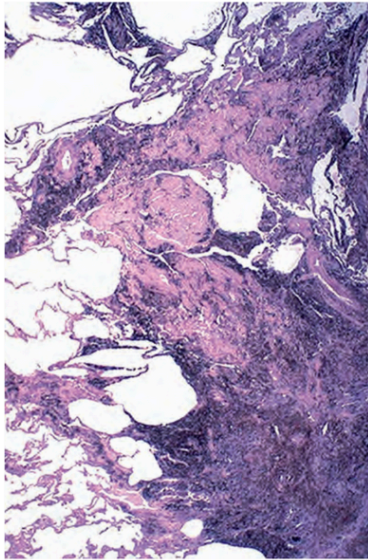


2026 Mitosisphere April Challenge

Part A (MCQ):

Anatomy & Physiology (2 Questions):

1. What is the most likely pathology of this histopathological micrograph?



- A) Advanced silicosis
- B) Asbestos-related damage
- C) Progressive massive fibrosis in a coal worker
- D) Desquamative interstitial pneumonia
- E) Diffuse alveolar damage (acute respiratory distress syndrome)

2.

A group of researchers studies lipid metabolism in two patients with rare genetic mutations affecting lipoprotein processing. Patient 1 has marked accumulation of large triglyceride-rich particles ($\sim 5000 \text{ \AA}$) containing apoB-48. Patient 2 has elevation of $\sim 300 \text{ \AA}$ apoB-100-containing particles while LDL is reduced. Given the information in the graphic below, which of the following combinations explains the two patients' phenotypes?

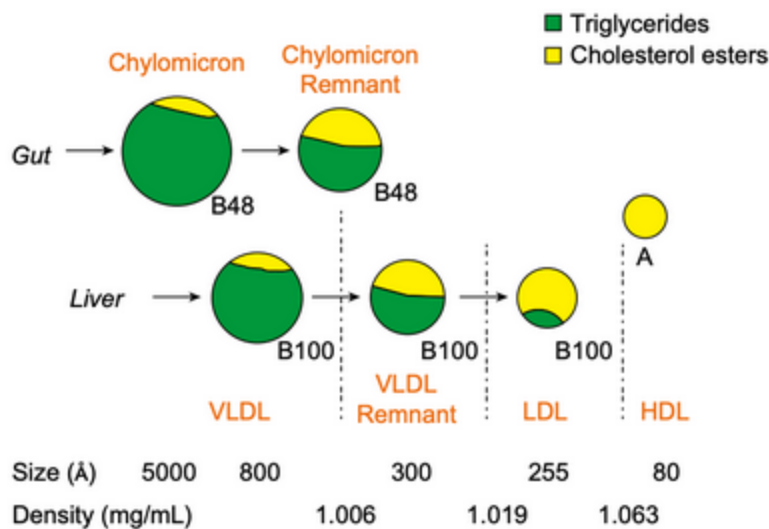


Fig. 11.2 Metabolism of apoB-containing lipoproteins.

A) Patient 1: Defective intestinal microsomal triglyceride transfer protein (MTP) preventing chylomicron assembly; Patient 2: Loss of hepatic LDL receptors

B) Patient 1: Loss of lipoprotein lipase activity in peripheral capillaries; Patient 2: Impaired hepatic lipase activity, preventing conversion of VLDL remnants into LDL

C) Patient 1: Defective apoC-II activation of lipoprotein lipase; Patient 2: Loss of ACAT (Acyl-coenzyme A:cholesterol acyltransferases)-mediated cholesterol esterification in hepatocytes

D) Patient 1: Loss of NPC1L1 (Niemann-Pick C1-Like 1)-mediated intestinal cholesterol uptake; Patient 2: Defective PCSK9 (Proprotein Convertase Subtilisin/Kexin type 9)-mediated LDL receptor degradation

E) Patient 1: Impaired hepatic uptake of chylomicron remnants via apoE receptors; Patient 2: Defective VLDL secretion from hepatocytes

Cell Biology (2 Questions):

In a hypothetical organism, a mutation eliminates all cohesins along chromosome arms during meiosis I but leaves centromeric cohesins intact. Which of the following best predicts the outcome at the end of meiosis II?

A) Four genetically identical haploid cells are produced because without arm cohesins, crossing over cannot occur and chromosomes segregate without recombination.

