Four lobes of the cerebral cortex

FRONTAL LOBE

PARietal LOBE

occipITAL LOBE

TEMPORAL LOBE
• Each cortical area (lobe) is associated with different structures and functions
• Named after the bone in the skull they lie beneath
• Each lobe contains:
  – Sensory areas and/or
  – Motor areas
  – Association areas
FRONTAL LOBES

• Largest lobe, located in the upper forward section of EACH cerebral hemisphere
• Contains the primary motor cortex
  – Runs laterally (across) the top of the brain at the rear of the lobe
• primary motor cortex is characterised by:
  1. Contra-lateral organisation – left motor cortex controls voluntary movements on the right side of the body and vice versa
  2. Topographically (how they are mapped out) - The size of the motor cortex devoted to body parts reflects the dexterity of the part.
  3. Inverse representation of body – feet at top and face at bottom
Primary motor cortex...
Homonculus of the motor cortex
Frontal lobe continued...

• Association areas:
  – Higher mental functioning such as reasoning, planning, judging and using initiative
• Also involved in personality and emotional behaviour
• EG Phineas Gage – change of personality
Example - Phineas Gage

- Railway construction supervisor, 1848.
- After an accidental explosion, and iron rod (3.5cm diameter, 1m long & 6kg) was shot through his skull, damaging his frontal lobes.
- His personality, social behaviour and temperament changed after the incident.
- Phineas lived for a further 12 years.
Phineas Gage Skull
Broca’s Area

• Located in **left frontal lobe**
  – Near face, tongue, jaw and throat of motor cortex
• Involved in production of **clear fluent & articulate** speech
• **Broca’s aphasia (expressive aphasia)** – damage to area – a language disorder characterised by an impaired ability to produce speech

• Can understand others, can read, but likely to have difficulty with speaking (motor) and poor grammar and pronunciation. Know what they want to say but can’t get the words out.

• So: - Poor grammar, **slow** and **laboured** speech
  – Mainly verbs and nouns, no conjunctions
  – *(May have difficulty interpreting the meaning of words if the usual order of words is changed)*

• E.g. “*here....head.....operation...here...speech...none.... talking.....what....illness....*”
PARIETAL LOBES

- Located at the top and centre of the brain between the frontal and occipital lobes of EACH cerebral hemisphere
- Involved in functions such as:
  - Sense of touch
  - Detection of movement
  - Location of objects in the surrounding environment
Primary somatosensory cortex

Contains the **primary somatosensory cortex**

Runs laterally (across) the top of the brain at the front of the lobe

primary somatosensory cortex is characterised by:

1. **Contra-lateral organisation** – left somatosensory cortex receives sensory information from the right side of the body and vice versa

2. **Topographically** (how they are mapped out) - The size of the somatosensory cortex devoted to body parts reflects the sensitivity of the part.

3. **Inverse representation** of body – feet at top and face at bottom
Homunculus of the sensory cortex
Comparison of sensory & motor homunculus
Parietal lobes cont...

• **Association areas:**
  – Sense our body in space (using information from visual and auditory cortex)
  – Determining where objects are in the environment (using visual and spatial reasoning)

• **Damage to the parietal lobe association areas:**
  – May result in ‘Neglect Syndrome’ i.e. ignoring the left side of the ‘world’
  – May result in spatial disorientation e.g. unable to find the way home
OCCIPITAL LOBES

• Located at the back of the brain
• Contains the primary visual cortex
  – Receives visual information from photoreceptors (rods and cones) in the back of the eye
• Association Area:
  – Allows us to form visual perceptions, think visually and remember visual things

What might occur if there is damage to the occipital lobe?
TEMPORAL LOBES

• Located in the lower, central area of the brain
• Used in auditory perception, memory, visual perception & recognising faces
• Contains the **primary auditory cortex**
  – Receives and processes auditory information
• Has different locations for different aspects of sound (pitch, frequency etc)
• **Association Areas:**
  – Involved in memory & linking emotions
  – Involved in facial recognition
Wernicke’s Area

• Located in left temporal lobe
  – Near primary auditory cortex
• Involved in comprehension of speech, interpreting sounds, and locating appropriate words to express meaning
• **Wernike’s aphasia (receptive aphasia)** – no trouble with a word’s pronunciation or grammar but the words chosen may be inappropriate and the meaning may be expressed in a round about way. Also, difficulty with understanding the meaning of the spoken word.

• So:
  – Causes fluent, meaningless strings of words
  – Sounds like normal speech, but makes no sense

• E.g. “I was over the other one, and then after they had been in the department, I was in this one”
• Besides Wernicke’s aphasia, what other problems might arise as a result of damage to the temporal lobe?
Functions of the Cerebral Cortex

- Motor area
- Somatosensory area
- Speaking language (Broca's area)
- Understanding language (Wernicke's area)
- Visual area
- Auditory area