



2025 Mitosisphere p + q = 1

Part I: Animal Anatomy & Physiology (12 Questions)

1. Which of the following statements are TRUE:

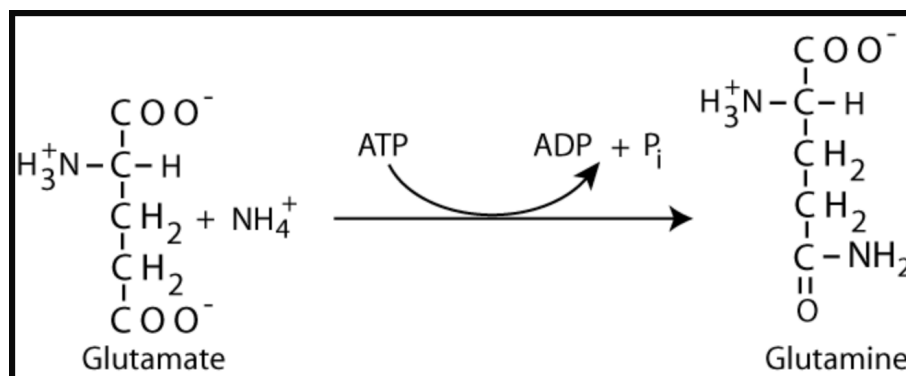
- I. The fovea of the retina contains the highest density of rod cells, making it crucial for dim-light vision.
 - II. The Eustachian tube connects the middle ear to the larynx, helping it equalize air pressure on both sides of the tympanic membrane.
 - III. The semicircular canals in the inner ear detect rotational acceleration, while the organ of Corti assists with balance.
 - IV. During visual accommodation, the ciliary muscles contract or relax to alter the tension in the suspensory ligaments resulting in differing curvature of lens causing light to focus on the retina.
- A. IV only
 - B. I and II
 - C. II and IV
 - D. II, III, and IV
 - E. I, II, III, & IV

2. Which of the following statements are FALSE:

- A. The enzyme pepsin is secreted in the stomach as an inactive precursor, pepsinogen, which is activated by hydrochloric acid.
- B. Bile salts, produced in the gallbladder, are essential for emulsifying lipids and aiding fat digestion in the small intestine.
- C. Most nutrient absorption occurs in the jejunum, a middle portion of the small intestine specialized with villi and microvilli.
- D. Pancreatic secretions empty specifically into the duodenum of the small intestine.
- E. The large intestine primarily functions in absorbing water and electrolytes, while also housing gut microbiota that produce vitamins such as vitamin K.

3. Methionine sulfoximine (MSO) is a known inhibitor of the enzymatic reaction shown below. Inhibition of this enzyme via MSO has been studied in mouse models in order to better understand neurodegenerative diseases such as amyotrophic lateral sclerosis (ALS). In fact, MSO treatment in

transgenic mice overexpressing SOD1, the most commonly inherited form of the human gene in ALS, was seen to decrease this enzyme's activity *in vitro* by 85%.



Which of the following cell type's function would be most directly affected by MSO treatment?

- A. Astrocytes
- B. Schwann cells
- C. Oligodendrocytes
- D. Microglia
- E. Alpha motor neurons

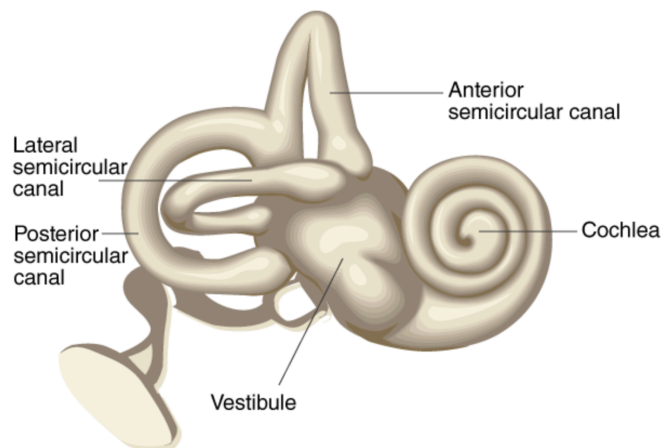
4. A patient comes in complaining of fatigue, weight loss, and an unusual darkening of the skin despite it being the middle of winter. After running a few tests, you see that the patient has low sodium levels and blood pressure. You then run a blood test to check hormone levels, and obtain the following results:

	Patient's levels	Normal range
TRH	13.0 pg/mL	< 15 pg/mL
CRH	9.1 pg/mL	< 10 pg/mL
TSH	0.32 $\mu\text{IU/mL}$	0.4 – 4.0 $\mu\text{IU/mL}$
ACTH	118 ng/dL	10 – 60 pg/mL
T4	.7 $\mu\text{g/dL}$	0.8 – 1.8 ng/dL
Cortisol	1.3 $\mu\text{g/dL}$	5 – 25 $\mu\text{g/dL}$

Which of the following best explains the results obtained?