B) Cells arrest in meiosis I because the spindle assembly checkpoint cannot detect tension without cohesins holding homologs together.

C) Homologs separate normally in meiosis I and sister chromatids separate normally in meiosis II, producing haploid cells, but with reduced genetic variation due to absence of crossing over.

D) Homologs fail to separate in meiosis I because chiasmata cannot be maintained without arm cohesins, producing diploid secondary oocytes that then fail meiosis II.

E) Sister chromatids separate prematurely in meiosis I because arm cohesins are needed to hold them together until meiosis II.

Why might alkaline conditions promote RNA self-hydrolysis?

A) This conjecture is false. Rather, acidic conditions promote self-destruction.

B) Deprotonation of the 2'-hydroxyl allows oxygen to act as a nucleophile, attacking the adjacent phosphodiester bond.

C) Hydroxide ions are able to act as a nucleophile to cleave the ribose sugar at the 3' position.

D) Alkaline pH causes base-catalyzed elimination of the 5'-phosphate, resulting in strand cleavage.

E) Alkaline conditions stabilize backbone conformations that make hydrolysis more favorable

Genetics (2 Questions):

A new test has just been devised to test for a specific autosomal dominant disease. The test has a sensitivity of 96% and a specificity of 92%. A doctor decides to administer the test to a random person from a population in Hardy-Weinberg equilibrium with a recessive allele frequency of 0.3. What is the probability that the test result is a false negative?

A) 3.64%

B) 7.28%

C) 8.28%

D) 8.64%

E) 10.82%

You decide to perform a yeast two-hybrid assay to determine the extent of an interaction between two proteins, protein A and protein B. You use a LacZ reporter gene with an upstream activator sequence that binds to a transcription factor with an activation and

DNA-binding domain. Which of the following mistakes in your procedure will maintain transcription of the reporter gene?

- A. Fusing both protein A and B to an activation domain
- B. The activator sequence is part of a larger enhancer that requires other transcription factors that can't be transferred in vivo
- C. Protein A forms homotrimeric complexes that bind the activator sequence**
- D. Close proximity of separate domains is not sufficient to have a functioning transcription factor
- E. Proteins A and B interact via a much larger protein C

Plant Biology (1 Question):

Rice is deciding how he wants to poison Shriyan after Shriyan bottom frags his Valorant games. Below are 4 statements regarding plant immunity. Which of the following are true?

I. Alkaloids are made of poisons like cocaine, nicotine, and morphine, and are mainly used to deter herbivores

II. Jasmonates and salicylic acid usually potentiate each others' effects, ensuring proper defense against predators.

III. Phytoalexins are involved in the expression of R genes, and play an important role in the innate immunity of plants.

IV. Although jasmonate release initially inhibits root growth, prolonged elevation can cause branching of root hairs.

A) II only

B) I and IV

C) I III and IV

D) I II III and IV

E) II III and IV

Ecology (1 Question):

Which of the following are characteristic of k-selected species?

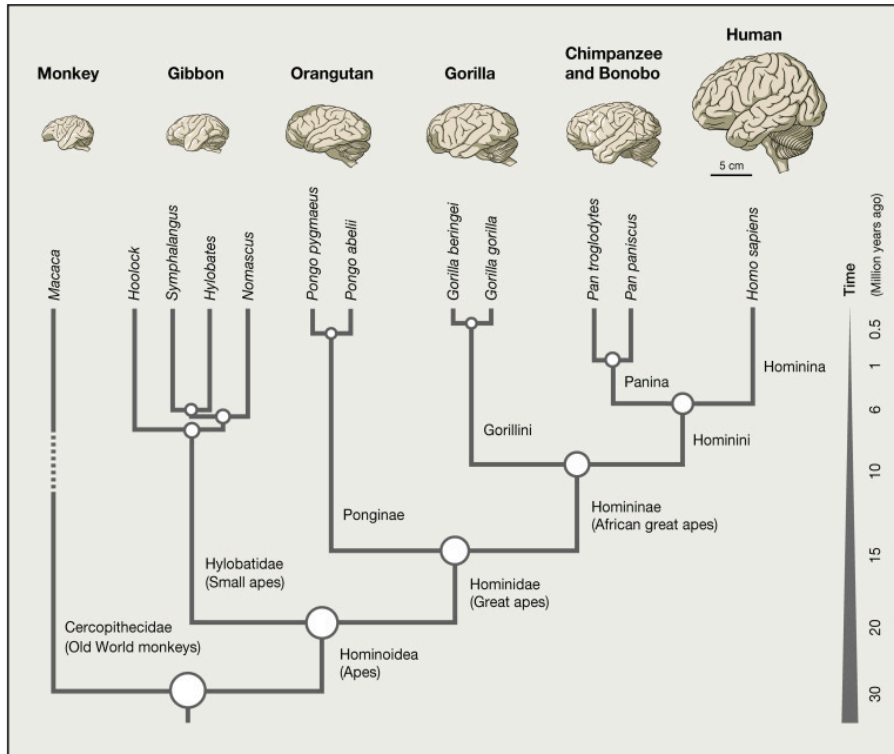
- A. Easy Dispersal
- B. Minimal parental investment in offspring
- C. Typically pioneer species
- D. Limited ability to compete for resources
- E. Late reproductive maturity

