.

Why?

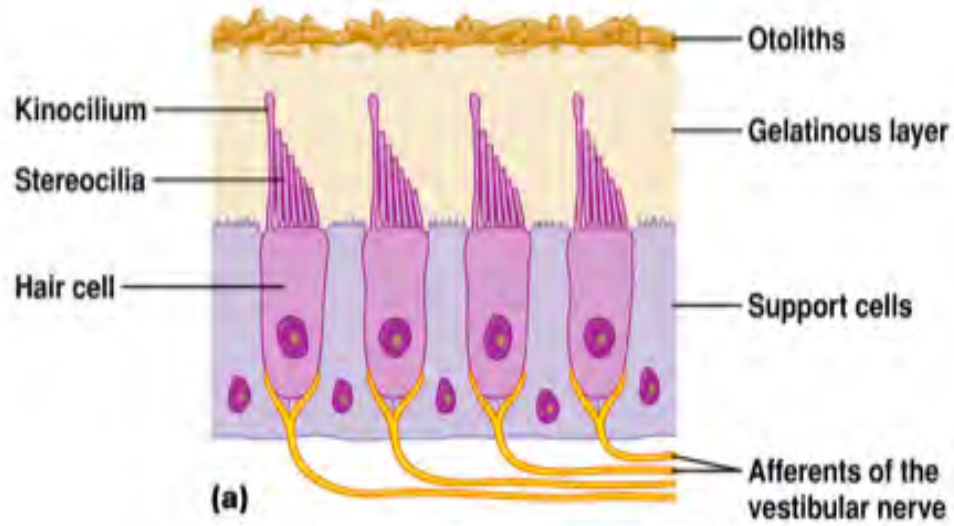


The Utricle and Saccule – Otolith Organs

- The otolith organs – the utricle and saccule - sense linear acceleration.
- Linear movement horizontally (riding in a train on a straight track) is sensed by the utricle.
- Linear movement up and down (riding in an elevator) is sensed by the saccule.

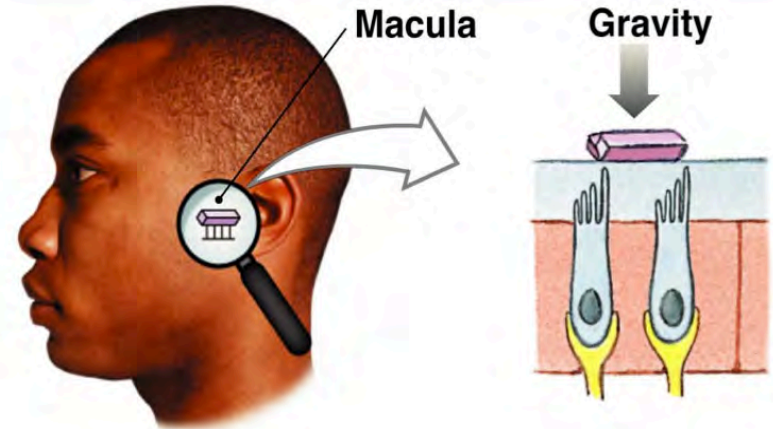


The Otoliths – Utricle and Sacculle



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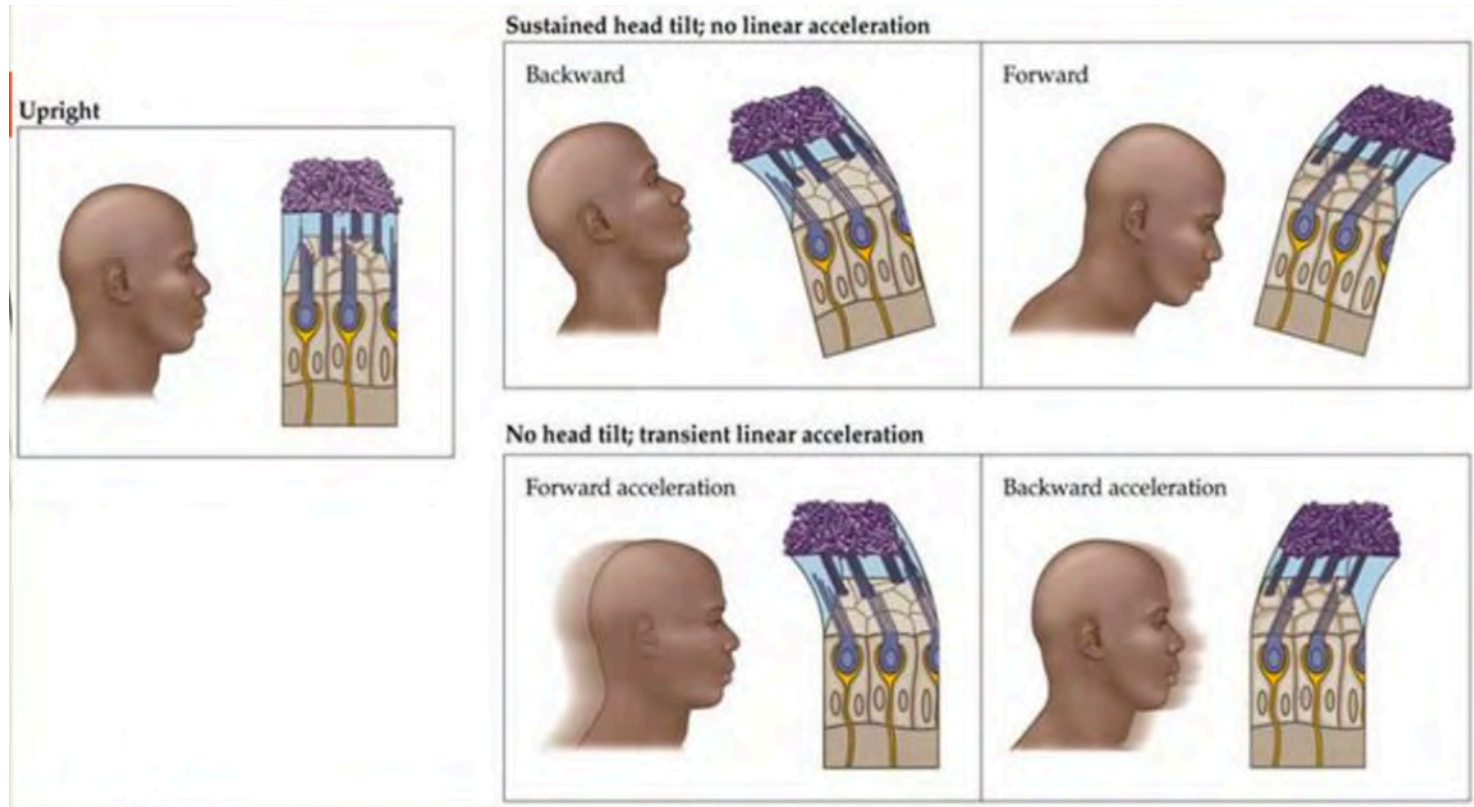
(a) Head in neutral position



