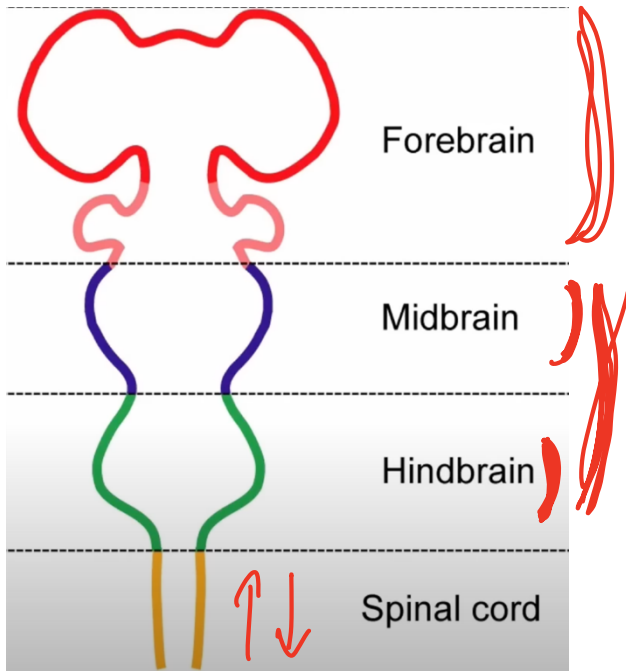


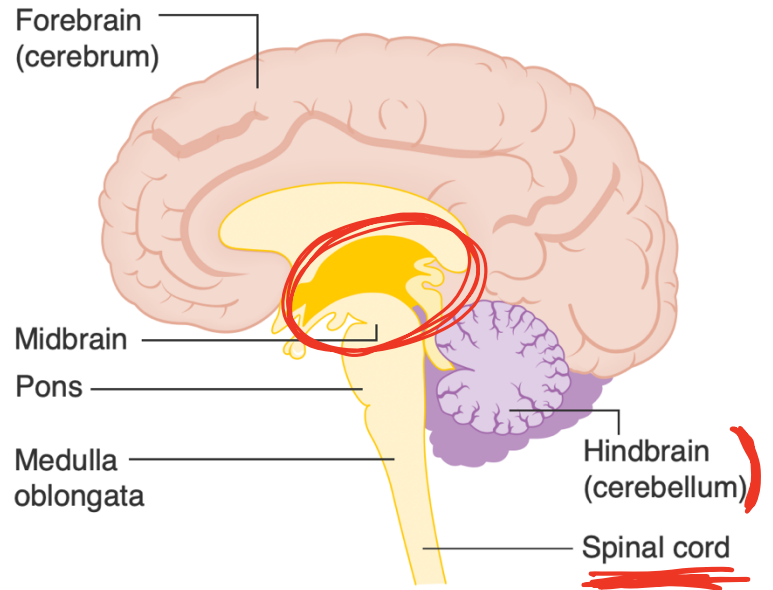
## Take Home Lessons from Today 9-19-23

1. Brain anatomy basics: There are four general areas in all animal brains; starting bottom to top, they are the **spinal cord, the hindbrain, the midbrain and the forebrain** . In human brains, the hindbrain is called the cerebellum and the forebrain is called the cerebrum. The human cerebrum is much larger than other animals. It has an outer layer called the cerebral cortex that has four lobes; **the frontal lobe, the temporal lobe, the parietal lobe and the occipital lobe** .
2. Underneath the cerebral cortex there are many other distinct areas of the brain including the limbic lobe, the corpus callosum, the thalamus, the hypothalamus, the mamillary body, the pituitary gland, the medulla oblongata, the pons, and the pineal gland, among several others we are not mentioning.
3. **The key concept about brain anatomy is that specific areas of the brain are responsible for specific functions.** These have been mapped accurately and include areas associated with planning, attention, decision-making, movement, speech, smell, touch, taste, hearing, vision, movement coordination, memory processing, emotion, heart rate and breathing.
4. **Neurons interconnect all of the functional areas of the brain in complex ways** , facilitating communication and allowing for coordination between the different functions.
5. **A neuronal signal enters the brain, generally from the senses, is processed in the appropriate area then after it is interpreted, a signal is forwarded to different areas that generate an appropriate response or action.** The various connections between neurons facilitate appropriate responses through direct axonal connections. **These connections are created during brain development in the first years of life. Connections that are used survive, neuronal connections that are not used during development are “pruned”.** Early experiences leave permanent pathways and connections in the brain.
6. For our study of happiness, the limbic system in the interior of the brain is important. **The limbic system controls the release of the neurotransmitters important for emotions, mood and reward** .
7. **Rewarded behaviors are reinforced through release of neurotransmitters such as dopamine, serotonin and oxytocin from specific areas of the limbic system.** The neurotransmitters spread through other appropriate areas of the brain, thereby modifying how those neurons respond to inputs in their dendrites and how they fire. This is the mechanism in which behavior, mood and feelings are controlled based on experience.
8. These neurotransmitters, especially dopamine, oxytocin and the endorphins create the perception of happiness. **The release of these molecules in the limbic system of the brain is the physical source of feeling happy.** -
9. **People behave in ways that are reinforced by these neurotransmitter reward mechanisms, leading to repeated rewarded behaviors.**
10. **Addiction occurs when these reward pathways are stimulated directly or indirectly by a substance.** Often the direct stimulation process replaces and blocks the reward mechanism for normally rewarded behaviors, explaining why addiction often leads to collapse/loss of everything that makes non-addicted people happy.