- A. Primary adrenal insufficiency
- B. Secondary adrenal insufficiency
- C. Hyperadrenalism
- D. Hyperthyroidism
- E. Hypothyroidism

5. The semicircular canals located within the ears provide information on the angular acceleration of the head. There are three semicircular canals located in each ear, oriented perpendicularly to one another so as to provide information about all three dimensions. As the head rotates, endolymph within the semicircular canals provides inertia so that the stereocilia may bend in a direction opposite to that of the angular acceleration of the head. For example, as the head rotates left, the stereocilia bends right. Shown below is a diagram of the inner ear. Which of the following options correctly identifies which semicircular canals would be most stimulated during a cartwheel and somersault respectively?



- A. Lateral, Posterior
- B. Anterior, Posterior
- C. Posterior, Anterior
- D. Posterior, Lateral
- E. Lateral, Lateral

6. According to the sliding filament theory of muscle contraction, which of the following configurations of thick and thin filaments would maximize muscle tension at a given load?

- A) Maximizing both thick-thin and thin-thin filament overlap
- B) Minimizing both thick-thin and thin-thin filament overlap

- C) Maximizing thick-thin filament overlap, while minimizing thin-thin filament overlap
- D) Minimizing thick-thin filament overlap, while maximizing thin-thin filament overlap
- E) Maximizing thick-thin filament overlap, with an intermediate amount of thin-thin overlap.

7. A neuron's axon membrane is suddenly depolarized and held steady at -10 mV using a voltage clamp. At this voltage, both the voltage-gated sodium and voltage-gated potassium channels are open. Assuming the leaky channels and pumps have negligible effects, which statement best describes what happens to the net ionic current across the membrane at this short interval?

- A. More Na^+ rushes in than K^+ leaves, so the net current is inward (positive charge enters).
- B. Less Na^+ enters than K^+ leaves, so the net current is outward (positive charge exits).
- C. Both ions move equally but in opposite directions, producing no net current.
- D. Na^+ briefly enters, but the K^+ current reverses direction, making the total inward.
- E. Neither Na^+ or K^+ moves significantly because the membrane potential is near their equilibrium values.

8. Suppose a patient has a blockage in one of the major lymphatic trunks draining the lower limb (e.g. the lymphatic vessels from the leg). Over time, the patient begins to develop swelling (edema) in that limb. Which of the the following is the most plausible explanation for the edema, and which compensatory mechanism might the body try (but ultimately fail) to use?

- A. Fluid accumulates in interstitial spaces because capillary hydrostatic pressure increases; the body compensates by constricting arterioles to reduce filtration.
- B. Plasma proteins leak more from capillaries to wash out stagnant fluid; the body compensates by increasing albumin synthesis in the liver.
- C. Interstitial fluid can not return to the venous circulation, so fluid builds up; the body compensates by increasing capillary reabsorption by lowering capillary filtration pressure.
- D. Lymphatic vessels begin reverse flow to divert fluid backward; the body compensates by opening collateral lymphatic channels.
- E. More fluid is forced into veins upstream, raising venous pressure; the body compensates by increasing venous return via stronger skeletal muscle pumps.

9. In a physiology lab, a student is studying a frog's leg muscle. She applies steady electric shock to the leg muscle and notices that when she increases the pulse frequency, the muscle also seems to twitch faster. Excited, she raises the frequency even higher, expecting more force. However, the contraction stops getting stronger... Given that there's enough Ca^{2+} and ATP, what's the best reason that the muscle can't generate more force?

- A. The actin binding sites are saturated with myosin, so no more cross-bridges can form.
- B. The muscle has run out of Na^+ to generate action potentials.
- C. The troponin-tropomyosin complex becomes permanently locked at high frequency, preventing more crossbridge cycling.

- D. The rate of crossbridge detachment is the bottleneck: myosin heads cannot cycle faster.
- E. The sarcoplasmic reticulum cannot release any more Ca^{2+} — it is fully saturated.

10. John Doe is a 42-year-old man with poorly controlled hypertension, profuse sweating, palpitations, and periodic severe headaches. One day, his symptoms worsened as he experienced tremors and a sudden sense of impending doom. He went to the hospital and got the following MRIs taken:



After close examination, which diagnosis would you most likely give?

- A. Pancreatic neuroendocrine tumor
- B. Cushing's syndrome
- C. Graves' disease
- D. Adrenocortical carcinoma
- E. Pheochromocytoma

11. Very low density lipoproteins (VLDLs) are produced by the liver and later converted into LDLs after tissues have utilized the bulk of their triglycerides. Cells with apolipoprotein receptors recognize and endocytose LDLs; most LDLs are cleared by the liver in this way. Given the previous information, which of the following statements regarding the metabolism and regulation of cholesterol is FALSE?