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Figure 10-25a

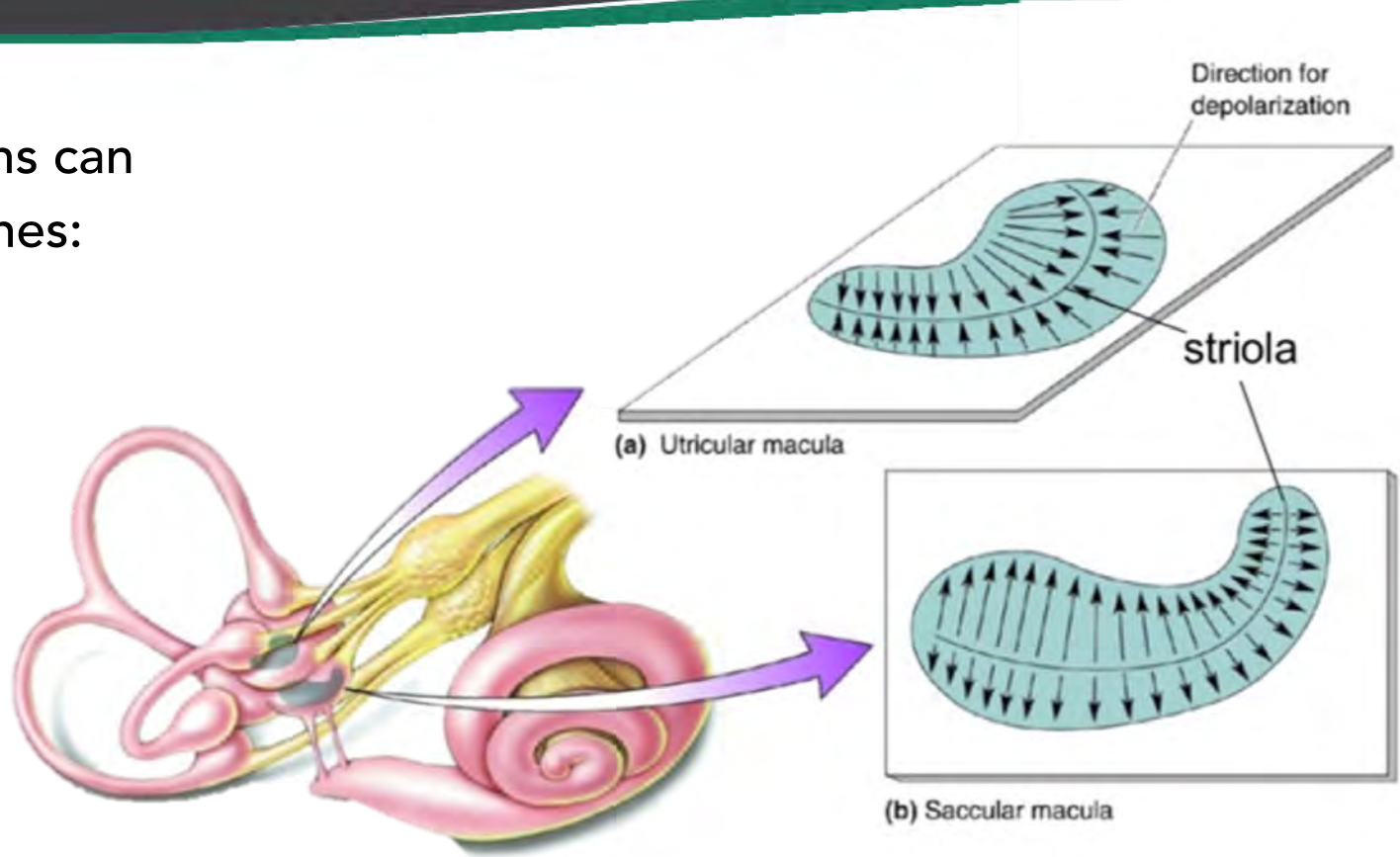
The Otoliths in Action



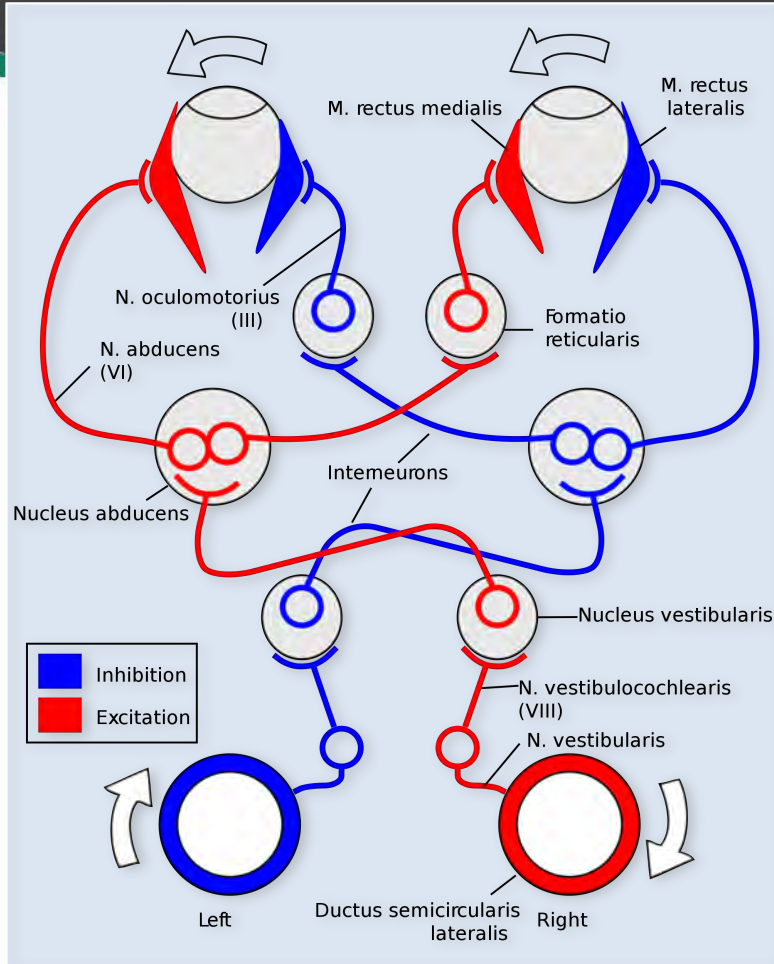
The Otoliths in Action

Each of the Otolith Organs can sense movement in 2 planes:

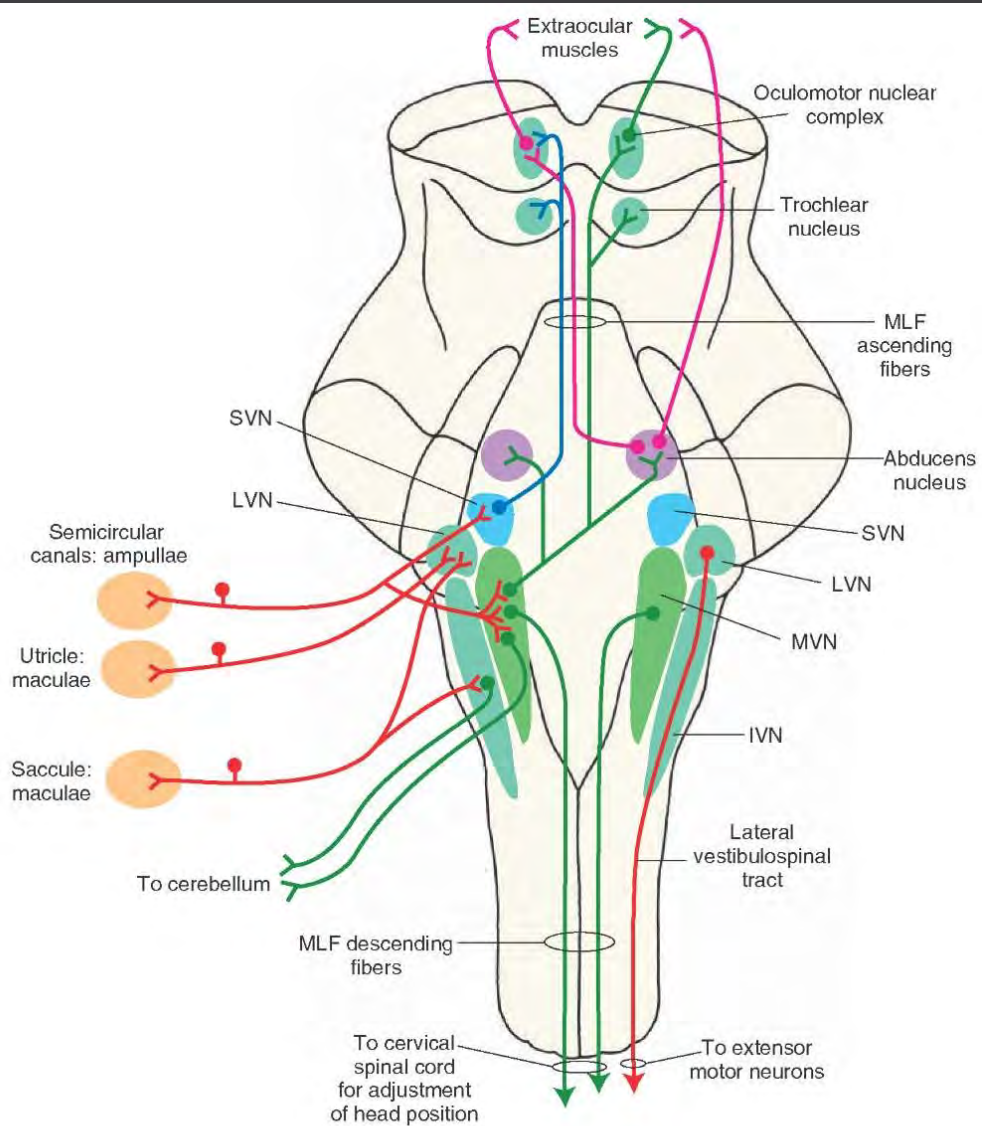
- Utricle:
Forward/Backward
& Left/Right
- Saccule:
Up/Down &
Forward/Backward



The 3 Major Vestibular Reflexes



1. Vestibuloocular Reflex (VOR): Keeps the eyes still in space when the head moves.
1. Vestibulocolic Reflex (VCR): Keeps the head still in space or on a level plane when you walk.
1. Vestibulospinal Reflex (VSR): Adjusts posture for rapid changes in position.

