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LESSON



The Science

In this lesson:

- Common foot care myths
- Wolff's Law
- Davis' Law
- Neuroplasticity
- Neuromuscular adaptation
- Neuromuscular mechanics

Your Critical Connection Resources

To download the resources, visit biopodsmedical.com



Slide Deck

guides you through the presentation.

A good place for you to take notes.



Coursebook

provides more in-depth coverage of each lesson's topics.



Monograph

provides a deeper dive into all of the lessons.

Introducing **Your Instructors**



Introducing **Your Instructor**



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Conventional Footwear. **It's a Problem.**



In North America

- More than 66% of the population experiences some type of foot-related discomfort
- 85% will see a medical professional for foot-related issues over their lifetime



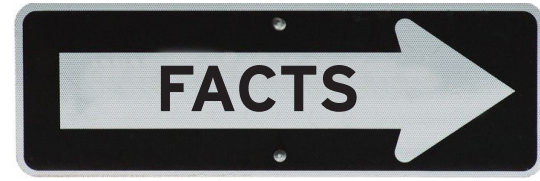
By contrast,

in environments where people don't wear shoes

- Less than 3% will exhibit foot-related issues- none of them debilitating!

Conventional treatments and products don't help, either.

They treat the symptoms, not the cause.



Cushioning reduces damaging shock and stress.

Orthotics correct faulty foot biomechanics.

We should always wear supportive shoes.

Continual use of cushioning products can weaken and destabilize the feet.

Prolonged use of orthotics results in functional atrophy and dependence on artificial support

Tight supportive footwear is a leading cause of lower limb maladaptive neuromuscular mechanics.

