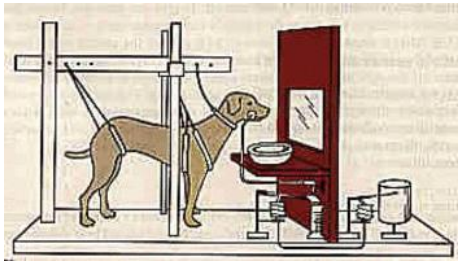
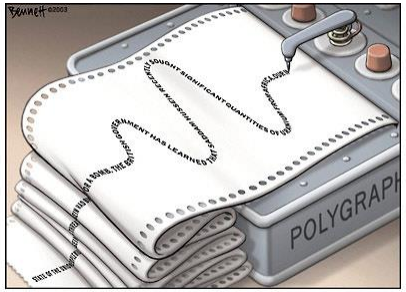
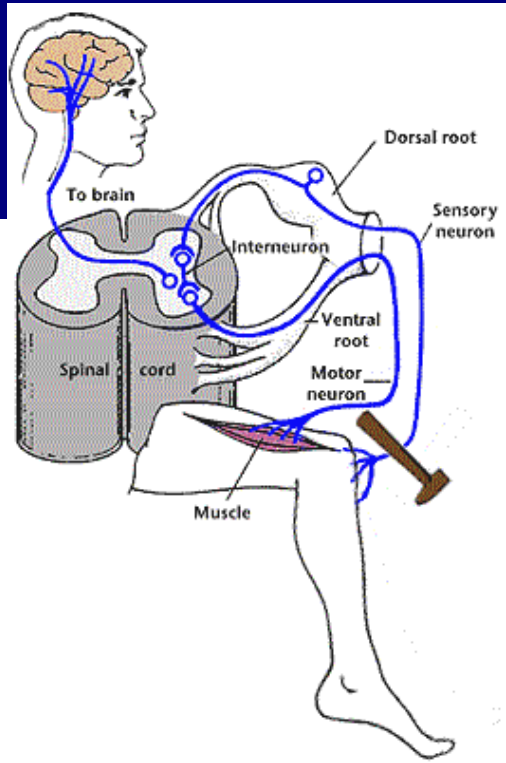




Nervous system, reflexes and reaction time

- Reflexes
- Voluntary action
- Autonomous reflex

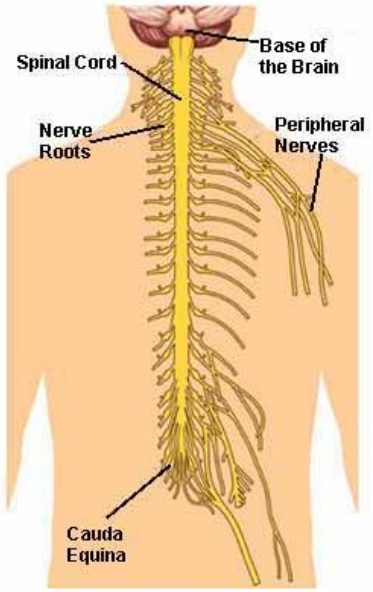


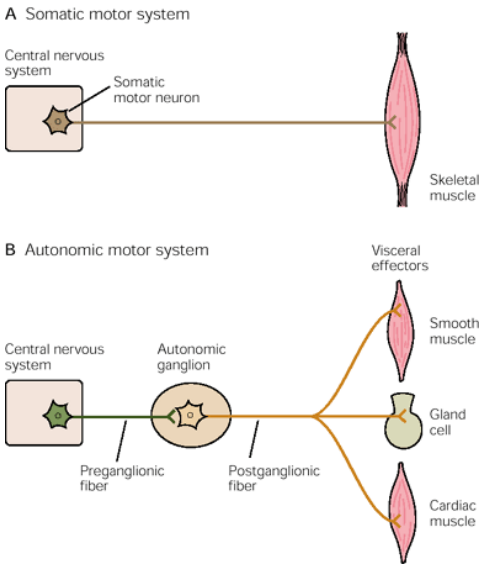
Nervous system

Central NS – brain, spinal cord

Peripheral NS – spinocerebral nerves

- **Somatic NS**
  - somatic sensory and somatic motor system; **somatic reflexes**
  - Affects skeletal muscle tissue
- **Autonomic NS**
  - Involuntary; **visceral reflexes**
  - sympaticus/parasympaticus
  - Viscelar system: affects cardiac muscle, smooth muscles, exocrine glands





