

Cell Biology 282b FINAL

EXAM CODE 444

April 29th, 2006

READ INSTRUCTIONS CAREFULLY:

1. **NO QUESTIONS** can be asked of the proctors. If issues arise with specific questions, they will be dealt with **AT A LATER DATE**.
2. Completely fill in the bubbles with an ordinary lead pencil. Marks made with a ballpoint pen or felt tip marker will NOT be detected. Do not make stray marks and completely erase errors.
3. Print your name and course in the blanks on the top of the SCANTRON sheet.
4. STUDENT NUMBER: Print the digits of your student number in the squares provided. Mark the corresponding bubble in the column below each printed digit.
5. SECTION: Fill in your course section:
001 (1:30pm lecture NATSCI 145) or 002 (11:30am lecture NCB 101)
6. CODE: Fill in the exam code you are writing (top of this sheet).
7. Mark the one best choice from the alternatives provided for each question.
8. There are 50 questions in this test. Check your paper to ensure all questions are present. It is your responsibility to transfer all answers from the examination paper to the SCANTRON sheet WITHIN THE THREE HOUR time period.
9. THE SCANTRON sheet MUST be handed in at the end of the examination. You may keep the question booklet.
10. Wrong answers WILL NOT be deducted from your score.

****NOTE****

When filling in the SCANTRON answer sheet, failure to PROPERLY include and "bubble in" your student number, section or exam code will result in a loss of 5% from your exam grade. Be sure to triple check!!!

1) Specialized cell junctions such as desmosomes and hemidesmosomes both require

- a) integrins. ✓
- b) microtubules. ✗
- c) microfilaments.
- d) intermediate filaments. ✓
- e) two of the above. ✗

2) A hypothetical cell exists in which there are high levels of glucose on the exoplasmic side of a vacuolar membrane. There is also a functioning GLUT1 uniporter present in this vacuolar membrane. As a result

- a) glucose will leave the vacuole through active transport. ✗
- b) glucose will enter the vacuole through active transport. ✗
- c) glucose will enter the vacuole through facilitated transport. ✗
- d) glucose will leave the vacuole through facilitated transport. ✓
- e) glucose is not transported by GLUT1. ✗

3) Chaperones that reside in the RER contain the following motif(s):

- a) Mannose-6-phosphate
- b) KDEL sequence ✓
- c) Ubiquitin ✗
- d) Construction box ✗
- e) Two of the above

4) Fruit flies that carry a mutation in the *BOSS* gene do not form the R7 photoreceptor. However, through a process called complementation the phenotype can be rescued by introducing:

- a) The *seven* gene in the R8 photoreceptor ✗
- b) A wildtype *BOSS* gene into the precursor cell immediately adjacent to R8 ✓
- c) A dominant *Ras* gene in the R8 photoreceptor
- d) A dominant *Mek* gene into the precursor cell immediately adjacent to R8 (R7)
- e) None of the above

5) With regards to MAPS, which is not true?

- a) They have an ATPase head domain.
- b) They have a microtubule binding domain.
- c) They can influence microtubule function.
- d) MAP types include MAP2, MAP4 and tau.
- e) They have an acidic projection domain.

6) *Amanita phalloides*, or the death cap mushroom, causes two types of poisoning in cells. The amatoxins may be the deadliest of the two because they are responsible for:

- a) Polymerizing most of the actin to the filamentous form in kidney cells ✗
- b) Keeping the Gas subunit in the "on" state in intestinal cells
- c) Hyperstimulating the NOS enzyme in smooth muscle cells
- ☒ d) Binding RNA polymerase in liver cells
- e) Blocking the Na⁺ channel in nerve cells

7) A toxin produced by a toad was found to cross the plasma membrane and cleave SRP into non-functional fragments. You are working with pancreatic islet cells and use an insulin assay to test how efficient the cells are in secreting the hormone into the media surrounding the cells. Which of the following would you expect to find when your cells are exposed to the toad toxin described above?

- a) Insulin secretion would not be affected ✗
- ☒ b) Insulin would be made, but would remain in the RER
- c) Insulin levels would increase in the trans-Golgi complex
- d) Insulin would accumulate in the cytoplasm ✗
- e) Only the leader sequence at the N-terminus of insulin would be produced ✗

* 8) Since cadherins have a cytosolic C-terminal tail, all of the following are true except:

- a) Their C-terminal tails can be associated with the cytoskeleton. ✓
- b) They have a transmembrane domain. ✓
- c) They have an N-terminal signal anchor. ✓
- d) Their N-terminal domain is exoplasmic. ✓
- ☒ e) Their N-terminal domain is involved with homophilic adhesion.

