

DEPARTMENT OF BIOLOGY PROGRAM ASSESSMENT INSTRUMENT

In association with our effort to assess the biology program, we are asking students to complete a pre-test and post-test sequence. The pre-test comprises 48 questions representing key objectives in our BI151-BI154 core sequence.

During the latter stages of each of the core courses, students will then take a post-test. Student scores on the post test, and improvement from pre to post test will then be used as a measure of the effectiveness of these core courses at promoting in students an understanding of the key biological concepts.

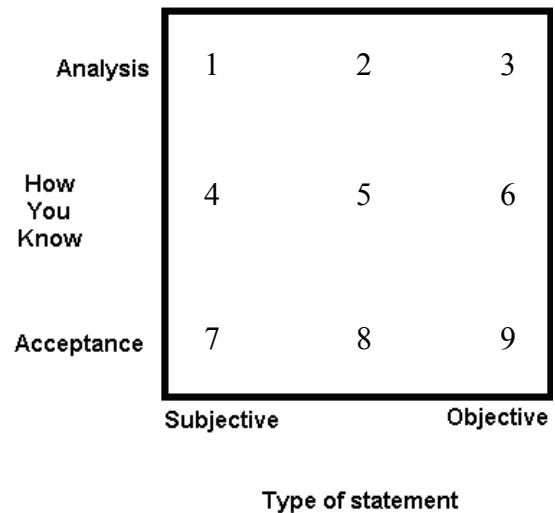
BI151 Questions

1) Consider the following two statements.

- A. The main campus of Southeast Missouri State University is located in Cape Girardeau.
- B. Chocolate ice cream is the best dessert.

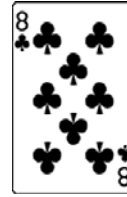
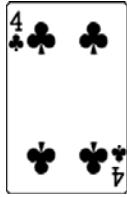
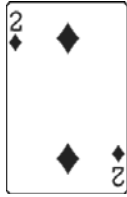
The best placement of these statements on the graph would be:

- a. A = 7, B = 9
- b. A = 3, B = 4
- c. A = 5, B = 6
- d. A = 1, B = 8
- e. A = 9, B = 2



- 2) A hypothesis is
- a. a statement that is objectively true and can be verified
 - b. a belief that can guide behavior
 - c. a natural phenomenon that has been proven to occur invariably
 - d. an attempt to trick an audience into believing that something false is real
 - e. a tentative, testable explanation of observations
- 3) Which of the following is **not** characteristic of scientific explanations?
- a. relies upon proven facts about the natural world
 - b. relies upon objective observations that may be confirmed by others
 - c. relies upon testable explanations that may be falsified
 - d. relies upon general conclusions based upon limited sets of observations
 - e. none of the above

- 4) Assume that you have an immensely large number of standard playing cards in a deck. The deck is arranged in a particular sequence or order of cards. The deck contains only normal playing cards, but any card may appear multiple times, or not at all. Look at the first four cards that are turned up. (Note: clubs and spades are black, diamonds and hearts are red.)

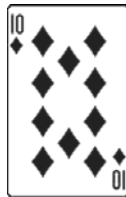


- A. hypothesis A. The deck alternates red and black cards.
 B. hypothesis B. The deck alternates diamonds and clubs

You examine the fifth card in the deck. Two possible outcomes for the fifth card are given below.

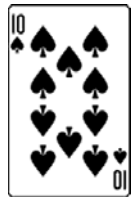
Outcome 1.

The fifth card observed is



Outcome 2.

