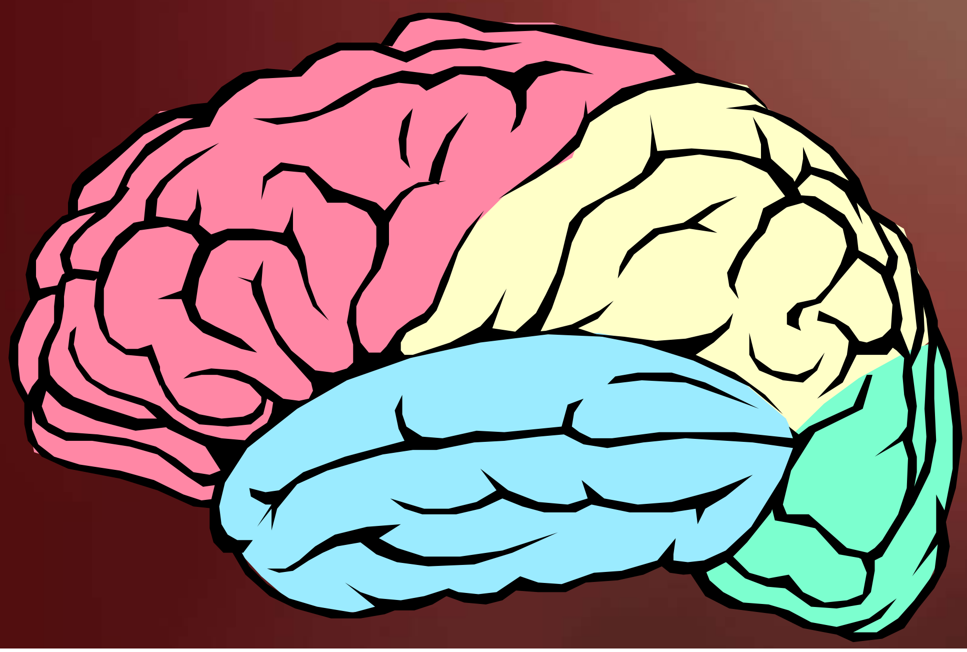
How are Parts of the Brain Related to Brain Function?

Scientists have found...

That the basic anatomical components of brain function are related to brain size and shape.



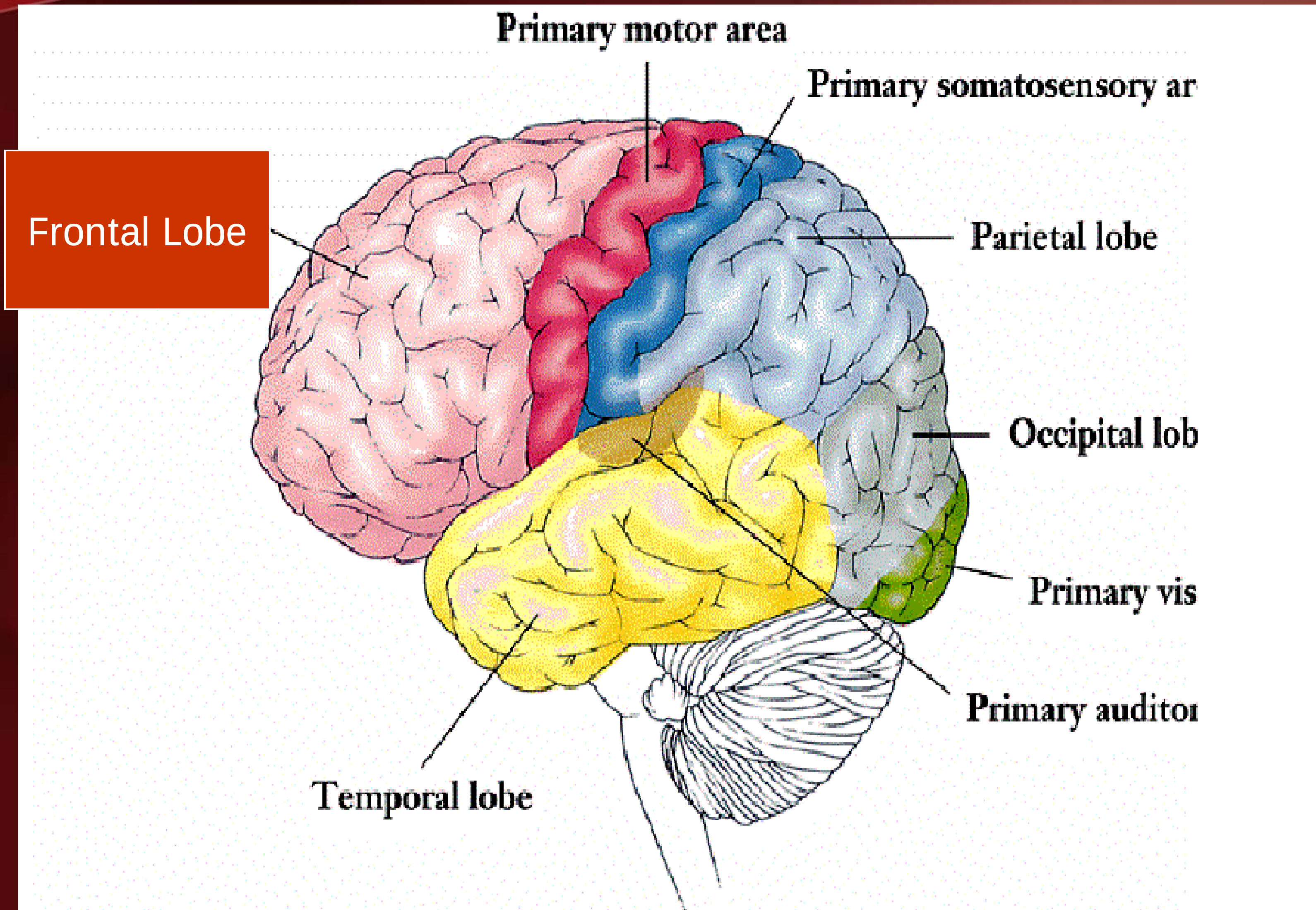
The brain is composed of two hemispheres.