9) With respect to the fatty acid C18:1, which statement is true?

- a) It is a polyunsaturated molecule.
- b) It is a molecule whose carboxylic acid group has 18 carbons.
- c) This molecule is hydrophobic. (comp. steric)
- ☒ d) Its T_m is lower than that of stearate.
- e) It is a glycolipid.

M
P
S
→ D
P
P

10) With regards to the arrangement of microtubule protofilaments, which is not true?

- ☒ a) Triplets are found in centrioles.
- b) Triplets are found in basal bodies. ✓
- c) Kinetochore microtubules are singlets. ✓
- d) Doublets are found in dendrites. ✓
- e) Doublets are found in axonemes. ✓



cellular + strogelia

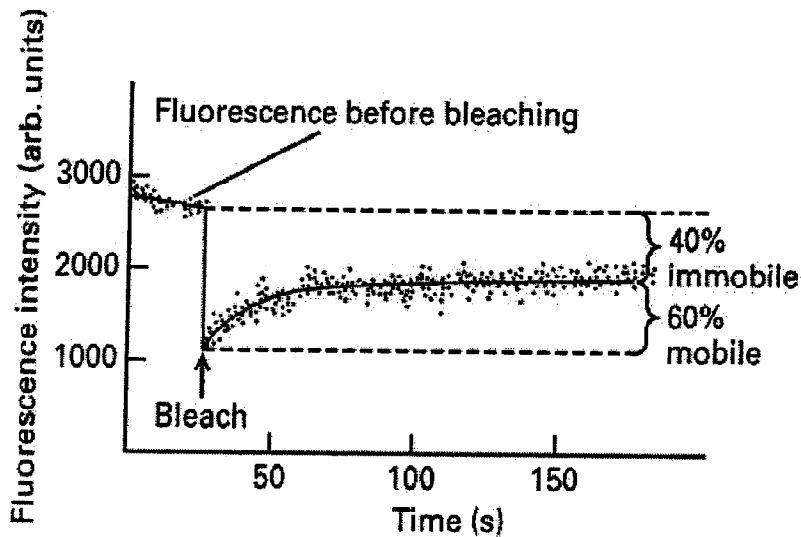


11) To complete the characterization of c-fos and its binding partner, you plan to use an independent method to corroborate the two-hybrid screen. Which one of the following techniques would be the best to prove that c-fos and the other protein were bona fide interactors?

- a) Gel filtration chromatography
- b) Ion exchange chromatography
- ☒ c) Affinity chromatography
- d) Isoelectric focusing
- e) Rate zonal centrifugation

12) The graph below demonstrates that

- a) 60% of the tubulin in the plasma membrane is mobile. ✗
- ☒ b) lateral diffusion occurs within a biomembrane.
- c) integral membrane proteins flip from one surface to the other. ✗
- d) 40% of the tubulin in the plasma membrane is mobile. ✗
- e) there is no link between the plasma membrane and the cytoskeleton. ✗



13) Resolution for a Transmission Electron Microscope is defined as being equal to:

- a) $\frac{0.61\alpha}{n \cos \lambda}$
- ☒ b) $\frac{0.61\lambda}{\alpha}$
- c) $\frac{0.61\alpha}{\sin \alpha}$
- d) $\frac{0.61\lambda}{n \sin \alpha}$
- e) $\frac{0.61 \cos \alpha}{n \arctan \lambda}$

14) Whooping Cough symptoms are obvious, but like any good clinician before administering antibiotics you suggest one test. You have taken a swab from the infected area and want to culture the bacteria to see if it is the one that causes Whooping Cough. Once the bacteria has grown up you collect the toxin to use in a biological assay. Which one of the following would indicate that your patient is in fact infected with bacteria that cause Whooping Cough?