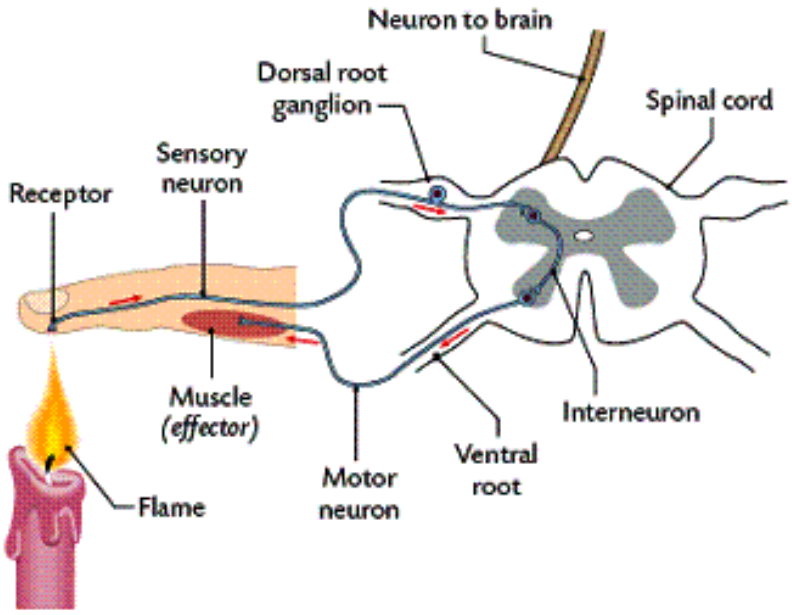
Reflexes

A **reflex**, or **reflex action**, is an involuntary and nearly instantaneous movement in response to stimulus

- Fast, stereotypic, automatic reaction of NS, without direct involvement of the brain

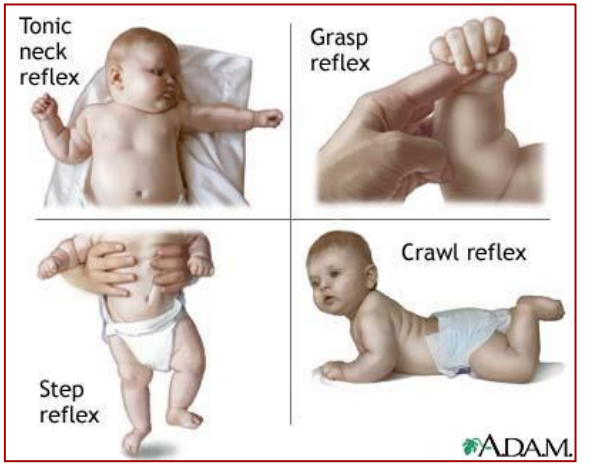
Reflex arc:

1. **Somatic receptor** (e.g. heat receptor or muscle spindle = stretch receptors of muscles)
2. **Afferent nerve fibers** *(muscles → dorsal horn of the spinal cord)*
3. **Integrating center** (gray matter of the spinal cord or brainstem)
4. **Efferent nerve fibres** (ventral horn of the spinal cord → muscles)
5. **Effector** (e.g. Neuromuscular junction of skeletal muscle)

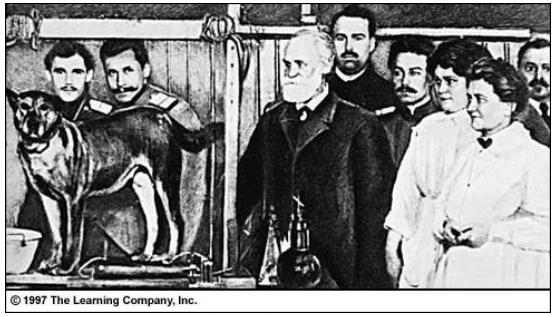


Reflexes

- **Innate lifelong reflexes** - an automatic instinctive unlearned reaction to a stimulus
  - protective reflexes – sneezing, coughing, corneal, pharyngeal, blink, withdrawal reflex,...
  - Posture reflexes – tendon reflexes (patellar reflex), stretch reflexes, ...
- **Special infant reflexes** – crawl, grasp, suck, moro, ... video

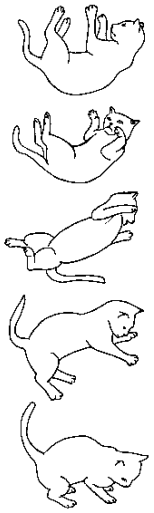


- **Conditional reflexes** – type of a learning procedure in which a biologically potent stimulus (e.g. food) is paired with a previously neutral stimulus (e.g. a bell); temporary
  - I. P. Pavlov – dogs: sallivation + sound
  - Taste aversion (nausea + food)