Ethology (1 Question):

You're in the library quietly trying to study when your friend shows up and keeps tapping on your shoulder to show you his newest 2K player. Eventually, as you become more locked in, you gradually forget about his presence. What is this phenomenon called?

- A. Sensitization
- B. Habituation
- C. Adaptation
- D. Classical conditioning
- E. Selective attention

Biosystematics (1 Question):

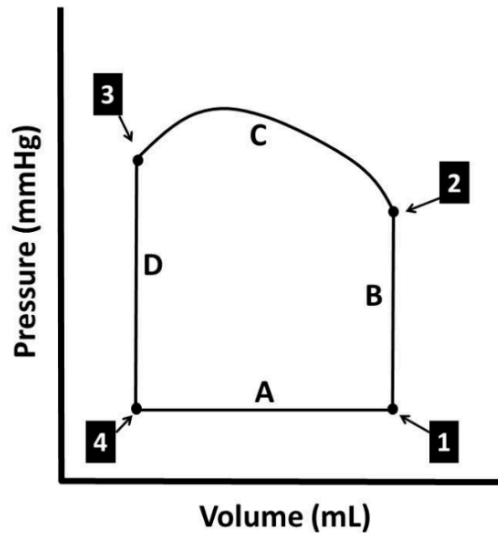


Which is true based on the data in this image only?