- The left hemisphere is larger than the right.
- The left hemisphere is responsible for verbal functions.
- The right hemisphere is responsible for spatial functions.

Additionally, the cerebral cortex is divided into lobes…

- The Frontal lobe (forehead) is responsible for **emotions, judgment,** and **planning**.
- This lobe is the last to mature (which explains why children do not plan very effectively).

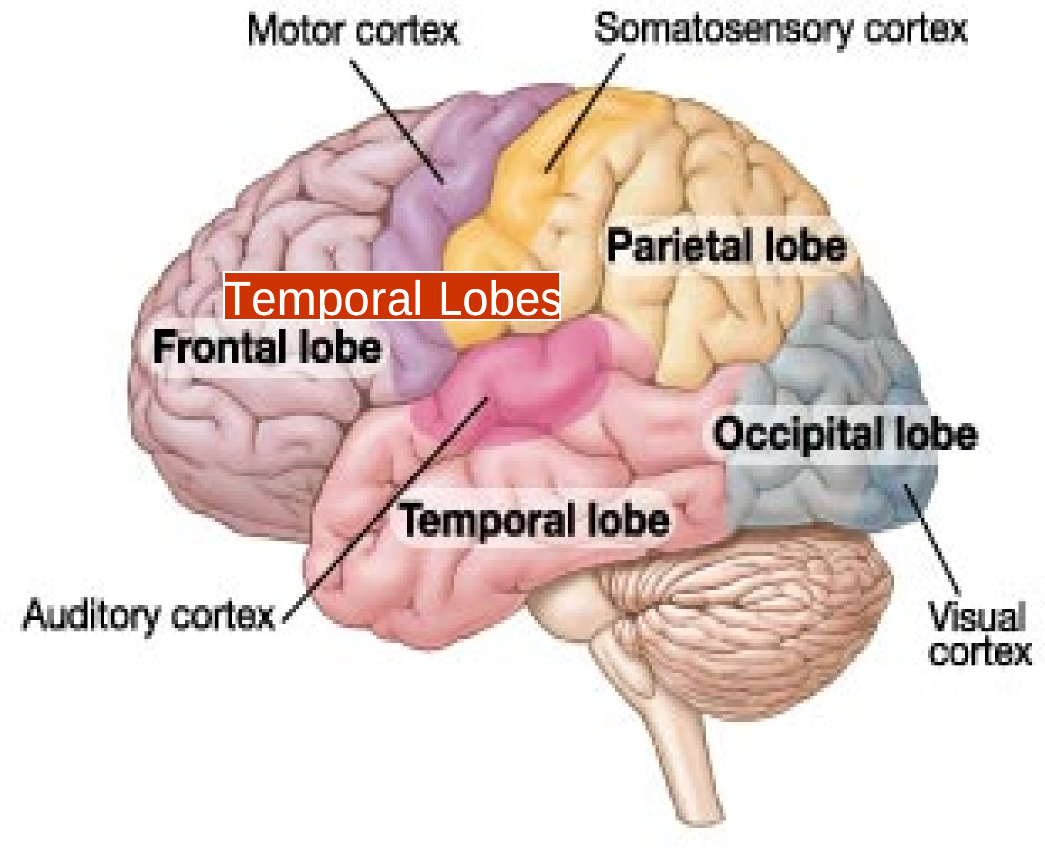
In this slide, the frontal lobe is pink.



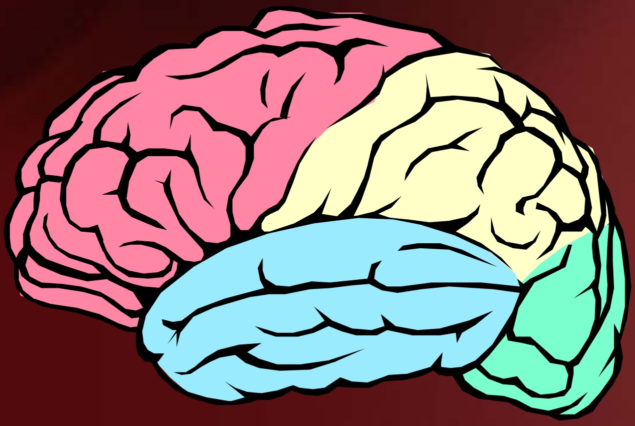
The Temporal lobes

- Are located at the temple areas. They are responsible for **timing** and **attention.**
- These lobes play an important part in **memory** and **expressive and receptive speech.**
- Temporal lobes are thought to mature at about the age of 7.

Temporal lobes are light pink in this slide.



