

**BMB/MICRB 252 – February 3, 2006 - Exam 1**

Use #2 pencil. Answer all questions on the enclosed optical read form.

There is only one answer for each question.

Read the question carefully and choose the best answer.

Write your name and student I.D. number and fill in the corresponding oval.

Be sure that your TEST FORM letter matches you EXAM FORM letter.

This is EXAM FORM A

There are 33 questions. This exam ends at 11:00 am

- 1 Which is NOT an example of a typical component of the signal transduction process?
  - A. Calcium
  - B. PDGF receptor
  - C. NF- $\kappa$ B
  - D. Wnt
  - E. Vitamin C
  
- 2 Which is NOT commonly involved in intracellular signaling?
  - A. ATP
  - B. Tyrosine side chain of a protein
  - C. Guanine nucleotide exchange factor
  - D. Phosphoenolpyruvate
  - E. MAP kinase kinase kinase
  
- 3 What type of activity will a trimeric G protein have that a monomeric G protein **lacks**?
  - A. GTPase
  - B. Kinase
  - C. Phospholipase C stimulation
  - D. Protease
  - E. Membrane binding
  
- 4 Which of the following is NOT a typical signal that at least some human cells respond to?
  - A. Music from Kanye West's latest album
  - B. Stomatal closure
  - C. Capsaicin in chili peppers
  - D. Glucocorticoids
  - E. Cytokines
  
- 5 What did Dr. Hwang of South Korea do to commit scientific fraud?
  - A. He falsely claimed to have cloned human embryos
  - B. He falsely claimed to have cloned the sheep named Dolly
  - C. He falsely claimed to have cloned an adult human
  - D. He falsely claimed to have clonally propagated human tissue cells in culture
  - E. He falsely claimed to have developed a cat/dog hybrid called a 'cog'.

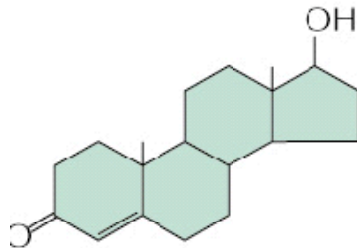
- 6 Olfactory nerves are regenerated from stem cells. What prevents Olfactory stem cells from differentiating into neurons.
- Notch interactions with a Delta-like protein embedded in the plasma membrane of neighboring cells.
  - Wnt interactions with frizzled
  - I $\kappa$ B interactions with jun/fos
  - Catenin interactions with Lef1
  - Olfactory receptors interacting with trimeric G proteins
- 7 Why are males more susceptible to red-green color blindness than females?
- Females produce estrogen which, along with the estrogen receptor, stimulate production of red and green rhodopsin.
  - Males tend to run more red and green traffic lights than females
  - Many males carry mutations in the blue rhodopsin gene, which makes them red-green color blind
  - The red and green opsin genes are located on the X chromosome but not on the Y chromosome.
  - Males produce testosterone which represses red and green rhodopsin production
- 8 What do the following proteins have in common?  
*Cubitus interruptus, Notch, NF- $\kappa$ B, glucocorticoid receptor, and protein kinase A*
- They all bind diacylglycerol (DAG)
  - All are receptor tyrosine kinases
  - All translocate from the cytoplasm to the nucleus upon activation and stimulate transcription
  - All translocate from the nucleus to the cytoplasm, where they are phosphorylated
  - All are GAPs
- 9 What is a major molecular ailment of Alzheimer patients?
- Wnt-Notch interactions are defective
  - Senilistatin levels increase
  - Presenilin protease becomes hyper-active
  - Notch-Delta interactions are defective
  - Neuronal ion channel remain open
- 10 When neutrophils chase bacteria around inside your body, what are they actually chasing after?
- cGMP emitted from the bacteria
  - Lipopolysaccharides sloughing off of the bacteria
  - B-cells that are attached to the bacteria
  - T-lympocytes
  - Cytokines emitted by neighboring cells
- 11 When Toll receptors become active in damaged tissue during a wound response, NF- $\kappa$ B stimulates what kind of genes?
- Genes that help sterilize the damaged tissue, including gene products that produce hypochlorite and peroxide.
  - Genes that clot blood
  - Genes that collect ATP
  - Genes that direct limb bud development
  - Genes that help the organism respond by producing adrenaline receptors located on muscle cells

