

# Exploring the Brain 3e

- Chapter 13: Spinal Control of Movement

- Motor Programs

- Motor system: Muscles and neurons that control muscles

- Role: Generation of coordinated movements

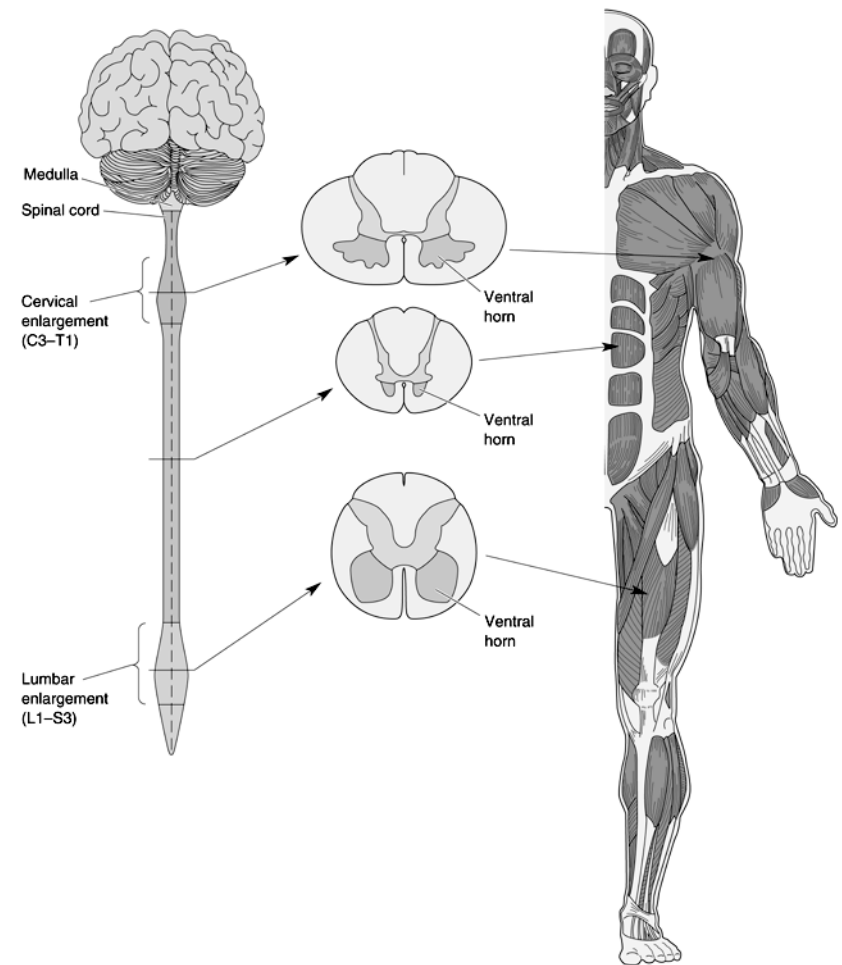
- Parts of motor control

- Spinal cord → coordinated muscle contraction

- Brain → motor programs in spinal cord

# The Somatic Motor System

- The Lower Motor Neuron
  - Lower motor neuron: Innervated by ventral horn of spinal cord
  - Upper motor neuron: Supplies input to the spinal cord



# ***Spinal cord injuries***

- *Motorneurons below the injury remain intact.*
- *Motor cortex commands do not reach muscles and muscles atrophy.*
- *Electrodes can artificially activate muscles and prevent atrophy*

## ***UPPER MOTOR NEURON SYNDROME DAMAGE TO DESCENDING PATHWAYS***

*Damage to the pathways driving the motor neurons*

- *Spasticity*

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***TONE AND REFLEXES INCREASED***