- a) Guanylyl cyclase levels are high ✗
- b) Snare proteins have been degraded ✗
- ☒ c) GDP remains attached to the G α i subunit
- d) The 28s component of the large ribosomal subunit is inactive ✗
- e) Phospholipase C is always active ✗

15) "Modafinil is a stimulant prescribed to treat narcolepsy, a neurological condition characterized by irresistible episodes of sleep." A microarray analysis shows that animals treated with Modafinil have elevated c-fos mRNA levels. C-fos is an immediate early response gene whose protein product works together with other proteins in growth-related transcriptional events. To determine what these other proteins might be you plan on using c-fos as bait in a yeast two-hybrid screen and you are successful, having identified five binding partners. You have each of the "fish" from the screen sequenced and although all bound to c-fos in the two-hybrid assay, you conclude 4 are false positives and only one is the true binding partner to c-fos. Which one is it?

- ☒ a) MAPK
- b) Vimentin ✗
- c) Gelsolin ✗
- d) Tubulin ✗
- e) Clathrin ✗

16) Once stimulated Protein Kinase A is responsible for activating and inactivating a variety of substrates. How many of the following directly pertain to PKA and its activation, and/or serve to activate PKA?

Requires cAMP to function; Made up of 1 regulatory domain and one catalytic domain; Catalyzes the breakdown of cGMP to 5'GMP; Binds NO; Activated in a GPCR-induced signal transduction cascade; Is targeted by the ricin RTA polypeptide; Is Inactivated by Tetrodotoxin

- a) 1
- b) 2
- c) 3
- ☒ d) 4
- e) 5

17) Which of the following is false?

- a) A liposome is bi-layered. ✓
- b) Stearate has a higher melting temp than oleate. ✓
- c) Phosphoglycerides have a glycerol scaffold. ✓
- ☒ d) C28:2 fatty acids are common in human cells.
- e) Cholesterol is amphipathic. ✓

M C14:0
P C16:0
S C18:0
C C18:1
C C18:2
L C20:0

18) A stem cell is best described as:

- a) A precursor cell that gives rise to gametes
- b) A cell that grows and divides more rapidly than normal
- c) A cell that divides once, then undergoes apoptosis
- d) An immune system cell that produces antibodies
- ☒ e) A self-renewing cell that divides symmetrically or asymmetrically

* 19) There are calcium indicators like Fura-Red that give off fluorescence when they bind calcium ions. When Fura-Red is introduced into *E. coli*, what organelle would I expect to see fluorescence in if the cells were examined by confocal microscopy?

- a) Nucleus
- b) Lysosome
- c) Proteasome
- d) RER
- ☒ e) None of the above

20) The lamins

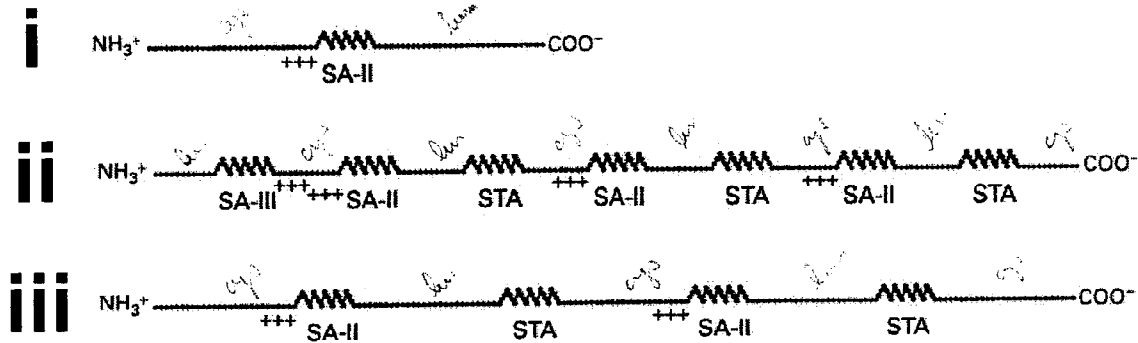
- ☒ a) are a component of the nuclear envelope.
- b) are destroyed by the cdc25 phosphatases.
- c) are composed of collagen.
- d) are proteins that attach chromatids to the mitotic spindle.
- e) are proteins of the extracellular matrix that bind fibronectin.

21) Proteasome degradation is a mechanism that is now known to regulate as much as 75-80% of the protein levels in our cells. Certain toxins can "fool" the cell, as the protein is not degraded in the usual fashion. This mechanism occurs in the case of ricin, which is very damaging, in fact lethal, to an affected cell. As a scientist you think you have found a way to prevent ricin deaths and although it is not an actual antidote the method involves a drug that specifically acts to _____ in the ricin A chain.

