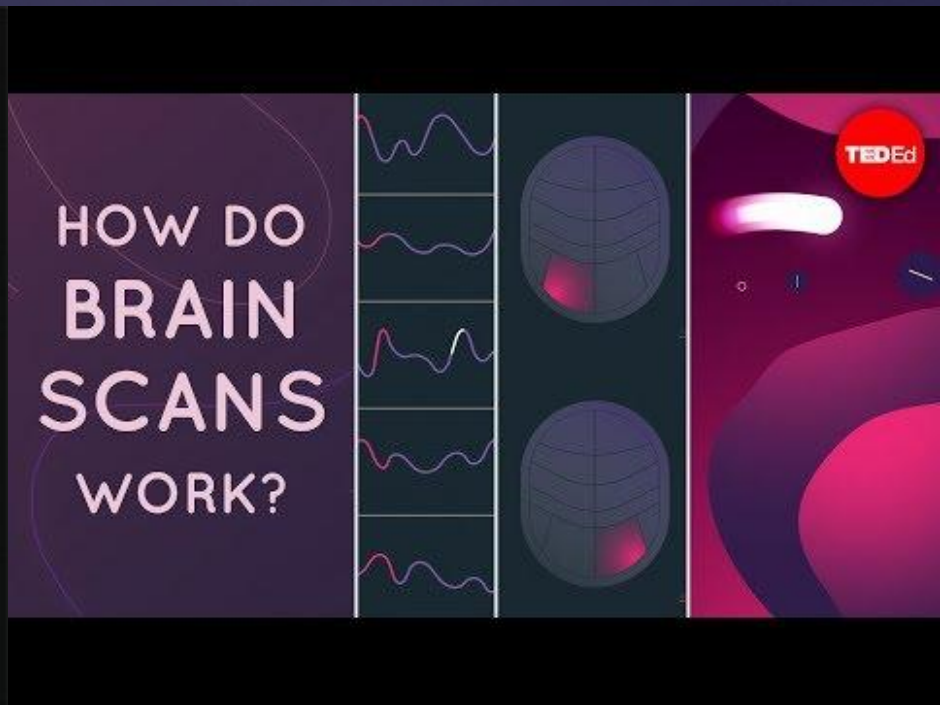
Studying the Brain

{ Scans and Imaging

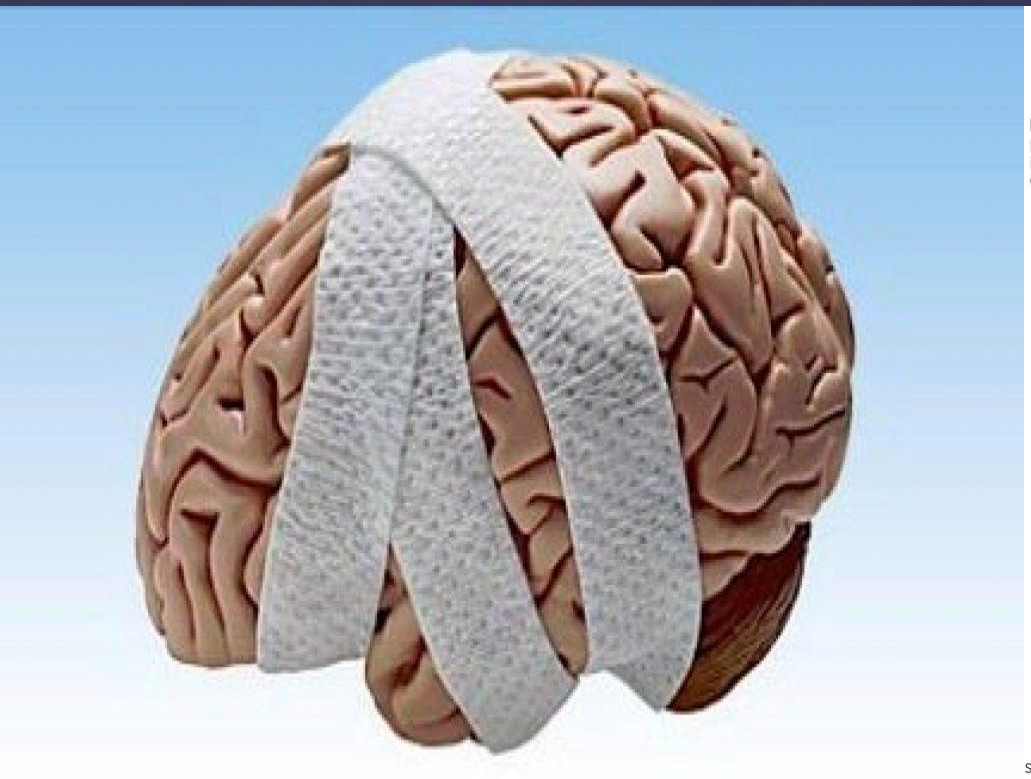
How do we “see” the Brain?

