Chapter 3

The Biological Bases of Behavior

Communication in the Nervous System

- Behavior depends on rapid information travel and processing…the _1_ system is a complex communication network handling information just as the circulatory system handles blood.
- The basic categories of the nervous system are living cells called _2_ and _3_.
- _4_ are cells that provide structure and insulation for neurons…(neural “glue”.)
- __5__ are cells that receive, integrate, and transmit information…permitting communication in the nervous system.
- A “typical” neuron consists of a _6_, or cell body; dendrites, which are feelerlike structures that are specialized to receive information; and an _7_, which is a long, thin fiber that transmits signals away from the soma to other neurons or to _8_ or glands.

Nervous Tissue (continued)

At the ends of an axon, the **9** (2 words) are small knobs that secrete chemical messengers **called 10**. When the signal gets to the end of the axon, it causes these chemical messengers to be released into the synapse…the junction of two neurons. The chemicals flow across the synapse and stimulate the next cell.

- The basic flow of information: dendrites receive info and pass it from the soma and down the axon to the dendrites another neuron at meeting points called **11.**
- Glial cells serve many functions besides structural ones. They supply **12** to neurons, help remove neurons waste products & provide insulation around axons. For efficient neural transmission, many axons are covered with an special type of glial cells called **13 (2 words)**. (This covering speeds up transmission of signals that move along axons.

The Neural Impulse: Electrochemical Beginnings

- Alan Hodgkin and Andrew Huxley in the 1950's discovered the mechanics of neural transmission by studying squid giant axon …which have axons that are about _14_(#) times larger than human axons.
- They found that fluids inside and outside the neuron contain electrically charged particles called _15_.
- Also found that when a neuron is "at rest" the inside has more _16_ charged ions than the outside..
- The stable negative charge of a neuron when it is inactive is its resting potential.

The Neural Impulse: The Action Potential

- When a neuron is stimulated, channels in the cell membrane open briefly, allowing the positive ions outside the cell to flow into the electronegative inside…this shift (brief change) in the electrical charge travels along the axon and is referred to as an _17_(2 words).
- Either an action potential occurs, or it doesn't. Once an action potential is initiated, it goes full force. Therefore the neural impulse is a _18_ proposition, like firing a gun (3 words).

The Synapse: Chemicals as Signal Couriers

- Neurons don't actually touch. Instead they are separated by a microscopic gap between the terminal button of one neuron and the _19_ (2 words) of another neuron. This gap is called the _20_ (2 words).

- Electrical signals can't jump this gap. Instead, the neuron that is sending the message across the gap (the _21_ neuron) releases neurotransmitters into the synaptic cleft. The neuron that receives the chemical signal across the synaptic cleft is called the _22_ neuron.

- The neurotransmitters diffuse across the space where they find open _23_ sites on the postsyanptic neuron. These sites recognize and respond to some neurotransmitters, but not to others.

When a Neurotransmitter Binds

- When a neurotransmitter from the presynaptic neuron crosses the synapse, finds an appropriate receptor site on the postsynaptic neuron and binds, a voltage change occurs. This voltage change in the postsynaptic neuron is not an all or none, the neuron will fire or it won't, kind of thing. Instead, it changes the probability or potential that the postsynaptic neuron will fire. This is therefore called a postsynaptic _24_.

- The post synaptic action potential message can be excitatory or inhibitory. An _25_ potential is a positive voltage shift that makes the neuron _26_ the likelihood of firing.

- An inhibitory postsynaptic potential increases the negativity of the inside of the neuron (negative voltage shift that) with respect to the outside which_27_ the likelihood of firing..

To Fire or Not to Fire

- A neuron may receive signals from _28_ of other neurons. Each neuron must integrate the many signals arriving at the same time before it “decides” to fire.
- If enough excitatory PSPs add up the cell’s voltage can reach the threshold at which the action potential will begin.
- EPSPs and IPSPs may balance out, as well, and the neuron would remain at rest.
- Most neurons are inter-linked in complex chaing, pathways, circuits and networks. Our perceptions thoughts and actions depend on _29_ of neural activity.

Neurotransmitters & Behaviors

- _30_ deliver their messages by binding to a receptor site…The binding process operates much like a "_31_ and key". Not just any receptor site will do…there must be a perfect fit between the shape of the neurotransmitters (NT) and the shape of the receptor site.
- Some drugs mimic neurotransmitters, fitting into receptor sites so perfectly that the site is fooled and a postsynaptic potentials are set up.
- Other drugs can block receptors. For example _32_, blocks Ach binding at motor neurons preventing wrinkles in the face from forming!
- Other chemicals oppose the action of a NT…they bind to the receptor site but don't really fit well enough to "fool" the site…they just block it.
- Right now, we know of about 15-20 substances that qualify as NTs…5 are commonly researched (Ach, DA, NE, Seratonin GABA & Endorphins.

Organization of the Nervous System

- The nervous system has two main divisions, the _33_ nervous system and the _34_ nervous system.
- The _35_(3 words) consists of the brain and spinal cord, while the _36_ (3 words) consists of nerves that lie outside the brain and spinal cord.
- In the peripheral nervous system, _37_ are bundles of neurons routed together and extent to the _38_ (the outside of the body).
- There are two divisions of the peripheral nervous system, the _39_ NS or voluntary portion, and the _40_ NS, or involuntary portion.
- The _41_ NS is made up of nerves that govern action of heart, breathing rate, blood vessels and glands. When a person is "autonomically aroused", these speed up.
- This speeding up is controlled by the _42_ division of the autonomic nervous system…the SNS mobilizes the body's resources for emergencies & creates the "_43_" (3 words) response.
- The _44_ nervous system, in contrast, activates processes that generally conserves bodily resources…slow heart, reduce BP, etc.

