• How do we study the brain?
• What are the parts of the hindbrain?
• What is the reticular formation?
• Parts of the forebrain?
• Parts of the limbic system?
• Lobes of the cerebral cortex?
• What is the sensory cortex? Motor cortex?
• What is the Sensory homunculus? 17 note cards
• What is the frontal lobe?
• What is the occipital lobe?
• What is the parietal lobe?
• What is the temporal lobe?
• Right vs. left hemisphere?
• What is Broca’s area and Wernike’s area?
• What is the corpus callosum?
• What is split brain?
• What is brain plasticity?
The Brain

Thanks to KAP at www.apppsychology.com!
Major changes by Mrs. C.
Ways we Study the Brain

- Accidents
- Lesions
- EEG
- CAT Scan
- PET Scan
- MRI
- Functional MRI
Accidents

Phineas Gage Story
• Personality changed after the accident.
What this this tell us?
• That different part of the brain control different aspects of who we are
• Show Video
http://www.learner.org/vod/vod_window.html?pid=1592
Lesions

• Purposeful removal or destruction of some part of the brain.

• Frontal Lobotomy
Lesions

Cutting into the brain and looking for change.

Brain tumors also lesion brain tissue.
Electroencephalogram

- EEG
- Detects brain waves through their electrical output.
- Used mainly in sleep research.
Computerized Axial Tomography

- CAT Scan
- 3D X-Ray of the brain.
- Good for tumor locating, but tells us nothing about function.
CT example
Magnetic Resonance Imaging

- MRI
- More detailed picture of brain using magnetic field to knock electrons off axis.
- Takes many still pictures and turns images into a movie like production.
- Does not study function!
MRI example

• Notice the tumor…
Positron Emission Tomography

- PET Scan
- Measures how much of a chemical the brain is using (usually glucose consumption).
- Good for studying function.
PET scan

- Depression
Your Brain After Drugs

Normal

Cocaine Abuser (10 da)

Cocaine Abuser (100 da)
Functional MRI

- Combination of PET and MRI
- fMRI is good for function, hence the f.
fMRI example

- Amygdala activation
- Primary Visual Cortex activation
“OK, Mrs. Dunn. We’ll slide you in there, scan your brain, and see if we can find out why you’ve been having these spells of claustrophobia.”
Dr. Jones, a brain researcher, is investigating the connection between certain environmental stimuli and brain processes. Which types of brain scans is she most likely to use?

A. MRI and CAT
B. CAT and EKG
C. PET and fMRI
D. EKG and CAT
E. lesioning and MRI
The answer was C. The CAT and the MRI give insight into brain structure, not function.
Class Discussion – Respond to the following:

- How might neuroimaging technology provide insights into the severely brain damaged and/or those in a “vegetative” state?
- Write your response in your notes.
- Think-Pair-Share
- Discuss
The Brain

- **Gray matter** – areas of the CNS with high concentrations of cell bodies; outer surface of cerebrum (cerebral cortex)

- **White matter** – areas of the CNS with mostly myelinated axons; inner part of cerebrum

- **Glial cells** – cells in the brain that nourish and protect neurons
Brain Structures

1. Hindbrain
2. Midbrain
3. Forebrain

Cerebral Cortex is part of forebrain
The brain was built like a house, bottom to top. The hindbrain controls basic functions like breathing. (oldest part) The forebrain is the most complex.
What is the hindbrain?

Most basic structures of the brain

**Medulla** (breathing, heart rate, blood pressure)

**Pons** *(helps coordinate movement)* (like facial expressions), may be involved in dreaming

**Cerebellum** (balance and muscle coordination)
Hindbrain

- Structures on top of our spinal cord.
- Controls basic biological structures.
- All animals have hindbrains!

The brain in orange makes up the hindbrain.
Medulla Oblongata

- Located just above the spinal cord.

