**Homework4-2015**

1. What are differences for release of peptide and classical small-molecule neurotransmitters.

From result of some experiments, researchers discovered that low-frequency stimuli can only involve the release of classical small-molecule neurotransmitter, whereas the release of peptide transmitter needs high-frequency stimuli.

2. What are the main structural and functional differences between ionotropic and metabotropic receptors?

**Structure:**

**Ionotropic receptor** is a kind of ligand-gated ion channel which contain pore (s) to transport ions.

**Metabotropic receptor** is G protein coupled receptor which doesn’t have structure like pore to provide permeability to membrane.

**Function:**

**Ionotropic receptor** can change its conformation after combination of neurotransmitter so that ions are capable to diffusion through membrane and cause the change of membrane potential.

**Metabotropic receptor** can trigger the activation of G-protein which will induce down-stream information transmission in cell. It can change the permeability of membrane or gene expression.

3. What features make Nitric Oxide (NO) such an unusual neurotransmitter?

(1) NO is a kind of gas, whereas other neurotransmitters are small organic molecules or peptide.

(2) It can diffusion from one cell to the other cell.

(3) NO usually interact with its receptor inside the cell.

(4) NO cannot be stored in the presynaptic vesicles.

(5) It can be also used like a second messenger.

4. How do second messenger systems “turn off” again after they have been turned on?

(1) Second messenger can be degraded by specific enzymes in plasma or transported to decrease concentration in cytoplasmic matrix (Ca2+).

(2) G-protein contains activity to catalyze the hydrolyzation of GTP, which will make G-protein be unable to induce down-stream information transmission.

5. Photoreceptors are atypical in that they are depolarized (40 mV) in darkness and are hyperpolarized by light stimuli. What components of photoreceptors account for this?

On photoreceptor outer segment membrane, there are cGMP sensitive channels which is permeable to Na+ and other cations. In dark condition, the cGMP level in outer segment is enough to support the open of channels. So, the membrane is permeable to Na+ so membrane potential is depolarization. With light stimuli, the level of cGMP will decrease, and channels will close. Without permeability to Na+, the membrane potential will be hyperpolarized.

6. List the key steps in phototransduction in a rod, from absorption of a photon to closure of ion channels.

(1) The absorption of photon triggers the configuration change of 11-cis-retinal which will convert to all-trans-retinal.

(2) The change of retinal induces the activation of transducin.

(3) Transducin interact with PDE and make it be active.

(4) PDE degrade cGMP to GMP inducing the decreasing of cGMP concentration.

(5) For the decreasing of cGMP concentration, the cGMP sensitive channels will close.

**Key Terms**

cAMP

cGMP

endocrine

enzyme-linked receptor

G-protein–coupled receptor

G-protein

heterotrimeric G-protein

inositol trisphosphate (IP3) receptor

nerve growth factor

NGF

paracrine

protein kinase

protein phophatase

ras

signal amplification

signal transduction

amacrine cell

bipolar cell

ciliary muscle

cones

cyclic guanosine monophosphate

fovea

foveola

ganglion cell

horizontal cell

interphotoreceptor retinoid binding protein

IRBP

iris

lens

light adaptation

off-center ganglion cell

on-center ganglion cell

opsin

optic disc

optic nerve

pigment epithelium

photoreceptor

phototransduction

retina

retinal

retinal pigment epithelium

retinoid cycle

rhodopsin

rods

transducin