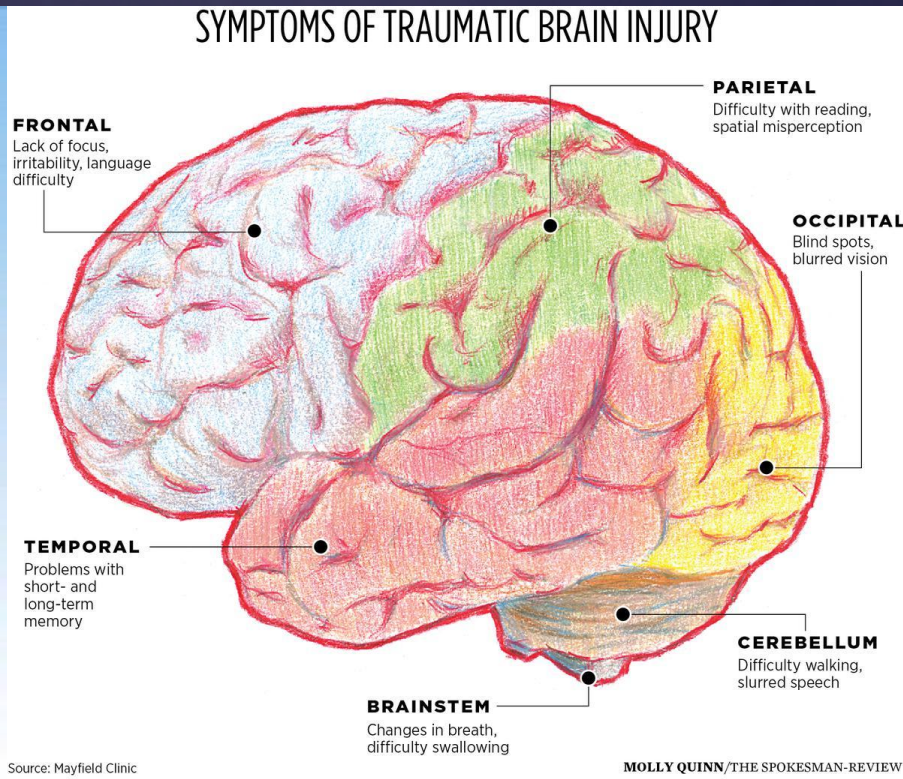
- The Brain is an extremely complex and fragile system
- This makes studying it very difficult



Why do we need to "see" the brain?

- Brain damage can result in a loss of various senses or thought processes.
- Comparing the damaged area with the loss of function, we can better tell how that area works





Injury leads to Insight

- Sports have been re-examining their safety in an attempt to understand their role in Traumatic Brain Injuries (TBI)

- Football and Soccer both have considered major changes to the sport in an effort to reduce TBIs

Electrical Stimulation

- The brain operates by electrical impulses
- By attaching nodes to certain portions of the brain and sending artificial charges, we can see what parts control what
- Electroshock Therapy was often used in patients with major depression and/or bipolar disorder

Study and Usage of Electrical Stimulation

- In a study with rats, scientists attached a button to the rat hypothalamus that stimulated pleasure.
- As a result the rats continually pushed the buttons up to 100 times per minute and sometimes gave up on food in favor of charging their brains.