3 scientific principles that dispel the myths



Wolff's Law of Bone Transformation

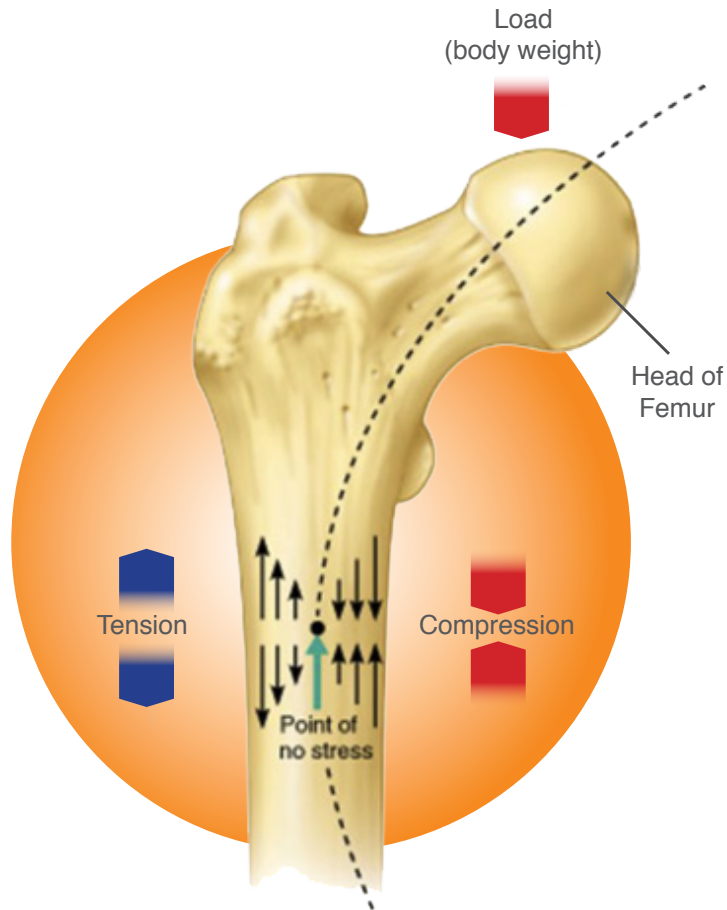


Davis' Law



Concept of Neuroplasticity

Wolff's Law of Bone Transformation

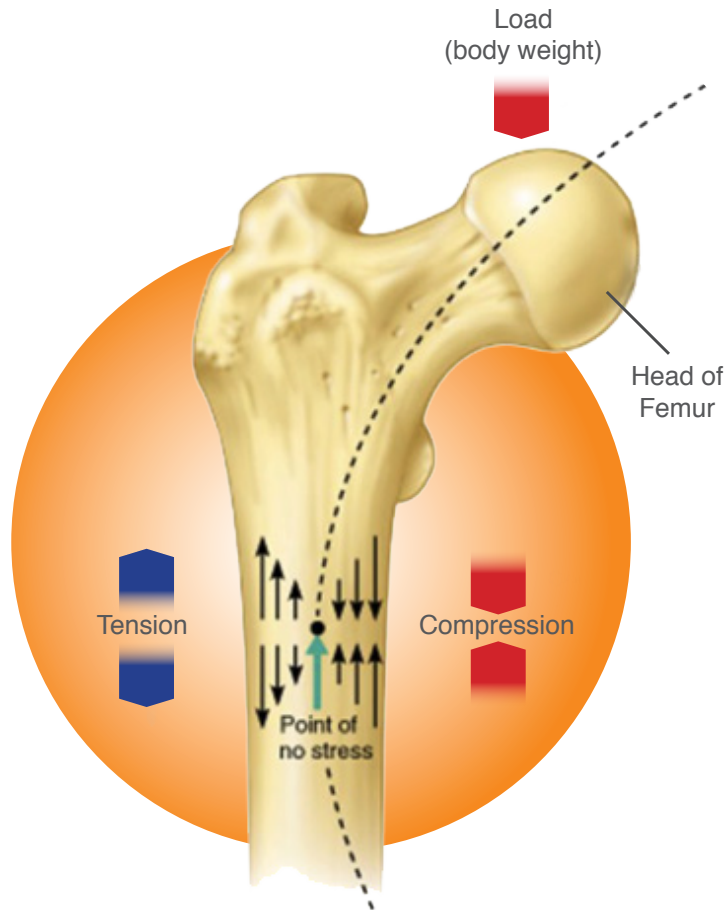


Bone in a healthy person will adapt to the loads under which it is placed. Stresses on a bone change its structure and strength.

When loading or stress on a bone increases, the bone will remodel itself over time to become stronger or resist that sort of loading.

When loading or stress on a bone decreases, the bone will remodel itself over time to become weaker and less dense due to the lack of stimulus needed for continued remodeling.