The fifth card observed is

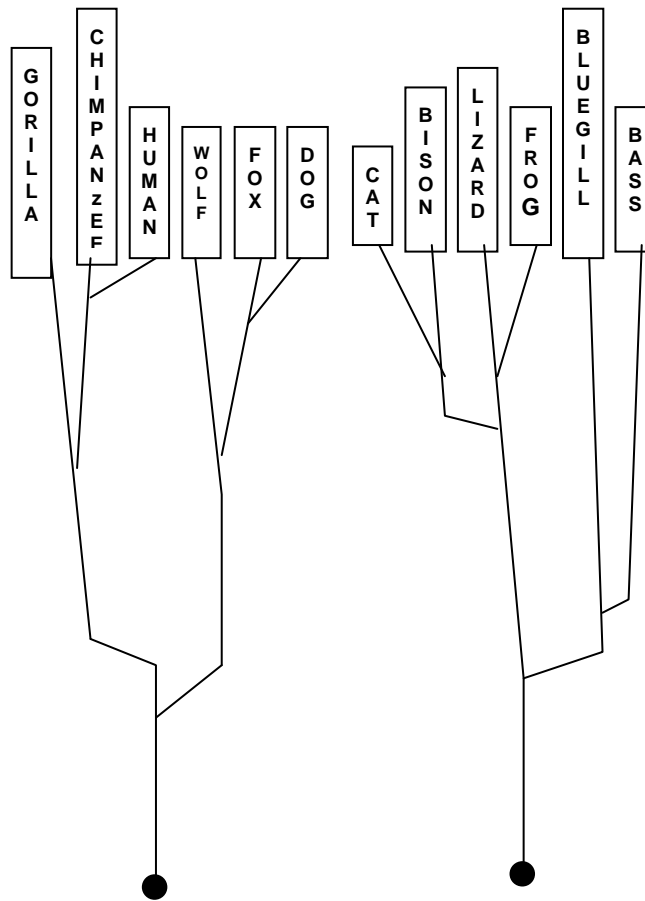


Select the statement that is most correct:

- a. outcome 1 supports hypothesis A and supports hypothesis B
 outcome 2 falsifies hypothesis A and falsifies hypothesis B
- b. outcome 1 falsifies hypothesis A and supports hypothesis B
 outcome 2 falsifies hypothesis A and falsifies hypothesis B
- c. outcome 1 supports hypothesis A and supports hypothesis B
 outcome 2 supports hypothesis A and falsifies hypothesis B
- d. outcome 1 supports hypothesis A and falsifies hypothesis B
 outcome 2 falsifies hypothesis A and supports hypothesis B
- e. outcome 1 falsifies hypothesis A and falsifies hypothesis B
 outcome 2 supports hypothesis A and supports hypothesis B

- 5) The most correct definition of the term “homology” is
- a. resemblance of structures that depends upon similarity of function
- b. structural similarity due to descent from a common ancestor
- c. relatedness of two or more species due to structural similarities
- d. a test to determine the similarity of two or more structures
- e. a function of organisms that can be compared in different species

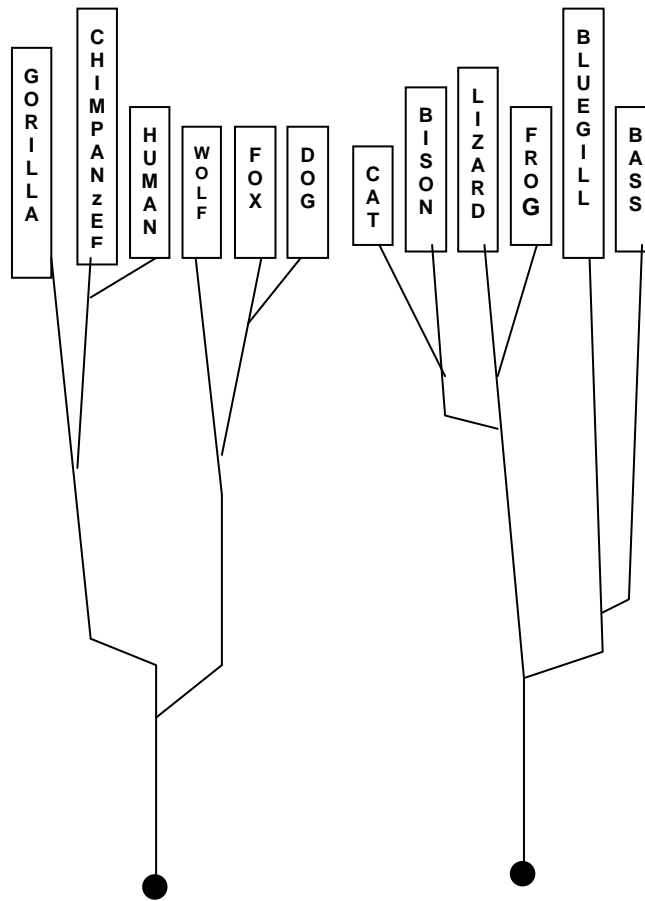
6) Consider the hypothetical tree depicted below:



Which of the following findings would support this hypothesis?