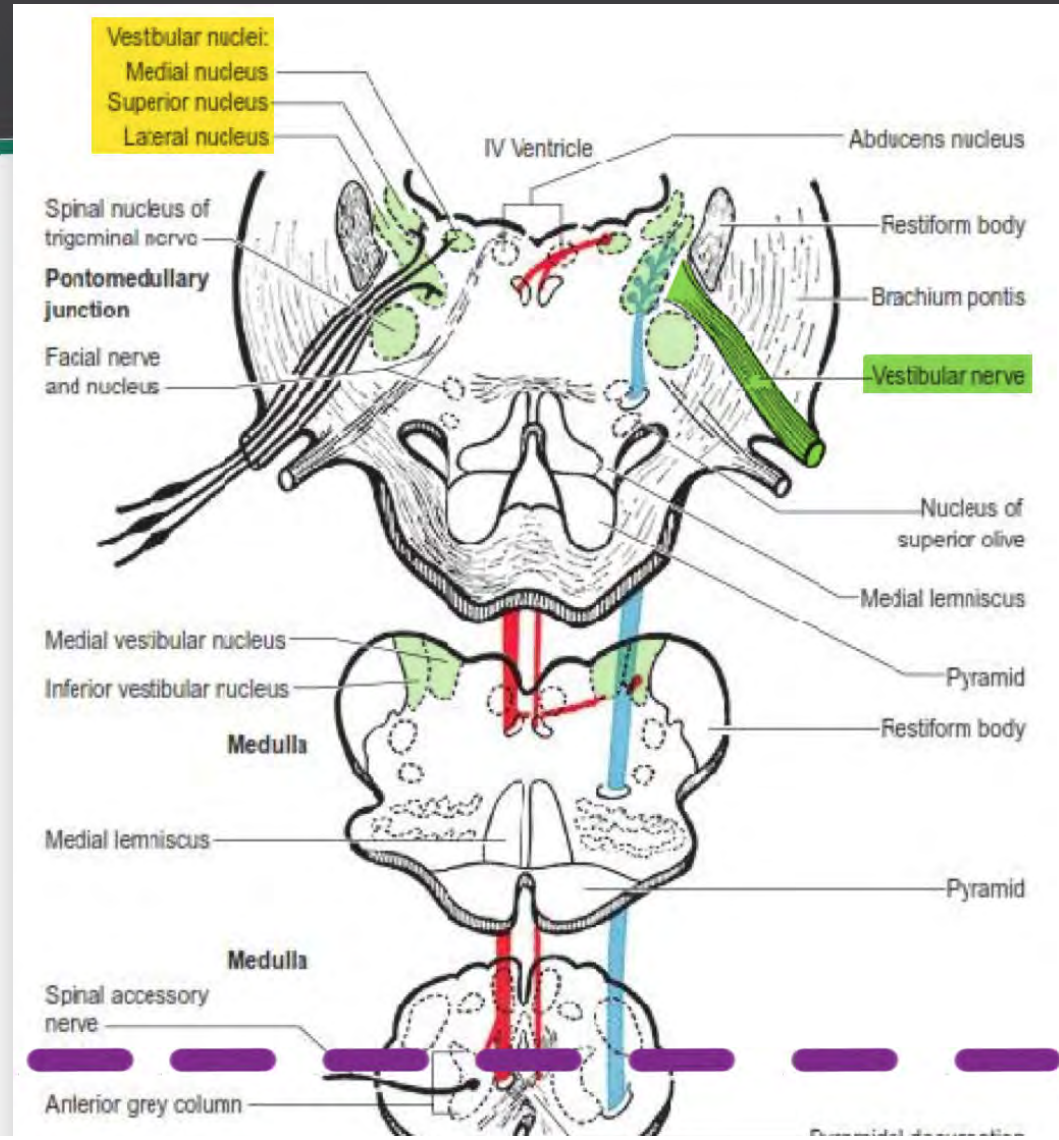


Vestibulospinal Tracts Impact:

- Neck Musculature for Cervical Stability
- Spinal Extensors
- Lower Limb Extensors

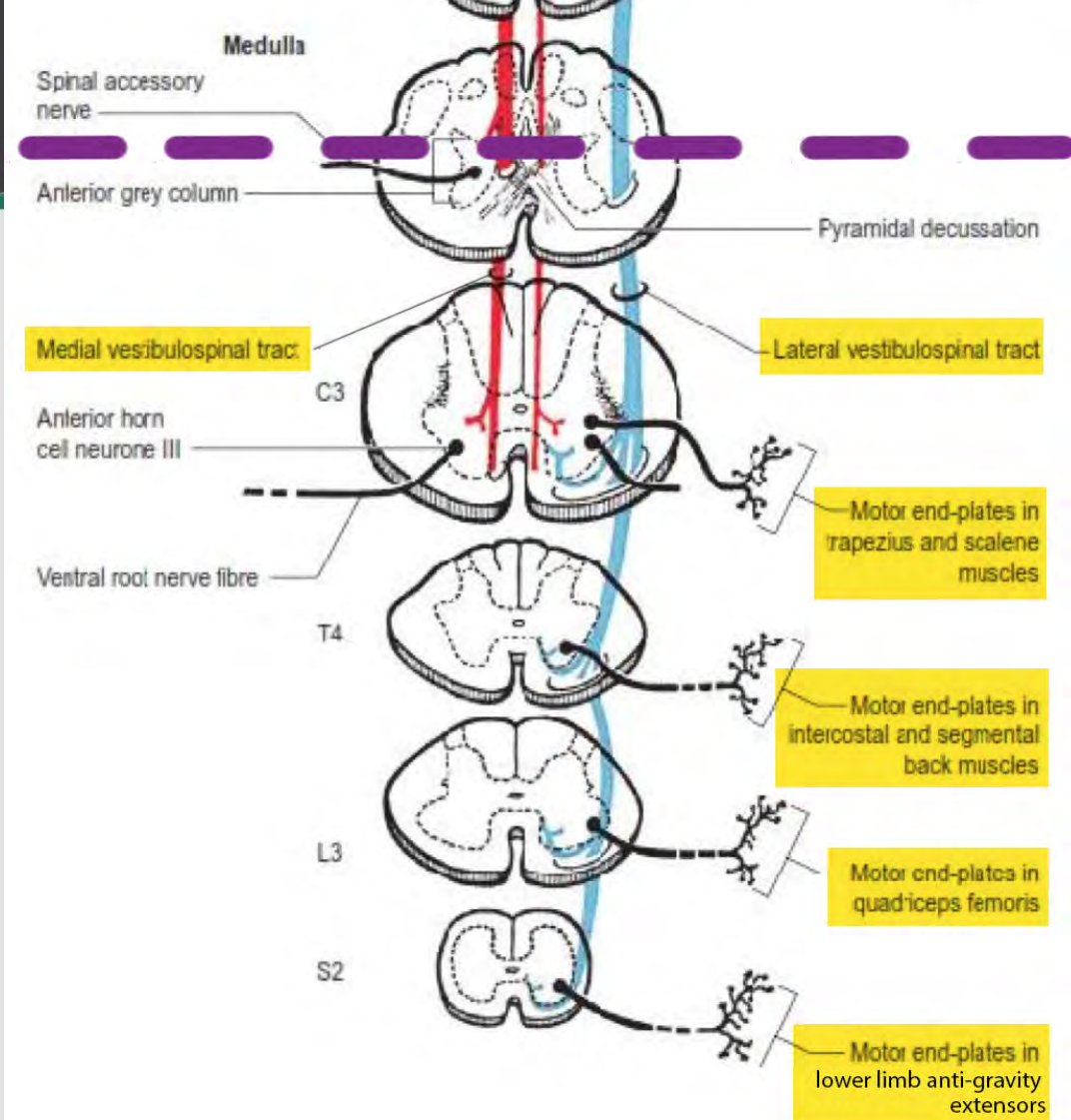
Vestibulospinal Tracts Impact

- Neck Musculature for Cervical Stability
- Spinal Extensors
- Lower Limb Anti-Gravity Extensors

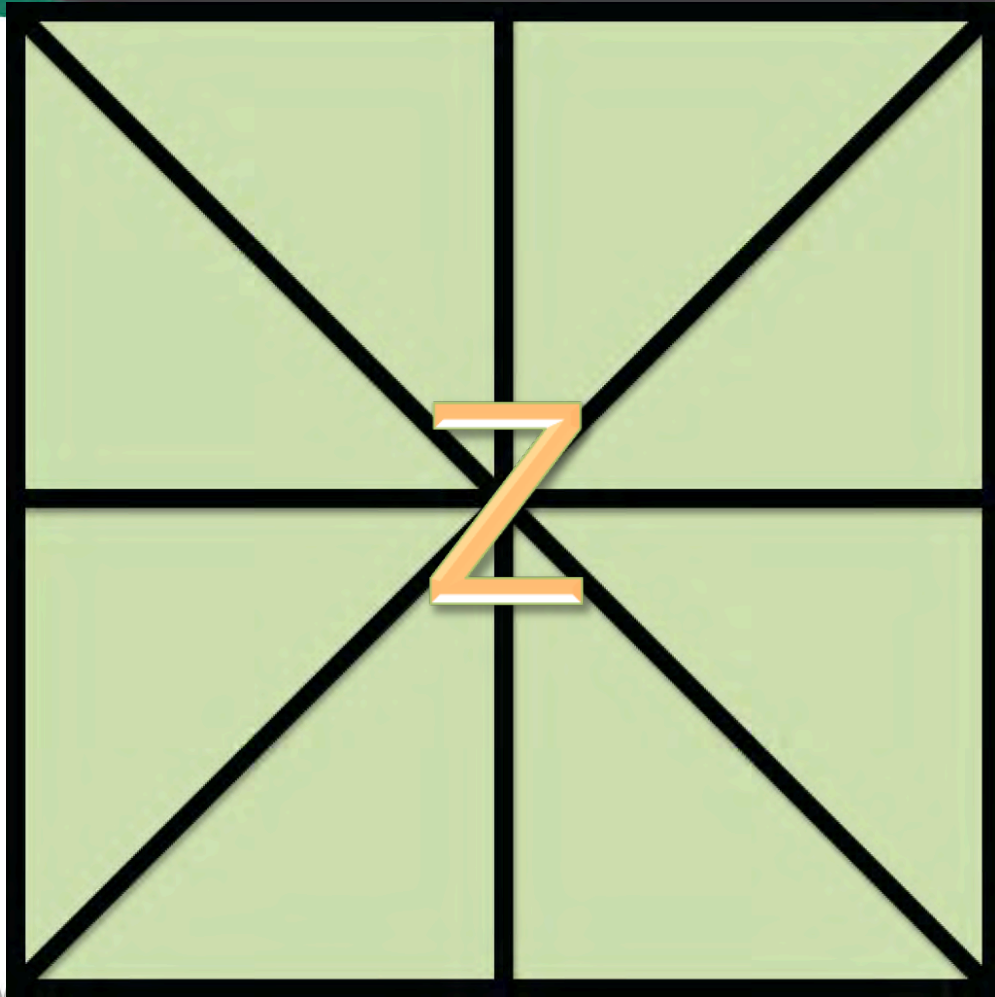


Vestibulospinal Tracts Impact

- Neck Musculature for Cervical Stability
- Spinal Extensors
- Lower Limb Anti-Gravity Extensors



