



Overview of Brain Structures

Psychology 470

Introduction to Chemical Addictions

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1

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First

- All parts are interrelated.
- You need all parts to function normally.

- Neurons = Nerve cells

2

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The Nervous System

- Is Composed of Two Parts
 - Central Nervous System
 - Consists of all neurons (nerve cells) located in the brain and spinal cord

 - Peripheral Nervous System
 - Consists of all neurons (nerve cells) located outside the brain and spinal cord.

3

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Peripheral Nervous System

- Two divisions
 - Somatic
 - Autonomic

4

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Somatic System

- Two parts
 - 1. Afferent neurons
 - Are sensory in nature.
 - Receive information from sensory receptors (structures) and sends that information toward the central nervous system

5

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Efferent Neurons

- Are motor in nature
- Gets information from the central nervous system and sends it to the muscles of the body.

6

Autonomic System

- Consists of neurons that go to and from various internal organs.
- Regulates heart rate, blood pressure, digestion, etc.
- Has two parts
 - Sympathetic nervous system
 - Parasympathetic nervous system

7

What Happens When a Lion Chases You

- | | |
|-------------------------|-------------------------|
| • Sympathetic | • Parasympathetic |
| • Increases Heart Rate | • Decreases Heart Rate |
| • Increases Respiration | • Decreases Respiration |
| • Decreases Digestion | • Increases Digestion |

8

Central Nervous System

- Consists of
- Brain
- Spinal Cord

9

Brain

- Has 100 billion neurons or nerve cells
- Neurons are the functional element of the brain.
- Also has approximately 120 billion Glial cells

10

Glial

- Has many functions
 - Acts as a glue
 - Provides nutrients
 - Helps Regulate Brain Activity
 - Eliminates Wastes
 - Breaks down Neurotransmitters
 - Makes Myelin

11

Conceptualize the Brain

- Best way to conceptualize the brain is how it develops through evolution

12

Hind Brain

- Also called Reptilian Brain
- Consists of three structures
 - Medulla
 - Pons
 - Cerebellum

13

Medulla

- Controls breathing, heart rate, digestion, blood pressure, temperature and other things
- Is the structure that keeps you alive. You can damage other parts of the brain and live, if you damage the medulla, you usually will die

14

Pons

- Is responsible for wakefulness or the sleep cycle

15

Cerebellum

- Is behind the medulla and pons
- Helps control muscle tone, body balance
- Helps coordinate voluntary muscle movement
 - Also smoothes out muscle movement so it is not jerky.
 - Is extremely important for controlling **rapid movement** such as startle responses
- Is also important for maintaining body balance
- Has a role in memory
 - Procedural memories
- One of the first structures influenced by alcohol and other drugs.

16

Midbrain

- Two major sets of structures
 - Superior and Inferior Colliculi
 - Reticular formation

17

Superior Colliculi

- Superior means above
- Function
 - Receives fibers from the retina of the eye and sends information to the cerebral cortex.
 - Is important for controlling eye movements (especially tracking).

18

Inferior Colliculi

- Receives information from the cochlea of the ear and sends information to the cortex.
- Has a role in organizing auditory stimuli.

19

Reticular Formation

- Is another part of the midbrain
- Are sets of fibers that go from the lower brain stem (all structures in the hind and mid brain) and extends to the Thalamus.
 - Thus, has fibers in both the hind and mid brain

20

Functions

- Is important for controlling your state of arousal
- May play a role in sleep.
- Has an important role in focusing attention and acting as a filter.
 - Allows you to concentrate on important things while ignoring unimportant things (buzz of a light)
- Is impacted by a variety of drugs

21

BRAIN STEM

- People talk about the brain stem.
- Consists of all structures in both the Hind and Mid Brain

22

Forebrain

- Consists of several structures in two major areas
 - Diencephalon (inter brain)
 - Telencephalon (end brain)

Encephalon = Brain

23

Diencephalon

- Consists of many structures
 - Thalamus
 - Hypothalamus
 - Others (you do not have to know about)

24

Thalamus

- Is basically a relay station from sensory structures to the cortex and back.
- Is the major center for collecting and integrating information
 - e.g., 80% of all fibers from the optic nerve of the eye goes to the thalamus before going to the occipital lobe (other 20% go to the superior colliculi).
- Also has a role in memory formation
- Is impacted by a variety of drugs

25

Hypothalamus

- Is in charge of several things
- Is smaller than the thalamus and is located in front of and below the thalamus (hypo = below).

26

Functions

- Governs eating, drinking, and sexual behavior
- Regulates endocrine activity (helps with a variety of hormones)
- Is involved with emotion
- Is also involved with pleasure circuits

27

Telencephalon

- These structures have increased the most as evolution has progressed.
- Has several major groups of structures.