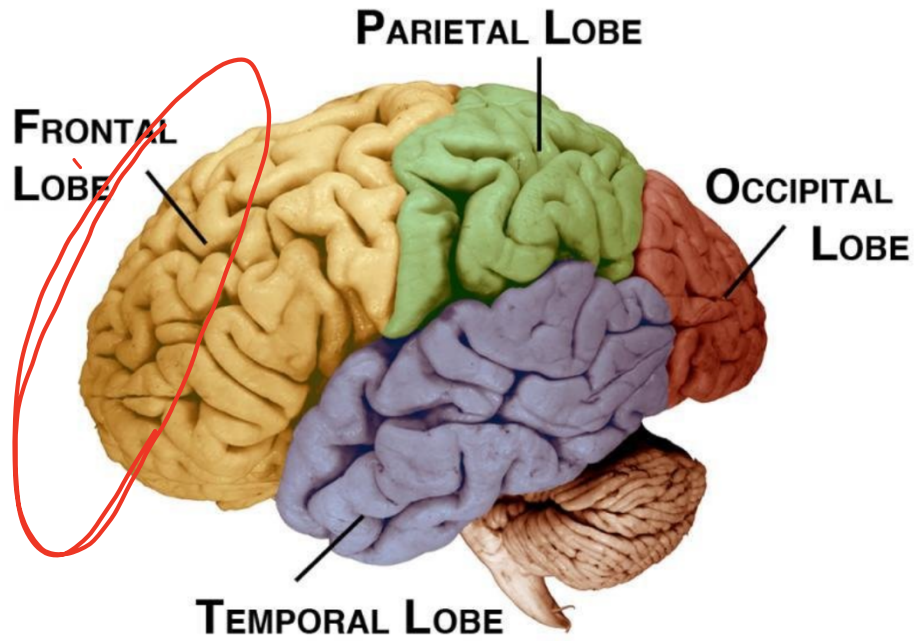
Basic Components of all animal brains.



Basic Components of human brains.



Lobes of the human forebrain (cerebrum)



The four lobes which form the cerebral cortex [18].