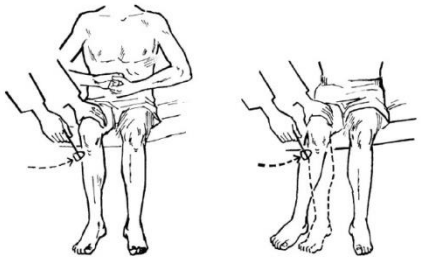


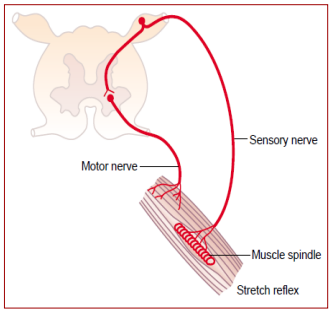
Taste aversion

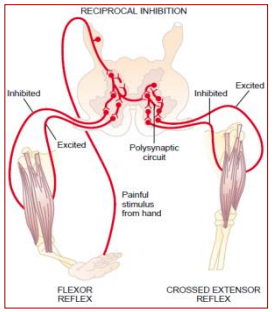
Somatic (motoric) control system



- 1. Reflexes
  - Maintaining posture and balance by muscle tone
  - **Myotatic reflexes** – strecth reflexes, tendon reflexes (e.g. knee jerk reflex)
  - Association with cerebellum, inner ear
  - Reaction time 20 – 40 msec





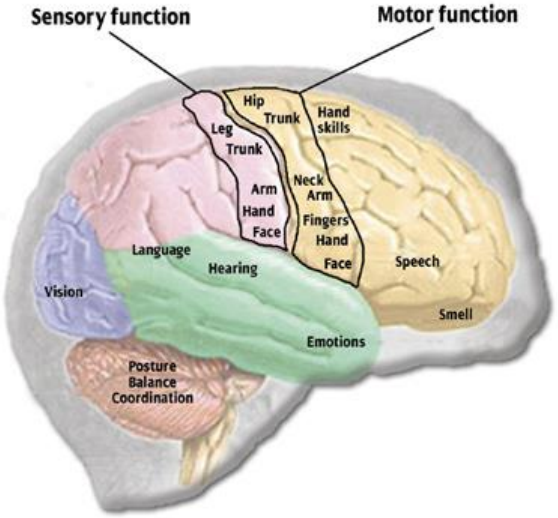


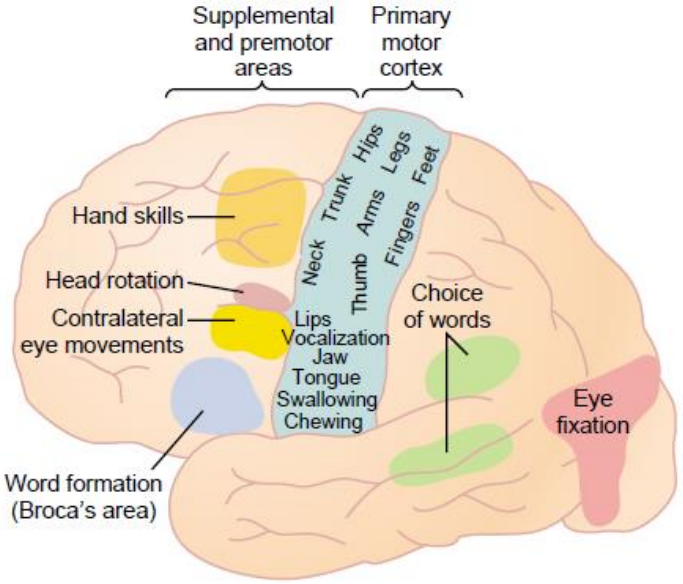
- 2. Voluntary action and motorics
  - Somatic system of voluntary action
  - Cerebral cortex, basal ganglia and other centres

Voluntary action

skeletal muscles control - CNS + peripheral nerves; cooperation and coordination (↑↑ chemical synapses)

- Exteroreceptor → Sensoric pathway → brain processing through the sensoric centre of the brain and motoric centre of the brain → motoric pathway → muscles

