

## Chapter 2

- Ions
- Diffusion
  - Molecules diffuse from high concentration to low concentration.
- Resting Membrane Potential
  - -70 mV
  - Inside of the cell is negative.
  - Chloride is negative and greater concentration outside the cell.
    - Chloride goes into the cell because of diffusion, even though electrostatic pressure is keeping it out.
  - Sodium is positive and goes in and out.
    - Concentrated on the outside of the cell.
    - The forces are in agreement because electrostatic pressure and diffusion both push it inside.
  - Concentration high on the inside.
  - Potassium is positive and is pushed out by concentration gradient.
    - But electrostatic pressure is trying to keep it in.
    - Diffusion is stronger so it's pushed out.
  - PostSynaptic Potentials
    - EPSP
      - Excitatory depolarization of the postsynaptic membrane.
      - Positive flow into the cell (sodium).
    - IPSP
      - Inhibitory hyperpolarization of the postsynaptic membrane.
      - Negative flow into the cell (chloride).
    - Action Potential
      - Buildup of charge (EPSP) opens windows allowing sodium to enter.
      - Potassium then goes rushing out of the cell.
      - Unlike action potentials, post synaptic potentials are graded responses.
- Process:
  - At rest (-70mV)
  - Neuron stimulated (EPSP).
  - Sodium entering, potassium begins leaving.
  - Sodium closed, potassium still leaving.
  - Sodium-potassium pump resets levels.
- Tetrodotoxin
  - Blocks sodium channels.

- 2nd Step in Zombification
  - Datura
  - Concoction of many different drugs.
  - Acetylcholine Antagonist
    - Neuromuscular Junction
    - Cognitive Functions
  - Drug: Agonist vs. Antagonist.
    - Point of view is important - neurotransmitters decide if it's good or bad.
    - If it's helping the neurotransmitter do its job, it's an agonist.
  - Arousal Neurotransmitters
    - Acetylcholine
    - Norepinephrine
    - Serotonin
    - Histamine
- Place Cells Vs. Grid Cells
  - Place cells are in the hippocampus that are directly involved in navigation.
    - Fires in a specific location.
  - Grid cells are in the entorhinal cortex
    - Fires all over in a grid-like pattern.
- VLPO
  - VLPO in the anterior hypothalamus serves as the "off" switch releasing the neurotransmitter GABA which shuts down the RAS.
  - Importance of fast switch, flip-flop.

### **Summary of Ch.2**

- Zombies have dramatically altered sleep-wake cycles and don't appear to sleep at all.
- Complete insomnia suggests RAS chronically engaged and consistent with that seen in other animals and damage to the VLPO (ant. hypothalamus).
- However, zombies lack awareness and often appear sleepy, similar to encephalitis lethargica suggesting deficits in the switch between "on" and asleep.
- Similar effects can be seen with sleepwalking and "somnambulism".
- Zombies seem to lack spatial awareness, exhibit deficits in episodic memory, and get lost easily.
  - This is because of sleep cycle and replay disruption.
- Sleep deprived individuals will eventually exhibit quick bouts of REM sleep, and the brain may exhibit regional sleep (some parts are awake while others are asleep). Thus, it is possible to experience dreaming with a disrupted sleep-wake cycle.

### The Neural Correlates of Lumbering (Ch. 3)

- The larval brain is specialized for locomotion as in other chordates. The brain is also metabolically expensive so digesting it and replacing it with another brain may be appropriate.
- The **red nucleus** is involved in motor coordination and relaying information from the motor cortex to the cerebellum.
- The **thalamus** is the gateway to the cortex. With the exception of smell, it receives all incoming sensory information, organizes it, and relays it to the cortex (V1).
- Cortical Pathways from Sensory Systems to Behavior
  - The thalamus sends information to the visual cortex, as well as the somatosensory cortex and the auditory cortex.
  - This information is sent to the frontal lobe (judgement and planning).
  - This sends information down the spinal cord to the muscles of the limbs to initiate the action.
- If we presume that one of the primary functions of the brain is to move us around, it is not surprising that much of the brain is devoted to the planning and execution of actions (motor cortex, premotor area, motor speech area (broca's), cerebellum)).
- The **parietal lobe** identifies where something is located and what it is, and transfers the information to the frontal lobe which decides what to do with the object. The premotor area then creates the action, and the primary motor cortex sends the information to the muscles to do the action.
- The **basal ganglia** (caudate nucleus, putamen, globus pallidus) are the areas that approve the action.
  - Signals first enter the striatum (caudate nucleus, putamen and nucleus accumbens).
  - The striatum sends signals to the globus pallidus to decide go/no go.
  - Go/No Go Decision
    - The striatum sends signals to the Globus Pallidus of the Basal Ganglia.
    - Excitatory/Direct Pathway (Go), Indirect Pathway (No Go).
- Dopamine
  - ADHD: Low levels of dopamine.
  - Substantia Nigra is the main place for dopamine.
  - Many addictive drugs increase dopamine release,
  - Reward motivated behavior
  - Motor control.

- Parkinson's Disease
  - Symptoms: rigidity, tremors, freezing (unable to execute motor commands).
  - Related to death of dopaminergic cells in substantia nigra.
  - Basal ganglia pathways do not work well with dopamine deficiencies.
- Cerebellum: Anatomy
  - Arbor Vitae
  - Folia
  - Dentate Nucleus
  - Peduncle
  - Vermis
  - Cerebellum was first described by Galen.
  - Early Hypotheses of Function:
    - Alternating Grey and White matter generates electricity like a battery.
    - Then believed to be the root of sexual appetite.. Ice was put on the back of the head over the cerebellum for problems like nymphomania.
      - Tested this hypothesis by removing the cerebellum of the rooster and saw that the rooster still had strong sexual appetite but no coordination to carry on sexual activities.
    - We know NOW that it is more involved in motor coordination and balance, and is the "quality control expert" for the motor system.
    - Monitors all sensory experiences, motor plans, and expectations.
    - Language, temporal perception, emotional processing, and decision making.
- Zombies often exhibit some motor function.
- But they do not exhibit tremors or freezing, and can generally plan and execute movements in the right direction, meaning that the basal ganglia and the motor cortex are functioning correctly.
- The lack of motor function would probably be related to the cerebellum.
- Subtype 1 Zombies : Slow, Subtype 2 Zombies : Fast and Agile.

#### **Chapter 4**

- A healthy brain has a limbic system that regulates anger, hunger, and fear.
- Limbic system accounts for the Five F's : Fighting, Flighting, Fleeing, Feeding and Fucking.
- Fight or Flight.