- a. a homology between cat and lizard
- b. an analogy between wolf and dog
- c. a homology between dog and cat
- d. an analogy between bison and fox

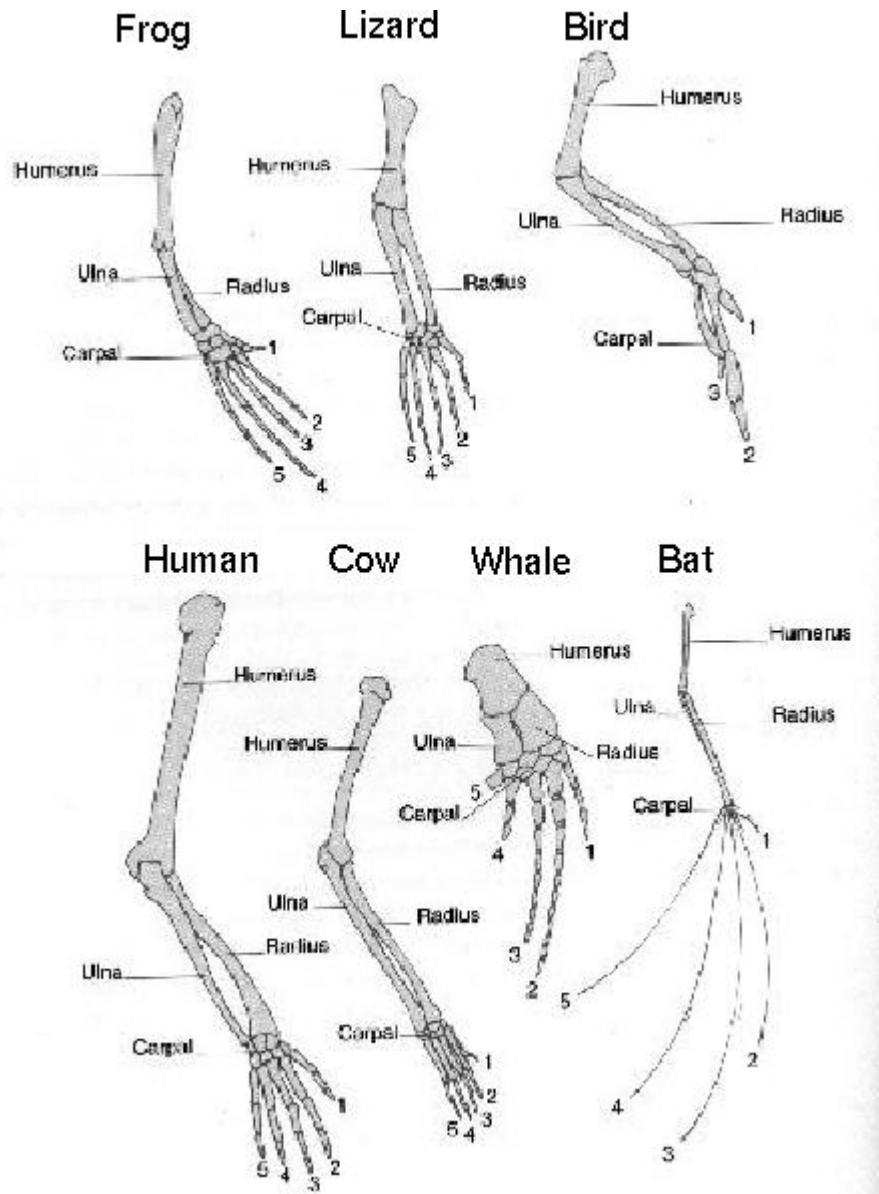
7) Consider the hypothetical tree depicted below:



Which of the following findings would falsify this hypothesis?