Practical VOR Training

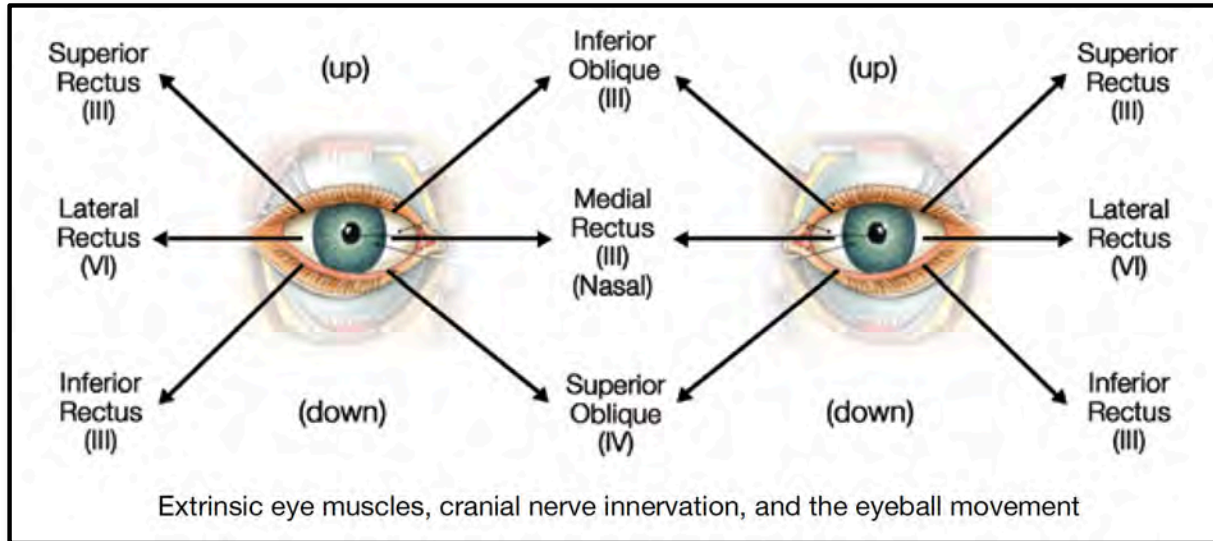


Create a BASIC "VOR" Template for clients to take home.

8 Compass Directions, with a centered visual target



The Vestibulo-Ocular Reflex



Eye Muscles That Obey Their Names

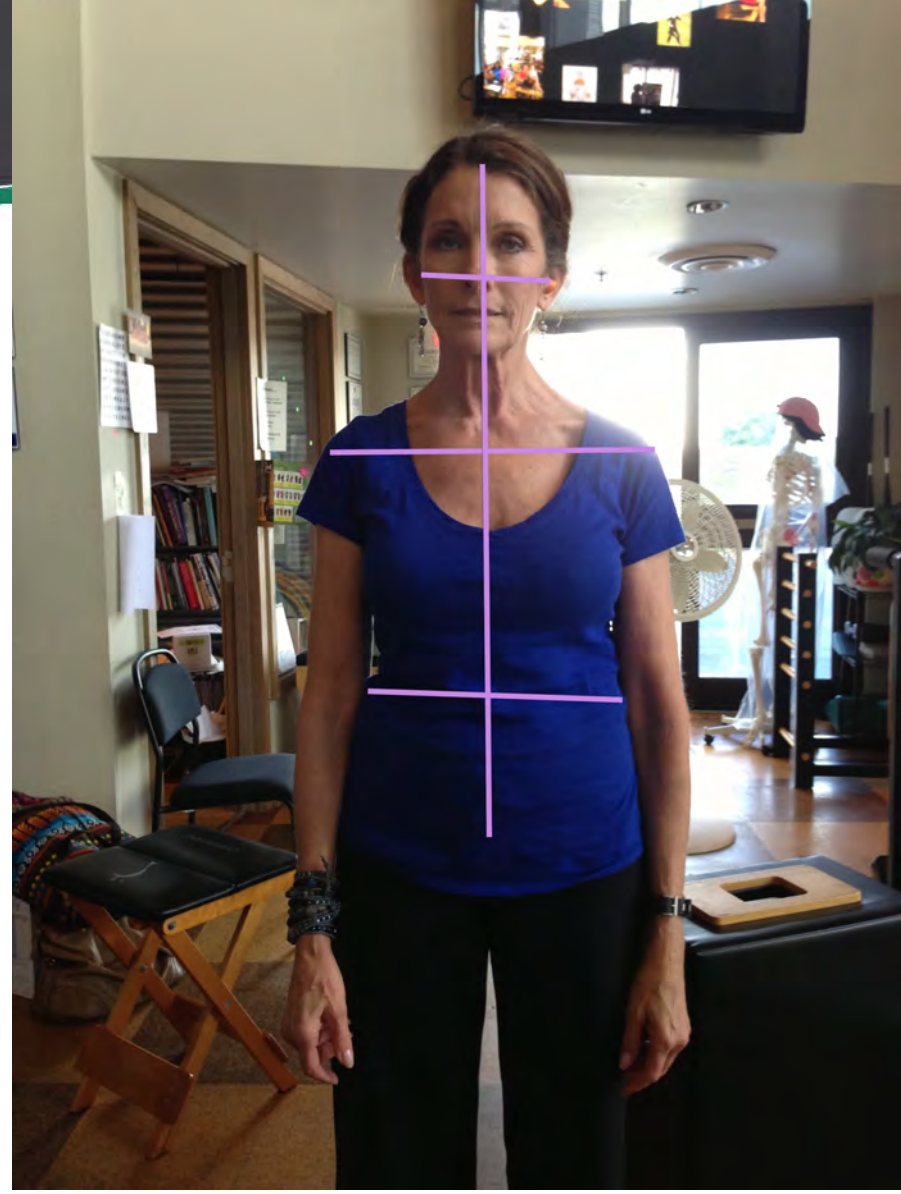
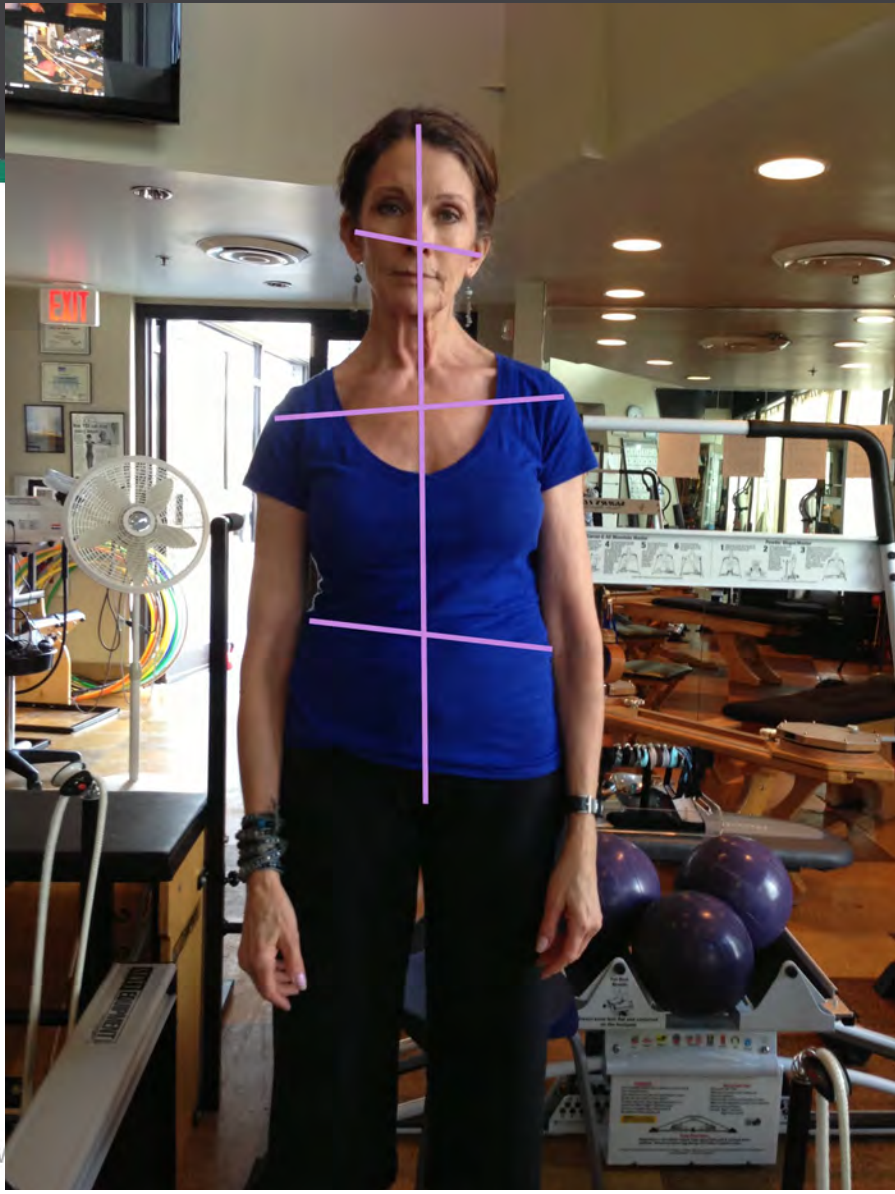
Superior Rectus (Pulls Eye Up)
Inferior Rectus (Pulls Eye Down)
Medial Rectus (Pulls Eye In)
Lateral Rectus (Pulls Eye Out)

Eye Muscles That Disobey

Inferior Oblique (Pulls Eye Up and In)
Superior Oblique (Pulls Eye Down and In)

Eye Muscle Connections to Semicircular Canals (VOR)

Movement =	Canal =	Eye Muscles =	Eye Position =
Nose Right	R Horizontal	R Med Rectus, L Lat Rectus	Eyes Left
Nose Left	L Horizontal	L Med Rectus, R Lat Rectus	Eyes Right
Nose Down & Left	R Anterior	R Sup Rectus, L Inf Oblique	Eyes Up & Right
Nose Down & Right	L Anterior	L Sup Rectus, R Inf Oblique	Eyes Up & Left
Nose Up & Right	R Posterior	R Sup Oblique, L Inf Rectus	Eyes Down & Left
Nose Up & Left	L Posterior	L Sup Oblique, R Inf Rectus	Eyes Down & Right





Essentials of Elite Performance

Day 3

What is S-Phase All About?