Wolff's Law of Bone Transformation



When loading or stress on a bone is intermittent

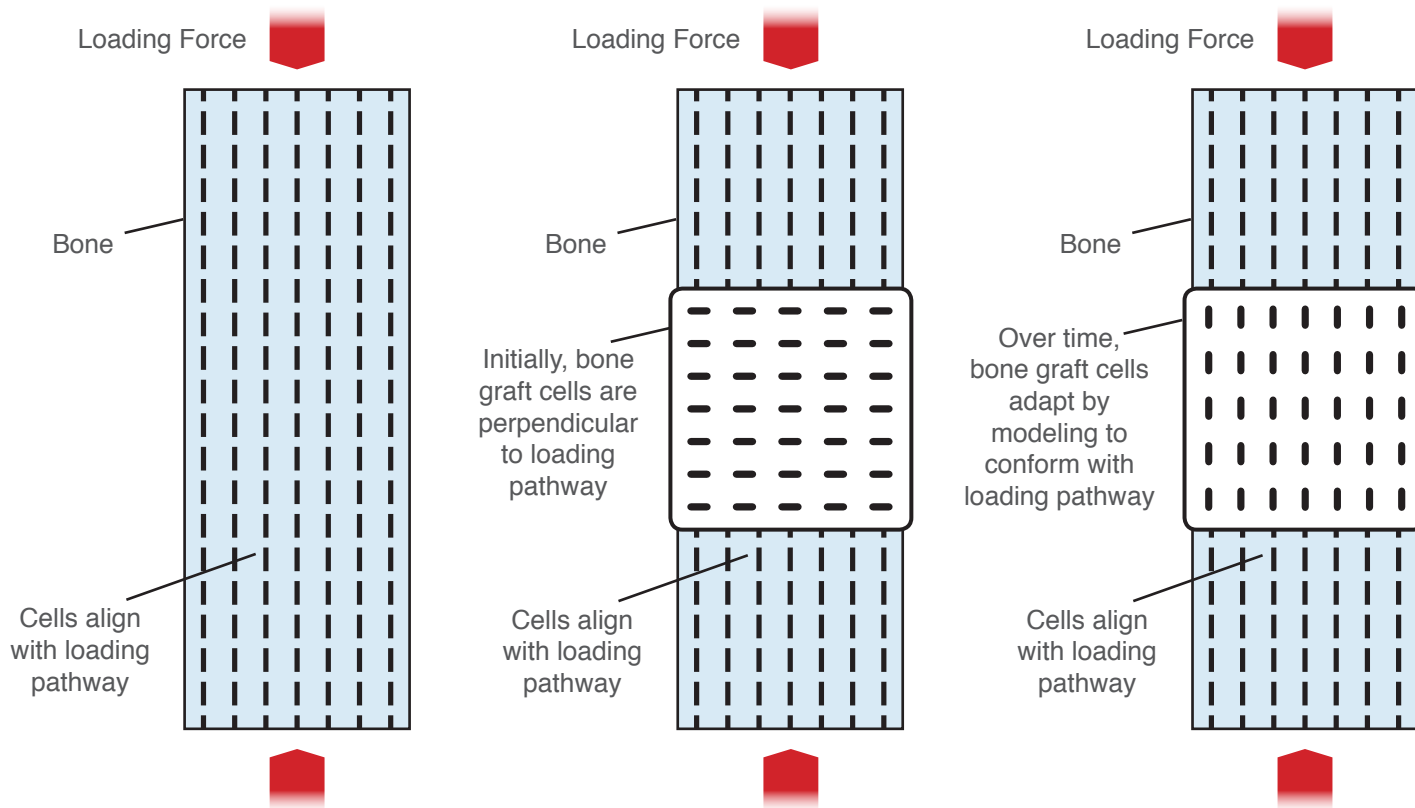
the bone will remodel itself over time to "fill in" the space or grow toward the source of the loading.

When loading or stress on a bone is constant

the bone will remodel itself over time to "pull away" from the source of the loading.

In other words **Bones remodel in response to stimuli.**

A variable stimulus creates the greatest adaptation.
A constant and unchanging stimulus does not produce the same adaptation in the bone.



Extreme Examples of Bone Loss

Astronauts in microgravity



When astronaut returns to Earth:

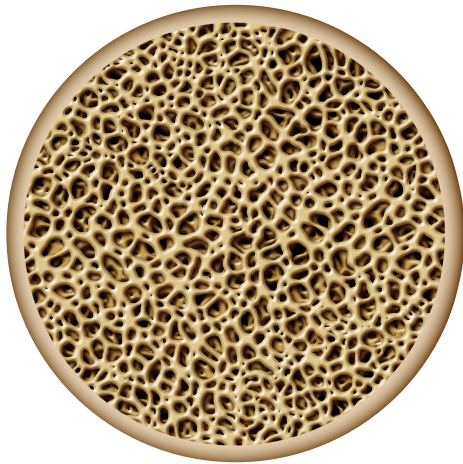
- Heart is smaller and weaker
- Balance system is used to a new set of signals
- Body fluids diminished
- Muscles atrophied

In microgravity your bones do not need to support your body:

- All of your bones, especially the weight-bearing bones in your hips, thighs and lower back, are used much less than they are on Earth
- The size and mass of these bones continue to decrease as long as you remain in microgravity at a rate of about 1-2% a month

Extreme Examples of Bone Loss

Osteoporosis



Healthy bone



Osteoporotic bone

Wolff's Law and the Mechanostat Model:

Bone in a healthy person will adapt to the loads under which it is placed.