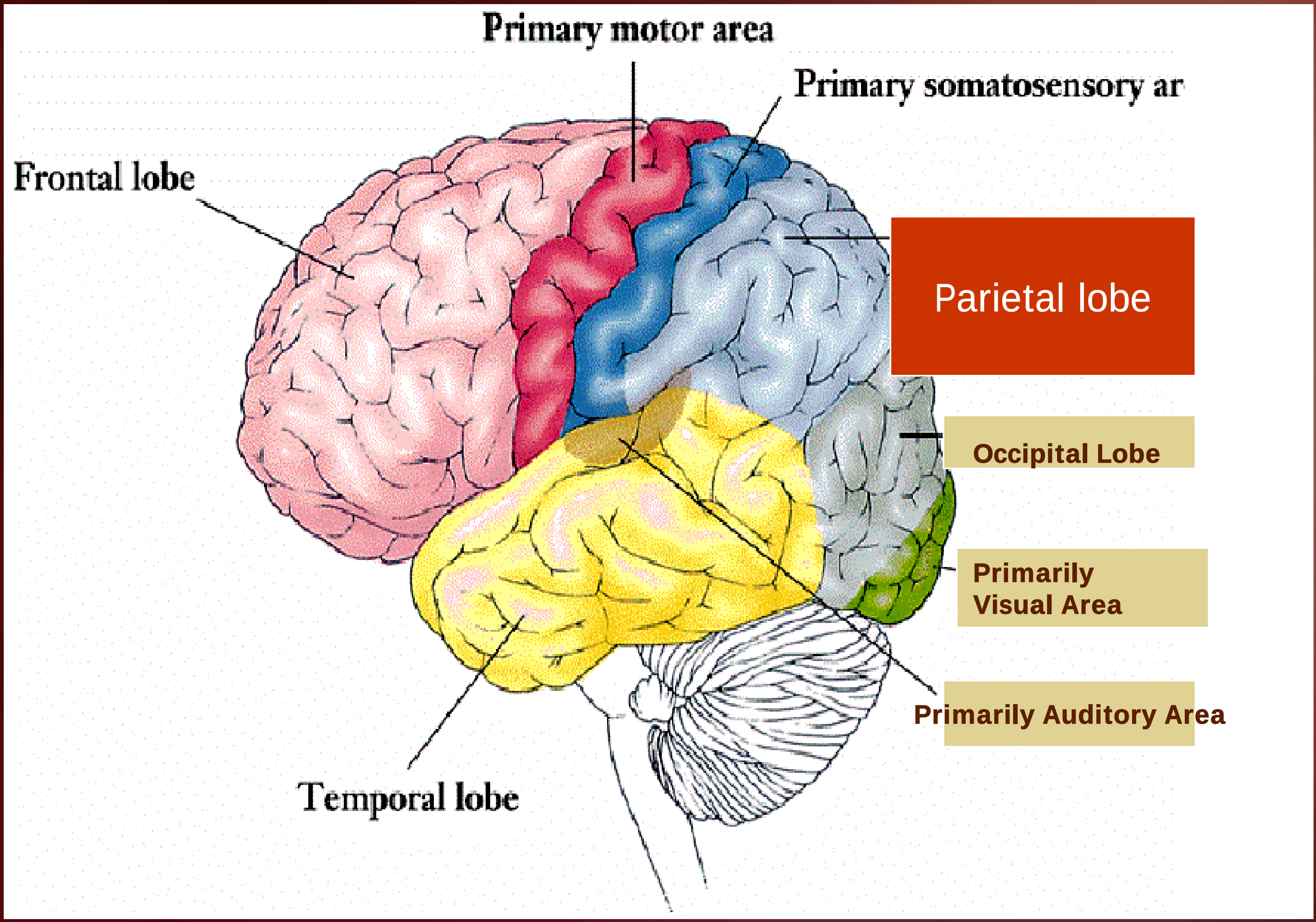
Parietal Lobes



Parietal Lobes

- The Parietal lobes are responsible for Spatial functions.
- The left Parietal lobe is responsible for spatial language (on, over, on top of, before)
- The right Parietal lobe is responsible for spatial functions (How big is the room you are in?)
- They are located on the sides of the head behind the temporal lobes
- M

The Parietal Lobes are Blue-Gray on this slide.



Since young children do not understand spatial relationships…

- It is more difficult to teach them to tell time.

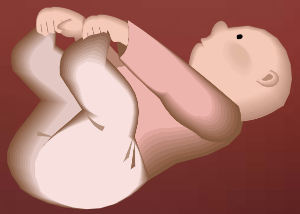
- They do not understand conservation, a concept discussed by Piaget.

- Piaget discovered that conservation was not mastered by young children regardless of intellect.

- It was age dependent.