- 1. Giving Clients More Options
- 1. Getting Rid of Recurring Pain
- 1. Fun Ways to Build Better Movement Maps

Essential Skills for Every Athlete

See Well

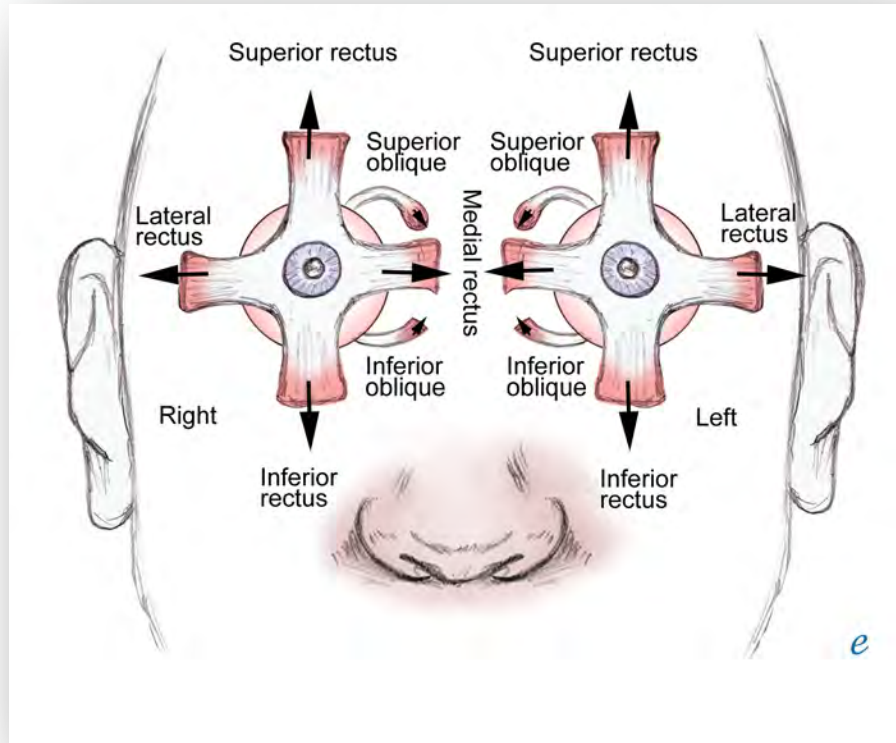
Balance Well

Move Well

Integrate Well



The Visual System Neurology - Oculomotor Reflexes



Eyes Up - Facilitates Extension

Eyes Down - Facilitates Flexion

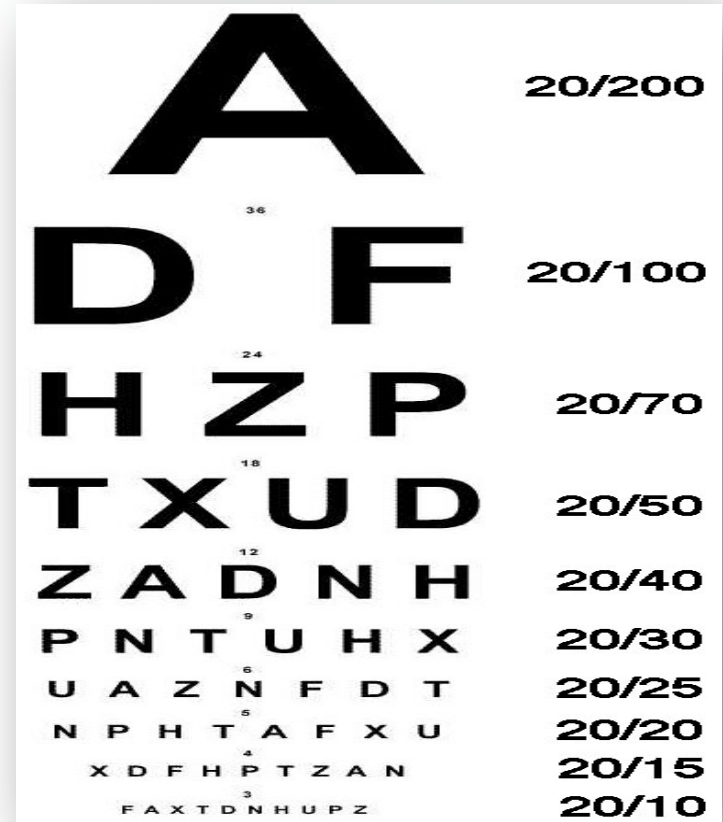
Eyes Right - Facilitates Right Rotation,
Right Extension, Left Flexion

Eyes Left - Facilitates Left Rotation,
Left Extension, Right Flexion

Vision Is More Than 20/20

"Eyesight is simply the ability to see something clearly, the so-called 20/20 eyesight (as measured in a standard eye examination with a Snellen chart). Vision goes beyond eyesight and can best be defined as the understanding of what is seen. Vision involves the ability to take incoming visual information, process that information and obtain meaning from it."

- Dr. Donald Getz, OD



5 Basic Elements of Vision Training



1. Vergence
2. Near/Far Focusing
3. Peripheral Awareness
4. Eye Tracking
5. Hand/Eye Coordination

Vision Training Skills & Drills – Peripheral Vision

The Skill: Peripheral Vision Awareness

Allows you to see people and objects "out of the corner of your eye" while concentrating on a fixed point.

What you see when you're not looking at it.



Vision Training Skills & Drills – Peripheral Vision

Peripheral Awareness

While the athlete is performing a drill (Gaze Stabilization), the coach will move his or her hand into the athlete's peripheral field. The athlete will say "now" when they become aware of the motion. The coach should challenge both sides of the athlete's body - making sure to challenge at the level of the eyes as well as above and below.



Visual Training Skill & Drills – Eye Tracking

The Skill: Eye Tracking

Eye tracking refers to your ability to "keep your eyes on the ball," no matter how fast it is traveling.



Visual Training Skill & Drills – Eye Tracking

The Drill: Letterball Catching

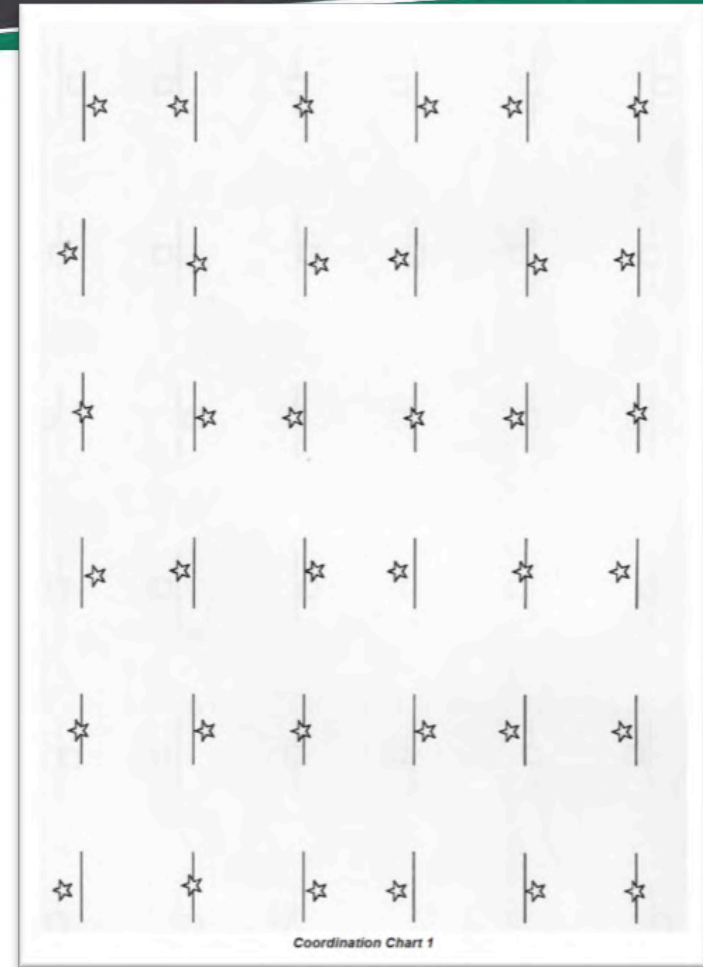
This test involves a smooth, rhythmic game of catch between the coach and athlete



Visual Training Skills & Drills – Hand/Eye Coordination

The Skill: Hand/Eye Coordination

Hand/Eye coordination is the ability to take in correct and appropriate visual information and translate it into necessary body movements. It is the ultimate fundamental skill for most activities and sports.



The Drill: Hand/Eye Coordination Charts

- As an assessment = 1:00 minute duration.
- As a drill = adjust the speed, duration, and position.