Real world examples

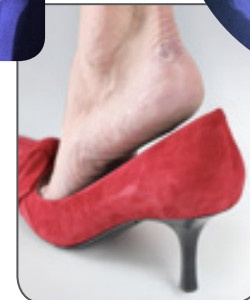
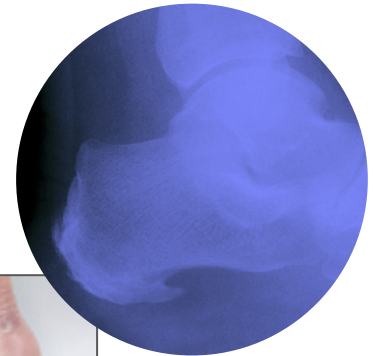
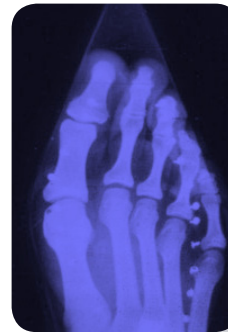
Braces on Teeth change bone structure of mouth

Fracture Cast causes atrophied bone structure

Foot Binding is another example of adverse loading on the feet

High Heels change the loading of body weight on the feet

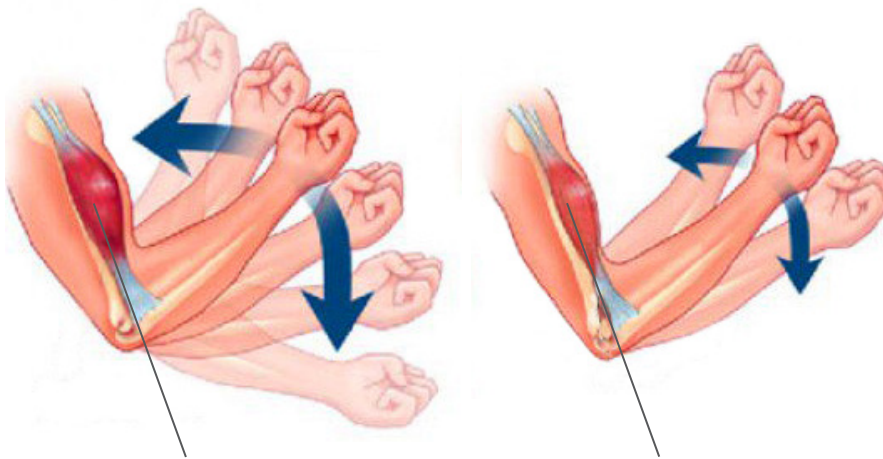
Heel Spur is the formation of additional bone on the heel



Davis' Law of Soft Tissue Adaptation

Muscles, tendons, and fascia in a healthy person will adapt to the loads under which they are placed.

