Synaptic Snowglobes

Materials:

-water
-straws (visitors cut into 1-2cm pieces)
-kid scissors
-glue gun
-clear dixie cup
-blue or black oil-based markers
-transparency sheet to fit whole length of glass jar
-glass jars
-glitter

Also use:
-set up website on a computer
http://faculty.washington.edu/chudler/synapse.html
-pre-made pipecleaner neurons to talk about how neurons talk to each other

Background:

The Synapse:
Neurons have specialized projections called dendrites and axons. Dendrites bring information to the cell body and axons take information away from the cell body.
Information from one neuron flows to another neuron across a synapse. The synapse contains a small gap separating neurons. The synapse consists of:
a presynaptic ending that contains neurotransmitters, mitochondria and other cell organelles
a postsynaptic ending that contains receptor sites for neurotransmitters
a synaptic cleft or space between the presynaptic and postsynaptic endings.

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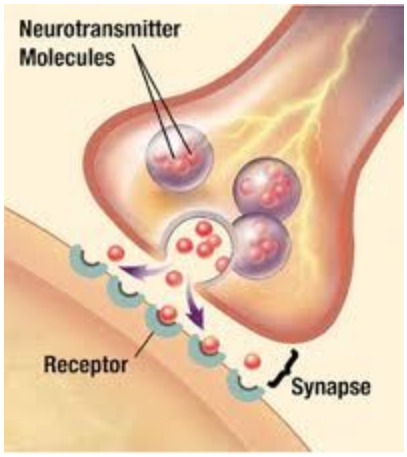

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The neurotransmitter molecules then diffuse across the synaptic cleft where they can bind with receptor sites on the postsynaptic ending to influence the electrical response in the postsynaptic neuron. In the figure on the right, the postsynaptic ending is a dendrite (axodendritic synapse), but synapses can occur on axons (axoaxonic synapse) and cell bodies (axosomatic synapse). When a neurotransmitter binds to a receptor on the postsynaptic side of the synapse, it changes the postsynaptic cell's excitability: it makes the postsynaptic cell either more or less likely to fire an action potential. If the number of excitatory postsynaptic events is large enough, they will add to cause an action potential in the postsynaptic cell and a continuation of the "message." Many psychoactive drugs and neurotoxins can change the properties of neurotransmitter release, neurotransmitter reuptake and the availability of receptor binding sites.

Activity:

Prep:

Cut transparency to fit ½ inch smaller than bottle diameter. (you will recut it once you have figured out how tall your dixie cup will sit in the bottle.) The transparency will sit in the middle of the bottle, on top of the dixie cup.

-cut clear dixie cup so that the newly cut top will fit in the glass jar's lid (about 1-2 inches high).
-cut slits in the sides of the dixie cup and turn them under to give you a surface to apply hot glue to glue the dixie cup upside down on the inside of the jar's lid. (see photo: the dixie cup is upside down with the straws glued on it)

-glue cut straws to the top of the upside down cup.(these are the Neurotransmitter receptors)

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-draw presynaptic neuron with NT in vesicles. Use the same shape and color of the foam that you will use. You can draw vesicles with different shapes and colors but to keep it scientific: only one NT is released at a time so only one shape/color will be added to the water. (for little kids, have them trace one)

-Have them pick a NT that they want theirs to be and write it on their snowglobe and add glitter (neurotransmitter) to the jar.

Neurotransmitters to choose from:
(There are 100s of NT!)

Table 11.1 Actions of Common Neurotransmitters

Neurotransmitter	Sites Where Released	Principal Actions
Acetylcholine	Brain Neuromuscular junctions Autonomic nervous system	Excitatory on skeletal muscles Excitatory or inhibitory on internal organs
Norepinephrine	Areas of brain and spinal cord Autonomic nervous system	Excitatory or inhibitory, depending on receptors Plays a role in emotions
Serotonin	Areas of brain Spinal cord	Usually inhibitory Involved in moods, sleep cycle, appetite
Dopamine	Areas of brain Parts of peripheral nervous system	Excitatory or inhibitory, depending on receptors Plays a role in emotions
Glutamate	Areas of brain Spinal cord	Usually excitatory Major excitatory neurotransmitter in brain
Endorphins	Many areas in brain Spinal cord	Usually inhibitory Natural opiates that inhibit pain
Gamma-aminobutyric acid	Areas of brain Spinal cord	Usually inhibitory Principal inhibitory neurotransmitter in brain
Somatostatin	Areas of brain Pancreas	Usually inhibitory Inhibits release of growth hormone

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Neurotransmitters and Their Effects				
Name	Primary Function	Locations	Receptors	Notes
Acetylcholine	Muscle control, memory formation, sensory response. Excitatory.	Neuromuscular junctions, CNS	Nicotinic, muscarinic	One of the most common, very well studied. A major player in memory. Imbalances cause twitching or paralysis.
Serotonin	Intestinal movement control, mood regulation, apetite, sleep, muscle control	Gut, CNS	5-HT	Most antidepressants mimic the effect of serotonin. Most narcotics affect its release or reuptake
Dopamine	Reward pathways, cognition, voluntary motion	Hypothalamus	D1, D2, D3, D4, D5	Imbalances cause Parkinsons. Cocaine and opiates have a significant effect on its release.
Norepinephrine	Fight or Flight response (increased heart rate, increased glucose in bloodstream, increased oxygen to brain and muscles)	Adrenal medulla	Andrenergic	Produced from Dopamine in the adrenal glands (on kidneys)
L-DOPA	Precursor to dopamine	Hypothalamus	N/A	Able to cross the blood-brain barrier making it an excellent pharmaceutical for treatment of Parkinsons or depression.
Tryptophan	Precursor to Serotonin	Blood	N/A	essential amino acid
GABA	Inhibits CNS	Brain	GABAA, GABAB	Mediates muscle tone, Receptors susceptible to alcohol which creates CNS depression
Glycine	Inhibits signals	Spinal Cord, Brainstem	NMDA	amino acid
Tyramine	Blood Pressure regulation	CNS, Kidney	TA1	amino acid, minor neurotransmitter that is largely not understood
Glutamate	Long-term potentiation, memory	CNS, PNS	NMDA, others	Most common