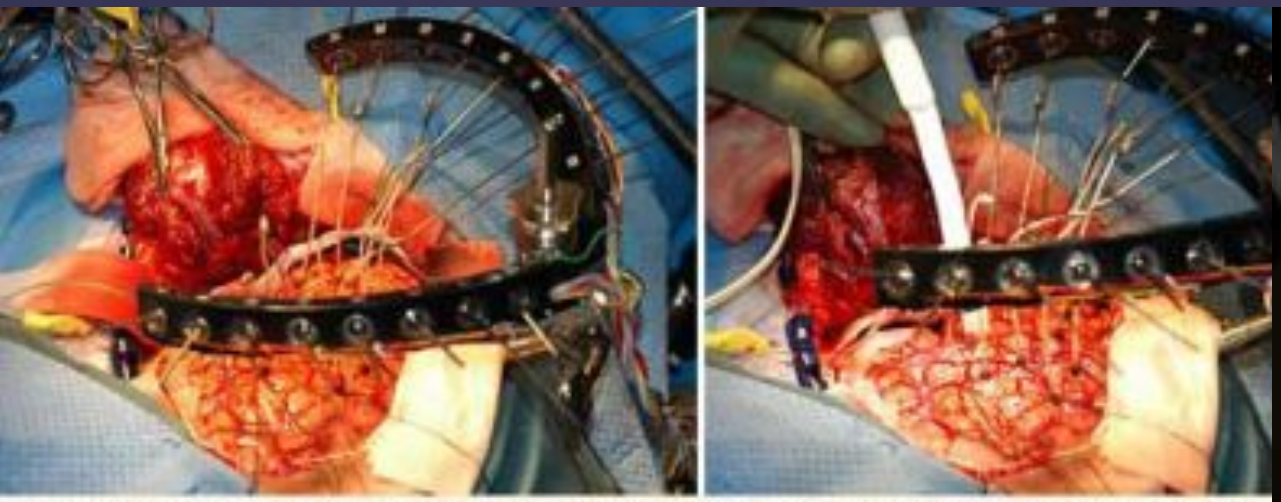
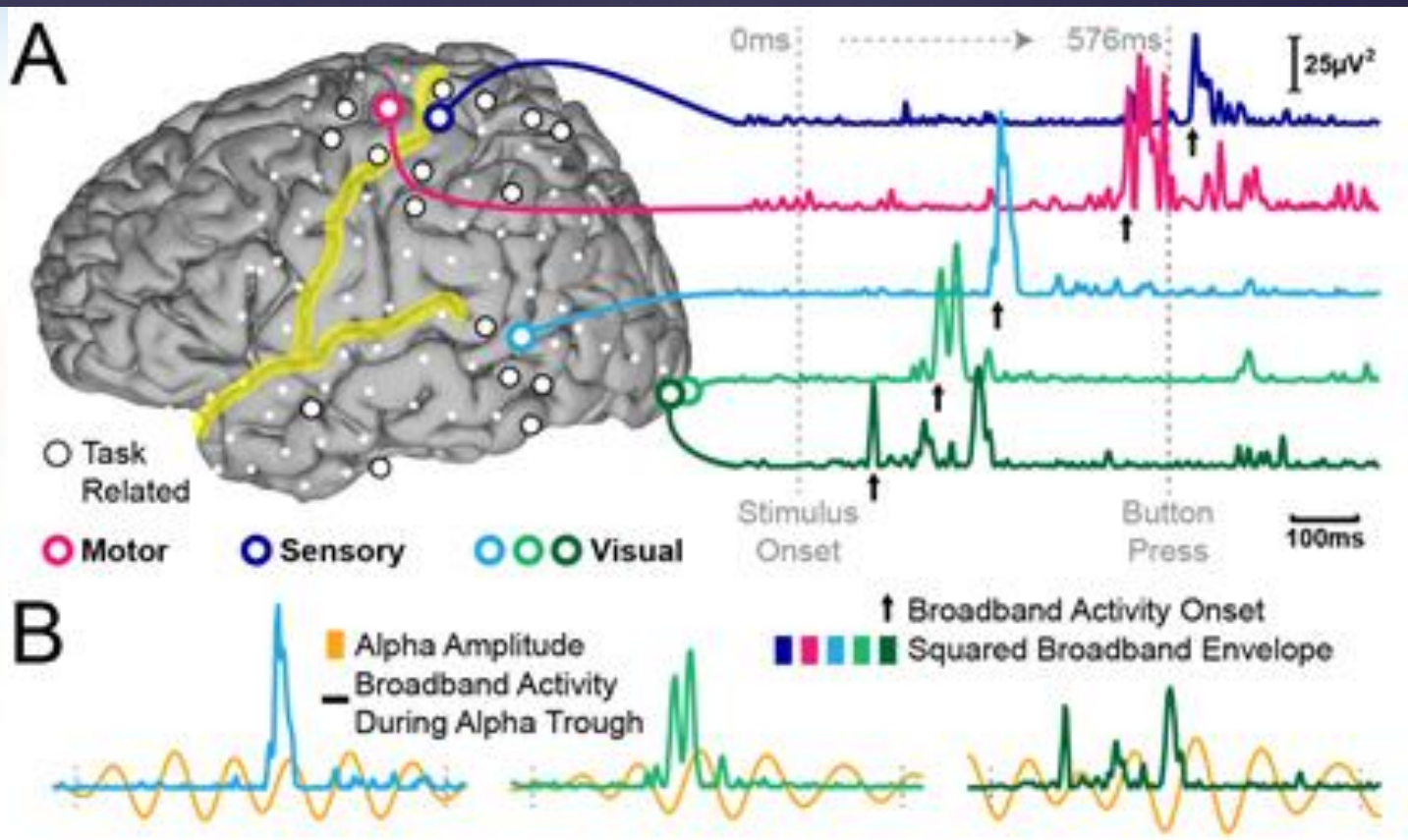


Figure 2 illustrates how the procedure can be used to identify epileptic areas (left image) and to determine the amount of current needed for electrical stimulation mapping (right image).

