An Introduction to Neuroscience

A presentation by Group 3
Neuroscience Overview

- Neuroscience is one of the largest growing fields of science today.
- Works with many other fields: chemistry, biology, engineering, philosophy, psychology, etc.
- While we have learned much, how the brain works is still relatively a mystery.
The Basics: Neurons

- Dendrites
- Cell body
- Axon
- Myelin sheath
- Terminal branches of axon
- Neural impulse
- Nucleus
- Dendrites from another neuron
The Organization of the Nervous System

- Nervous System
  - Central Nervous System
    - Brain
    - Spinal Cord
  - Peripheral Nervous System
    - Motor
      - Somatic
      - Autonomic
        - Sympathetic
        - Parasympathetic
    - Sensory
The Organization of the nervous system

Central nervous system - is composed of the brain and spinal cord

Peripheral nervous system - is composed of the somatic and autonomic nervous systems
Central nervous system

The spinal cord and the brain - most of our behavior involves the transmission of information between them.

Spinal reflexes - involve connections between sensory and motor neurons in the nervous system that quickly generate muscle contractions.
Peripheral nervous system

**Somatic nervous system** - receives sensory information and controls the contractions of voluntary muscles.

**Autonomic nervous system** - automatically controls the organs of the body
Autonomic nervous system

Sympathetic division - prepares the body for action during times of threat.

Parasympathetic division - is active during times of relaxation and rest.
Structure of the Brain

Hindbrain - an area of the brain that coordinates information coming into and out of the spinal cord

Midbrain - helps orient an organism in environment and responses to stimuli

Forebrain - controls complex cognitive, emotional, sensory, and motor functions
The Midbrain

from Yvonne's neuropsychology pictures
The Forebrain

Cerebral cortex (thought, planning)

Basal ganglia (movement)

Thalamus (gateway to cortex)

Hypothalamus (regulates body function)

Amygdala (emotion)

Hippocampus (memory)
Roles within hemispheres

- Parietal Lobe
- Frontal Lobe
- Occipital Lobe
- Temporal Lobe
Brain Plasticity

Different parts of the brain are in charge of different functions in general. However, the functions that these different parts are responsible for are not completely inflexible.
Evolution of the Nervous System

(a) Nerve net of jellyfish
(b) The flatworm nervous system has a primitive brain.
(c) The earthworm nervous system has a simple brain and ganglia along a nerve cord.

(d) The fish forebrain is small compared to remainder of brain.
(e) The goose forebrain is larger.
(f) The human forebrain (cerebrum) dominates the brain.
Genes and the Environment

• Nature (genetics) vs Nurture (environment)
• Major roles in affecting human behaviors
Chromosomes

- Chromosomes are made of DNA.
- Each contains genes in a linear order.
- Human body cells contain 46 chromosomes in 23 pairs – one of each pair inherited from each parent.
- Chromosome pairs 1 – 22 are called autosomes.
- The 23rd pair are called sex chromosomes: XX is female, XY is male.
Fragile X Syndrome (FXS)

• The most common inherited cause of mental impairment
• affects approximately 1 in 3600 males, and 1 in 4000 to 6000 females.
• caused by a mutation in the FMR1 gene on the X chromosome
The X Chromosome

**Fragile X Mutation:**
- Over 200 repeats of the CGG sequence on the fragile mental retardation 1 (FMR1) site
- Partial or complete silencing of the associated protein

**Premutation:**
- 55-200 repeats of the CGG sequence
- Prone to expansion in transmission

**Normal:**
- 5-55 repeats of the CGG sequence
Symptoms

- Typically have normal intelligence compared to patients with Fragile-X Syndrome (most common cause of mental retardation)
- Parkinsonism
- Cognitive decline
- Emotional difficulties
- Apathy
- Subtle facial abnormalities
Treatment

• No established treatment for neurological features of the disease
• A variety of drugs have been prescribed depending on symptoms
• Usually medications associated with Parkinson’s diseases are prescribed
• Most patients benefit from medications
• Physical therapy
Investigating the Brain

- Studying people with brain damage
- Taking electrical recordings of brain activity
- Relying on sophisticated imaging technique

The study of the links between the brain and behavior:
People with Brain Damage

-Split-Brain Experiment

-The right hemisphere controls muscles on the left side of the body; the left hemisphere controls the right side.
Electrical Recording

-EEG (electroencephalograph): a device used to record electrical activity in the brain
Imaging Techniques

Structural techniques:

- **CT** (computerized axial tomography)

- **MRI** (magnetic resonance imaging)
Imaging Techniques

Functional-brain-imaging techniques:

- **PET** (positron emission tomography)

- **fMRI** (functional magnetic resonance imaging)
Applications of Neuroscience

Sun Hwi Bang Team #3
Magnetic Resonance Imaging (MRI)

- First commercial MRI came out in 1981
- Use radio frequency current
- Hydrogen nuclei aligns in a magnetic field
- Measure brain structure and function

Reference:
Waisman Laboratory for Brain Imaging and Behavior
How MRI works?

MRI Simulation

Reference:
Left: Wellcome Trust, Bacterial Compass Needles Help Point to New Treatment
Right: http://www.howequipmentworks.com/
Alcohol and the Brain

Reference: Susan Seligson
Computed Tomography (CT)

- First commercial CT scanner was invented in 1971
- Use computer-processed x-ray to produce slides of object
- High-radiation diagnostic technique

Reference:
tran-sbi3ud-spring12.wikispaces.com/CT+Scan
MRI vs. CT

- Cost
- Radiation Exposure
- Effects on the body
- Applications

Reference:
tran-sbi3ud-spring12.wikispaces.com/CT+Scan
Thank you

Questions?