- A) People with familial hypercholesterolemia have downregulated LDL receptor levels in their livers.
- B) Statins, drugs which inhibit cholesterol synthesis, may be used to remove atherosclerotic plaques that have built up in a chronic smoker.
- C) Statins may lower testosterone levels in men.
- D) A high [LDL]/[HDL] ratio is indicative of high blood pressure.

- E) HDLs are generally considered “good cholesterol,” while LDLs are considered “bad cholesterol.”

12. Drugs used to treat arrhythmias can be broken up into four main classes: (1) voltage gated Na⁺ channel blockers, (2) beta-blockers, (3) K⁺ channel blockers, and (4) Ca²⁺ channel blockers. Which of the following statements regarding these drugs is NOT true?

- A) An inhibitor of cAMP phosphodiesterase would result in similar effects to that of drugs in class (2)
- B) Treatment of EDTA around myocardial cells would result in similar effects to that of drugs in class (4)
- C) The administration of class (3) drugs on a skeletal muscle cell may result in an action potential more similar to that of a myocardial cell
- D) The effects of class (4) drugs would be enhanced in response to increased stimulation of the parathyroid.
- E) The intended effects on heart rate of class (1) drugs are the same as that of class (3) drugs.

Part II: Cell Bio (10 Questions)

13. Chromatin packaging and level of compaction within eukaryotic cells may occur at various levels. These varying levels of compaction may differ across regions depending on their relative levels of expression, as well as depending on what phase of the cell cycle the cell is currently in. Which of the following statements is false regarding eukaryotic chromatin organization?

- A) As the cell progresses from G1 through S phase, chromatin in general becomes less condensed
- B) As the cell progresses from the metaphase to anaphase, chromatin compaction remains relatively constant
- C) Methylation around the lac repressor may increase beta-galactosidase expression
- D) Lysine and Arginine residues of histones tightly bind with DNAs negatively charged backbone
- E) During interphase, genes of related function tend to cluster near one another.

14. A huge range of cellular processes rely on the polymerization of G actin subunits into F actin filaments. Which of the following structures/processes does NOT rely on actin polymerization?

- A) Nuclear lamina
- B) Cellular motility
- C) Intercellular transport
- D) Contractile ring
- E) Vesicle formation

15. Minghao, an avid climate change denier, is interested in the steps of cellular respiration that produce carbon dioxide. Identify all of the following four steps that produce carbon dioxide as a byproduct.

- I. Glycolysis
- II. Pyruvate oxidation
- III. Krebs cycle
- IV. Electron transport chain

- A) I & IV
- B) I & III
- C) II & III
- D) I, II, & III
- E) I, II, III, & IV

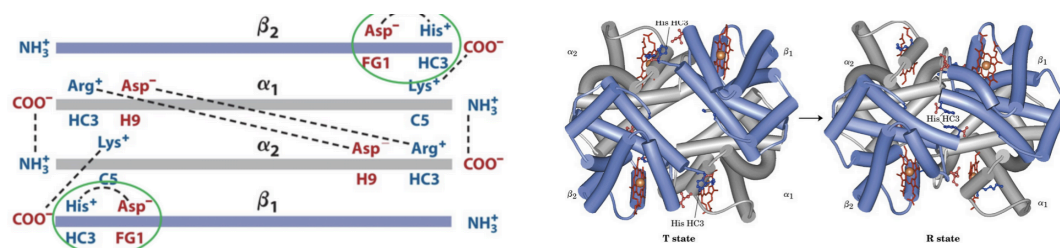
16. A mutation in a gene coding for a regulatory protein in the endoplasmic reticulum leads to failure in regulating high temperatures. Which of the following outcomes would most likely result from this treatment?

- A. Increase in concentration of misfolded proteins, leading to apoptosis
- B. Increased mitochondrial ATP production to reduce ER stress
- C. Increase in efficiency of lysosomal degradation of cytosolic proteins
- D. Increased release of secretory proteins
- E. Upregulation of nuclear pore complex components to assist in mRNA export

17. The injection of a drug inhibiting the production of GPCRs is introduced to a collection of muscle fibers. What is the most likely outcome of this action?

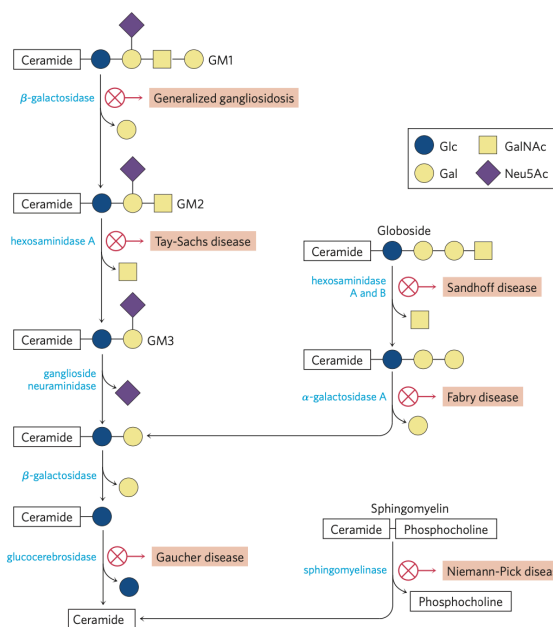
- A. Increased sensitivity to hypertrophy
- B. Inhibition of caspases from degrading the cell
- C. Decreased sensitivity to GH
- D. Increased intake of glucose from bloodstream
- E. Decreased reception of epinephrine