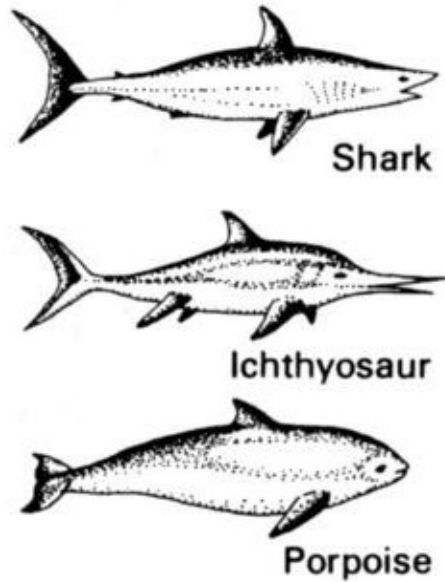
- a. a homology between frog and bass
- b. an analogy between wolf and fox
- c. a homology between cat and human
- d. an analogy between bison and wolf

- 8) Consider the pentadactyl (= five digit) limb of vertebrates depicted below. The best explanation for the structural similarity observed in these various species is



- homology due to inheritance from a common ancestor
- analogy due to inheritance from a common ancestor
- homology due to convergent evolution
- analogy due to convergent evolution

- 9) Consider the shark, ichthyosaur (extinct), and porpoise depicted below and note the streamlined body and stabilizing appendages:



The best explanation for the structural similarity observed in these various species is:

- a. homology due to inheritance from a common ancestor
- b. analogy due to inheritance from a common ancestor
- c. homology due to convergent evolution
- d. analogy due to convergent evolution

- 10) Given the mRNA sequence shown below, what is the sequence of nucleotides in DNA that would result in this mRNA strand?

AUG UCG CCC UUC ACA

- a. GCA CUA UUU CCU GUG
- b. UAC AGC GGG AAG UGU
- c. GCA CTA TTT CCT GTG
- d. CGT GAT AAA GGA CAG
- e. TAC AGC GGG AAG TGT

Consider the code template depicted below to answer questions 11 and 12:

FIRST LETTER	SECOND LETTER				THIRD LETTER
	U	C	A	G	
U	UUU phe	UCU ser	UAU tyr	UGU cys	U
	UUC phe	UCC Ser	UAC tyr	UGC cys	C
	UUA leu	UCA ser	UAA (stop)	UGA (stop)	A
	UUG leu	UCG ser	UAG (stop)	UGG trp	G
C	CUU leu	CCU pro	CAU his	CGU arg	U
	CUC leu	CCC pro	CAC his	CGC arg	C
	CUA leu	CCA pro	CAA glu	CGA arg	A
	CUG leu	CCG pro	CAG glu	CGG arg	G
A	AUU ile	ACU thr	AAU asn	AGU ser	U
	AUC ile	ACC thr	AAC asn	AGC ser	C
	AUA ile	ACA thr	AAA lys	AGA arg	A
	AUG (start) met	ACG thr	AAG lys	AGG arg	G
G	GUU val	GCU ala	GAU asp	GGU gly	U
	GUC val	GCC ala	GAC asp	GGC gly	C
	GUA val	GCA ala	GAA glu	GGA gly	A
	GUG val	GCG ala	GAG glu	GGG gly	G

11) What is the amino acid sequence of the polypeptide that would be formed from this mRNA sequence?

AUG UCG CCC CGA UUC ACA

- tyr thr gly ala lys cys
- met ser pro arg phe thr
- met thr pro ala phe cys
- tyr ser gly gly lys thr
- met trp pro ala lys cys

- 12) Given the mRNA sequence shown below, which of the following mutations would not change the polypeptide formed from this sequence?

AUG UCG CCC CGA UUC ACA

- a. a mutation that changed AUG to AUA
- b. a mutation that changed ACA to ACC
- c. a mutation that changed UCG to UAG
- d. a mutation that changed ACA to AAA
- e. a mutation that changed CCC to GGG

BI152 Questions

Imagine you are studying the Japanese Koi carp (*Cyprinus carpio*). You work as the director for research and development for Koichow Inc. Your department has developed 5 different fish foods; you are charged with the undertaking a project to decide which should be marketed. Before you conduct your study, there is no reason for thinking one brand is any better than any of the others. All foods cost the same amount, so sales price is not an issue.

To investigate the question, your team establishes a series of aquaria housing representatives from the same cohort (i.e. the same batch of fertilized eggs) of juvenile fish. All experimental aquaria are subjected to the same set of non-manipulated conditions (i.e. aquarium lighting and location, water temperature, treatment, and source, all aspects of the feeding regime in terms of timing, frequency and amount of food). After three months, 1 fish was harvested from each of ten aquaria exposed to each food treatment and their lengths measured as a means of judging if there is a difference in the growth of fish in the different foods.