Looking Inside the Brain: Research Methods

- Electroencephalography (EEG) – monitoring electrical activity of the brain
- Damage studies/lesioning – observing consequences of damage to certain areas
- Electrical stimulation (ESB) – stimulating a portion of the brain and observing effects
- Brain imaging –
  - computerized tomography (CAT SCAN) – computer enhanced X-ray
  - positron emission tomography (PET SCAN) – radioactively tagged chemicals serve as markers of blood flow or metabolic activity in the brain that are monitored by X-ray
  - magnetic resonance imaging (MRI) – uses magnetic fields, radio waves, and computer enhancement to image brain structure

Brain Regions and Functions I

- The hindbrain is located at the lower part of the brainstem. The _45_ is in charge of circulation, breathing, muscle tone, and regulating reflexes… The _46_ is important in sleep and arousal…
- The cerebellum is critical in the coordination of _47_and sense of _48_ (physical balance).
- The _49_ lies between the hindbrain and the forebrain…it is involved in sensory functions such as locating where things are in space. It also contains structures that release the dopamine system that is involved in _50_ movement (Parkinson's disease is due to degeneration of the substantia nigra, a structure in the midbrain).

Brain Regions and Functions II

- The _51_ (2 words) is found in both the hindbrain and midbrain and is important in sleep and wakefulness, as well as breathing and pain perception.
- The _52_ , the largest and most complex region of the brain, includes the _53_ –the way station for all incoming sensory information before it is passed on to appropriate higher brain regions; the _54_ – a regulator of basic biological needs such as hunger, thirst, sex drive, and temperature regulation… the limbic system – which is a loosely connected network of structures involved in emotion, motivation, memory.
- Also included is the cerebrum, which is the largest and most complex part of the human brain…the convoluted (wrinkled) outer layer of the cerebrum is the _55_ (2 words). The cerebrum is responsible for _56_ “complex thought activities” such as learning, remembering, thinking, and consciousness itself.

The Cerebrum: Two Hemispheres, Four Lobes

- The cerebrum is divided into two specialized hemispheres that are connected by the _57_(2 words), a thick band of fibers (axons) that transmits information between the hemispheres.

- Each hemisphere has four lobes: _58_ lobe– where the primary visual cortex is located, _59_ lobe– where the primary somatosensory cortex is located; the _60_ lobe – where the primary auditory cortex is located; and the _61_ lobe – where the primary motor cortex and executive control system is located.

- Recent research has demonstrated that the brain is more flexible or "plastic" then once assumed. Studies have shown the brain anatomically changes with experience/learning, reorganizes itself when damaged, and can generate new neurons.

- Researchers of _62_ surgery patients (had their corpus callosum surgically severed) have learned that each hemisphere is specialized for different functions, with the left usually dominant for language functions and the _63_ for visual spatial skills.

The Endocrine System

- _64_ are chemical messengers in the bloodstream that are secreted by the endocrine glands.
- The pituitary gland -- sometimes called the "_*65*_ *gland*", -- secretes substances influencing the operation of all the other glands, as well as growth hormone. The actions of the pituitary/endocrine system is controlled by the nervous system through the hypothalamus.
- Hormones play important roles in preparing the body for times of emergency, physiological development and reproductive activity. The hormone, **_66_** has far reaching effects of human social behaviors like, adult bonding and bonding experience between mothers and their children.

Genes and Behavior: The Interdisciplinary Field of Behavioral Genetics

- Questions about how much of behavior is biologically based and how much is environmentally based are very old ones in psychology. Since the 1970's, however, research methodologies have been developed in the field of behavioral genetics that shed new light on the age-old nature vs. nurture question.
- Each _67_ (threadlike strands of DNA) contains thousands of _68_, which also occur in pairs…a dominant gene always expresses itself.
- When a person has two genes in a specific pair that are the same, the person is homozygous for that trait…if the genes are different, heterozygous
- Like chromosomes, genes operate in pairs with one gene of each pair coming from each parent. In the simplest scenario, a single pair of genes determines a trait. However most human traits are not so simple with regard to genetic transmission…they appear to be _69_ traits, or influenced by more than one pair of genes.

Behavioral Genetic Research

- _70_ studies can yield better evidence about the possible influence of heredity because identical twins have the exact same genotype…they share 100% of the same genes.
- Fraternal twins only share _71_%(#) genetic relatedness…the same as any two siblings born to a set of parents at different times.
- Twins of both types, however, are raised in more similar environments (same age, configuration of relatives, etc.). Therefore if identical twins are more similar on a given trait than fraternal, its probably genetic.

Evolutionary Psychology: Behavior in Terms of Adaptive Significance

- The field of _72_ psychology is a relatively new theoretical perspecitve in psychology that focuses on analyzing behavioral processes in terms of their adaptive significance.
- Based on the work of _73_(last name) and the ideas of natural selection, and _74_…i.e. that variations in reproductive success (number of descendants) are what really fuels evolutionary change.
- Some behaviors extend even when they are no longer useful (adaptive). For example, humans show a taste preference for _75_ substances…this was adaptive in a hunter/gatherer society, when dietary fat was scarce… before potato chips, etc.…resulting in obesity, heart disease, etc. While this may lead to decreased longevity, its effect on reproductive success is more difficult to gauge.