Involved in control of
- blood pressure
- heart rate
- breathing. (basic stuff!)
Pons

- Located just above the medulla.
- Connects hindbrain with midbrain and forebrain.
- Involved in facial expressions. (Pons = yawns)
Cerebellum – “Cinderella”

• Bottom rear of the brain.
• Means “little brain”
• Coordinates fine muscle movements and balance.
Anencephaly: Born with little or no brain tissue. Always Fatal.

Survival is limited to days. The longest a baby has survived with anencephaly is 2 months.

One reason babies can survive for a short while with virtually no Forebrain is because they may have parts of their hindbrain. **(Pons, Medulla)** Medulla controls vital reflexes.

It is the functions of the forebrain that define us as human and distinguish us from other creatures.
Midbrain

- Coordinates simple movements with sensory information.
- Most important structure in Midbrain is the **Reticular Formation**: controls arousal and ability to focus our attention.

If stimulated

If Destroyed
What is reticular formation?

• Part of brain – affects consciousness. Sleep meds affect this part of the brain. Damage leads to a coma.
Forebrain

- What makes us human, not homo erectus!
- Largest part of the brain.
- Made up of the Thalamus, Limbic System and Cerebral Cortex.
Corpus Callosum

limbic system

Thalamus
Relay sensory information

Hypothalamus
Controls body
Metabolism
Regulates drives
Thalamus

• Switchboard “relay station” of the brain.
• Receives sensory signals from the spinal cord and sends them to other parts of the forebrain.
• Every sense except smell.
The Limbic System deals with memory and emotions.
Limbic System

- EMOTIONAL CONTROL CENTER of the brain.

- Made up of Hypothalamus, Amygdala and Hippocampus.
Hypothalamus

- Pea sized in brain, but plays a not so pea sized role.
- Body temperature
- Hunger
- Thirst
- Sexual Arousal (libido)
- Endocrine System
Rat with an Implanted Electrode in pleasure center of Hypothalamus
The Ventromedial Nuclei gives a signal that you are hungry. The lateral hypothalamus tell your body you’re full.
Hippocampus

- Involved in the processing and storage of memories.
- Its proximity to your emotional centers explains why memories and emotions are so linked!
Amygdala “emotional Amy”

- Brain part involved in telling your body to produce norepinephrine (adrenaline)
- More involved in volatile emotions like anger.

The emotion of anger has not changed much throughout evolution.
The hindbrain consists of the:

- A. endocrine system and the limbic system.
- B. reticular formation
- C. thalamus, hypothalamus, and cerebrum
- D. cerebellum, the medulla, and the pons
The thalamus can be characterized as

- A. a regulatory mechanism
- B. the consciousness switch of the brain
- C. a relay system
- D. a bridge between the 2 cerebral hemispheres
The Cerebral Cortex

- Made up of densely packed neurons we call “gray matter”
- Glial Cells: support brain cells.
- Wrinkles are called *fissures*.
- If you lay brain out it would be as big as a large pizza.
- It’s divided into 2 hemispheres and 4 lobes!
Hemispheres

- Divided into a left and right hemisphere.
- Contralateral controlled - left controls right side of body and vice versa.
- Brain Lateralization.
- Left handed peeps are better at spatial and creative tasks.
- Right handed peeps are better at logic.
Hemispheres

Divided into two hemispheres.

In general,
Left Hemisphere: logic and sequential tasks. Language!

Right Hemisphere: spatial and creative tasks. Reading emotions.
Areas of the Cerebral Cortex

- Divided into eight lobes, four in each hemisphere (frontal, parietal, occipital and temporal).
- Any area not dealing with our senses or muscle movements are called association areas.
What are Frontal Lobes?

- Abstract thought and emotional control and planning.
- Contains **Motor Cortex**, **Broca's area**.
- **Broca's Aphasia**
- **Lobotomies damage this**.
- **Suppresses the Amygdala**.
What is the motor cortex?

- Part of the brain in the frontal lobe that tells my body how to move (like typing this).
Demonstration

• Try moving your right hand in a circular motion – like polishing a table

• Start your right foot doing the same motion, synchronized with the hand.

