2 4 pts

Match the examples below with the type of signaling they represent:

a. The activity of the ventral inducer BMP during frog development Paracrine
b. The stimulation of glucose uptake by insulin Endocrine
c. The depolarization of a nerve cell in response to a neurotransmitter Synaptic
d. The transfer of ions through gap junctions in the heart Contact-dependent

a. paracrine since this is localized signaling.
d. Contact dependent because the gap junctions occur between adjacent cells.

3 – 3 pts

Which ONE of the following is FALSE regarding G-protein coupled receptors (GPCRs):

a. Targeting GPCRs with drugs is common in pharmaceutical research
b. GPCRs contain seven alpha-helical transmembrane domains that span the membrane
c. GPCRs are the largest family of receptors in animals; humans have the largest number of any animal
d. The intracellular surface of the receptor is involved in the interaction with G-proteins, and the extracellular surface with the signaling molecule (ligand).

c. is correct because humans do NOT have the largest number of any animal. GPCRs are the largest family of receptors in animals.

Multi-answers

Q6) – 3 pts

Below are possible explanations for why, during GDP/GTP exchange, release of GDP from a G-protein is usually followed by binding of GTP rather than another molecule of GDP. Which ONE is the best explanation?

a. The intracellular concentration of GTP is higher than the concentration of GDP
b. A modification of the G-protein no longer allows binding of GDP
c. A competitive inhibitor blocks the binding of GDP
d. A mutation prevents GDP but not GTP binding

Q7 2 3pts, 1 pt each

This was discussed by Dr. Welch. I think it also came up during Dr. Schekman's portion of the class. GTP is at a much higher intracellular concentration than GDP.

Q10 3 pts

Which ONE of the following experiments would be the most appropriate for determining how a hox gene controls other genes in flies to affect development?

a. Dissect the flies to identify organs that are different in wild type and hox mutants
b. Sequence all mRNA transcripts in wild type and hox mutants
c. Treat wild type and mutants with drugs that affect GPCRs
d. Use affinity chromatography to find ligands that bind to Hox proteins

Options a., c. and d. as listed here (may not be the same order as you got as the answers are shuffled) would not work. Comparing the levels of all mRNA transcripts from a wild type to a specific hox mutant would allow you to see how that specific mutation affected expression of other genes.

Q11 2 pts

ONE of the following statements about fertilization is TRUE, if none are true select none are true.

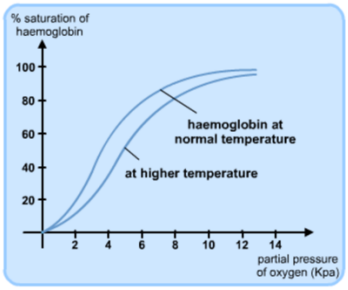
a. During membrane fusion sperm components inactivate phospholipase C zeta found within the egg, this results in the hydrolysis of PIP2 into PIP3 and DAG.
b. Increased levels of Ca2+ allow cortical granules to fuse with the plasma membrane and release their content, which are involved in the fast block to polyspermy
c. Fertilization is followed by meiosis in the egg to produce haploid gametes
d. Phospholipase C zeta hydrolyzes PIP2 into DAG and IP3, and DAG is recognized by its receptor in the ER, which allows the release of Ca2+ into the cytoplasm.
e. None of the statements are true.

a. false because the sperm donates an active phospholipase. b. describes the SLOW block to polyspermy. c. is false because meiosis happens BEFORE fertilization. Note it is true (a rare exception) that in primates fertilization occurs after meisos, but it does not produce a haploid egg gamete. Instead the sperm nucleus and the egg nucleus are in a common cytoplasm. This is known as a heterokaryon. d. is false because DAG remains in the membrane, it is IP3 that is recognized by the receptor on the ER stimulating calcium release.