Effects of Atrophy on Muscle

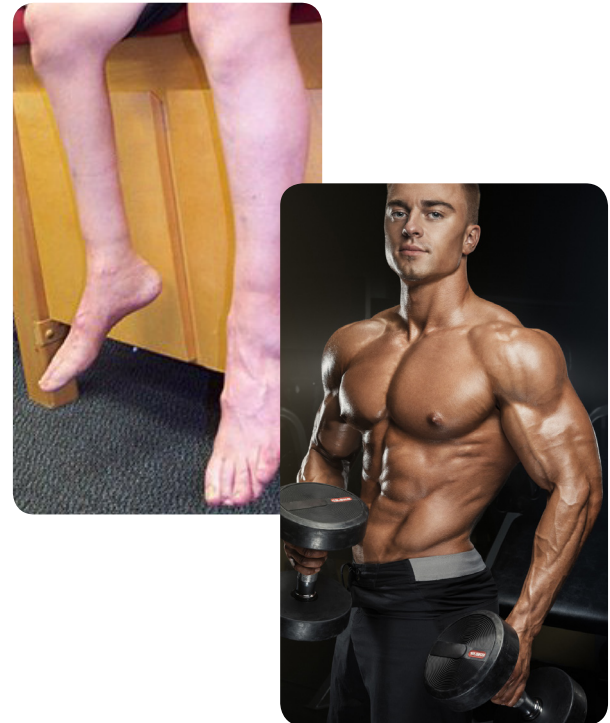


Normal muscle

Atrophied muscle

- Decreased size
- Decreased strength
- Decreased mobility

From Atrophy to Adonis



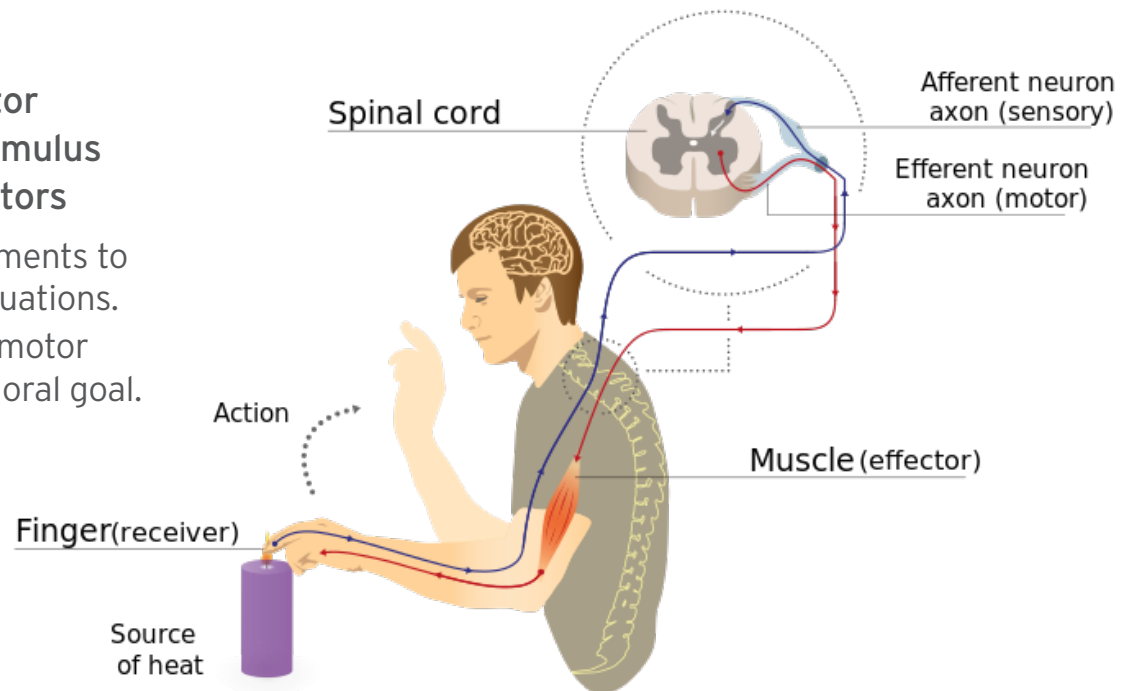
Neuroplasticity and Sensory Motor Systems

With every movement, the central nervous system receives information from sensory receptors to generate the right muscle activations.