• Attempt to reverse the direction of your foot only (Tough, huh? 😊)

• Now try moving left foot opposite direction of right hand. (Interestingly easy 😊)

• WHY???? Discuss
What is the Broca’s Area?

- Think “Boca” = mouth
- Damage to this area can cause Broca’s Aphasia – you will be unable to talk
Sensory homunculus

A visual representation of how much space your brain needs to operate parts of your body. Notice how big the face and hands are. How small everything else is!
Need a volunteer wearing flip flops

• Which toe did I poke????
Motor strip and homunculus
Parietal Lobes

• Contain **Sensory Cortex**: receives incoming touch sensations from rest of the body.

• Most of the Parietal Lobes are made up of **Association Areas**.

Where would this girl feel the most pain from her sunburn?
What is the sensory cortex?

It’s the part that deals with touch sensations. It’s in the parietal lobe.
Motor and Sensory Cortexes
What are Motor and Sensory Cortices?

The wires are switched! Right controls left! The motor cortex is in which lobe?
Occipital Lobes

- Think “optical”.
- Contains **Visual Cortex**: interprets messages from our eyes into images we can understand.
Notice how close the auditory cortex is to the ears.
Temporal Lobes

- Process sound sensed by our ears.
- Interpreted in Auditory Cortex.
- NOT LATERALIZED.
- Contains Wernike’s Area: interprets written and spoken speech.
- Wernike’s Aphasia: unable to understand language: the syntax and grammar jumbled.
• In what region of the brain is the Broca’s area located?

• In what region of the brain is the Wernicke’s area located?
The ______ lobe is to hearing as the occipital lobe is to vision

• A. frontal
• B. temporal
• C. parietal
• D. cerebellar
Sounds presented to the right ear are registered

- A. only in the right hemisphere
- B. only in the left hemisphere
- C. more quickly in the right hemisphere
- D. more quickly in the left hemisphere.
• In people whose corpus callosum have not been severed, verbal stimuli are identified more quickly and more accurately:
  • A. when sent to the right hemisphere first
  • B. when sent to the left hemisphere first
  • C. when presented to the left visual field
  • D. when presented auditorially rather than visually.
• Blindness could result from damage to which cortex and lobe of the brain?
• A. visual cortex in the frontal lobe
• B. visual cortex in the temporal lobe
• C. sensory cortex in the parietal lobe
• D. visual cortex in the occipital lobe
• E. cerebral cortex in the occipital lobe
According to the theory of evolution, why might we call some parts of the brain the old brain and some parts the new brain?

A. Old brain parts are what exist in very young children, and new parts develop later.
B. Old brain developed first according to evolution.
C. The old brain becomes more active as we grow older.
D. The new brain deals with new information, while the old brain deals with info gained in childhood.
E. The old brain is most affected by age deteriorations (dementias) while the new brain remains unaffected.
• Paralysis of the left leg might be explained by a problem in the
• A. motor cortex in the frontal lobe in the left hemisphere
• B. motor cortex in the frontal lobe in the right hemisphere
• C. Sensorimotor cortex in the temporal lobe in the left hemisphere
• D. motor cortex in the parietal lobe in the left hemisphere
• E. motor cortex in the occipital lobe in the right hemisphere
Specialization and Integration in Language

1. Visual cortex (receives written words as visual stimulation)
2. Angular gyrus (transforms visual representations into an auditory code)
3. Wernicke’s area (interprets auditory code)
4. Broca’s area (controls speech muscles via the motor cortex)
5. Motor cortex (word is pronounced)
Brain Activity when Hearing, Seeing, and Speaking Words

Which side of the brain are we seeing?
In most people, which one of the following is a specific function of the left hemisphere that is typically not controlled by the right hemisphere?

- A. producing speech
- B. control of the left hand
- C. spatial reasoning
- D. hypothesis testing
- E. abstract reasoning
Brain Plasticity

• The idea that the brain, when damaged, will attempt to find new ways to reroute messages.