Q12) 4 pts You are looking through a microscope at a piece of tissue and you are interested in understanding how the cells are connected to each other. You make the following observations: [1] In one section of the tissue, you detected bundles of actin in both cells that are in close proximity. [2] In another section of the tissue, you inject a fluorescent small molecule into one cell, and observe it can readily pass into neighboring cells. What type of junctions did you most likely detect from each observation:

(1) a. Tight junction
b. Adherens junctions
c. Desmosome
d. Gap junction
e. Hemidesmosome
f. Flagellum complex

Adherens junctions are connected on the inside of the cell to actin bundles.



Q26 2 pts

During exercise, increasing body temperature results in a shift in the oxygen-hemoglobin dissociation curve towards the right, as depicted in the graph. Compared with tissues at rest, this results in which of the following:

a. Increased hemoglobin concentration
b. Increased release of O2
c. Increased pH
d. Increased binding of CO2

The curve shifts to the right and results in increased release of O2 at the tissues. For example, at Kpa of 4 the saturation of Hb is about 30% but at normal temperature the saturation of Hb is about 55%.

Q30 3 pts

Which ONE of the indicated structures produce the kidney filtrate and ultimately reabsorb components from the filtrate?

a. nephrons
b. collecting duct
c. glomerulus
d. capillaries

Capillaries is the site of exchange. In this case the glomerulus is where the filtrate is being formed as it enters the Bowman's capsule of the nephron. Uptake after reabsorption is eventually via the capillary bed known as the vasa recta.

Q31 2 pts

Active transport of NaCl in portions of the kidney is necessary to:

a. Maintain the high osmolarity of the interstitial fluid
b. Keep salt from diffusing out of the filtrate
c. Keep water from diffusing out of the filtrate
d. Maintain very dilute urine

The sodium chloride pump establishes the osmotic gradient of the kidney (medulla hypertonic to cortex).

Q35 3 pts

Which ONE of the following options does NOT contribute to generating a membrane potential?

a. Higher number of potassium channels than sodium channels (leak channels)
b. Higher extracellular concentration of potassium compared to sodium
c. Activity of the sodium-potassium pump
d. Movement of ions due to diffusion and electrical forces

Potassium has a higher INTRACELLULAR concentration, not extracellular concentration.

Q42 3 pts

Which ONE of the following is a possible path for a signal to follow in the nervous system:

a. Sensory receptors -> afferent neuron -> CNS -> Efferent Neuron -> Autonomic nervous system -> cardiac muscle
b. Sensory receptors -> efferent neuron -> CNS -> afferent Neuron -> Autonomic nervous system
c. Sensory receptors -> afferent neuron -> CNS -> Efferent Neuron -> Autonomic nervous system -> skeletal muscle
d. Cardiac muscle -> afferent neuron -> CNS -> Efferent Neuron -> Autonomic nervous system -> sensory receptors
e. All are possible paths

Note: sensory receptors send signals toward CNS using afferent neurons and after processing in the CNS signals are sent out efferent neurons. Thus, the answer choices are either a. or c. (as listed). Skeletal muscle belongs to the motor system, not the ANS. The ANS controls smooth and cardiac muscle and glands.

Q46 3 pts

Graded potentials can be differentiated from action potentials by the fact that:

a. the extent of depolarization depends on the extent of stimulus
b. they always result in hyperpolarization
c. they always result in depolarization
d. they remain close to -70mV
e. they result in a change in overall ion concentrations inside and outside the cell

Graded potentials are essentially defined by the fact that the extent of depolarization is determined by the extent of the stimulus. b. and c. are not true because the cones and rods in vision are hyperpolarized in response (most others are depolarized in response). d. is not true of cones and rods (-40 mV discussed for rod cell). Both AP and graded potentials result in ion changes.

Q50 3 pts

In the light rhodopsin will be ____, transducin will be bound to _____, and the concentration of cyclic guanosine monophosphate (cGMP) in rod cells will be_____.

a. inactive; GDP; lower
b. inactive; GTP; lower
c. active; GDP; higher
d. active; GTP; lower

Light causes activation of rhodopsin which results in activation of a G protein known as transducin. The activation occurs by the exchange of GDP on transducing with GTP from the cytosol (in part due to higher GTP concentrations). Activated transducing activates phosphodiesterase which decreases cGMP concentrations.