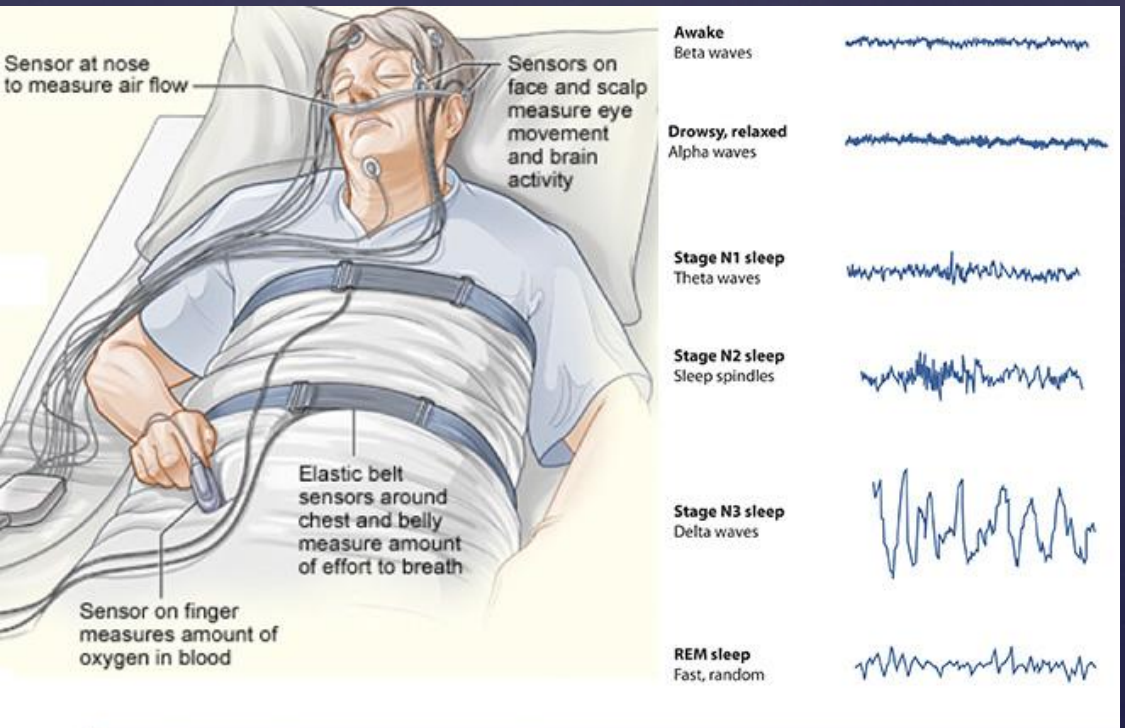
The Electroencephalogram (EEG)

- Instead of shooting electricity into the brain, we can sometimes read the charges that are already there.
- **The EEG connects electrodes to your head and reads the electrical communication in your skull.**



Study and Uses of EEG

- This allows scientists to see what areas activate for what behaviors/emotions
- We can also locate tumors based on where communication is disrupted