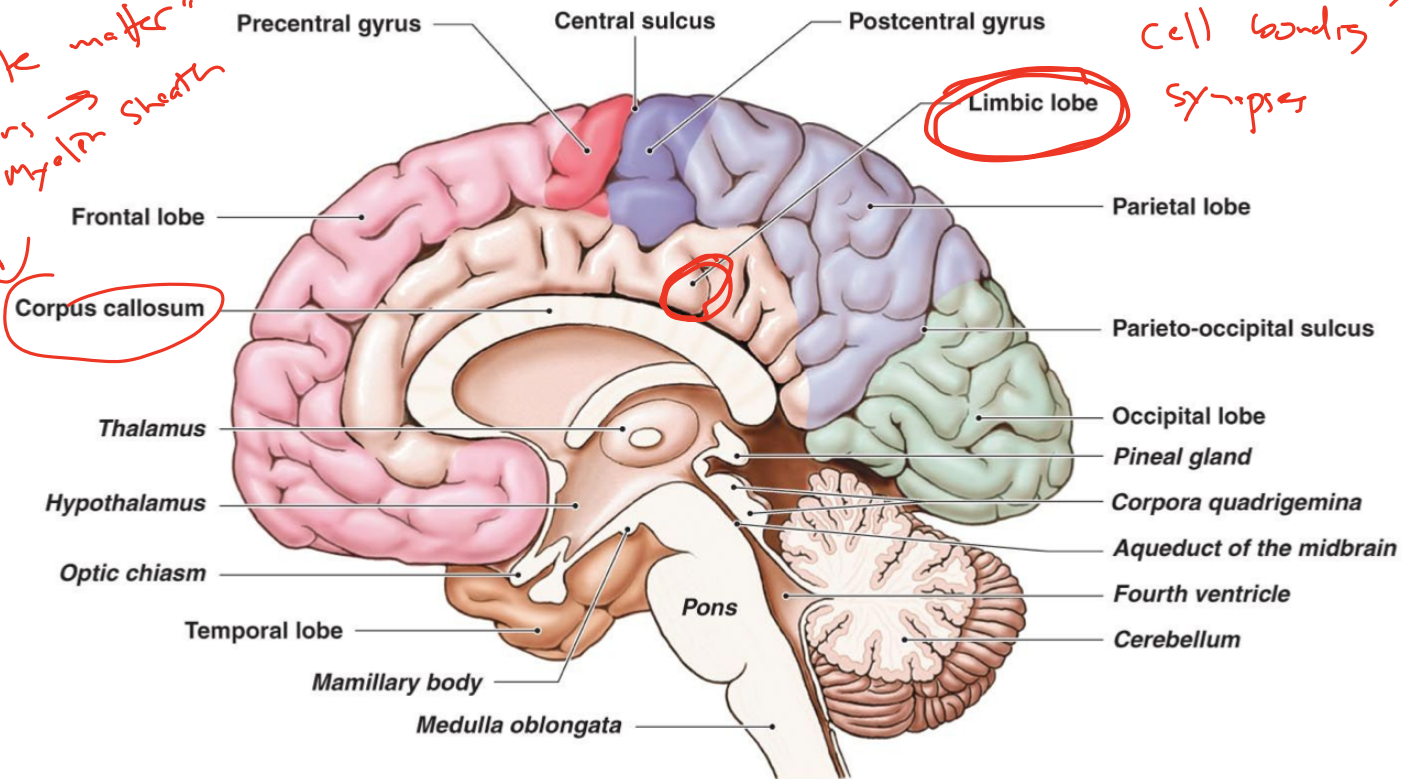
# Your Brain: An Introduction to Its Anatomy

By: Rachel Kimball

A midsagittal view showing the inner boundaries of the lobes of the cerebral cortex (Structures outside of the cerebrum are labeled in italics.)

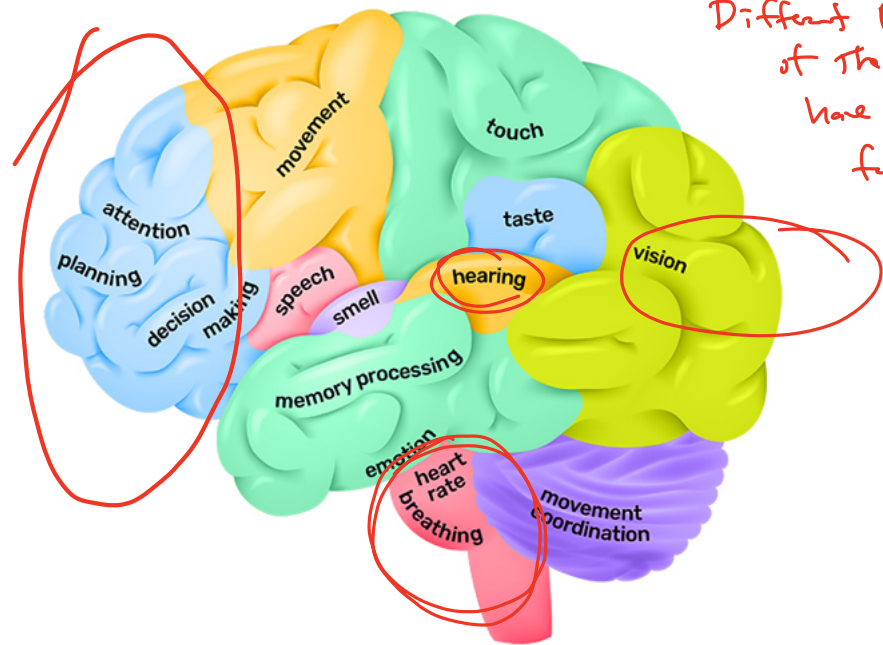
Grey matter is dendrites, cell bodies, synapses