- a) Carboxylate glutamate
- ☒ b) Ubiquitinate lysine
- c) Phosphorylate tyrosine
- d) Hydroxylate proline
- e) None of the above

Questions 22 and 23 are all based on the diagram below which represents the topogenic sequences found in transmembrane proteins.

STA = Internal stop-transfer anchor sequence
 SA-II = Internal signal-anchor sequence
 SA-III = Internal signal-anchor sequence



22) With regards to the above diagram, which protein(s) have cytosolic N-terminal domains?

- a) i
- b) ii
- c) i and ii
- ☒ d) i and iii
- e) all i, ii and iii

23) With regards to the above diagram, which statement is true

- a) Protein ii has eight transmembrane domains. x
- b) Protein i has two cytosolic domains. x
- ☒ c) Protein iii has two luminal domains.
- d) Protein iii has three luminal domains. x
- e) Protein iii is a peripheral membrane protein. x

24) You saw this year that the improper preparation of some plants can have disastrous consequences on those who eat them. In the case of the cassava, cyanogenic glucosides can breakdown yielding extreme toxic products to human cells. Which one of the following is a direct target of hydrocyanic acid poisoning?

- ☒ a) Mitochondria
- b) Ribosomes
- c) Gap junctions
- d) Intermediate filaments
- e) Microtubules

e-transport

25) G-protein coupled receptors (GPCRs) play an integral role in many signal transduction events in our body. Which one of the following pertains to GPCRs?

- a) They bind GTP
- b) They inhibit the activity of Adenylyl cyclase ×
- c) They bind cGMP
- d) Two of the above
- ☒ e) None of the above

26) How many directly pertain to the lamins?

Are continuous with the smooth endoplasmic reticulum; Are destroyed by the wee1 phosphatase; Are composed of collagen fibers; Attach centromeres to the mitotic spindle; Are made up of DNA; Form tetramers following phosphorylation; Bind fibronectin ×

- ☒ a) One
- b) Three ×
- c) Five ×
- d) All of the above ×
- e) None of the above

27) Of transmembrane proteins and phospholipid molecules, which have both hydrophobic and hydrophilic regions?

- a) Transmembrane proteins and phospholipids.
- ☒ b) Phospholipids only.
- c) Transmembrane proteins only. ×
- d) Neither. ×
- e) Phospholipids, but only when cholesterol is present. ×

28) Growth factors serve as mitogens to activate MAPK pathways. These pathways are complex and involve many protein intermediates. Which one of the following is true regarding the MAPK pathway discussed in lecture?

- ☒ a) Raf is activated by 14-3-3
- b) Active Ras binds MEK ×
- ☒ c) Adenylyl cyclase is needed to generate cAMP
- d) SOS binds the SH2 domains on GRB2 ×
- e) GAPs serve to inactivate the signaling transduction process ×

29) Cell free systems are used extensively in cell biological research because you simply add in or leave out reagents that may influence a biological response. You have a cell free system established from a line of fibroblast cells and have absolutely **everything**, including energy and microsomes needed to translate and fully process the 900kDa protein laminin present in the extracellular matrix. In your experiment you add the mRNA encoding full-length laminin, which includes the 300 nucleotides encoding laminin's leader sequence, and remember each amino acid weighs 100 Daltons, and radioactive methionine to detect the size of the protein(s) by autoradiography. During the reaction, however, a clumsy lab assistant dropped an entire vial of botox into the reaction mixture and then tells you after you have run the gel. Which one of the following would you expect to see once the film has been developed?

- ☒ a) Nothing
b) One band with a molecular weight of 900kDa >
c) One band with a molecular weight of 800kDa >
d) Two bands, one with a molecular weight of 10kDa and one of 890kDa x
e) Two bands, one with a molecular weight of 10kDa and one of 900kDa

30) According to the National Institutes of Health, "Tay-Sachs disease is a fatal genetic lipid storage disorder in which harmful quantities of a fatty substance called *ganglioside G_{M2}* build up in tissues and nerve cells in the brain. The condition is caused by insufficient activity of an enzyme called *beta-hexosaminidase A* that catalyzes the biodegradation of acidic fatty materials known as *gangliosides*." The disease results from mutations on chromosome 15, in the gene encoding part of the enzyme. As a cell biologist you have evidence that the enzyme is normally localized to a specific organelle. That organelle is the:

- a) Mitochondrion >
b) Chloroplast >
☒ c) Proteasome
d) Golgi complex
e) Lysosome

* 31) Which one of the following would allow you to come to the conclusion that *hexosaminidase* is localized to a specific organelle in normal individuals.