Recognition that this skill is dependent on organic maturity…

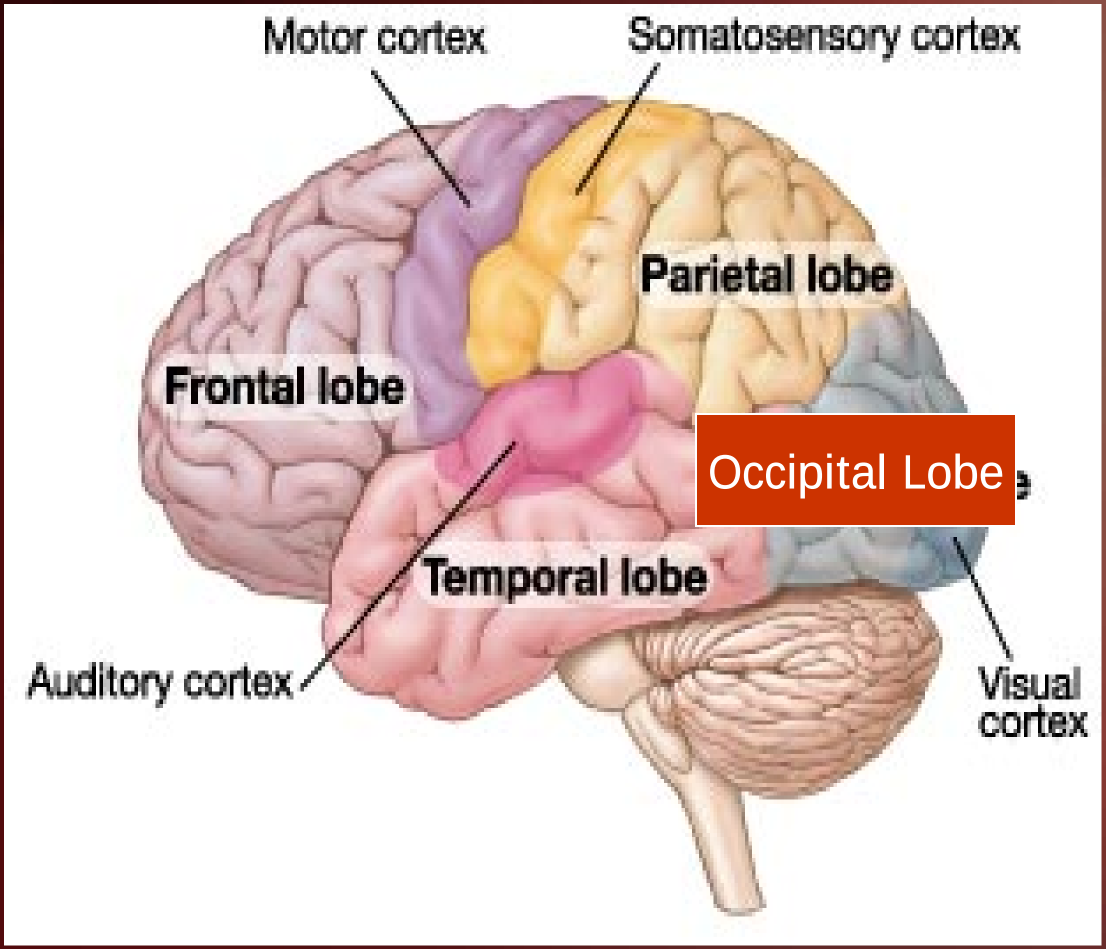
- Explains why it cannot be mastered by young children who are highly intelligent.
- They simply do not have the organic maturity to support this understanding.
- It is analogous to trying to teach a 6 month-old child to walk.
- The child simply does not have the physical ability to master this skill.



The Occipital Lobe

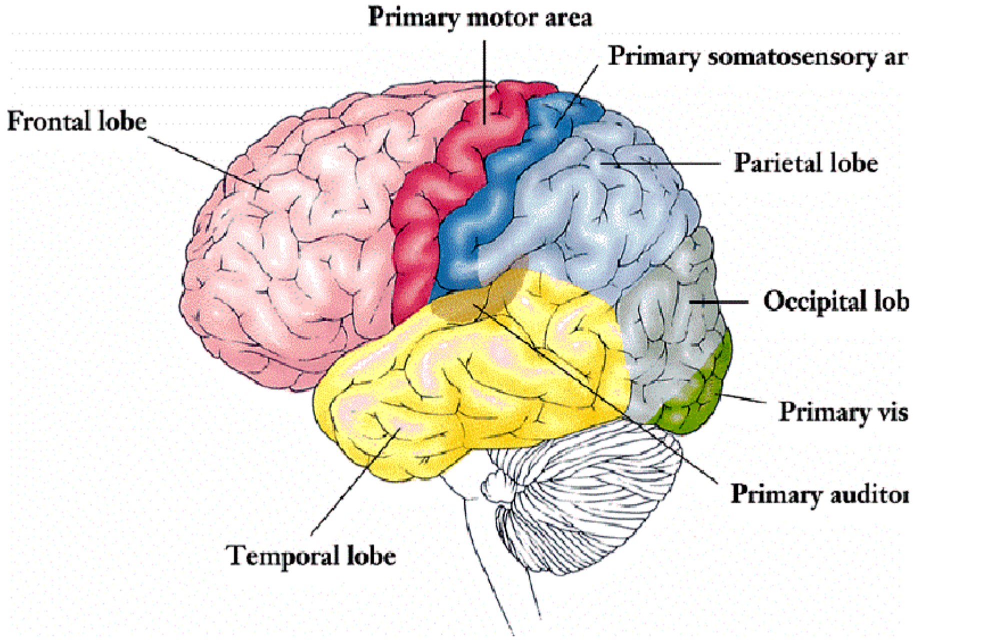
- **Located in the back of the head is primarily responsible for sight.**

The Occipital Lobe is gray on this slide.

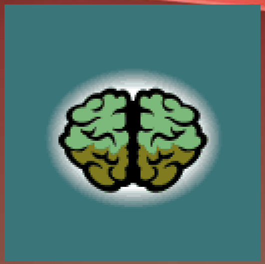


Sometimes lobes work in concert…

- For example, estimating depends on both the Parietal and Frontal lobes.
- The Parietal lobe is responsible for spatial concepts.
- And the frontal lobe for judgment.
- Difficulty with estimation can implicate either or both of these regions.