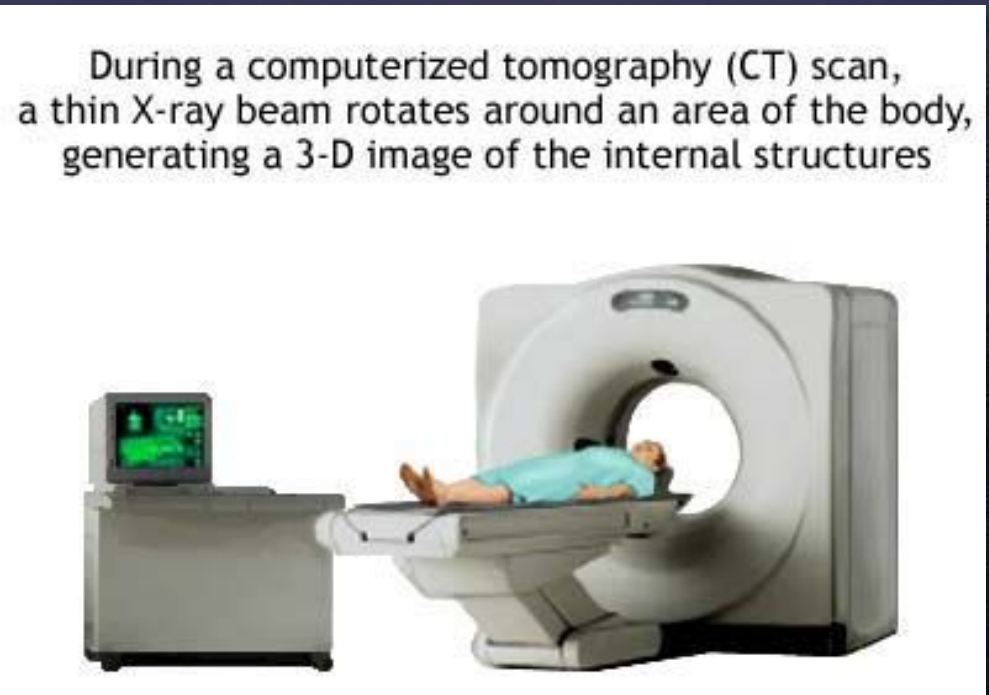
Types of Brain Scans

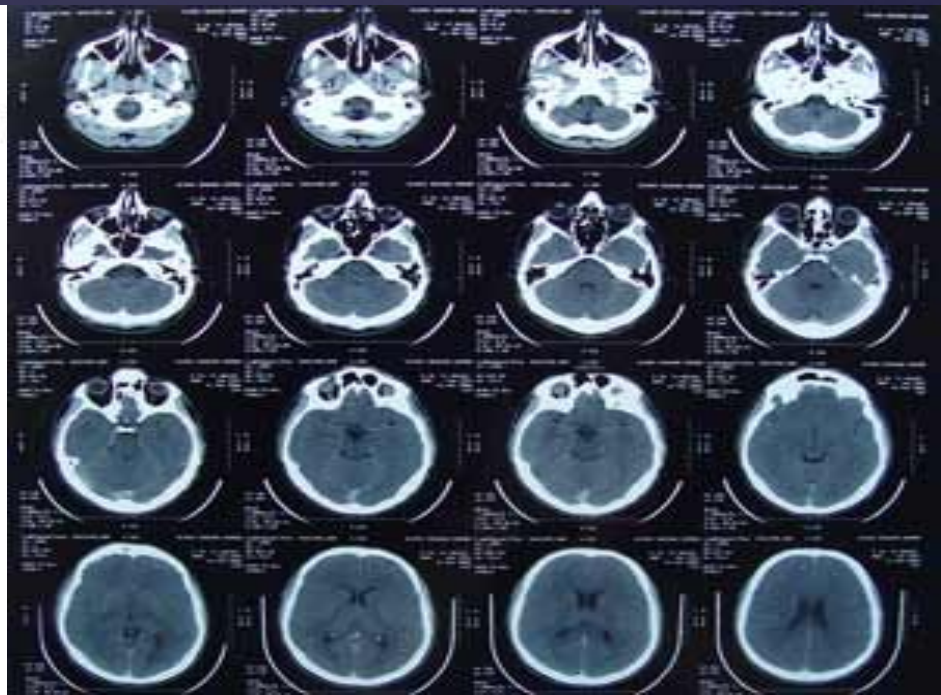
- There are several types of advanced scanning systems that have been developed in recent years.

  - Computerized Axial Tomography (CAT)
  - Magnetic Resonance Imaging (MRI)
  - Positron Emissional Tomography (PET)

Computed Axial Tomography (CT or CAT)

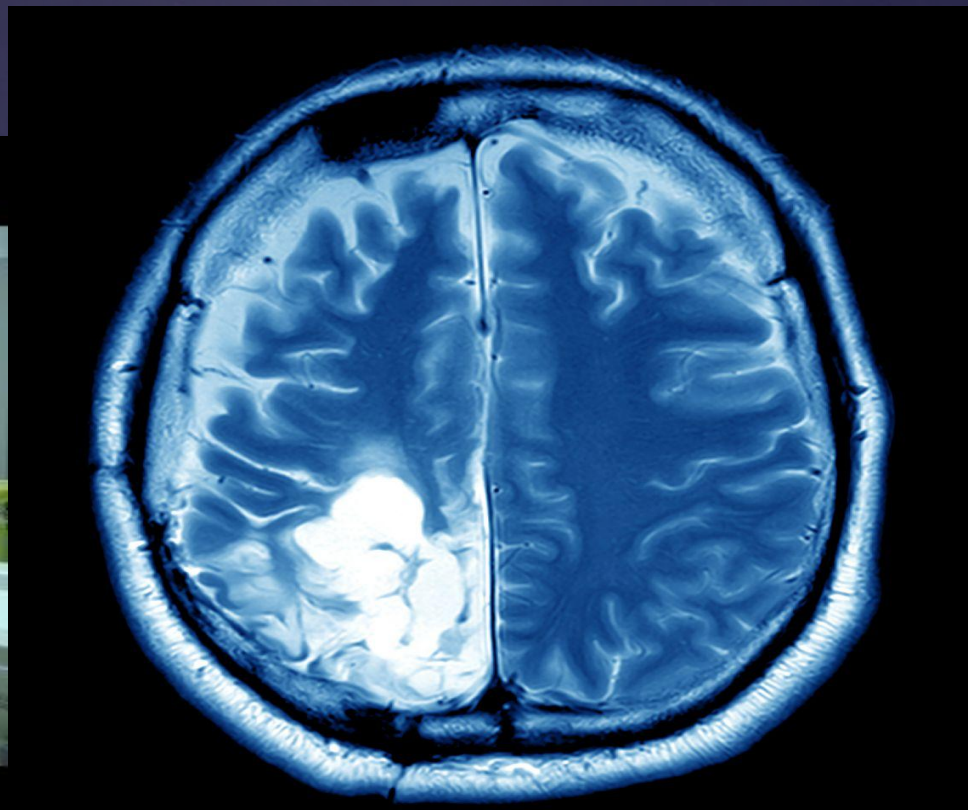
- Uses special x-ray equipment to help detect a variety of diseases and conditions
- Fast, painless, noninvasive and accurate
- It can reveal internal injuries and bleeding