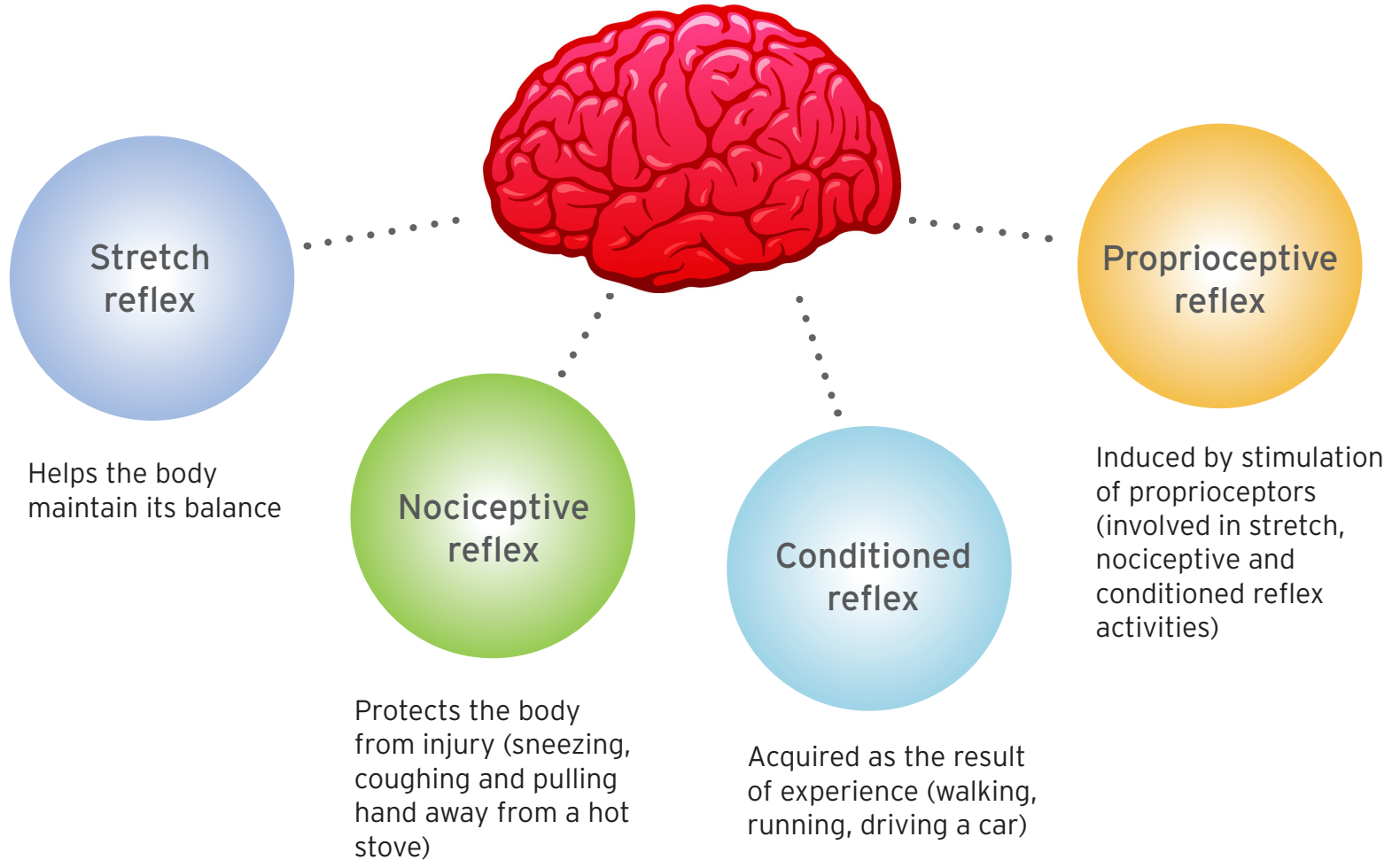
- Sensory information from muscles, joints, and skin is needed to regulate movement.
- Lack of this somatosensory input results in imprecise movements. And tasks that require fine coordination aren't possible.

Reflexes: coordinated motor responses initiated by a stimulus applied to peripheral receptors

- Some reflexes initiate movements to avoid potentially harmful situations.
- Others automatically adapt motor patterns to achieve a behavioral goal.



Types of Reflexes



Proprioception: The Unconscious Perception of Body

Proprioceptive reflexes- their primary function is to adjust motor output according to the biomechanical state of the body and limbs

- Ensures a coordinated pattern of motor activity during an evolving movement
- Provides a mechanism for compensating for the intrinsic variability of motor output

Motor reflexes- provide for optimal self-protective responses

- May be disrupted as a result of trauma
- May also be disturbed in the course of otherwise normal motor development

Proprioceptive sense can be sharpened through the study of many disciplines that enhance mind-body integration.



Sensory Integration and Neural Adaptation

- **Sensory Integration**- the automatic natural process by which the brain organizes sensory information that comes from our surroundings and from our own bodies [touch, hearing, vision, taste, smell, vestibular (inner ear balance), and proprioceptive], and utilizes that information for adaptive and fulfilling interaction with the environment.
- **Sensory Modulation**- Prioritization - the brain is constantly organizing sensory input (i.e., locate, sort, and order) with priority attention “alertness” given to new or varied stimulus.
- **Neural Adaptation**- occurs when sensory processing automatically (without conscious effort) becomes less sensitive to repeated stimuli.

It happens all the time, i.e., when you walk into a dark room and can't see anything, but after a while you can begin to make out shapes and outlines; or when you first smell coffee when you enter a room and don't notice the smell after a few minutes.