18. Hemoglobin (Hb) predominantly exists in two forms: a T, or tense, state, or a R, or relaxed state. When Hb is deoxygenated, it is in the T state; when it's bound to oxygen, the R state. Hb may bind up to 4 molecules of oxygen, each bound molecule increasing Hb's affinity for the next. Which of the following statements is true regarding hemoglobin?



- Hemoglobin's affinity for oxygen can be well modeled by Michaelis-Menten kinetics
- Hemoglobin forms alpha-alpha homodimers that combine with beta-beta homodimers
- Increasing H^+ concentration may lead to increased Hb affinity for oxygen
- In the R state, Hb's proximal His residue to form an ion pair with Asp due to rotation of the molecule.
- Given that carbon monoxide (CO) binds the same site as oxygen with 200x greater affinity, binding of CO to one of Hb's oxygen binding sites results in decreased oxygen affinity at the other sites.

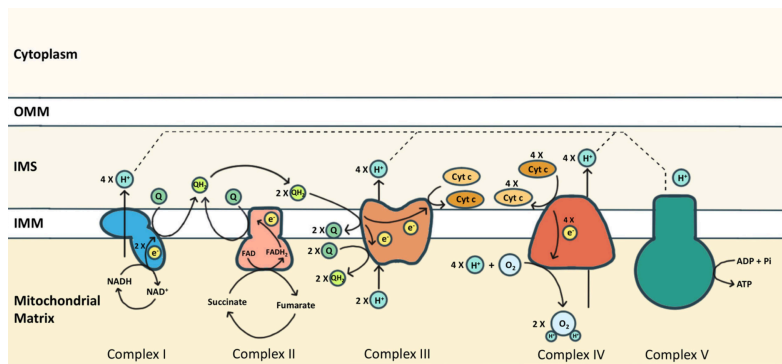
19. Shown below are pathways for the breakdown of GM1, globoside, and sphingomyelin to ceramide. A red X indicates the absence of/mutation in certain enzymes and their associated diseases. Based on the figure below, which of the following statements is/are true?



- An individual with a deficiency in hexosaminidase A could not also have Sandhoff disease
- Complete breakdown of GM1 results in a ceramide with a conjugated galactose monomer.
- Deficiency in any one of these enzymes results in lipid accumulation in the brain.
- An individual with a defect in the enzyme converting GM2 to GM3 likely has two parents that were carriers for the defective enzyme.

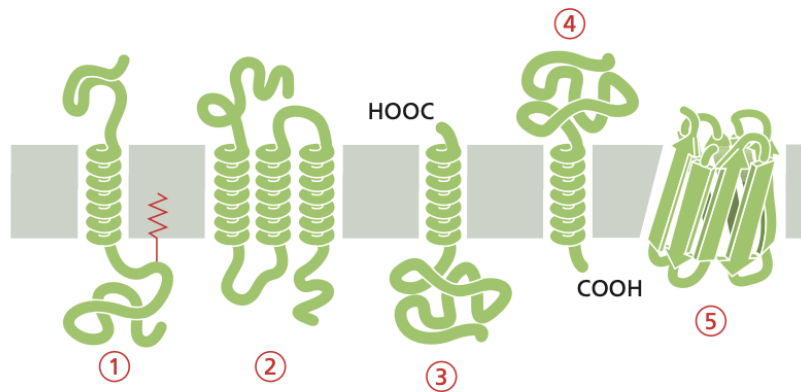
- A. II only
- B. IV only
- C. III, IV
- D. II, IV
- E. I, III, IV

20. The electron transport chain (ETC) pumps protons across the inner mitochondrial membrane (IMM) creating an electrochemical gradient that drives their flux through ATP synthase to generate ATP. Various drugs and chemicals may be utilized to inhibit the ETC at different points along the chain. Which of the following drugs would be most effective in slowing ATP production, but not completely halting it?



