Chapter highlights: Brain Basics (Ch 1)

The purpose of “chapter highlights” is to offer a framework in which to think about the specific information discussed in each Brain Facts chapter. These highlights draw upon information in the chapter and on the new Brain Facts web site (http://www.brainfacts.org) and occasionally, on our own knowledge of neuroscience that may not be discussed in Brain Facts. Questions for Brain Bee will come from Brain Facts (new 2012 publication) and entries from the new Brain Facts web site that have “brainfacts.org” in the URL. Some but not all relevant entries are cited below. Questions to guide your studies are noted in italics.

Different parts of the brain are devoted to different functions. To learn more go to http://www.brainfacts.org/brain-basics/brainanatomy/

The brain has three main parts: forebrain, midbrain and hindbrain

**Forebrain:** higher level functions which receives and integrates information to make executive decisions

The cerebral cortex is divided into 4 lobes *can you name them?* that concentrate on different incoming information and functions (e.g., visual, hearing, speech, touch, motor, etc; can you pair function with each of the lobes?)

**Thalamus:** main relay station for all sensory information that gets sent to the cerebral cortex

**Hippocampus** is important in learning and memory

**Hypothalamus** is involved in the homeostatic control of internal regulatory systems by receiving and sending information to various peripheral organs (endocrine glands, stomach, arenals, etc)

**Basal ganglia:** important for movement

**Midbrain:** relaying sensory information

**Hindbrain:** controls essential life-sustaining functions (heart and respiration)

**Cerebellum** is important for movement

Nervous system divisions

The central nervous system (CNS) is made up of the forebrain, midbrain, hindbrain, and spinal cord

The peripheral nervous system is made up of nerves and ganglia outside of the CNS
The autonomic nervous system is made up of nerves that connect the CNS and internal organs. (can you name the divisions of the ANS and their functions?)

Neurons are polarized cells designed to transmit information

Dendrites receive information

Axons send information

The function of neurons depends on “support” cells called glia

Glia first guide the development of neurons, then promote the function of mature neurons by providing insulation and serving as an conduit for the delivery of needed factors to and the removal of metabolic byproducts from neurons

There are several different types of glia that serve specific roles

Neurons use two modes of communication: electrical and chemical

Electrical—for sending information along or within a neuron.

This code involves the movement of ions across the neuronal membrane causing localized changes in potentials

Chemical—for sending information between neurons at synapses

Nerve impulses or action potentials enter axonal endings to trigger the release of neurotransmitter (from presynaptic terminals) into the synaptic junction

Neurotransmitter then binds to specialized receptors located postsynaptically

Activation of neurotransmitter receptors triggers either ion channels to open or activates second messenger systems

This can then “excite” the next neuron by triggering the same sequence of events (nerve impulses followed by the release of neurotransmitter) or it can inhibit activity in the target neuron or cell

Neurons “talk to” other neurons and non-neuronal cells such as muscle fibers

Neurotransmitters or neuromodulators come in many different “flavors” which either increase or decrease activity in the next neuron. To learn more go to http://www.brainfacts.org/brain-basics/cell-communication/

The predominant excitatory neurotransmitter is glutamate

The predominant inhibitory neurotransmitter is GABA
Neurotransmitter action at the synapse is terminated by enzymatic breakdown or reuptake

Other chemicals such as hormones or neurotrophic factors also affect neurons

Many drugs alter brain function (e.g., to improve mood, reduce pain, or enhance neuromuscular function) by altering neurotransmission in two basic ways:

- By dampening or boosting the effect of various neurotransmitters by altering transmitter production, release and/or the mechanisms that terminate it action postsynaptically
- By mimicking the action of a neurotransmitter by activating its receptor directly

(Can you think of some examples?)

(Can you list the neurotransmitters discussed in Brain Facts? Can you pair the neurotransmitter with location in the nervous system and/or function? Can you link neurological diseases with the neurotransmitter that shows dysfunction?)

Also look at http://www.brainfacts.org/brain-basics/neural-network-function/