*Spastic cerebral palsy for example*

## ***LOWER MOTOR NEURON SYNDROME - DAMAGE DIRECT TO MOTOR NEURONS***

*Diseases or lesions at the level of the motorneuron or its axon*

- *Atrophy- loss of muscle volume*

***DECREASED TONE AND REFLEXES***

*Poliomyelitis for example*

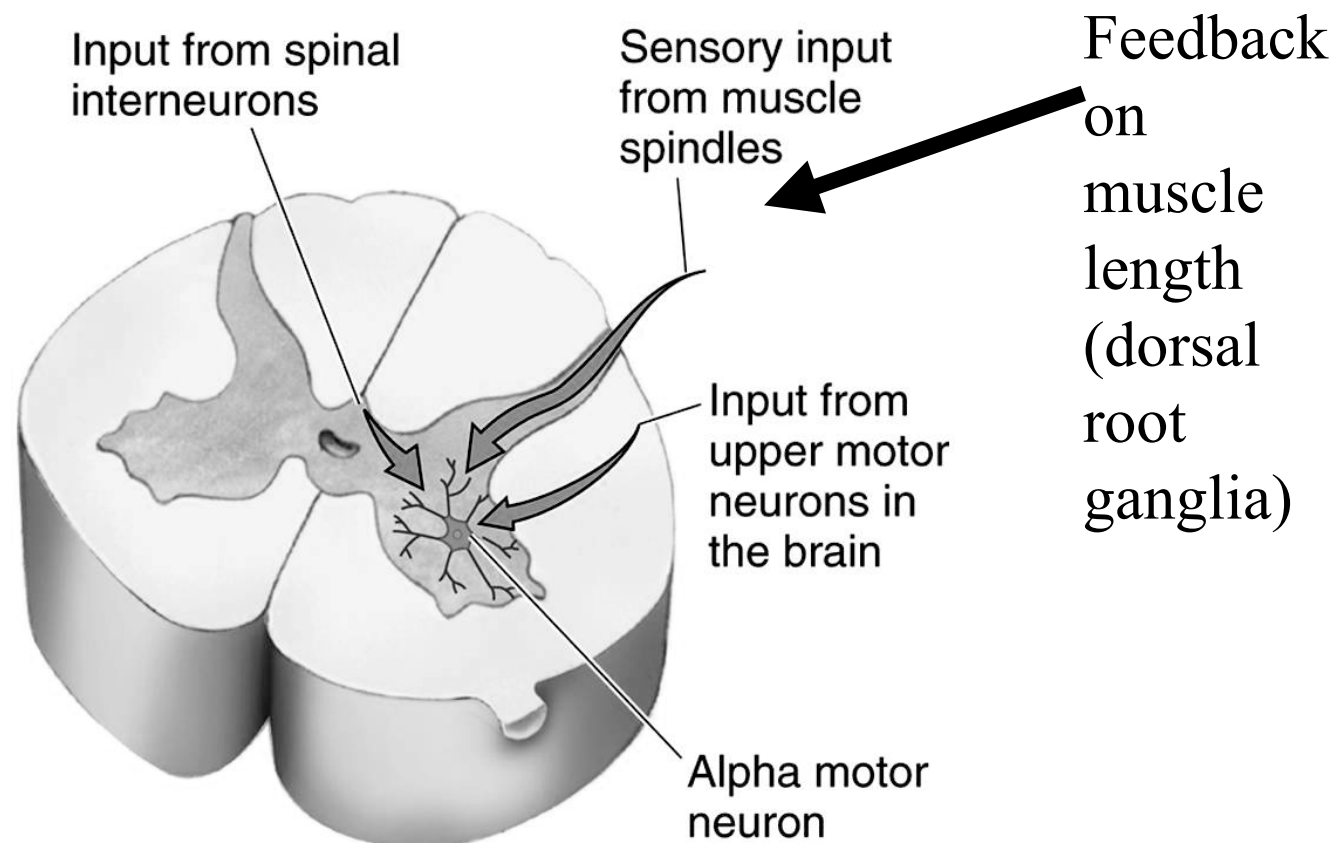
# Guillain Barre syndrome

(ghee yan bah ray)

- Syndrome not disease (unclear what disease)
- Paralysis (can be total)
- Attacks Schwann cells, then axons
- Autoimmune
- Similar to MS in CNS
- 70% recovery! Why????
- Following vaccine (rabies, swine flu)
- 1 case per million 1 death per 20 million (normal?)