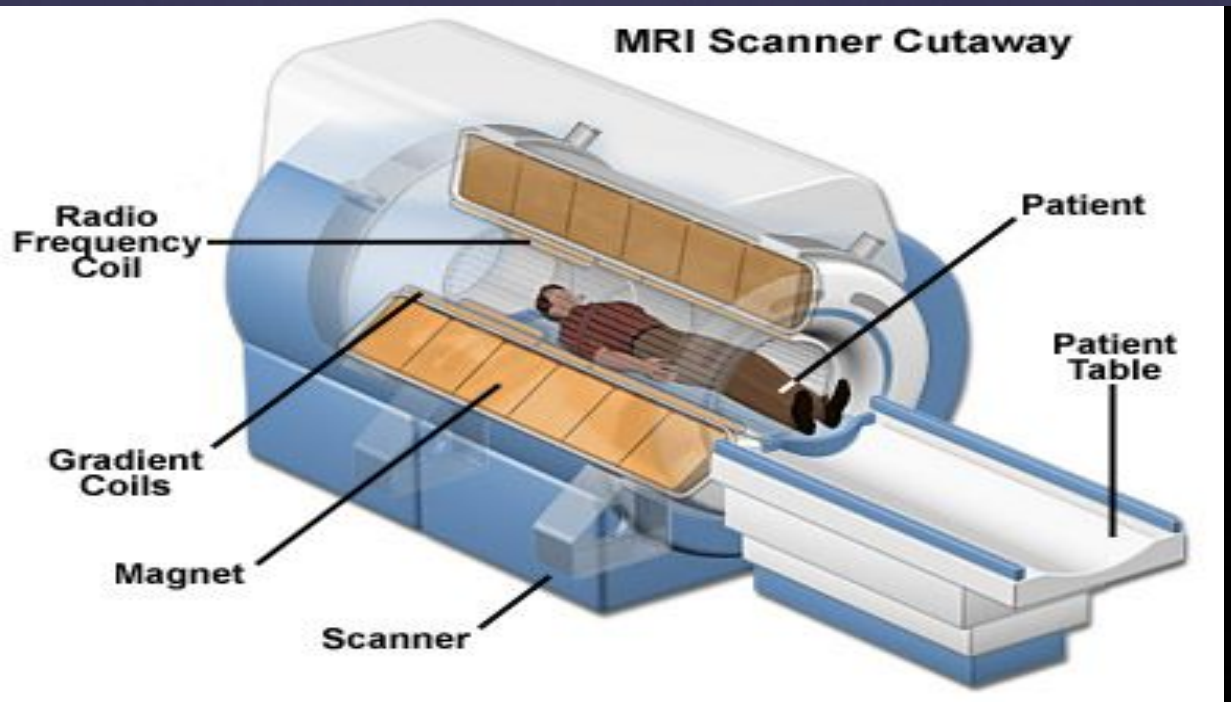
CT Scan Uses

- Discover brain injuries
  - Internal bleeding
  - Blood clots
  - Cancerous tumors



Magnetic Resonance Imaging (MRI)

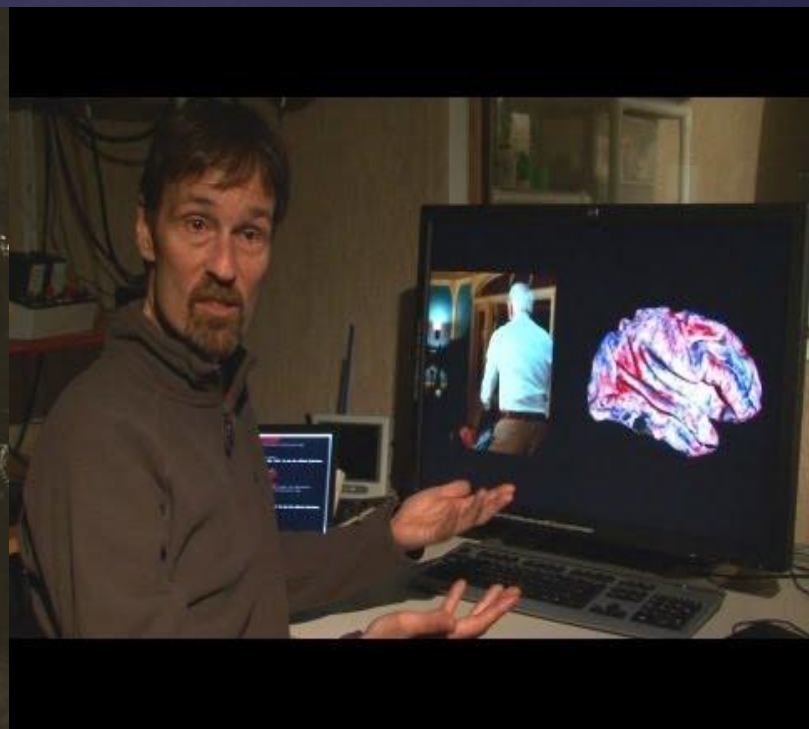
- **Uses a powerful magnetic field, radio waves and a computer to produce detailed pictures of the brain**
- It is much more powerful than a CT Scan resulting in clearer and more detailed than other imaging methods.