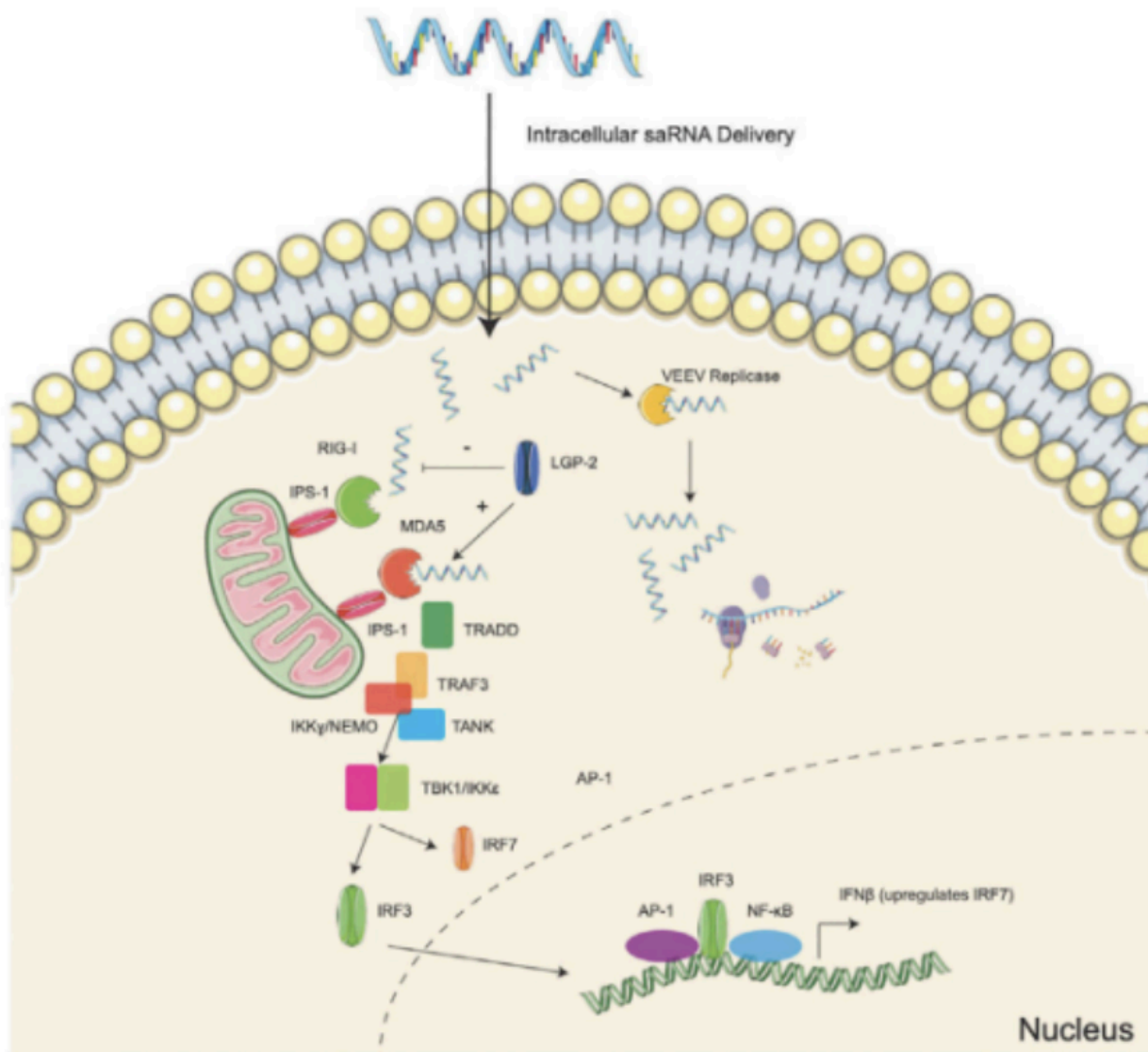
- A. The rate of change of brain size increased significantly after the divergence of Hominini
- B. Similarities between orangutans and gorillas must be homologous
- C. A trait shared by chimpanzees, bonobos, and humans most likely originated from a common ancestor
- D. A and B
- E. A and C

Part B (MTF):
3 Questions

Given this PV Loop, select all that would be true given the following conditions:



- A. The area in between the PV loop is equal to ventricular work.
- B. If volume does not end up changing, work is equal to zero.
- C. B represents isovolumetric contraction
- D. If the PV loop clockwise instead of counterclockwise, ventricular work would be negative.
- E. In positive inotropy, the PV loop would be shifted right and up.



The image above depicts the RIG-I-like receptor (RLR) signaling pathway. Based on your background knowledge and the diagram, determine whether or not the following statements are true or false.

- A. The interaction between the cytoplasmic RNA sensors (RIG-I and MDA5) and the mitochondrial outer membrane anchor protein (IPS-1) occurs within the mitochondrial intermembrane space
- B. The VEEV replicase inhibits the production of type I interferons by promoting the proteasomal degradation of the LGP-2 protein.
- C. The activation of both IRF3 and IRF7 leads to their dimerization and subsequent translocation into the nucleus to induce the transcription of target genes, including IFNβ.

D. The recruitment of TRAF3 and TANK to the IPS-1 complex is an event that precedes the phosphorylation of TBK1/IKKε and the subsequent nuclear translocation of NF-κB.

The Wright Fisher model describes a population that has its change in allelic frequencies affected solely by genetic drift. One of its assumptions are that generations are non-overlapping. Which of the following describes the result on allelic frequencies of population was overlapping (SELECT ALL THAT APPLY)?

A. Allelic frequencies would change more slowly because older individuals continue contributing alleles across multiple generations.

B. Fitness of certain individuals may increase as a result of altruistic behavior, creating selection forces on the population.

C. Genetic drift would stop entirely because individuals from different generations mix, and it causes certain recessive alleles to become fixed in the population.

D. All alleles in the population would remain at exactly the same frequency indefinitely.

E. Due to the presence of older individuals, errors in crossing over would increase, causing deleterious (or beneficial) mutations to increase, causing selection forces to appear.