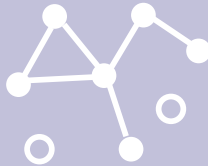
Neuroplasticity: How the brain changes



Neuroplasticity

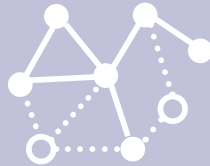
The ability of the brain to reorganize itself, both in structure and how it functions

How the Brain Changes



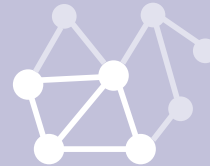
Neurogenesis

Continuous generation of new neurons in certain brain areas



New Synapses

New skills and experiences create new natural connections



Strengthened Synapses

Repetition and practice strengthens natural connections

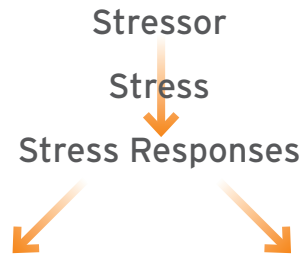


Weakened Synapses

Connections in the brain that aren't used become weak

Poor Technique vs. Proper Technique

Poor Technique = Maladaptive Function



Adaptive responses

Behavior

- Avoidance actions:**
- Reflexes
 - Locomotion
 - Shelter seeking
 - Defense

Physiology

- Decreased:**
- Ammonia
 - Lactate
- Increased:**
- pH
 - Immune function
 - Ion balance

Maladaptive responses

Behavior

- Reduced or lost:**
- Reflexes
 - Locomotion
 - Shelter seeking
 - Defense
 - Feeding

Physiology

- Increased:**
- Ammonia
 - Lactate
 - Ion imbalance
- Decreased:**
- pH
 - Immune function

Proper Technique = Enhanced Function



Reflex improvement

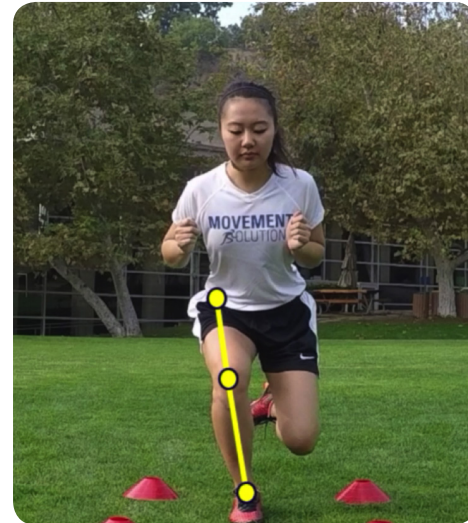
Proprioception and Reflexes



Incorrect

Results of training with Poor Technique:

- An imbalance of strength and flexibility in opposing muscle groups
- The least robust physical "Sweet Spot" capabilities
- An increased risk of injury (actually predisposed to injury)



Correct

Results of training with Proper Technique:

- A balance of strength and flexibility in opposing muscle groups
- The most robust physical "Sweet Spot" capabilities
- A reduced risk of injury

Everyone has a 'sweet spot'

for optimal musculoskeletal function.

Poor Technique = Maladaptive Function



Proper Technique = Enhanced Function



Immobilization

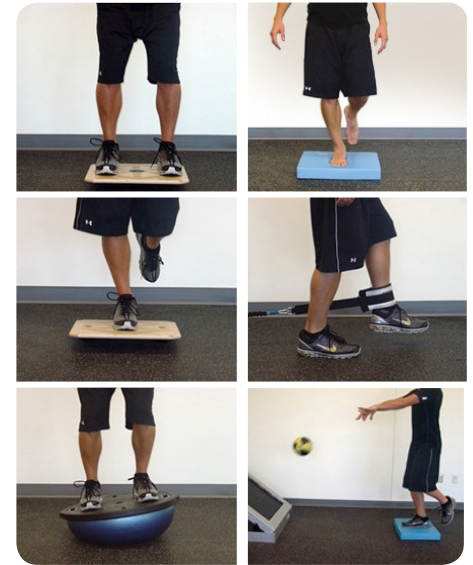
has marked adverse effects on all systems of the body.



Maladaptation and degenerative stresses



Atrophy caused by lack of activity



Progression of neuromuscular rehabilitation exercises



How did you do?

Let's test your knowledge.
You'll need to answer 10 questions.