Sports Balance Training Drills



1. Head Movement

- A. Rotations
- B. Tilts
- C. Flexion/Extension

Combined with:

2. Stances

- 2 Legs, Eyes Open
- 2 Leg, Eyes Closed
- 1 Leg, Eyes Open
- 1 Leg, Eyes Closed

Remember you can include other “template” poses in your balance training. (e.g. walking, speed work, loaded, etc)

Sports Movement Drills

We've reverse engineered sports to teach "elite" movement skills to "normal" people.



The Athletic Vocabulary:

- Stand
- Start
- Run
- Change Direction
- Stop

The Transitional Movements – Athletic Fundamentals

1. Static Athletic Ready Stance
2. T-Step
3. Hip-Turn (45° & 90°)



The Static Athletic Ready Stance

Learning this stance is vital to developing virtually all athletic movement patterns.

Remember to check:

1. Foot position
2. Knee position
3. Shin/Trunk Angles
4. Arm Position



Dynamic Athletic Ready Stance

This stance is exactly like the static athletic ready with the exception that there is either side-to-side motion or very slight up and down motion occurring.

An active stance is very important in certain sports that allow an athlete to be in motion at all times, such as tennis.



The T-Step



1. Begin walking or running forward.
2. As you make the decision to stop and change direction, quickly "jump" from a running position, splitting the legs out to each side and landing in the static athletic ready position.
3. The jump should be done quickly with the feet just barely clearing the ground.
4. What is essential in the movement is to maintain good control of the body's center of gravity and move it closer to the base of support as quickly as possible.
5. The "feel" of this movement is that the center of gravity "freezes" in motion and the legs simply widen out to maintain balance.

The Hip Turn

1. Begin in a Static Athletic Ready Stance.
2. Initiate the hip turn by jumping very slightly, allowing the feet to just clear the ground.
3. Simultaneously, rapidly rotate the hips to a position in which the pelvis is squarely facing the intended direction of movement.
4. As the pelvis reaches the correct position, split the legs apart, landing in either the SARS or the plyo step position.
5. Explode out of the plyo step position in



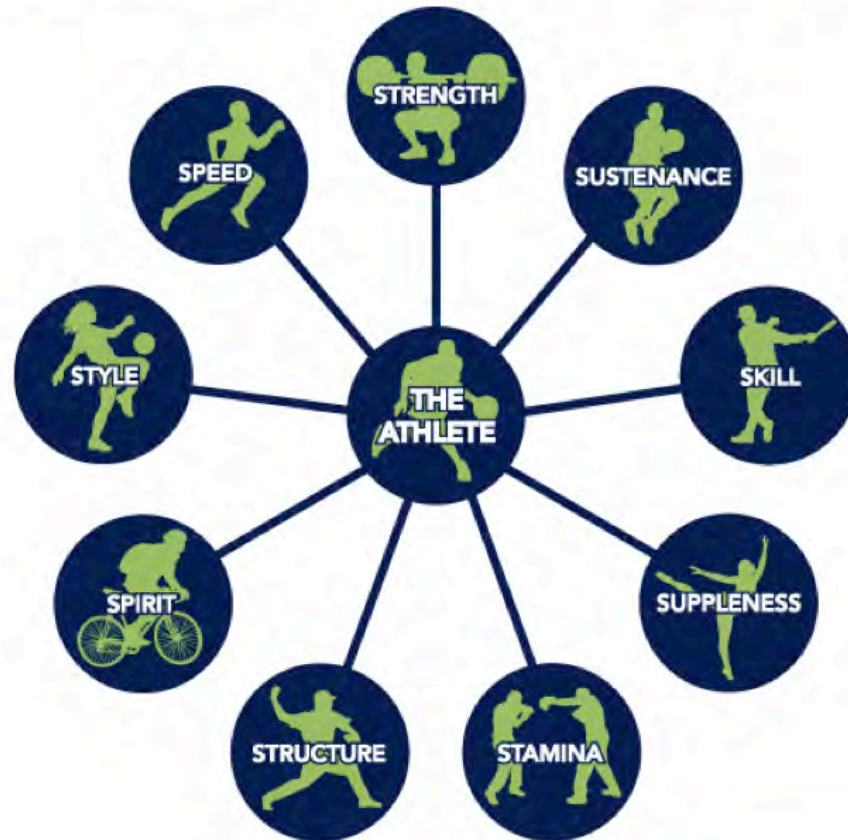
Sports Combination Drills – Integration Training

Combination Drills

1. Walk / T-Step / Letter Ball
2. Hip Turn / Letter Ball
3. Peripheral Cue / Hip Turn / Jog / T-Step / Letter Ball

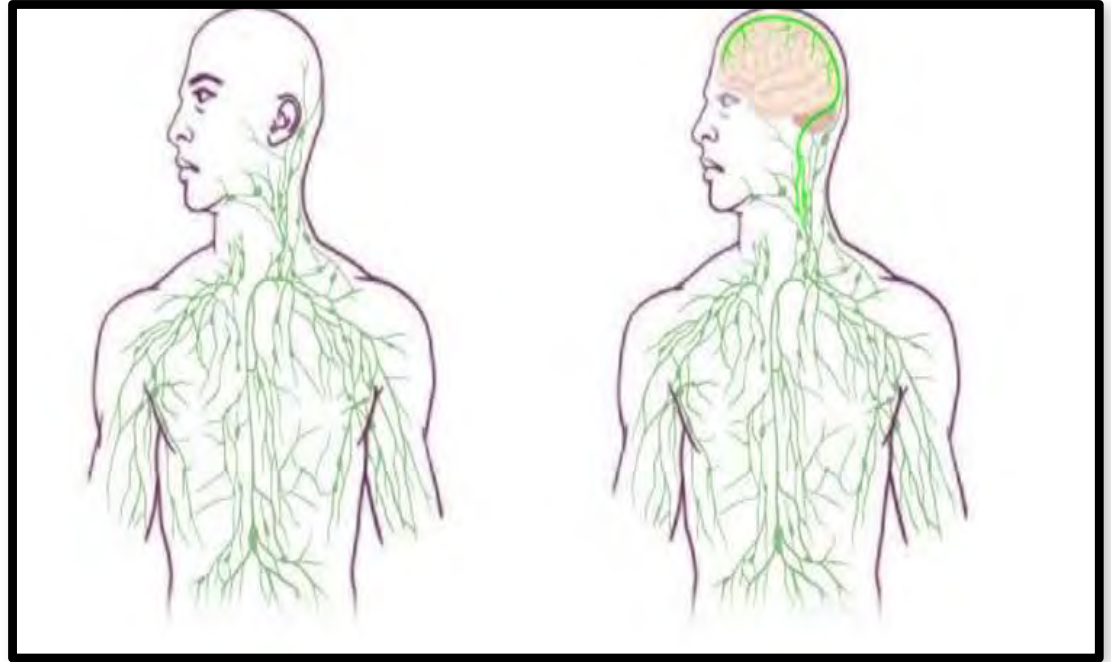


Z-Health 9S Athletic Development Model



"They'll have to change
the textbooks."

- Dr. Kevin Lee, PhD
(June 1, 2015)



"It is simply no longer possible to believe much of the clinical research that is published, or to rely on the judgment of trusted physicians or authoritative medical guidelines. I take no pleasure in this conclusion, which I reached slowly and reluctantly over my two decades as an editor of the New England Journal of Medicine."

-Dr. Marcia Angel

"The case against science is straightforward: much of the scientific literature, perhaps half, may simply be untrue. Afflicted by studies with small sample sizes, tiny effects, invalid exploratory analyses, and flagrant conflicts of interest, together with an obsession for pursuing fashionable trends of dubious importance, science has taken a turn towards darkness."

-Dr. Richard Horton, Current Editor-In-Chief of The Lancet



Referral – The Professional Approach

Recommended members of your referral network:

- 1.Z-Health® Trainers
- 2.General Physician
- 3.Chiropractic Physician
- 4.Orthopedic Surgeon
- 5.Neurologist
- 6.Pain Management Specialist
- 7.Behavioral Optometrist (FCOVD)



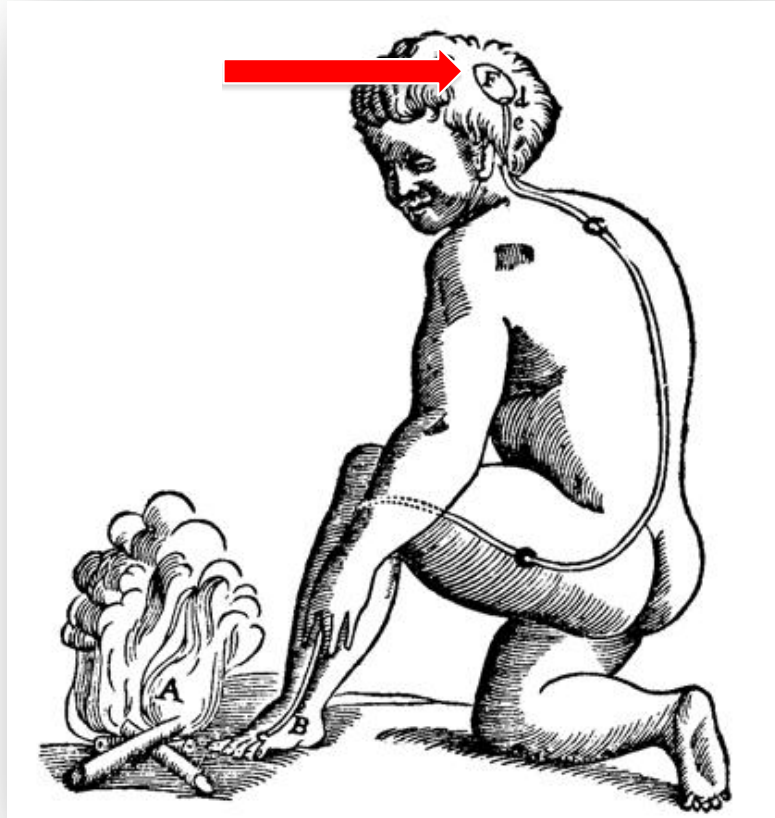


To Learn More About Z-Health
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Z-Health Pain & Performance Basics