- 12 Proper functioning of APC (adenomous polyposis coli) helps prevent colon cancer. What does APC do?
- A. APC is a receptor tyrosine kinase that stimulates the *src* oncogene.
  - B. APC directly binds to ion channels in the gut, keeping them closed. Without APC, the open ion channels lead to oncogenesis.
  - C. APC is required for apoptosis, which when defective, causes uncontrolled cell growth.
  - D. APC is a Ras GAP that when defective causes Ras to continually emit growth stimulating signals.
  - E. APC promotes the proteolytic degradation of  $\beta$ -catenin in the cytoplasm, keeping it from inappropriately activating cell growth genes.
- 13 How is the cytoskeleton involved in regulating gene expression by *hedgehog* signaling?
- A. Actin filaments bind to Wnt in the cytoplasm keeping Wnt from activating *hedgehog*-responsive genes.
  - B. Microtubules connect cell surface receptors directly to genes inside the nucleus.
  - C. Actin filaments connect cell surface receptors directly to genes inside the nucleus.
  - D. Microtubules hold a latent transcriptional activator in the cytoplasm. *Hedgehog* signaling leads to dissociation of the activator and its subsequent translocation to the nucleus.
  - E. The cytoskeleton plays no role *hedgehog* signaling.
- 14 Where would you find PIP<sub>2</sub> (phosphatidyl inositol bis-phosphate)?
- A. Cell membrane inside surface
  - B. Nuclear membrane
  - C. Bound to the exterior surface of Receptor Tyrosine Kinases
  - D. Bound to microtubules
  - E. Bound to actin
- 15 What does phospholipase C  $\gamma$  (PLC- $\gamma$ ) do?
- A. Delivers phosphoryl groups to proteins
  - B. Removes phosphates from proteins
  - C. Phosphorylates lipids
  - D. Cleaves PIP<sub>2</sub> into DAG (diacylglycerol) and IP<sub>3</sub> (inositol tris-phosphate)
  - E. Converts ATP to cAMP
- 16 How many different **kinds** of Olfactory receptors are you likely to find on the cilia of a particular Olfactory cell?
- A. 0
  - B. 1
  - C. hundreds
  - D. millions
  - E. no one knows
- 17 What is one purpose of autocrine signaling?
- A. To allow many different signals to become integrated along the intracellular signal transduction pathway.
  - B. To stimulate long distance communication between organs and the brain.
  - C. To enhance estrogen signaling in females and testosterone signaling in males.
  - D. To move calcium between adjacent cells.
  - E. To re-inforce local decisions made by a neighborhood of identical cells.
- 18 Cells constantly receive signals. Which is NOT a plausible consequence of such signaling?
- A. Differentiation into nerve cells
  - B. Mitochondrial export
  - C. Cell growth
  - D. Release of neurotransmitters like serotonin from nerve cells
  - E. Apoptosis

- 19 Which is NOT a natural signaling molecule that cells respond to
- A. Nitric oxide
  - B. Ephrins
  - C. Interleukins
  - D. Lithium acetate
  - E. Steroids

- 20 Which of the following is not a membrane-bound protein?
- A. Inositol tris-phosphate (IP<sub>3</sub>)
  - B. Ras
  - C. Receptor tyrosine kinase
  - D. Adenylyl cyclase
  - E. Phospholipase C - $\beta$  (PLC- $\beta$ )