- A. Oligomycin, an inhibitor of the F_0 subunit of ATP synthase
- B. Cyanide, which has a much higher H^+ affinity than oxygen
- C. Carbon monoxide, which blocks complex IV by binding its heme iron
- D. UCP1, an ionophore that allows for the passive diffusion of protons across the IMM
- E. Rotenone, a competitive inhibitor of succinate dehydrogenase (complex II)

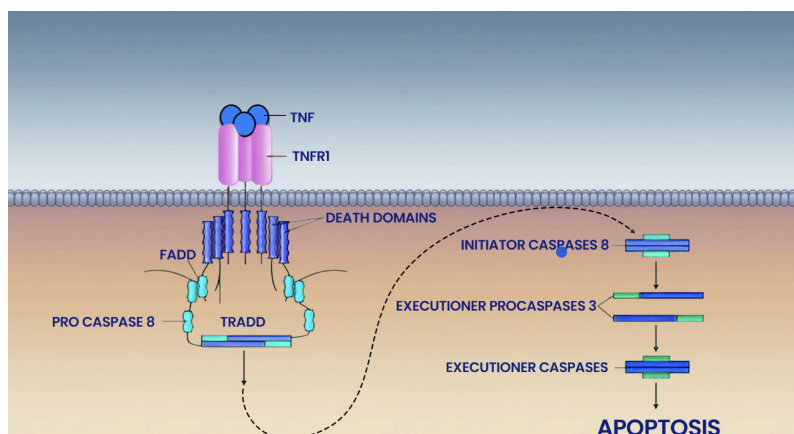
21. Membrane proteins may differ in their topology based on their amino acid properties. Below is a diagram of different classes of membrane proteins. Based on the diagram, which of the following is NOT true?



*Top of the image is cytosol, bottom is lumen.

- A) Type 1 membrane proteins anchored in the ER likely would have had an SRP cleaved after insertion.
- B) Type 2 membrane proteins are often involved in the transport of molecules across a membrane
- C) If a type 3 membrane protein is found on the plasma membrane, its carboxyl (COOH) likely faced the luminal side of the vesicle that carried it there.
- D) Type 4 membrane proteins would likely NOT have any/very many proline residues in its transcellular domain.
- E) Type 5 membrane proteins would be present at a high density in erythrocytes.

22. Shown below is the mechanism of activation for the extrinsic pathway of apoptosis. In addition to TNF, many other ligands including FAS and TRAIL may activate this pathway. Many immunologically privileged regions of the body, such as the anterior chamber of the eye and the sertoli cells of the testes release the FAS ligand which binds the Fas receptor, inducing apoptosis in Tregs that would otherwise mount an autoimmune attack. Based on the information above, as well as the figure, which of the following is false?



- A) Sequestration/removal of the Fas receptor in Tregs may result in an autoimmune attack
- B) A competitive inhibitor of the TNF receptor would directly induce increased cell proliferation
- C) Caspase 8 does not directed chop up/ destroy DNA
- D) Neither caspase 8 nor the executioner caspases are constitutively active under standard conditions in a cell.
- E) Compared to apoptosis, necrosis of Tregs would more likely cause an inflammatory response.

Part III: Genetics & Evolution (10 Questions)

23. Which of the following is NOT a necessary condition for Hardy-Weinberg equilibrium?

- A. Phenotypic frequencies remain constant throughout generations
- B. Random mating
- C. No flow of genes into the population
- D. No natural selection of genes
- E. Large population size

24. In the pathway to create blue pigment in a certain plant, a white precursor is first converted by one enzyme into a yellow intermediate, which is then acted upon by another enzyme to form the blue pigment. After crossing a population of yellow flowers with a population of white flowers, all F1 offspring are blue. Backcrossing the F1 generation with each of the parental strains produces the following results. Assuming 1 copy of each chromosome in these plants is required for survival, and based on the information provided, which of the following statements is NOT true?

	F1 x Yellow Parent	F1 x White Parent
White	3	342
Yellow	351	4
Blue	344	357

- A) Each parent is homozygous dominant for 1 gene and homozygous recessive for another
- B) The 3 white offspring from the F1 x Yellow parent may have resulted from a nondisjunction
- C) The yellow parent is missing a functional copy of the second enzyme in the pathway
- D) If the F1 generation was self-crossed, it would produce a 9:3:4 ratio.
- E) Ignoring mutations, if the blue offspring from both crosses were crossed with one another, some white offspring would be produced

25. In the bacterial pathway for the biosynthesis of arginine, proline is converted into ornithine, which is converted into citrulline, which is finally converted into arginine. A certain class of mutants can grow citrulline. A certain mutant X cannot convert ornithine into citrulline; another mutant Y cannot convert citrulline into arginine; finally, a mutant Z cannot convert proline into ornithine. Given the information above, which of the following is not true?

- A) A merodiploid (fusion of two bacteria) between mutant X and Z would be able to grow on media containing ornithine
- B) A colony of mutant X bacteria could grow in the presence of citrulline
- C) A colony of mutant Z bacteria would show some growth in a media without proline but with vitamin C
- D) A colony of mutant X bacteria adjacent to a colony of mutant Y bacteria would show some growth in excess ornithine
- E) A mutant Z may grow in proline if it's transformed with a plasmid containing the enzyme it lacks

26. In order to study and maintain the recessive small wing mutation in a population of fruit flies, you decide to cross a true breeding population of WT winged flies with a true breeding population of small winged flies with a balanced chromosome that contains numerous nested inversions, a dominant green earlobe marker, and a recessive lethal mutation. After self crossing the F1 generation, what is the expected ratio of WT winged to small winged flies?