28

Olfactory System

- Is involved with smell

29

Limbic System

- Has several structures
 - Septal area
 - Amygdala
 - Hippocampus
 - Parahippocampus

30

Septal Area

- Is involved with controlling aggression and pleasure

31

Amygdala

- Is involved with controlling rage behavior and aggression
- When destroyed, the organism attacks anything

32

Hippocampus and Parahippocampus

- Has a major role in memory formation
- When damaged, you cannot form any new memories
- Also shuts down when taking a variety of drugs
 - Alcohol
 - Depressants
 - Opiates
 - Others
- Reason for memory loss and blackouts

33

Limbic System

- In general, the limbic system controls animal instinctive behavior
- Also is involved with pleasure circuits
- Have large numbers of dopamine pathways

34

Basal Ganglia

- Has several structures as well.
 - Caudate Nucleus
 - Lenticular Formation
 - Putamen
 - Red Nucleus
 - Substantia Nigra

35

Like the Cerebellum

- Is involved with controlling movement.
- While cerebellum controls rapid movement;
- Basal Ganglia helps with
 - Controlling slower movements
 - Starting and stopping movement
 - Balance

36

In General

- The basal ganglia controls the direction and amplitude of movement; especially postural movement.

37

When Damaged

- Causes problems with posture, walking, etc. Get a lot of tremors, jerks, twitching, etc.
- Parkinson's syndrome
 - Classic symptom tremor at rest.
 - Once you move the tremor stops until in later stages of the disease, then you always have tremors.
- Occurs because the Substantia Nigra degenerates.
- Is impacted by a variety of drugs

38

Neocortex

- Also called Cortex or Pallium

39

Neocortex

- Is the most developed in Humans
- Has many folds and fissures
 - The folds of tissue are called gyri or a gyrus (single)
 - The fissures or valleys are called sulci or a sulcus (single)

Is what you see when you look at a brain from the outside

40

Neocortex

- Structures are divided into several sections or lobes.
 - Each lobe has a different function
- Cortex is separated in half by a fissure called the central fissure
- Cortex Splits the brain into left and right halves called hemispheres

41

Hemispheres

- Left Hemisphere controls the right side of the body
- Right Hemisphere controls the left side of the body
- Each hemisphere contains 4 lobes
 - Frontal
 - Parietal
 - Temporal
 - Occipital

42

Lobes

- Each lobe is separated by a fissure or a sulcus. For us three are important
- Central Sulcus
 - Separates the Frontal and Parietal lobe
- Lateral Sulcus
 - Separates the Temporal lobe from the Frontal and Parietal lobe
- Parietal Occipital Sulcus
 - Separates the Parietal lobe from the Occipital lobe

43

Lobes of the Brain

- Frontal
- Parietal
- Temporal
- Occipital

44

Frontal Lobe

- Contains a variety of structures
- Precentral Gyrus
 - Also called Area 4
 - Is responsible for voluntary motor movement
- Areas 6 and 8
 - Are responsible for muscle tone
 - Gets muscles ready to fire

45

To Get Movement

- Areas 6 and 8 prepare muscle to contract
- Area 4 causes the muscle to contract
 - Basal Ganglia, Cerebellum, and other structures help smooth out the movement.

46

Broca's Area

- Is located at the bottom of area 4, 6 & 8.
- Is concerned with speech
- When damaged, the person can understand speech, but they cannot talk well.
- Called Broca's Aphasia

47

Association Area

- Remainder of the Frontal Lobe
- Is important for thought processes, memory formation and problem solving.
- When damaged have problems with memory
- Is important with drug abuse
 - Systems are shut down
 - Systems can die

48

Parietal Lobe

- Also contains a variety of structures
- Somatosensory area (Area 3)
 - Is concerned with sensory functioning.
 - Is where you feel pain, temperature etc.
- Area 1, Area 2, and association cortex
 - Interprets what is happening in Area 3

49

Temporal Lobe

- Is below the Lateral Sulcus
- Is concerned with hearing and patterning of sound (speech).
- Wernicke's Area
 - Is a sub-area of the Temporal Lobe

50

Wernicke's Area

- Is concerned with the integration and comprehension of speech.
- Also receives information from other areas such as the occipital lobe
- When damaged, you can speak fluently but the content is Nonsense
 - Called Wernicke's Aphasia
- When damaged, it is also hard to comprehend and understand written stimuli (reading).
- Is often impacted by drug abuse

51

Arcuate Fasciculus

- Is a set of fibers that look like an arc
- These fibers connect Wernicke's area with Broca's Area
- When damaged, the symptoms look like Wernicke's Aphasia

52

Occipital Lobe

- Is concerned with vision
- Area 17
 - Is the primary visual cortex
 - Is where visual information goes first
- Areas 18 and 19
 - Helps with organization of visual stimuli
 - Information is then sent to other lobes

53

Island of Reil

- Also called the Insular Lobe
- Is located under the lateral Sulcus
- Is concerned with memory and processing of information
 - May have function with smell

54

Conclusion

- The brain has lots of structures
- Each structure is involved with lots of functions
- Is very resistant to damage
- When damaged, individuals can have lots of problems
- Problems can identify where the brain is damaged.