# The Somatic Motor System

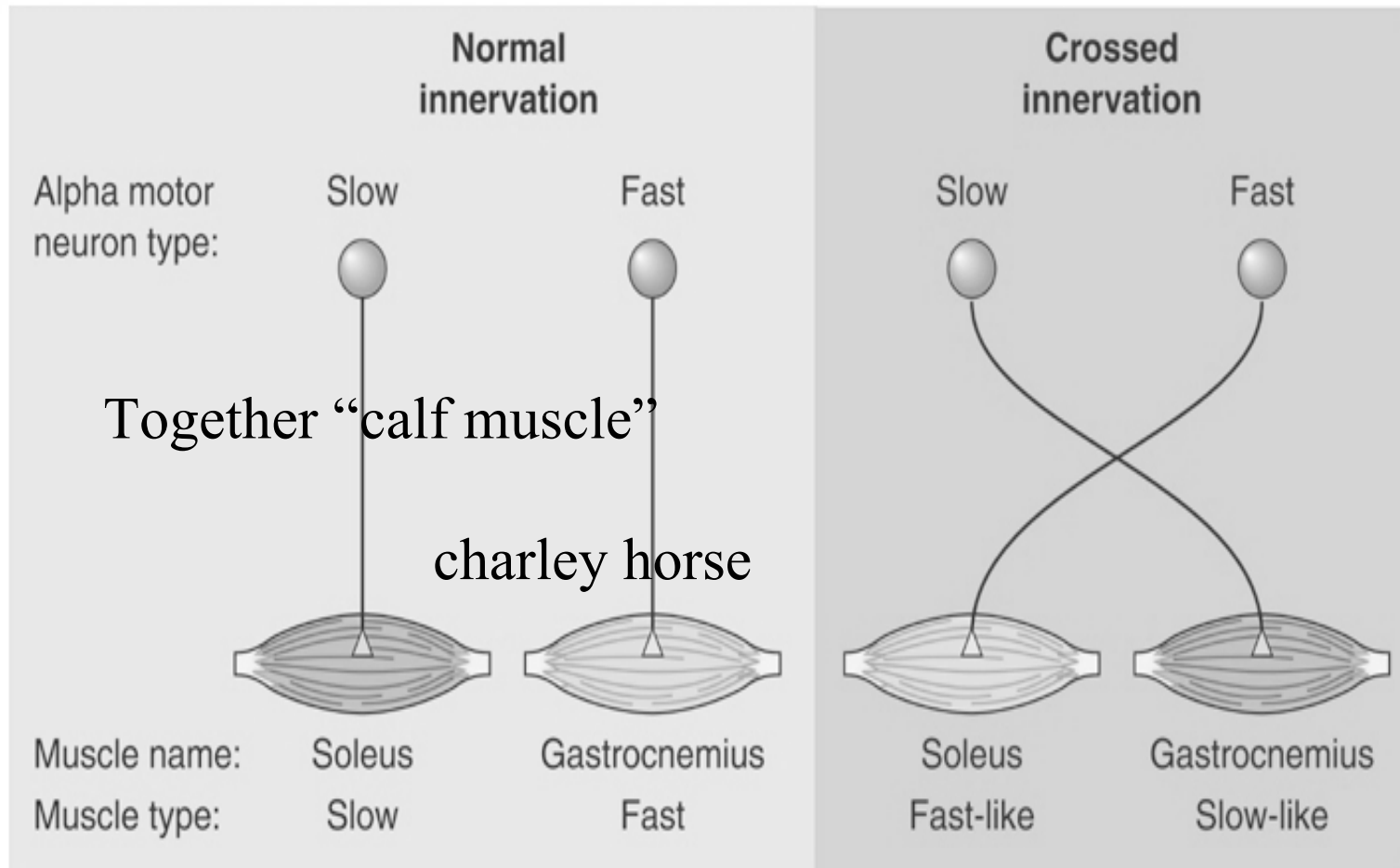
- **THREE** Inputs to Alpha Motor Neurons



# The Somatic Motor System

- Types of Motor Units
  - Red muscle fibers: Large number of mitochondria and enzymes, slow to contract, can sustain contraction
  - White muscle fibers: Few mitochondria, anaerobic metabolism, contract and fatigue rapidly (but POWERFUL - escape)
  - Fast motor units: Rapidly fatiguing white fibers
  - Slow motor units: Slowly fatiguing red fibers

FAST twitch (fatigue rapidly – white) SLOW twitch (fatigue slow – red)



Neuroscience: Exploring the Brain, 3rd Ed, Bear, Connors, and Paradiso Copyright © 2007 Lippincott Williams & Wilkins

Forced change in input – switch phenotype (physical characteristics)

30-60/sec bursts - 10-20/sec steady

# Excitation-Contraction Coupling

- Muscle contraction
  - Alpha motor neurons release Ach
    - Innervate muscle fibers
  - ACh produces large EPSP in muscle fibers (via nicotinic Ach receptors)
  - EPSP evokes action potential
  - Action potential (excitation) triggers  $\text{Ca}^{2+}$  release, leads to fiber contraction
  - Relaxation,  $\text{Ca}^{2+}$  levels lowered by organelle reuptake