• Children’s brains are more plastic than adults.
Brain plasticity

Neurons’ ability to re-route their messaging in case of injury.

Neurons in the brain connect with one another to form networks.

The brain learns by modifying certain connections in response to feedback.
When brain researchers refer to brain plasticity, they are talking about:

- A. the brain’s ability to quickly reroute damaged neurons
- B. the surface texture and appearance caused by the layer known as the cerebral cortex
- C. the brain’s versatility caused by the millions of neural connections
- D. our adaptability to different problems ranging from survival needs to abstract reasoning
- E. new connections forming in the brain to take over for damaged sections
The cerebral hemispheres and the corpus callosum. (Left) As this photo shows, the longitudinal fissure running down the middle of the brain (viewed from above) separates the left and right halves of the cerebral cortex. (Right) In this drawing the cerebral hemispheres have been "pulled apart" to reveal the corpus callosum. This band of fibers is the communication bridge between the right and left halves of the human brain.
The Corpus Callosum

Corpus callosum

Divides the 2 hemispheres.
Divides the left from right sides.

The corpus callosum is cut to prevent seizures from spreading to the other side of the brain.
What is Split Brain?
Split Brain Patients

Those who, due to epilepsy, have their corpus callosum cut or removed.
Testing the Divided Brain

“Look at the dot.”

“Point with your left hand to the word you saw.”

Two words separated by a dot are momentarily projected.

“What word did you see?”

Art

or

HE

ART
Experiment #1 Split-brain patients

- Experimenter shows fork to left hemisphere (presents to the right side)
- Participant is asked what he saw…
- He states “fork”
- Experimenter shows spoon to right hemisphere
- Participant is asked what he saw
- Response: “I don’t know”
- Participant is asked to reach in a bag with left hand (right hemisphere) to retrieve what he saw
- He pulls out a spoon…explain?
Other weird issues with split-brain

• A split-brain patient was asked what he wanted to do with his life…
  – Left hemisphere wrote: architect
  – Right hemisphere wrote: race car driver

• Suicide case study
  – Left hand (right hemisphere) kept trying to strangle herself
  – Left hemisphere was unaware of why this was happening and had to defend herself
  – Tumor was discovered on her corpus collosum
• Case study of lesioned corpus collosum
  – Right hand (left hemisphere) chose conservative clothes
  – Left hand (right hemisphere) would unbutton shirts without the left hemisphere’s awareness

• Implication: Are there two of us?
• "The great pleasure and feeling in my right brain is more than my left brain can find the words to tell you."

• Roger Sperry
On the next slide, say the COLOR of the word without reading the word.
Look at the chart and say the **COLOUR** not the word

**YELLOW**  **BLUE**  **ORANGE**
**BLACK**  **RED**  **GREEN**
**PURPLE**  **YELLOW**  **RED**
**ORANGE**  **GREEN**  **BLACK**
**BLUE**  **RED**  **PURPLE**
**GREEN**  **BLUE**  **ORANGE**

Left – Right Conflict

Your right brain tries to say the colour but your left brain insists on reading the word.
• Split brain patients are unable to:
  • A. coordinate movements between their major and minor muscle groups
  • B. speak about information received exclusively in their right hemisphere
  • C. speak about information received exclusively in their left hemisphere
  • D. solve abstract problems involving integrating logical (left hemisphere) and spatial (right hemisphere) information
  • E. speak about information received exclusively through their left ear, left eye, or left side of their bodies
• The scientist who won a Nobel Prize for his work with split brain patients is
  • A. Walter Cannon
  • B. Paul Broca
  • C. Roger Sperry
  • D. James Olds
  • E. Cheech Marin
A Tour Through The Brain: Split-Brain Research

- Severing the corpus callosum provides data regarding the functions of the brain’s two hemispheres.
A Tour Through The Brain: Split-Brain Research (Continued)
A Tour Through The Brain: Lateralization

- The left and right hemispheres of the brain each specialize in particular operations.