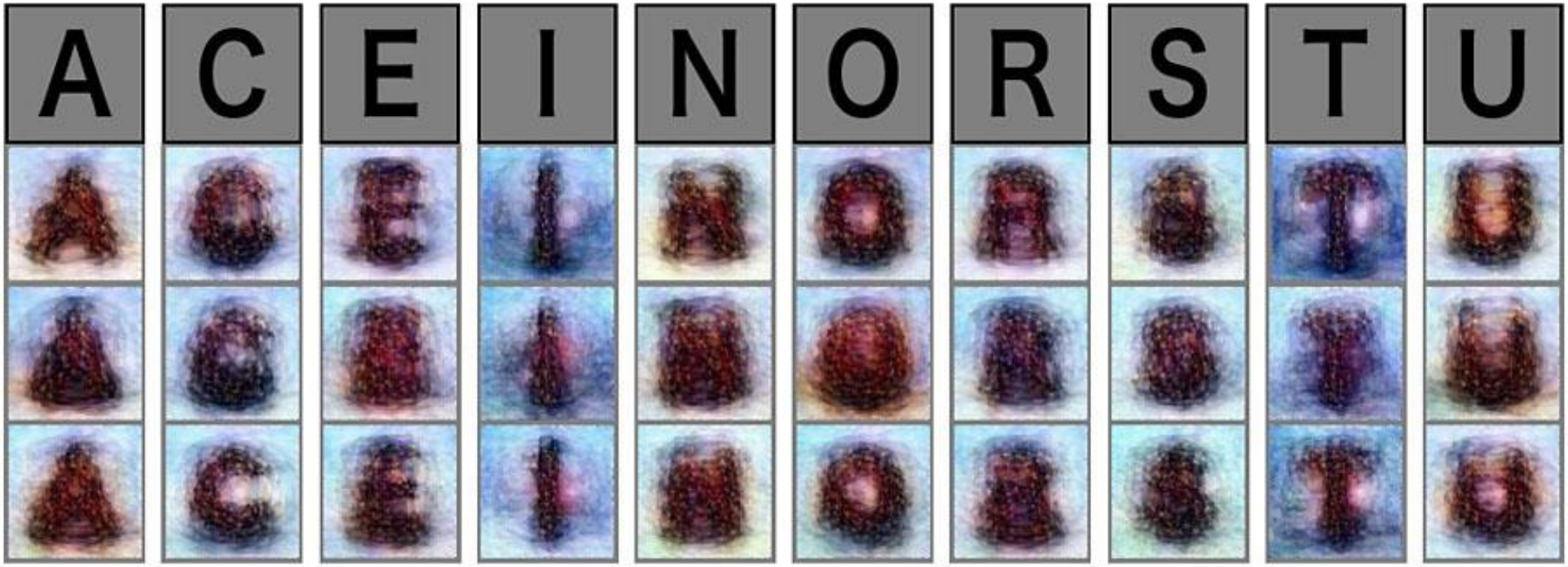


MRI Studies and Uses

A new type of polygraph test?

Dream analysis?