"white matter" Axons → myelin sheath



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Different Regions of the brain have different functions



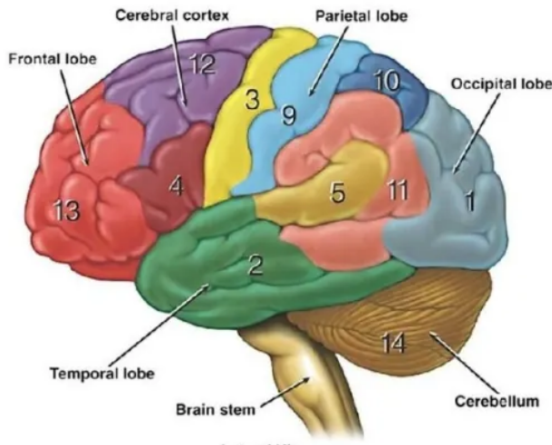


### Functional Areas of the Cerebral Cortex

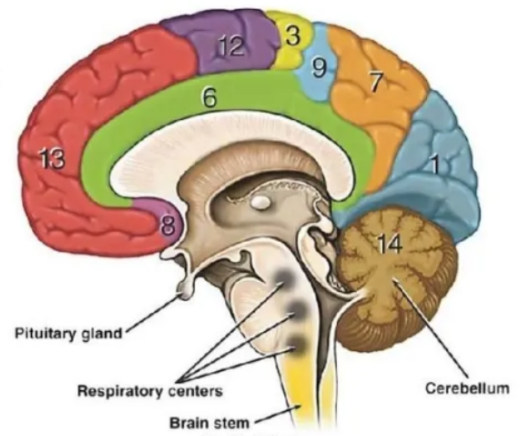
- 1 **Visual Area:**  
Sight  
Image recognition  
Image perception
- 2 **Association Area**  
Short-term memory  
Equilibrium  
Emotion
- 3 **Motor Function Area**  
Initiation of voluntary muscles
- 4 **Broca's Area**  
Muscles of speech
- 5 **Auditory Area**  
Hearing
- 6 **Emotional Area**  
Pain  
Hunger  
"Fight or flight" response
- 7 **Sensory Association Area**
- 8 **Olfactory Area**  
Smelling
- 9 **Sensory Area**  
Sensation from muscles and skin
- 10 **Somatosensory Association Area**  
Evaluation of weight, texture, temperature, etc. for object recognition
- 11 **Wernicke's Area**  
Written and spoken language comprehension
- 12 **Motor Function Area**  
Eye movement and orientation
- 13 **Higher Mental Functions**  
Concentration  
Planning  
Judgment  
Emotional expression  
Creativity  
Initiation

### Functional Areas of the Cerebellum

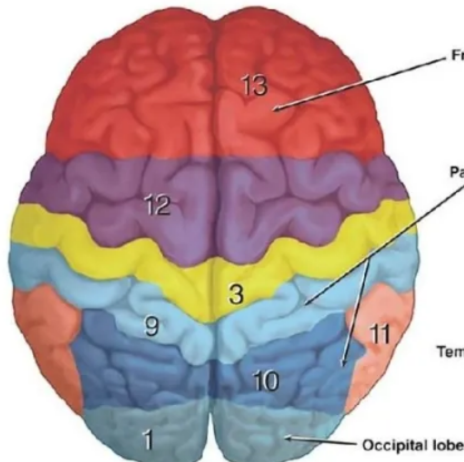
- 14 **Motor Functions**  
Coordination of movement  
Balance and equilibrium  
Posture