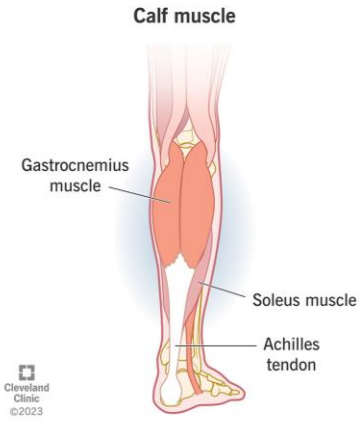




- Reaction time of voluntary action ≥100ms

Experiment 1 - **Reaction time comparison**

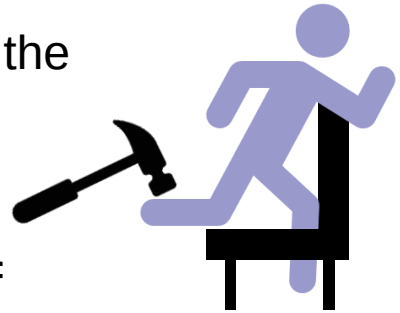
- **Electrodes on the calf muscle, special hammer, software**



- **Monosynaptic reflex** (achilles reflex) - tap on Achilles tendon with special hammer → reflexive calf muscle locomotion

A sudden stretch, tapping the Achilles' tendon, causes a reflex contraction in the muscle as the spindles sense the stretch and send an action potential to the motor neurons which then cause the muscle to contract; this particular reflex causes a contraction in the group of muscles.

T = 20-40ms



- **Voluntary action** – voluntary locomotion of calf muscle after the tap of hammer on shoulder