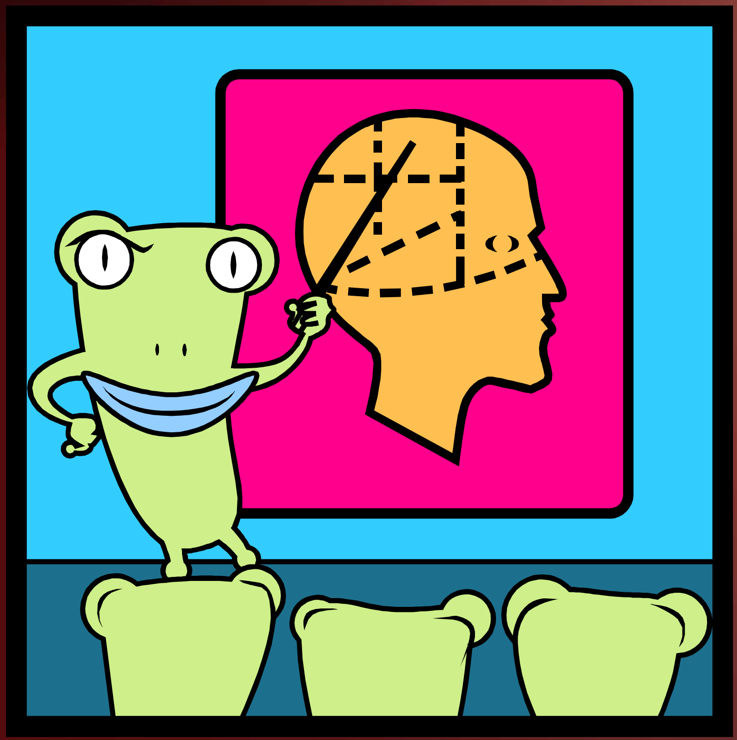


Beneath the cerebral lobes



- Are the most sensitive brain structures.
- Here lie areas responsible for moving short-term memory traces into long-term memory traces (the hypocampal area).
- Also housed in this region is the diencephalon which helps the body maintain homeostasis.
- Of critical import to learning is the reticular activating system which helps with attention and concentration.

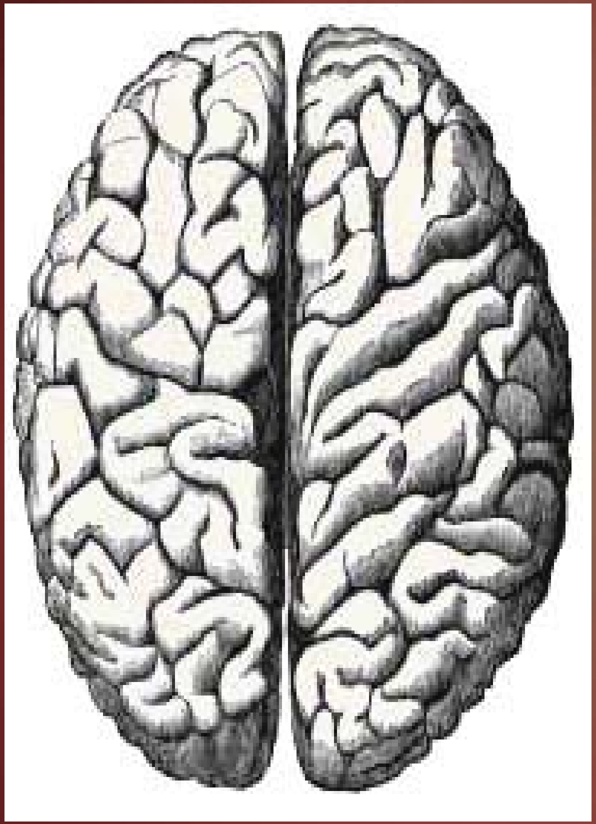
Scientists are aware that difficulty with specific cortical regions influence learning.



Let's look at specific differences in brain structure in individuals with reading disorders.

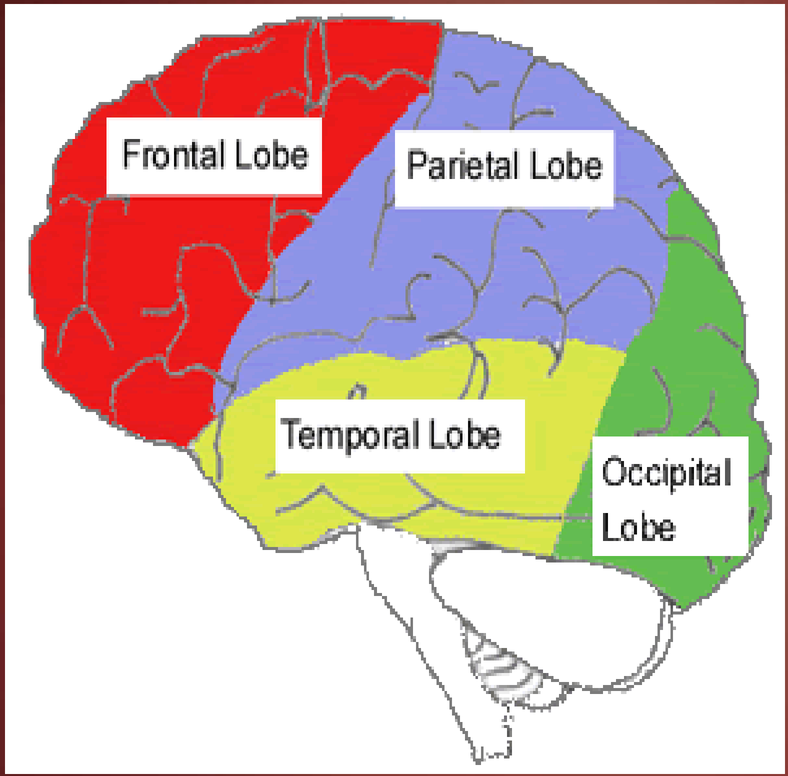
Research has focused on reading disabilities, since they represent the most common and frequently identified type of Learning Disability.

- Studies have shown that brains of subjects with reading disabilities have no asymmetry in brain structures.
- Both hemispheres are equal in size.