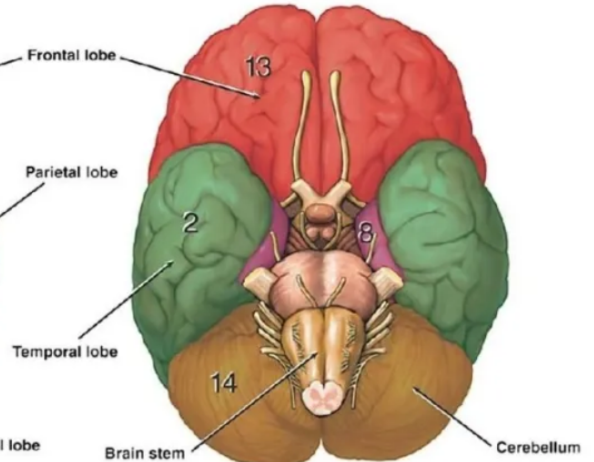
Lateral View



Sagittal View

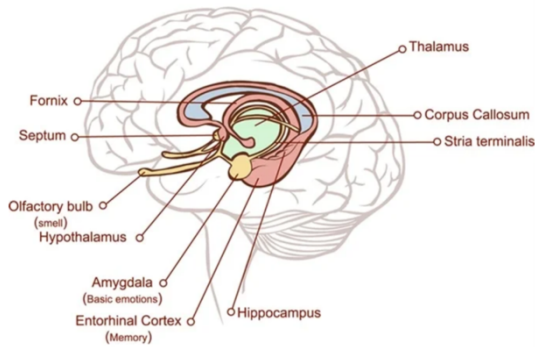


Superior View

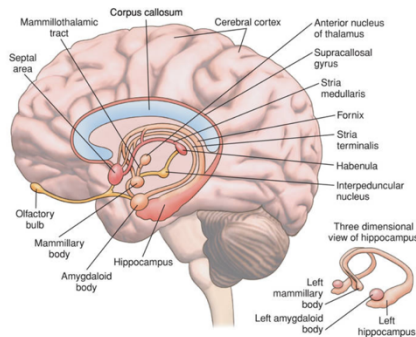
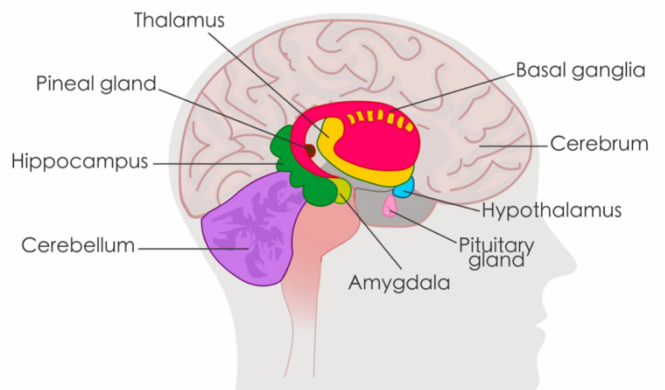