- ☒ a) S³⁵-methionine and electron microscopy
b) Ampholytes and SDS-PAGE x
c) Sucrose and gel filtration chromatography x
d) cDNA and confocal microscopy x
e) None of the above

32) A symporter

- a) moves two ions or molecules across the membrane in the same direction one at a time. ✗
- b) moves two ions or molecules across the membrane in opposite directions one at a time. ✗
- c) moves two ions or molecules across the membrane in opposite directions at the same time.
- ☒ d) moves two ions or molecules across the membrane in the same direction at the same time. ✓
- e) moves two ions or molecules across the membrane either in the same direction or in the opposite direction, depending upon the concentration gradients. ✗

33) If a plasma membrane were fully permeable, and not just semi-permeable, which of the following would be true?

- a) Small uncharged molecule (such as gases) could not pass through. ✗
- b) K^+ concentration would be lowest in the cytosol.
- c) Na^+ concentration would be highest in the cytosol. ✗
- d) Glucose would become integral to the membrane. ✗
- ☒ e) None of the above is true.

34) Which of the following statements below are true in reference to signal transduction?

- 1) G-proteins and Ras are active when GTP is bound ✓
 - 2) Most extracellular signals that elevate cGMP levels do so by activating cGMP phosphodiesterase ✓
 - 3) The rapid response to changes in external signals is due to the short lifespan of activated Raf, which rapidly hydrolyzes GTP-to GDP due to its inherent enzymatic activity
 - 4) Adenylyl cyclase is activated or inhibited by G-proteins ✓
 - 5) Growth factor receptors form homodimers during activation ✓
- a) 1, 4 and 5 are true
 - b) 2, 3 and 4 are true ✗
 - ☒ c) All are true
 - d) 3, 4 and 5 are true ✗
 - e) Only statement 1 is true ✗

*35) The next generation of chemotherapeutic agents is being designed to target a variety of cell biological processes. In this manner it would be ideal to target a cancer cell to undergo apoptosis. If that were the case, however, and if delivering these agents into a cell was not a problem, you would NOT want to:

- a) Target a cancer cell with a monoclonal antibody to Mdm2
- b) Inhibit ubiquitin ligase in this cell
- c) Block p53-Mdm2 binding in this cell
- d) Target a cancer cell with a monoclonal antibody to p53
- ☒ e) All of the above

36) A cell whose membrane is primarily made of oleic and linoleic fatty acids is treated such that all carbons in the fatty acids are now saturated. As a result the membrane will

- a) decrease its melting point. ✗
- b) become more fluid. ✗
- c) become less fluid.
- d) become 30% thicker per saturation event. ✗
- e) become more permeable. ✗

O C15:1
L C18:2
A C22:4

37) A cell has excessive ATP and active profilin proteins. If the C_{c+} for a microfilament is $0.1 \mu M$ and the C_{c-} is $0.6 \mu M$, what would happen to this microfilament at a G-actin concentration of $0.7 \mu M$?

-↓ +↑

- a) The microfilament would depolymerize from both ends. ✗
- b) The microfilament would polymerize from the plus end, and depolymerize from the minus end, and therefore treadmill.
- c) The microfilament would depolymerize from the plus end, and polymerize from the minus end, and therefore treadmill. ✗
- d) The microfilament would polymerize at both ends. ✗
- e) The G-actin would be sequestered and the microfilament would remain unchanged. ✗

38) This year marks the 20th anniversary of the nuclear disaster at Chernobyl. There are conflicting reports as to the number of people who are likely to die from the exposure to radiation. As an independent scientist you are brought in to assess the damage and take tissue samples from 100 individuals picked at random. You plan to look for differences in the expression of the proto-oncogene c-myc, which is up-regulated in many human cancers. What method below would be the best diagnostic tool to see which, if any of the 100 individuals have elevated c-myc protein levels?