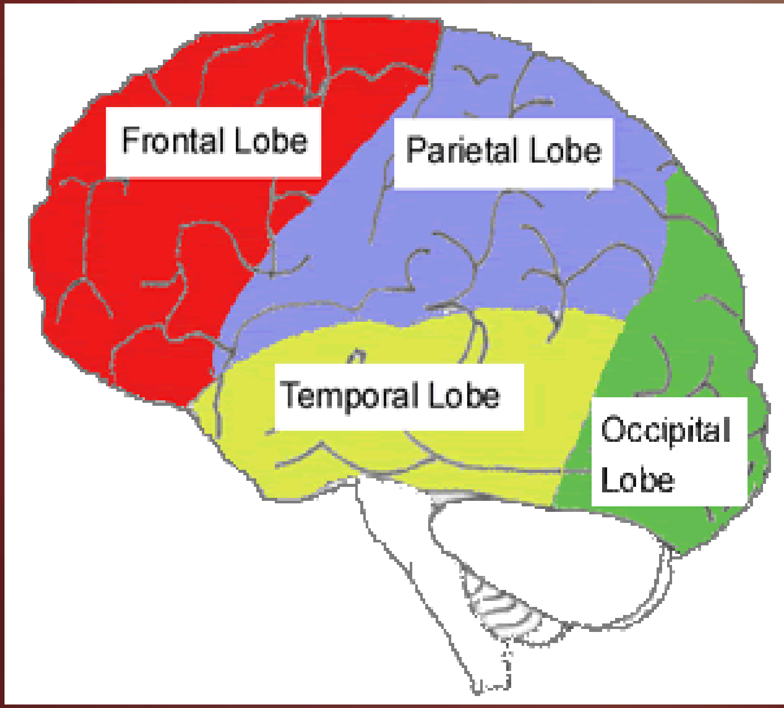
The differences are specific to the temporal lobe.

The temporal lobe (planum temporale area) in the left hemisphere has been found to be typically larger than the temporal lobe (planum temporale area) in the right hemisphere in subjects without LD.



In normal individuals there is asymmetry in the size of the temporal lobes.

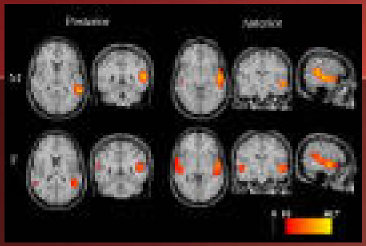
In subjects with LD the left hemisphere has been found to be the same size as the right hemisphere.



This is a logical finding since…

- The left hemisphere is primarily responsible for language.
- It makes sense that when this area is diminished in size, skills housed in the region will be compromised.

The CT Scan



•One technique for studying the brain is the CT scan (computed tomography).

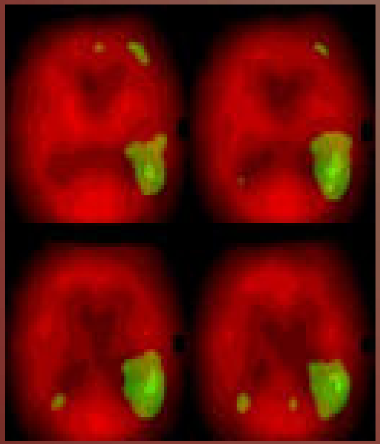
•With this technique, a beam of x-rays is shot through the brain, identifying bone, grey matter, and fluid.

•A computer then reconstructs an image of each slice or brain section

allowing abnormalities in structure to be detected.

Individuals with reading disorders have another important difference in brain anatomy.

- CT scans of the occipital lobe have shown asymmetry of the occipital pole in subjects without LD,
- and symmetry in subjects with LD.



Scientists believe differences in the occipital lobe…

- Are related to how the individual sees words rather than how the individual processes words.

- Many individuals with reading disorders have difficulty with letter stabilization.

The MRI shows other important differences.

- Magnetic resonance imaging (MRI) is a technique that involves
  recording the electromagnetic energy of brain protons
  and constructing an image by superimposing magnetic fields.

The MRI allows the practitioner to gain a valuable perspective of the brain.

MRI's show differences

- MRI research has shown that subjects without LD showed leftward asymmetry in the angular gyrus of the parietal lobe,
- Whereas, subjects with Reading Disorders did not show the expected asymmetry.

Imagining includes....

- Functional neuroimaging techniques, including PET (positron emission tomography),
- rCBF (regional cerebral blood flow),
- fMRI (functional magnetic resonance imaging), and
- SPECT (single photon emission computed tomography).

These techniques are

used to measure brain activity while subjects are engaged in a task such as reading.

These techniques measure various aspects of cortical physiology.

- An fMRI is a non-invasive method that measures blood flow.
- PET and SPECT scans involve the injection of radioactive materials and allow the metabolic activity of specific brain regions to be measured.
- SPECT scan results have indicated that subjects with LD show under-functioning in the occipital lobe when reading, in comparison to subjects without LD.

Various imagining devices…

- Show collaborative information that testify to cortical differences in LD individuals.
- These differences indicate brain size and shape differ in various aspects.
- The differences are specific to the disability.

This research has added significant support to the hypothesis that brain function is causal to the etiology of learning disorders, and that the individual’s low motivation and behavior are secondary to organic differences.