Inferior View

### The Limbic System



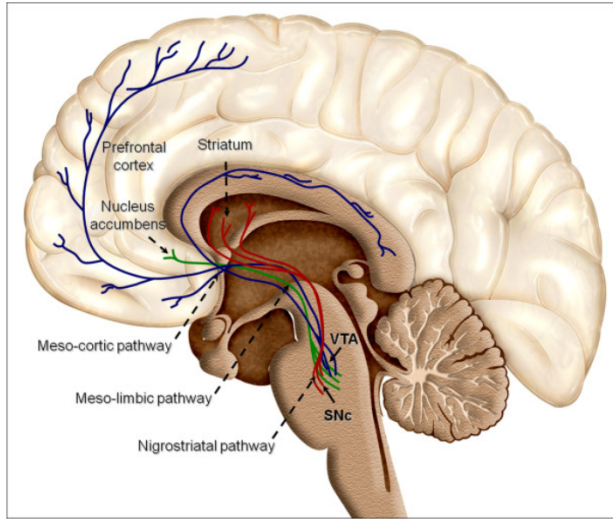
### Limbic System



THE LIMBIC SYSTEM OF THE BRAIN

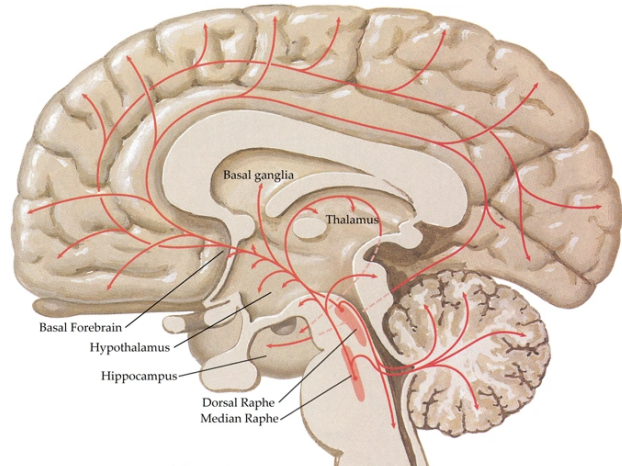
Modifies the reaction of neurons

## Dopamine Reward System



Overview of reward structures in the human brain. Dopaminergic neurons are located in the midbrain structures substantia nigra (SNc) and the ventral tegmental area (VTA). Their axons project to the striatum (caudate nucleus, putamen and ventral striatum including nucleus accumbens), the dorsal and ventral prefrontal cortex. Additional brain structures influenced by reward include the supplementary motor area in the frontal lobe, the rhinal cortex in the temporal lobe, the pallidum and subthalamic nucleus in the basal ganglia, and a few others.

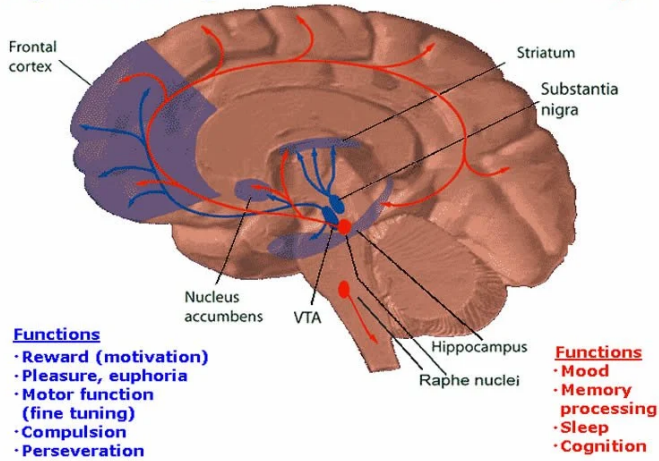
## Serotonin Reward System



## Dopamine and Serotonin Reward Systems

### Dopamine Pathways

### Serotonin Pathways

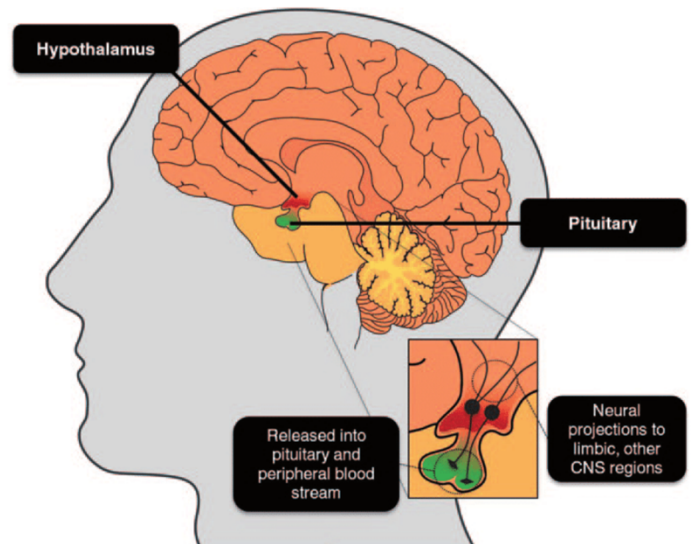


- Functions**
- Reward (motivation)
  - Pleasure, euphoria
  - Motor function (fine tuning)
  - Compulsion
  - Perseveration

- Functions**
- Mood
  - Memory processing
  - Sleep
  - Cognition

The brain's reward system is a group of structures - including the amygdala and the hippocampus - that reinforce beneficial experiences, are involved in memory and complex decision-making and have been implicated in the development of substance use disorders. NeuroscienceNews.com image is for illustrative purposes only.

## Oxytocin Reward System



Oxytocin is produced in the hypothalamus. Neural projections release oxytocin to limbic regions and other areas of the brain. Oxytocin is also released into the pituitary, where it is then secreted into the peripheral blood stream and carried to the rest of the body (Bethlehem et al. 2013)