- a) Microarray analysis ✗
- b) Southern blot analysis
- c) Northern blot analysis ✗
- d) Western blot analysis
- e) None of the above ✗

39) If anyone in your subject group from above was found to have elevated c-myc levels, they might be fortunate to not get cancer if the mutated cells can undergo apoptosis. During apoptosis, however, these cells would NOT...

- a) Release their intracellular contents ✗
- b) Undergo mitosis ✓
- c) Cause an inflammatory response ✓
- d) Two of the above
- e) All of the above

40) The generation and maintenance of a resting membrane potential requires

- a) a very permeable membrane. x
- b) ATP. x
- c) gap junctions.
- d) active diffusion of glucose. x
- e) nerve impulses. x

(facilitate d
transport of K⁺)

41) With respect to anaphase A and anaphase B, which is true?

- a) Only anaphase A uses microtubules.
- b) Only anaphase B uses microtubules.
- c) Anaphase A is driven by motor proteins.
- d) Anaphase B is driven by motor proteins.
- e) Anaphase A is dependent on telophase. x

42) Many chemotherapeutic cancer drugs selectively act on rapidly growing cells like those seen in many cancers. The overexpression of mitogens or their receptors and the involvement of second messengers is often the "trigger" that induces uncontrolled cell growth. In one of these cascades PIP2 is cleaved by _____ to yield two second messengers.

- a) PKC
- b) PKG
- c) PKA
- d) MAPK x
- e) PLC

43) The two second messengers that form from the cleavage of PIP2 outlined above are:

- a) cAMP and cGMP
- b) IP3 and Ca²⁺
- c) Raf and Mek
- d) Calmodulin and NO
- e) None of the above

IP3 + DAG

44) Which is associated with normal striated muscle function? ✓

- a) P-class pumps.
- b) Tropomyosin. ✓
- c) Voltage gated channels. ✓
- d) Only b and c
- e) a, b and c

45) In muscle cells dystrophin can be considered

- a) a plus end directed actin motor protein.
- b) a MAP.
- c) a peripheral membrane protein.
- d) an IFAP.
- ☒ e) both a and c.

46) Which cannot influence membrane fluidity?

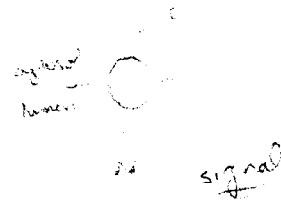
- a) phospholipid composition -
- ☒ b) water concentration
- c) temperature -
- d) steroids -
- e) proteins -

47) With regards to peripheral membrane proteins, which is not true?

- a) Peripheral membrane proteins must all be directly linked to microtubules. -
- b) Peripheral membrane proteins are all covalently linked directly to long carbon chains. -
- c) Peripheral membrane proteins are found on both sides of the membrane. -
- d) Both a and b.
- ☒ e) None of the above.

48) Cadherin is a type 1 transmembrane protein. Therefore, its C-terminal domain

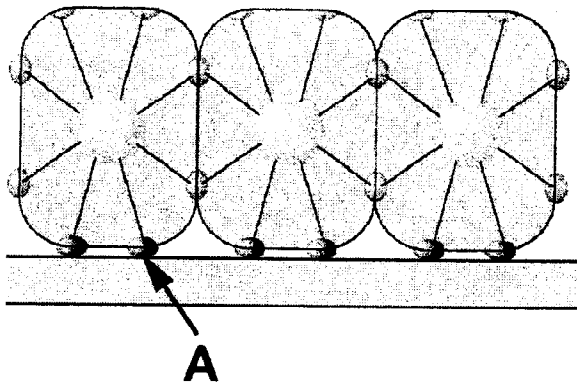
- a) can interact with its cadherin partner on another cell. x
- ☒ b) can interact with the cytoskeleton.
- c) binds to extracellular fibronectin. x
- d) is cleaved to remove the signal peptide. x
- e) is amphipathic. x



49) Which is not a phospholipid?

- a) SM
- ☒ b) GM
- c) PI
- d) PS
- e) PE

50)



"A" in the diagram above represents all structures in the following list except:

- a) Cell-ECM binding. ✓
- b) A hemidesmosome. ✓
- c) Integrin-RGD binding. ✓
- d) The basal surface of an epithelial cell. ✓
- ☒ e) A voltage gated channel.