These differences do not prohibit learning…

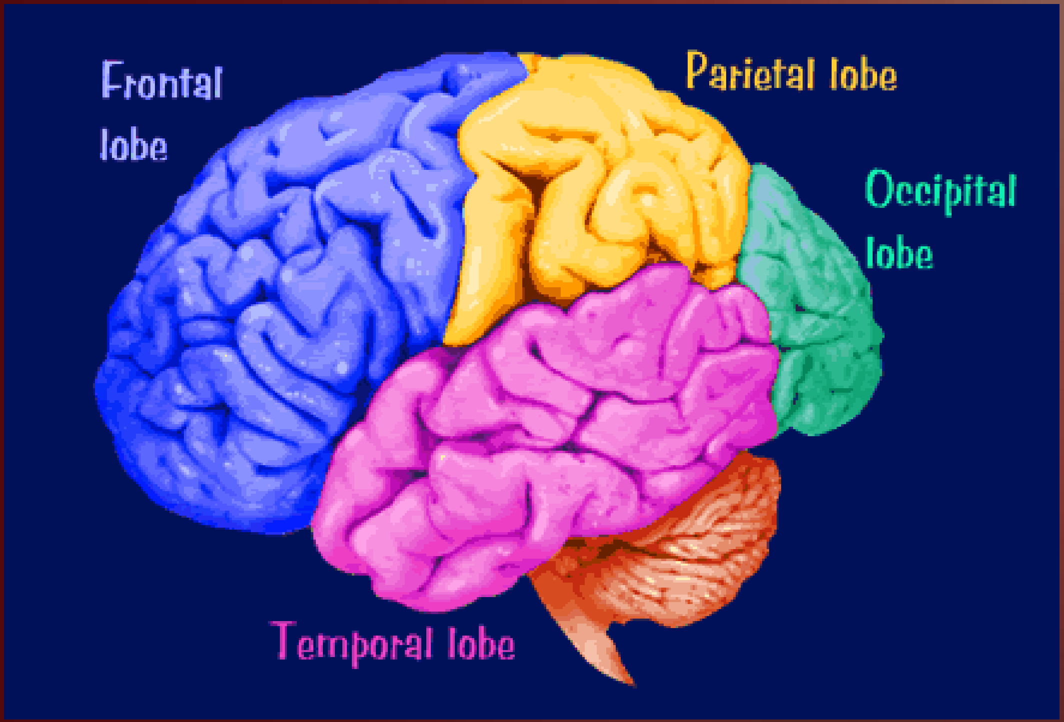
- Individuals with LD *can* learn;
  - the process may be inefficient because of the differences in brain structure and function.
- Inefficiency presents as:
  - low accuracy or
  - slow speed in learning or performing a task.

This is quite distinct from inability or incapacity.

- Information can be processed,
  - but at a slower rate
  - and/or by different methods

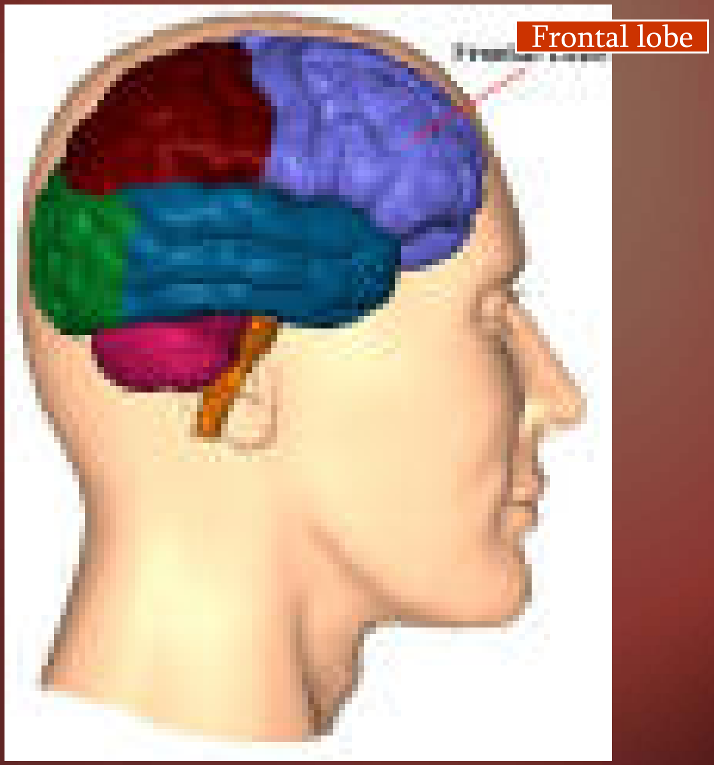
as compared to individuals without LD.

There are several studies that explore brain differences in ADHD individuals. These, too, show a pattern of differences in brain anatomy.

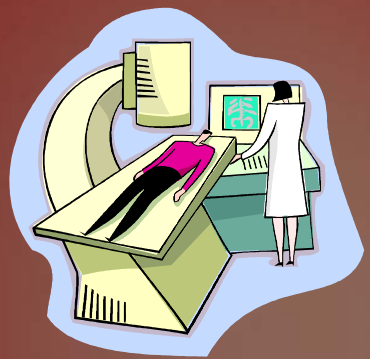


Changes found in the cortical region of individuals diagnosed with ADHD include differences in:

- Overall brain size
- and the frontal lobe
- which is responsible for
  - executive functioning, and
  - regulating impulse control,
  - attention, and
  - other thought processes.



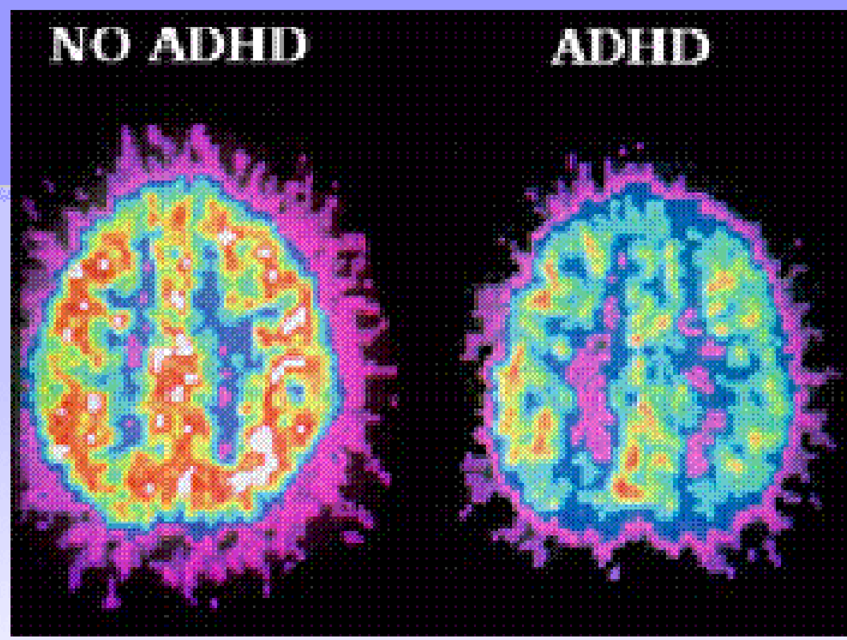
Brain size is affected in ADHD



•The brain of ADHD children was found to be 3% smaller in volume compared with those of normal children.