- A. 1:2
- B. 1:3
- C. 2:1
- D. 3:1
- E. 4:1

27. A trait appears in every generation of a pedigree. Affected fathers transmit the trait to all daughters but none of their sons. Unaffected mothers can have affected daughters only if the father is affected. What is the most likely inheritance pattern?

- A. Autosomal dominant
- B. Autosomal recessive
- C. X-linked dominant
- D. X-linked recessive
- E. Mitochondrial

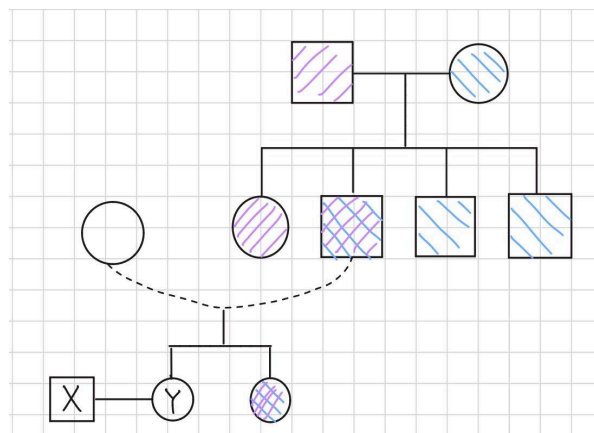
28. An autosomal recessive disease has an incidence of 1 in 2,500 live births. Assuming Hardy–Weinberg equilibrium, what is the approximate carrier frequency?

- A. 1 in 25
- B. 1 in 50
- C. 1 in 100
- D. 1 in 250
- E. 1 in 500

29. Imagine there are 2 heterozygous parents for curly hair and they produced 8 children. Given that curly hair is dominant, what is the probability that there are exactly 3 children with curly hair?

- A. 0.37%
- B. 0.41%
- C. 1.33%
- D. 2.31%
- E. 20.8%

30. Shown below is the pedigree of a certain family. Blue lines indicate curly back hair, purple lines indicate brittle toenails. Based on the most probably patterns of inheritance and given that the frequencies of the curly back hair allele and the brittle toenail allele in the general population are 10% and 20% respectively, which of the following is closest to the probability that if individuals “X” and “Y” have a child, they will be a son with regular (not curly) back hair and brittle toenails? (Note that X and Y both have regular/straight back hair and normal toenails)



- A. 1%
- B. 2%
- C. 3%
- D. 4%
- E. 5%

31. Researchers create the following variants of a human cell line and then measure DNA content and progression through the cell cycle after serum starvation and release. For each variant, they add serum (stimulus) and score which phase cells predominantly arrest in after 24 hours:

- **Wild type (WT):** normal cyclin expression → cells progress through G1 → S → G2 → M normally.
- **Line A:** constitutive overexpression of Cyclin D (high Cyclin D at all times).
- **Line B:** loss-of-function mutation in Cyclin E.
- **Line C:** nondegradable Cyclin B (Cyclin B persists and cannot be ubiquitinated).

Which of the following best describes the most likely arrest point for each line?

- A. A → G1/S checkpoint (early S), B → G1 arrest, C → metaphase (M arrest).
- B. A → premature S entry (shortened G1), B → G1/S arrest (failure to enter S), C → anaphase (accelerated exit from mitosis).
- C. C. A → G2 arrest, B → G1 arrest, C → cytokinesis failure (telophase arrest).
- D. A → prolonged G1 due to Rb hyperactivity, B → S/G2 arrest, C → G1 arrest.
- E. A → apoptosis immediately after serum addition, B → accelerated S entry, C → no effect on mitosis.

32. In which of the following stages of meiosis could a nondisjunction have occurred to produce a child with Klinefelter's syndrome?

- I. Meiosis I, Mother
- II. Meiosis II, mother
- III. Meiosis I, Father
- IV. Meiosis II, Father

- A. I, III
- B. II, IV
- C. I, II, III
- D. I, II, IV
- E. I, II, III, IV

Part IV: Plant Biology (8 Questions)

33. Ken Zeng, possibly (probably) the second worst plant biologist in the world, decides to finally give plant bio a try. Much to his excitement, he finds out plants have hormones, similar to those found in

the human body. He decides to study auxin, a plant hormone that plays a major role in plant response to the environment. Which of the following statements regarding auxin is true?

- A. During phototropism, auxin is transported laterally to the side with more sunlight to inhibit growth.
- B. During gravitropism in roots, auxin transporters are moved to the bottom of the cell (towards the center of the earth), causing inhibition of growth and curving of the root towards the ground.
- C. The sensitivity of auxin in the root and the stem are the same, resulting in similar mechanisms for different tropisms.
- D. Auxin is derived from terpenoids, similar to abscisic acid.
- E. None of the above are true.