Presented clip

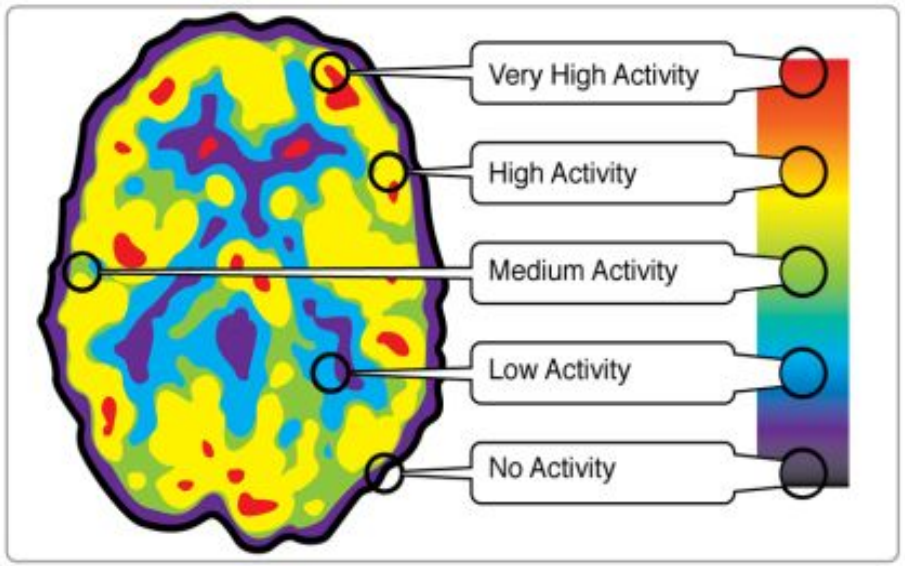
Clip reconstructed from brain activity

Presented clip

Clip reconstructed from brain activity

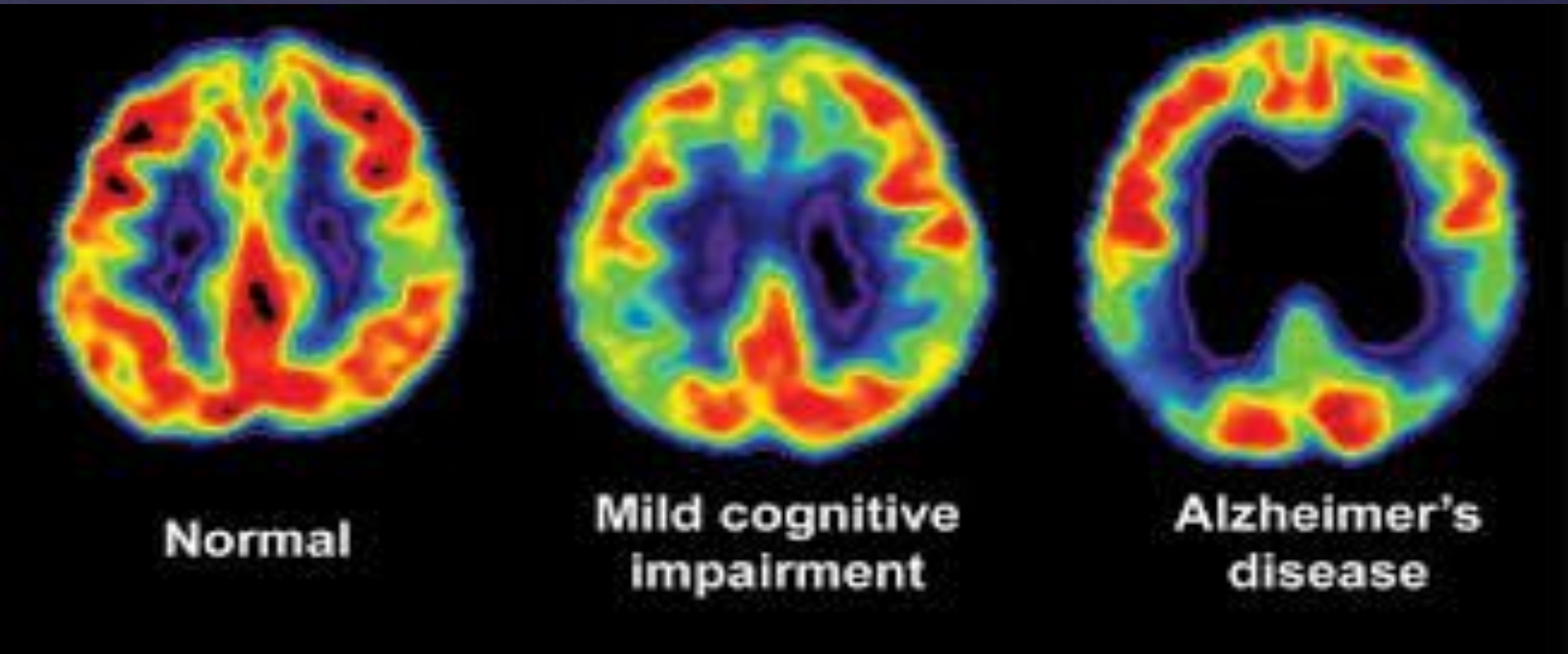
Positron Emissional Tomography (PET)

- **Subject is injected with a radioactive sugar which travels to the brain and is used in certain areas of high activity.**
- Radioactivity can be read by the PET machine, mapped, recorded, and printed.
- This allows researchers to catch the brain at work.



PET Scan Uses

How drugs affect brain
Look for alzheimer's
Lowest time resolution



3D Printers & The Brain

- Depending on the imaging and scanning system used, these files can be uploaded to 3D printers.
- This is a brand new technology that allows scientists to study exact replicas of patients brains without having to cut them open.

3D Printers & The Brain

- Due to how new this technology is, the usefulness of 3D printers in science and research has yet to be perfected
- 2017 Australian scientists replicate brain tissue using stem cells and 3D printers

Brain Disorders

Video 1) https://www.youtube.com/watch?v=bnOp9KpVDLI
hemispherectomy
Video 2) https://www.youtube.com/watch?v=zx53Zj7EKQE
corpus callosum severed
Video 3) https://www.youtube.com/watch?v=f31m5-5-xUY
Ralph - Cerebellar Hypoplasia
Video 4) https://www.youtube.com/watch?v=awolchTol4A&t=72s&disable_polymer=true
Clyde - Cerebellar Hypoplasia
Video 5) https://www.youtube.com/watch?v=3oef68YabD0
Wernicke's aphasia
Video 6) https://www.youtube.com/watch?v=JWC-cVQmEmY
Broca's aphasia