•Brain differences remained the same through a child's development, suggesting that differences are fixed.

Pet scans also show distinct differences in cortical size with ADHD.



http://www.health-center.com/english/brain/adhd/default.htm

Speculation as to the reasons for decreased cortical size…

- Include many factors, but one has been ruled-out.
- Some scientiests speculated that brain size was affected by cortical stimulants which were routinely prescribed for ADHD individuals.
- However, research has proved otherwise.

Medication to help ADHD does not affect brain physiology.

- Brain differences among ADHD children who took medication, such as Ritalin, and those who did not were similar.
- That suggests that medication does not cause changes in brain development, as some researchers have suggested.

Lack of change in physiology supports congenital etiology.

- The fact that the brain differences remain largely unchanged suggests that the cause of ADHD occurs prenatally.

- It could be genetic or occur early in life.

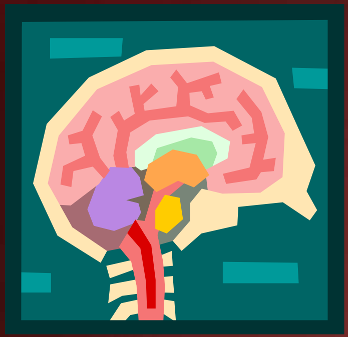
This gives researchers directions to examine regarding the causes of ADHD and variations of the disorder.

In addition to size, brain chemistry is affected in ADHD

Neurotransmitters are affected in ADHD individuals.

- Children in the ADHD group seemed to have decreased levels of GABA, which might explain poor impulse control,
- and higher levels of glutamate, which is excitatory and can be toxic to nerve cells in high amounts.

Both GABA and glutamate are neurotransmitters, or brain chemical messengers.



- Not only do children with ADHD tend to have brains that are slightly smaller than normal.

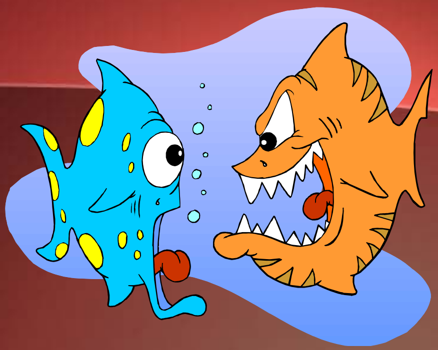
There are other cortical differences.

- Researchers have long suspected that the disorder is caused by a dysfunction in the frontal lobes of the brain, which control emotions and impulses.

This explains many aspects of ADHD behavior.

- The frontal lobe is thought to be the seat of emotion in the individual. Many ADHD individuals have angry outbursts and are easily irritated.
- It was postulated that emotional outbursts were contributed to by easy fatigability.
- ADHD individuals use an enormous amount of energy paying attention even when they are on medication.

Therefore…



- They are more easily fatigued,
- More easily irritated,
- And tend to have difficulty with behavior.

Neurotransmitters have other implications

- Studies have shown that ADHD individuals often have lower levels of dopamine, a neurotransmitter that is implicated in depression.
- This finding, as well as the genetic connection may help explain

why parents, particularly mothers, of ADHD individuals are often diagnosed with

recurrent depression.

Frontal lobe involvement...

- explains why ADHD individuals have difficulty modulating both emotion and attention.
- Their irritability is not only due to fatigue, but also, to a compromised ability to control emotions.

Research on brain differences is substantiated by several scientists.

- Children and teenagers with ADHD have less tissue in parts of the brain's prefrontal and temporal lobes than those without attentional disorders.
- This was reported by neurologist Elizabeth R. Sowell of the University of California, Los Angeles School of Medicine and her coworkers.

In addition,

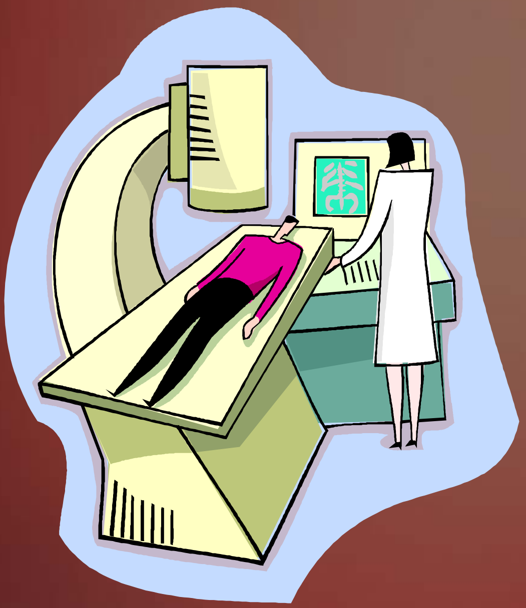
children with ADHD display an excessive density of the neuron-rich tissue known as gray matter in regions of the cortex toward the back of the brain. The cortex is the brain's outer layer.

More information on brain physiology

- And its relationship to cortical function and learning can be found on other power point presentations on this site.

Brain differences in ADHD are well documented.

- Changes in brain physiology for ADHD and Reading Disorders have been documented by several researchers.
- But not all disorders have brain changes that have been easy to identify.



This Power Point Presentation has presented one aspect of cortical functioning.

More information is available on other Presentations

The David Center