# Duchenne Muscular Dystrophy

- Genetic – Duchenne 1 in 3500
- ONLY males, so X-linked  
(single X is enough)

X region codes for protein “dystrophin”

In MD, no mRNA for this cytoskeletal protein

Muscles tears

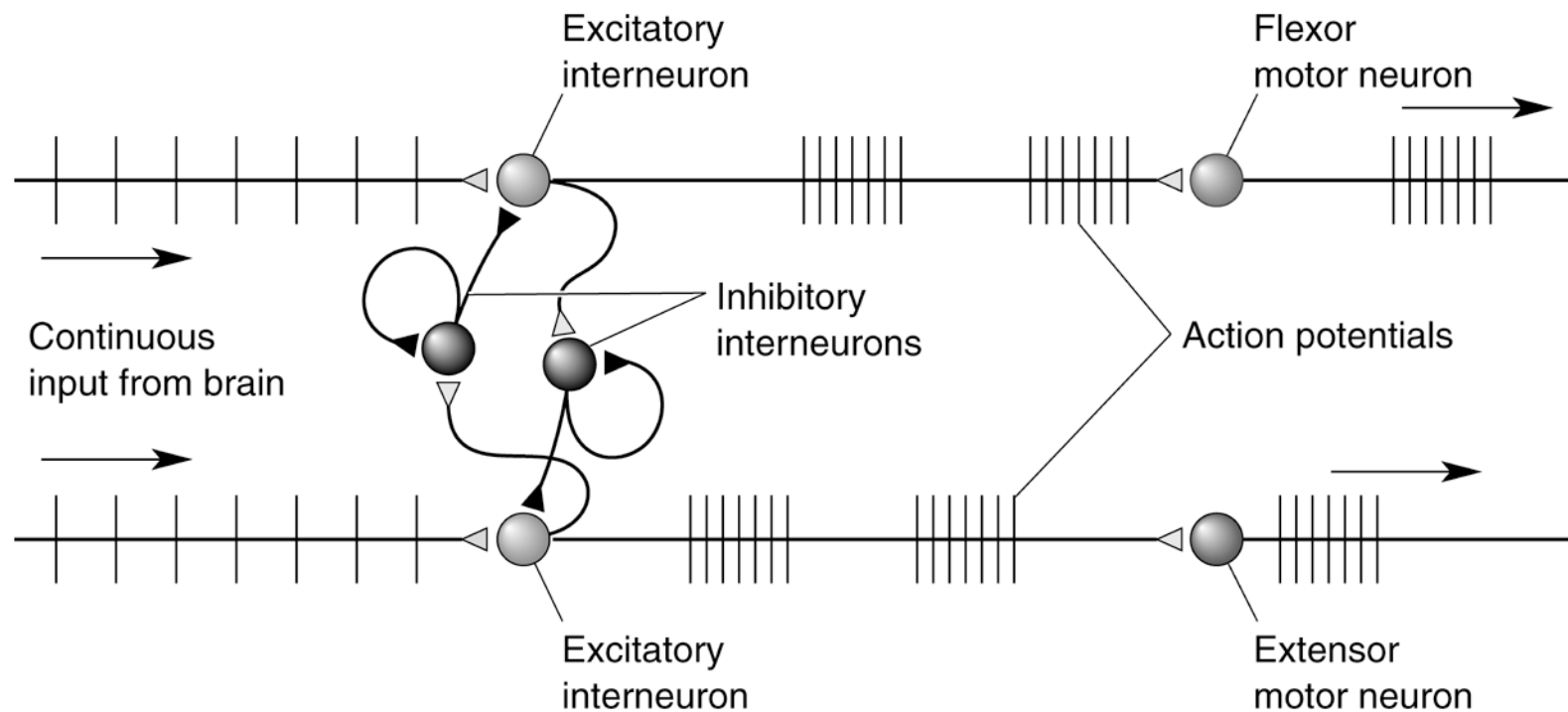
WHY normal phenotype for early life?

Could virus help????? (gene therapy)

Could stem cells help?

# Excitation-Contraction Coupling

- The Generation of Spinal Motor Programs for Walking



# Excitation-Contraction Coupling

- The Generation of Spinal Motor Programs for Walking