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- Which is unlikely to be true about this molecule
- A. It is derived from cholesterol
  - B. It requires an intracellular receptor
  - C. It binds to a cell surface receptor
  - D. It is a steroid
  - E. It is hydrophobic
- 22 Hundreds of different proteins contain SH2 domains. Will any protein that possesses an SH2 domain bind tightly to any other protein that possesses a phosphotyrosine? If yes, why? If no, why?
- A. No, every SH2 domain is very different which causes it to bind to different proteins.
  - B. No, interaction specificity is maintained by precise docking interactions with amino acids that surround the SH2 domain.
  - C. Yes, SH2 domains interact with phosphotyrosine, so any protein with a phosphotyrosine will be tightly bound by SH2-containing proteins.
  - D. Yes, SH2 domains interact with tyrosine kinases which phosphorylate tyrosines allowing SH2-containing proteins to bind.
  - E. Yes, SH2 domains are phosphotyrosines and thus interact with any protein.
- 23 What is NOT a property of the vitamin D receptor?
- A. Binds DNA
  - B. Binds an activating ligand
  - C. Binds to a transcriptional coactivator protein
  - D. Has a nuclear localization signal in its protein sequence
  - E. Binds to ephrins
- 24 Which is NOT an “on/off” switch for regulating protein activity?
- A. Phosphorylation/dephosphorylation
  - B. GTP/GDP binding
  - C. Cooperative cAMP binding
  - D. Lipidation
  - E. Proteolysis

- 25 How does your eye become desensitized to light?
- A. Arrestin binds to phosphorylated Rhodopsin
  - B. Ion channels remain open
  - C. All cGMP gets converted to GTP
  - D. Transducin becomes proteolyzed
  - E. Protein kinase A remains active
- 26 What typically happens that turns some protein tyrosine kinases into oncoproteins?
- A. They are always inactive (in the “off” state).
  - B. They are always active (in the “on” state).
  - C. They phosphorylate many hundreds of different proteins which causes uncontrolled cell proliferation.
  - D. They prevent cell-growth proteins from becoming phosphorylated, which leads to cancer progression.
  - E. They rapidly and reversibly switch their “on/off” state when responding to cell growth signaling molecules
- 27 When people get Cholera, what happens?
- A. The cholera toxin binds to protein kinase C preventing its activation and this leads to calmodulin binding to CaM kinase and a disruption of the ion balance.
  - B. Notch signaling weakens leading to defects in neuronal function
  - C. Sodium export pumps remain open because cholera toxin covalently modifies a trimeric G-protein so it cannot hydrolyze GTP (necessary for closing the ion channels).
  - D. Calcium import channels remain closed because the cholera toxin binds to the ion channels. This causes an ion imbalance
  - E. Calcium ion channels on the cell surface and on the endoplasmic reticulum remain open due to direct binding of the cholera toxin, leading to dehydration
- 28 A kinase is to a phosphatase as what is to what?
- A. Guanine nucleotide exchange factor (GEF) is to GTP activating protein (GAP).
  - B. Diacylglycerol (DAG) is to inositol tris-phosphate (IP<sub>3</sub>).
  - C. PIP<sub>2</sub> is to PIP<sub>3</sub>
  - D. ATP is to cAMP
  - E. Calcium is to calmodulin
- 29 What activates MAP kinase?
- A. MAP kinase kinase
  - B. MAP phosphatase
  - C. MAP phospholipase
  - D. MAP acetyltransferase
  - E. MAP methylase
- 30 How do JAKs activate STAT transcriptional regulators?
- A. STATs bind to steroid ligands, which causes inhibitory JAKs to dissociate.
  - B. The JAKs phosphorylate Protein Kinase A which then phosphorylate the STATs
  - C. STATs dock onto phosphorylated receptors, which allows JAKs to phosphorylate them.
  - D. JAKs become phosphorylated then move into the nucleus where they bind to STATs on the DNA
  - E. JAKs phosphorylate Smads which then dissociate from STATs allowing STATs to move into the nucleus

- 31 A protein kinase primarily uses which as a substrate?
- A. GTP
  - B. ATP
  - C. CTP
  - D. UTP
  - E. TTP
- 32 Bears have a great sense of smell because
- A. They have a high density of olfactory receptors
  - B. They have a high density of opsin receptors
  - C. They have a high density of acetylcholine receptors
  - D. They have poor eyesight
  - E. They use trimeric G proteins.
- 33 Consequences of protein phosphorylation include all of the following except
- A. Activation of the enzymatic activity of the protein
  - B. Causes the protein to be degraded
  - C. Induces translocation of steroids across membranes
  - D. Provides a binding site for another protein
  - E. Allows the protein to move into the nucleus