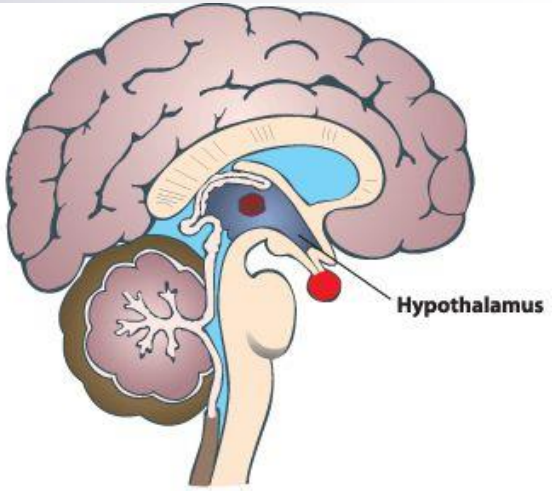
T ≥ 100ms

Experiment 2

Reaction time of voluntary action

Web task reaction time or here

Autonomous reflexes

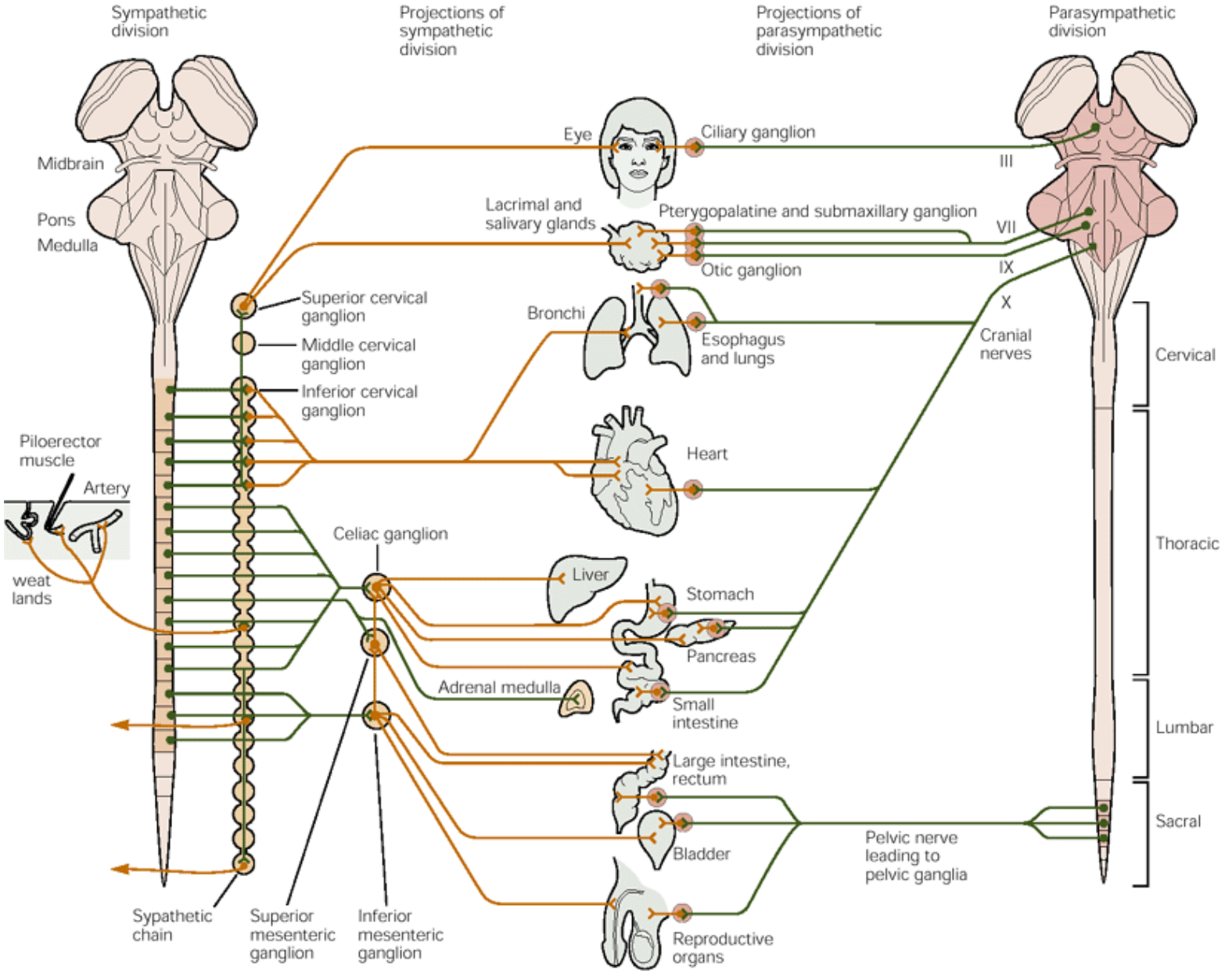


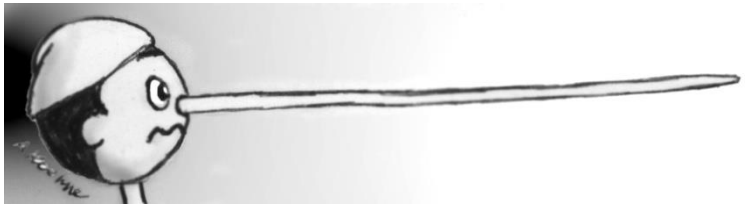
- Visceral, involuntary
- Under the control of **hypothalamus**
- Sympaticus + parasympaticus
- Connection with limbic system and amygdala – emotions: breath frequency, heart beat, sweating, salivating, ...

- Much slower than motoric reflexes

- Crucial for smooth muscle, glands and heart functions

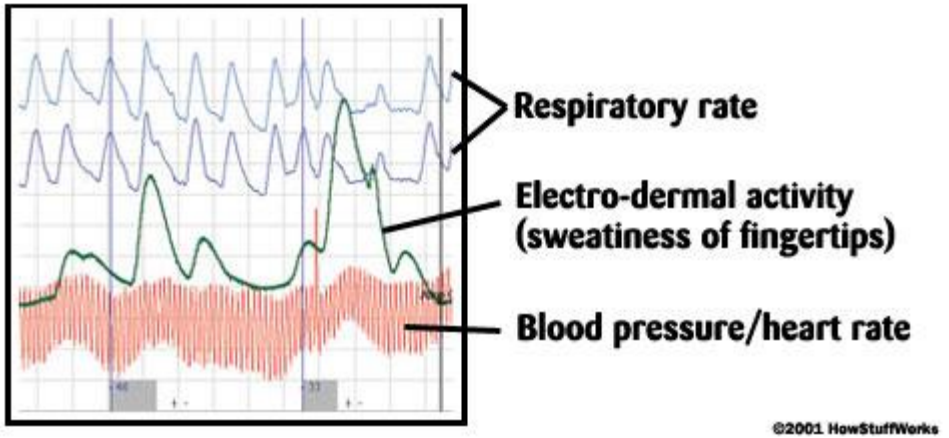
Fight-or-flight reaction ⟵ antagonists ⟶ Rest & digest system





Polygraph (lie detector test)

- Stress caused by lying → cerebral cortex + hypothalamus + limbic system → **sympaticus** → hand sweating (etc.) → higher conductivity → higher graph amplitude on record



- In most European jurisdictions, polygraphs are generally not considered reliable evidence and are not generally used by law enforcement.

EXPERIMENT 3

Polygraph experiment

1. Put the electrodes on palms (do not moisture), keep eyes closed, keep calm and think about one particular number from 1 to 5
2. Audience question about numbers in random order
3. After being asked, say **No** to every single question

Do not forget: Autonomous reflexes are much slower, therefore be patient about physiological response