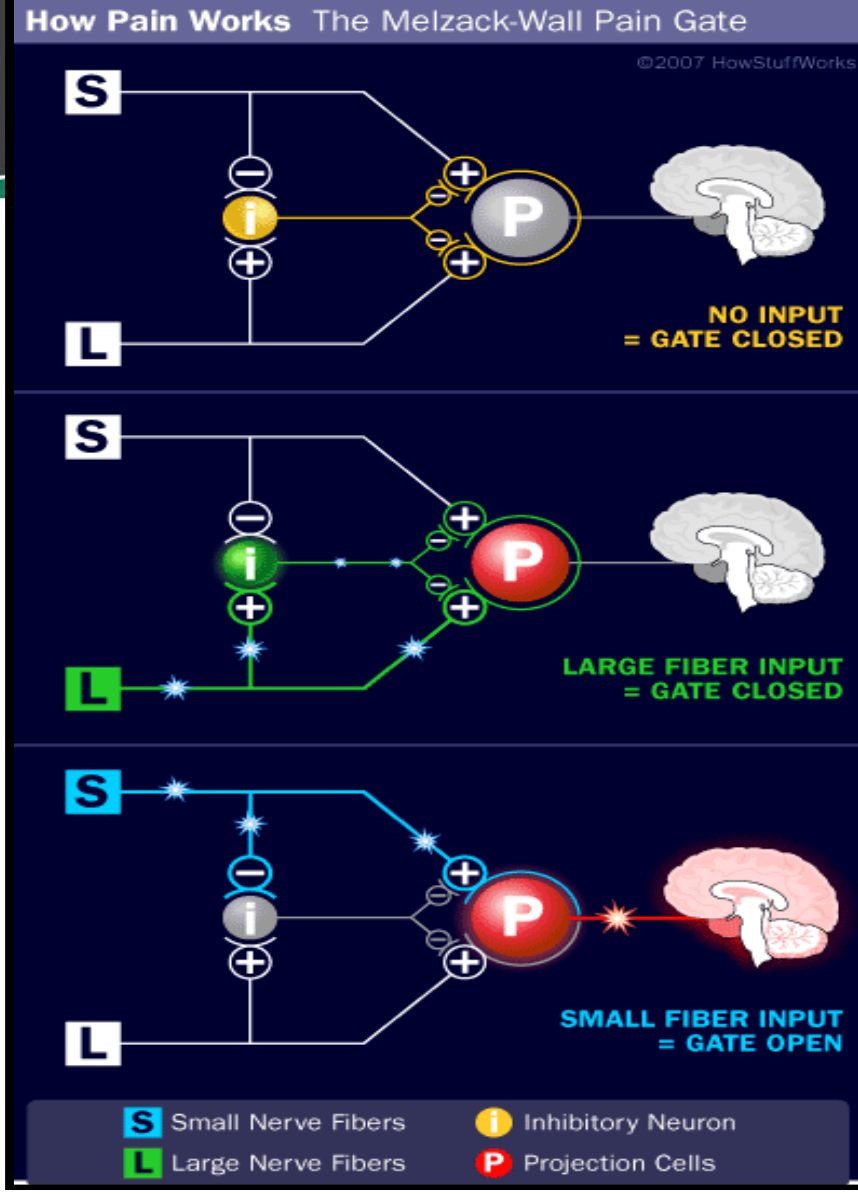
Pain Does NOT Work Like This!

Unfortunately most "body" professionals STILL do not recognize this fact. This concept (of a single, isolated pain center in the brain) originated hundreds of years ago and has been in "place" since the mid-1600's.

Illustration: Descartes Reflex 1664

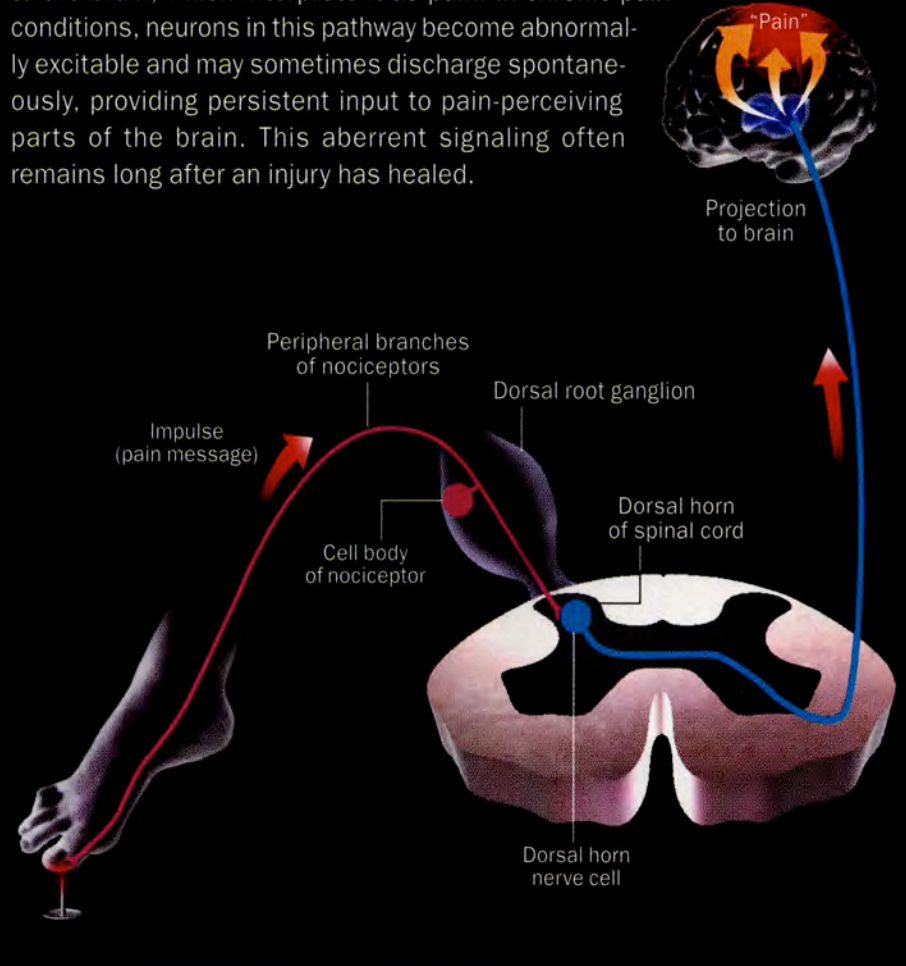
How Pain Works – Part 1

- In 1965, the world began to change. Melzack and Wall, to whom we ALL owe an enormous debt, introduced the revolutionary Gate Control Theory of Pain.
- While it was a step in the right direction, it was still incomplete and incorrect in many of its assumptions.



Perceiving Pain

In a healthy system for perceiving pain, a tissue injury causes pain-sensing nerve cells, or nociceptors (*pink*), to send a message to nerve cells in the dorsal horn of the spinal cord. These spinal cord cells pass the message to the brain, which interprets it as pain. In chronic pain conditions, neurons in this pathway become abnormally excitable and may sometimes discharge spontaneously, providing persistent input to pain-perceiving parts of the brain. This aberrant signaling often remains long after an injury has healed.



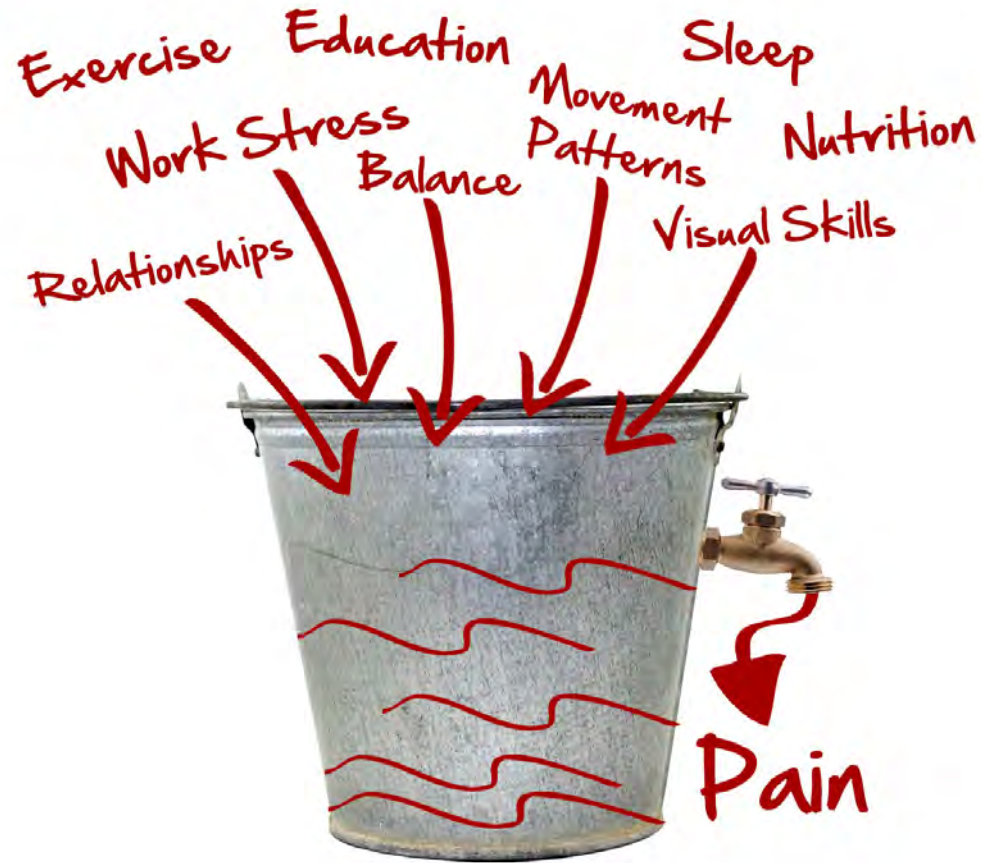
How Pain Works – Part 2

- After much study and further research, along with the advancements in MRI, fMRI and PET scans, everything began to change. In 1999, Melzack introduced the Pain Neuromatrix and life has become both simpler and far more complex as a result!