34. Iron absorption strategies differ between plants, with different strategies. The figure below shows a simplistic version of the process. Based on the figure, which of the following statements is true?

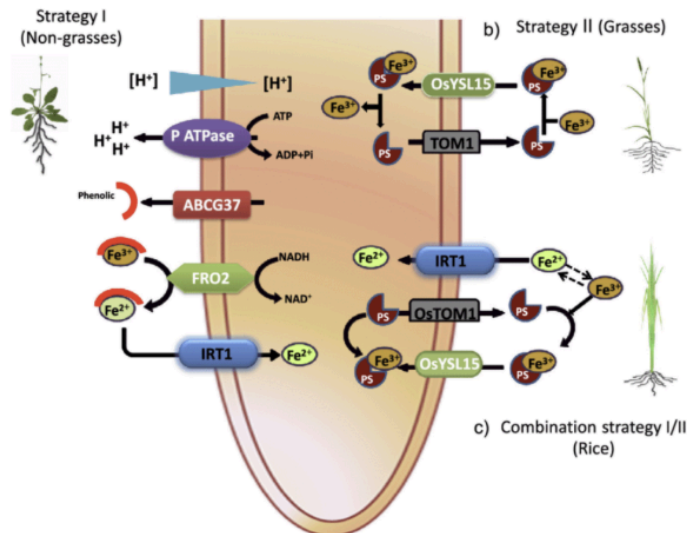
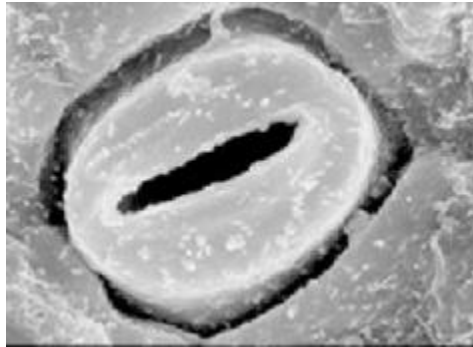


Image from Research Gate - [Link](#)

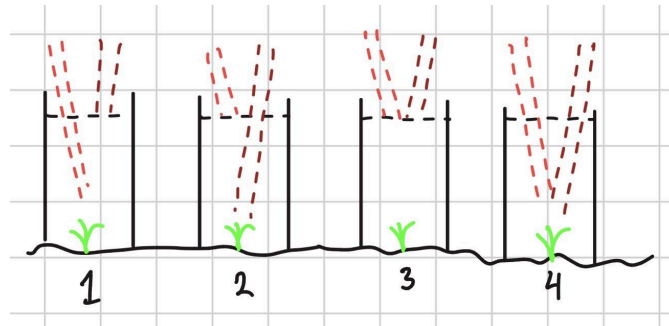
- A. Due to the high reducing power of H^+ , Fe^{3+} is able to be reduced into Fe^{2+} , a more soluble form of the element and can be absorbed by the plant.
- B. In grasses, phytosiderophores, similar to nongrasses, reduce Fe^{3+} into a more soluble product that allows for its uptake.
- C. Both strategies result in acidification of the soil
- D. Phenolics play the same role as phytosiderophores, both only chelating the insoluble iron and helping absorb it.
- E. None of the above are true.

35. Shown below is an SEM image taken of a certain plant. From which of the following groups of plants could this image NOT have been taken?



- A. Mosses
- B. Liverworts
- C. Hornworts
- D. Club Mosses
- E. Quillworts

36. Scientists grew *A. Thaliana* under four different conditions: under a filter that blocks far red light (1); under a filter that blocks red light (2); under a filter that blocks both red & far red light (3); and under a filter that does not block either wavelength of light. Which of the following statements is false regarding this experiment?



- A) Plants in condition 1 would exhibit more vertical growth than plants in group 2
- B) Plants in group 3 would show little to no growth
- C) Plants synthesize phytochromes in the form that can absorb light in condition 1
- D) The receptors responsible for de-etiolation would not be directly affected by condition 3
- E) Plants in conditions 1 and 2 would shift predominantly towards different forms of phytochrome

37. You are investigating a plant with a deficiency in a specific hormone. You observe that this plant (out of many symptoms) has dark green, thickened leaves, as well as reduced vascular development. Which hormone deficiency likely caused this?

- A. Auxin
- B. Brassinosteroids
- C. Cytokinins
- D. Jasmonic acid
- E. Ethylene

38. Which of the following statements about the signaling pathway for de-etiolation is true?

- A. Inhibition of Ca^{2+} channel will increase the rate of de-etiolation.
- B. De-etiolation results in the greening of plants through an auxin induced pathway.
- C. cGMP phosphodiesterase inhibitors would increase de-etiolation.
- D. The effector molecule is located on the cytoplasmic membrane of the plant cell.
- E. None of the above are true.

39. In C_4 plants, CO_2 fixation and the Calvin cycle occur between two specialized cell types; what are they and what enzyme do they use to function properly (cell type 1 & enzyme 1; cell type 2 & enzyme 2)?

- A. Mesophyll cells & Fixase; Bundle sheath cells & PEP Carboxylase
- B. Bundle sheath cells & Carbonic Anhydrase; Mesophyll cells & RuBisCO
- C. Guard cells & RuBisCO; Palisade mesophyll & PEP Carboxylase
- D. Collenchyma & PEP Carboxylase; Sclerenchyma & RuBisCO
- E. Mesophyll cells & RuBisCO; Bundle sheath cells & PEP Carboxylase

40. After girdling a grown and matured tree, the upper stem swells and produces excess sugars, while root growth is inhibited. Which process is most disrupted by this recovery?

- A. Active transport of minerals to the shoot
- B. Water movement via transpiration
- C. Translocation of photosynthates
- D. Cell division in the apical meristem
- E. Secondary xylem formation in the trunk

Part V: Ecology (5 Questions)

41. Which of the following characteristic of a trophic pyramid would likely indicate top-down control over the ecosystem?

- A) Increasing the abundance of a producer will increase abundance of its main predator
- B) An inverted biomass pyramid
- C) Tight coupling between nutrient availability and primary productivity
- D) At least one keystone species and foundation species
- E) High primary producer biomass and low consumer biomass

42. You discover two new organisms in the wild, *N.Onchalant* and *C.Halant*, and uncover a symbiotic relationship between them. *C.Halant* produces volatile compounds that limit space that *N.Onchalant* has. On the other hand, *N.Onchalant* doesn't care because he still has the basic resources to live. What symbiotic relationship encapsulates this interaction?

- A) Mutualism
- B) Commensalism
- C) Competition
- D) Predation
- E) Ammensalism

43. Charles is interested in different defensive adaptations in animals. Particularly, he is interested in how these adaptations are acted upon by selection. Which of the following choices incorrectly matches a type of defensive adaptation and the type of selection that would act upon it?

- A) Müllerian mimicry; Positive frequency dependent
- B) Batesian mimicry; Negative frequency dependent
- C) Cryptic coloration; Directional
- D) Aposematic coloration; Positive frequency dependent
- E) None of the above are incorrectly matched

44. Which dispersion pattern is most likely to be exhibited by the seedlings of a tree species that aren't properly dispersed by animals or natural phenomena?

- A) Random
- B) Clumped
- C) Uniform
- D) Spatiated
- E) Hindered

45. What is the main reason that the survivorship curve of a molting crab would differ from a type 2 survivorship curve?

- A) Crabs exhibit variable rates of survival due to the molting and strengthening of their shell
- B) Crabs show a type 1 survivorship curve
- C) Crabs are a k-selected species
- D) Crabs exhibit semelparity, limiting the amount of times that they can molt and reproduce
- E) Crabs are a type 2 survivorship curve

Part VI: Ethology (3 Questions)

46. A population of birds feeds on 2 insects. One of these insects provides 2 units of energy (Smaller insect) and the other insect provides 10 units of energy (Larger insect). The smaller insects are abundant and require 1 minute to catch. On the other hand the larger insects are rare and require 10 minutes to catch. According to optimal foraging theory, which prey type should the birds prefer if they want to maximize energy intake per unit time?

- A) Only small insects
- B) Only large insects
- C) Both Equally
- D) Mostly small insects, occasionally large insects
- E) Mostly large insects, occasionally small insects

47. A researcher studying prairie dogs observed that they seem to give alarm calls much more frequently when their close relatives are nearby. She then hypothesizes that this is kin selection. To test her theory she could:

- A) Compare alarm call frequency near unrelated individuals vs relatives.
- B) Measures alarm calls in predator-free areas.
- C) Measure alarm call frequency near different predators
- D) Count total number of prairie dogs in the colony
- E) Observe mating success of individuals giving alarm calls.

48. A lab rat presses a lever and receives a food pellet only 30 percent of the time given. Then after a few sessions, the rat presses the level more and more frequently but not as consistent as before. What type of reinforcement schedule is used and why is the rat's behavior irregular?

- A) Fixed ratio. Behavior is consistent
- B) Variable ratio. Behavior is highly resistant to extinction
- C) Fixed interval. Behavior increases right before reinforcement
- D) Variable interval. Behavior is irregular due to unpredictability
- E) Continuous. Behavior decreases because of satiation.

Part VI: Biosystematics (2 Questions)

49. Which genus is known for being a freshwater indicator organism as well as possessing a siliceous cell wall with intricate pore patterns?

- A. Paramecium
- B. Spirogyra
- C. Diatoma
- D. Euglena
- E. Amoeba

50. In a widely accepted vertebrate phylogeny, turtles nest within Diapsida alongside birds and crocodilians. If “Reptilia” is defined to include turtles, lizards, snakes, and crocodilians but exclude birds, the group “Reptilia” is:

- A) Monophyletic
- B) Paraphyletic
- C) Polyphyletic
- D) A clade synonymous with Amniota
- E) Two of the above