Adapted from Lorimer Moseley's "Reconceptualising Pain According to Modern Pain Science" first published in Physical Therapy Reviews 2007; 12: 169-178

Pain & Performance Neuroscience



Z-Health's
Threat Bucket

10 Vital Concepts of the Threat Neuromatrix

1. Pain is 100% of the time an output of the brain. This does NOT mean that peripheral receptors and tissues are uninvolved but it does mean that these tissues can only send DANGER signals to the brain.
2. Pain is a decision or construct made by the brain based on the perception of threat.
3. Because of the above, the brain should be the **primary target** for training in people experiencing pain and performance blocks.
4. Injury does not equal pain and pain does not equal injury.
5. Pain is an THREAT/ACTION signal - not an indicator of damage.
6. Objective evidence of tissue “damage” does NOT mean it is the cause of the pain.
7. There is no single pain center in the brain.
8. The pain neuromatrix is individual-specific which means that there is wide variability in which cortical areas are activated to produce pain between individuals.
9. Pain is experienced in the body image or “virtual body” held in the brain.
10. Practice of pain can create a neuroplastic change leading to a pain neurosignature.

Therapeutic Neuroscience Education

Author: Louw

Explain Pain Supercharged

Author: Butler and Moselely

Neurology of the Threat Neuromatrix

1. Premotor Cortex
2. Primary Motor Cortex
3. Prefrontal Cortex
4. Anterior Cingulate Cortex
5. Primary Somatosensory Cortex
6. Insular Cortex
7. Amygdala
8. Thalamus
9. Hypothalamus
10. Cerebellum
11. Hippocampus
12. Spinal Cord

A TYPICAL PAIN NEUROTAG

1. PREMOTOR/ MOTOR CORTEX
organize and prepare movements
2. CINGULATE CORTEX
concentration, focusing
3. PREFRONTAL CORTEX
problem solving, memory
4. AMYGDALA
fear, fear conditioning, addiction
5. SENSORY CORTEX
sensory discrimination
6. HYPOTHALAMUS/ THALAMUS
stress responses, autonomic regulation, motivation
7. CEREBELLUM
movement and cognition
8. HIPPOCAMPUS
memory, spacial recognition, fear conditioning
9. SPINAL CORD
gating from the periphery



Essentials Big Ideas!

1. Movement, Pain & Performance are the result of complex input, integration and output processes occurring in the BRAIN!
2. Disturbance in any of the INPUT, INTEGRATION, or OUTPUT processes can increase the brain's THREAT LEVEL. Increased THREAT usually results in decreased performance, poor movement and increases in pain over time.
3. Our PRIMARY GOAL as health and fitness professionals is to DECREASE the threat level.
4. We can DECREASE THREAT by focusing on and improving ANY INPUT, INTEGRATION or OUTPUT process.
5. When something doesn't "work" – CONSIDER OTHER THREATS!

Vision/Vestibular Findings in Gait

1. Wide Stance/Wide Arms
2. Bobblehead
3. Shuffling Gait
4. Wobbling Gait
5. Limp/Tottering/Uneven Gait Pattern
6. Looking at the Floor/Into Space/“Shifty Eyes”
7. PMRF or Cerebellar Gait Pattern
8. NOT Walking in a Straight Line
9. Bilateral Postural Issues (Kyphosis, Lordosis, Scoliosis)
10. Head Tilt or Head Rotation
11. Bilateral Posterior Chain Muscular Issues (Pain or Dysfunction)
12. History of Car Sickness/Travel Sickness



I-Phase Neurology Rules:

1. All sensory input eventually goes to the contralateral cortex, except smell.
2. Voluntary movement is created by the contralateral cortex, and controlled by the ipsilateral cerebellum (remember Accuracy, Balance, Coordination).
3. Reflexive stabilization is created by the ipsilateral cortex (through the brainstem and PMRF)
4. Mid-line brain areas control mid-line structures and movement (i.e. mid-line cerebellum, superior colliculus, frontal eye fields).



I-Phase Neurology Rules:

Frontal Lobe/Cortex Activation Drills

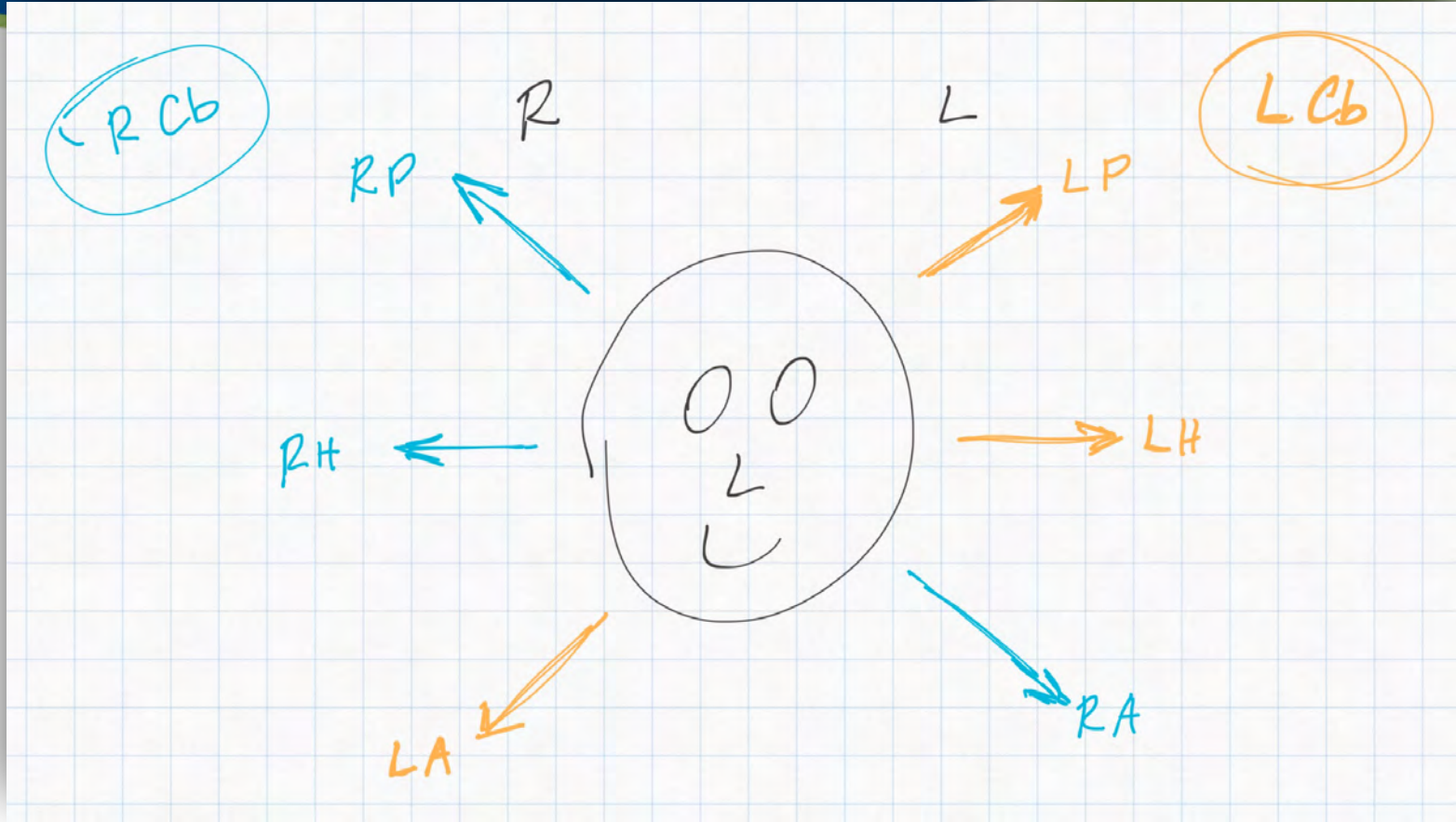
- Contralateral Complex Movements
- Contralateral Sensory Stimulus (with concentration!)
- Contralateral VOR Canals
- Ipsilateral Smooth Pursuits

Cerebellum Activation Drills

- Ipsilateral Complex Movements
- Ipsilateral VOR Canals
- Cerebellum Eye Positions (pg. 28)



Cerebellum/Vestibular Activation



Arrows represent HEAD movements to activate Semicircular Canals



I-Phase Neurology Rules:

Mid-line Activation Drills

- Axial Extension, Long Spine, Front Openers
- Vertical Eye Movements (Gaze Stab. or Smooth Pursuits)
 - Vertical a-VOR or Vertical L-VOR
- Humming, Swallowing, Tongue Activation
 - Convergence/Divergence Drills