The following data on fish length (in mm) were collected for the five brands:

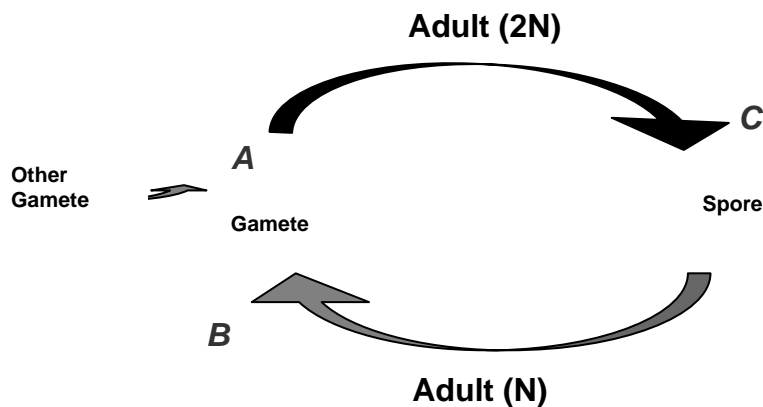
KoiPlus	Koipugh	Koyote	Koits	Koil
12	32	26	27	18
14	31	18	28	19
15	29	18	31	22
10	25	21	30	23
11	30	18	26	16
16	25	23	15	18
20	28	15	19	21
14	36	22	32	18
16	25	29	31	19
12	29	30	28	20
Mean: 14	Mean: 29	Mean: 22	Mean: 26.7	Mean: 19.4

From the study described above, answer the following questions:

- 13) The most appropriate **Research Hypothesis** for this project would be:
- In a study of 50 Koi, divided into 5 samples of 10 each, with each treatment being fed a different kind of KoiChow, there will be a difference in the growth rate of Koi among foods.
 - In a study of 50 Koi, divided into 5 samples of 10 each, with each treatment being fed a different kind of KoiChow, there will be no difference in the growth rate of Koi among foods.
 - In a study of 50 Koi, divided into 5 samples of 10 each, with each treatment being fed a different kind of KoiChow, the greatest growth rate will occur with Koipugh.
 - There is a difference in the growth rate among Japanese Koi (*Cyprinus carpio*) fed five different test brands of KoiChow.
 - There is no difference in the growth rate of Japanese Koi (*Cyprinus carpio*) fed five different test brands of KoiChow.
- 14) On the basis of the reported data (p. 1), which of the following interpretations is scientifically accurate?
- Koipugh is the best food.
 - KoiPlus is the worst food.
 - From a comparison of means alone it is impossible to judge.
 - All foods are equivalent.
 - Koipugh and Koits are equally as good.
- 15) Which of the following statistical procedures would be most appropriate in an analysis of these data?
- A Chi Square Test of the distribution of length classes among foods.
 - A Regression analysis of fish length against food type.
 - An Analysis of Variance comparing fish lengths among food types.
 - A Rank Sum Test comparing fish lengths among food types.
 - A series of T-Tests comparing fish length among pairs of food types.
- 16) Statistical Analysis of the data produced a Probability Value for the data set of < 0.0001 . Assuming we employed an alpha value of 0.05 this means that we should conclude:
- There is only a very small probability that the hypothesis of a difference among food types is correct.
 - There is only a very small probability that the hypothesis of no difference among food types is correct.
 - The Null Hypothesis of no difference among food types is supported.
 - The Research Hypothesis of a difference among food types is rejected.
 - There is only a small probability that the data test any of the hypotheses proposed.

BI153 Questions

- 17) When comparing the physiology of a seaweed and animal cell, the solute concentration relative to the environment is
- lower in seaweeds and higher in animals
 - lower in seaweeds and the same in animals
 - higher in seaweeds and lower in animals
 - higher in seaweeds and the same in animals
 - higher in seaweeds and higher in animals
- 18) When compared to plants, fungi's
- Osmoregulation and digestion are both different from those of plants.
 - Osmoregulation and digestion are similar to those of plants.
 - Osmoregulation is different from plants but they both have extracellular digestion.
 - Osmoregulation is similar to that of plants, but fungi have extracellular digestion unlike plants.
 - Osmoregulation is similar to plants' but neither use digestion to obtain nutrients.
- 19) Locomotion in Animals and Protistes have what in common?
- The influx of H ions rotates a flagella
 - They all use muscles
 - Motor molecules that move microtubules
 - It is under neural control
- 20) Consider the flow chart below:



- The spore is missing from which lifecycles?
- All Animals
 - All Plants
 - All Fungi
 - All Animals and all Fungi
 - All Animals and Plants

- 21) Alimentary canals and food vacuoles have which of the following in common?
- They create a selective barrier that controls which nutrients pass through
 - Protect the organism from unwanted chemicals in the food.
 - Transport food to location where nutrients are needed
 - a and b are correct
 - a, b and c are correct.
- 22) The malpighian tubules, nephridia and kidney all share basic process?
- Filtration, Reabsorption, Secretion, Excretion
 - Secretion, Reduction, Absorption, Excretion
 - Filtration, Reduction, Reabsorption, Excretion
 - Reception, Secretion, Digestion, Excretion
- 23) When comparing the energetics of photosynthesis and transpiration in plants
- Transpiration actively uses energy, whereas photosynthesis is a passive process.
 - Photosynthesis actively uses energy, whereas transpiration is a passive process.
 - Both processes actively use energy
 - Both are passive processes.
- 24) In plants water potential is important for which of the following processes
- Transpiration
 - Maintaining turgor pressure
 - Respiration
 - a and b are correct
 - All of the above
- 25) In all organisms the detection of a stimulus usually involves
- A protein that initiates an impulse in a cell.
 - A hormone that activates a cell.
 - A protein that reacts to some form of energy that activates a 2nd messenger system.
 - A lipid that reacts to some form of energy that activates a 2nd messenger system.
- 26) One of the assumptions of the Hardy-Weinberg Equilibrium Theory is that
- allelic frequencies in the population change from one generation to the next
 - there is a high rate of immigration into the population.
 - natural selection is constantly acting upon the population
 - mating is random
- 27) Genetic drift can result in
- loss of alleles in a small population
 - increase in alleles in a large population
 - an increase in mutations in a large population
 - reduced hybrid vigor

- 28) Taxonomy classifies organisms based upon
- evolutionary relationships
 - shared characteristics
 - geographic distribution
 - all of the above
- 29) A monophyletic clade includes
- the ancestor and all of its descendants
 - the ancestor and only some of its descendants
 - the descendants only
 - the ancestor and one of its descendants
- 30) The exponential growth model describes
- a population in decline
 - a population with unlimited resources
 - a population with limited resources
 - a population at equilibrium
- 31) Population growth is regulated through
- competition
 - limited resources
 - predation
 - all of the above
- 32) Resource partitioning allows for
- ecologically similar species to co-exist
 - a species to utilize more than one resource
 - competitive exclusion to occur
 - b and c

BI154 Questions:

- 33) The α -helix is
- The structure of double stranded DNA
 - a type of protein secondary structure
 - stabilized by hydrogen bonding
 - both b and c
 - all of the above
- 34) Which best describes the generation of ATP in photosynthesis?
- Electrons from energetic carbon atoms are transferred to oxygen generating a proton gradient that is released through ATP synthase.
 - Electrons from water are energized by light and transferred to NADP generating a proton gradient that is released through ATP synthase
 - High energy phosphates are transferred from sugars onto ADP
 - Electrons from carbon dioxide are transferred onto ADP
 - both c and d

- 35) An enzyme increases the rate of a reaction by
- causing a greater proportion of reactant molecules to reach the transition state in a given amount of time.
 - interacting with reactant molecules in a way that causes their collisions to be properly oriented.
 - interacting with reactant molecules in a way that causes them to be slightly less stable
 - all of the above
 - only b and c.
- 36) Which of the following are not true about hydrogen bonding?
- individual H-bonds are weak interactions
 - H-bonding between biological macromolecules allows for short-term intermolecular interactions.
 - H-bonding refers to the covalent bond between a hydrogen and another atom.
 - H-bonding occurs between polar molecules or polar residues on macromolecules
 - Actually all of the above are true.
- 37) Only one of the following sets of descriptors is properly related. Which one is it?
- Respiration, carbon oxidation, $-\Delta G$, energy releasing
 - Respiration, carbon reduction, $+\Delta G$, energy storing
 - Photosynthesis, carbon reduction, $-\Delta G$, energy storing
 - Photosynthesis, carbon oxidation, $+\Delta G$, energy storing
 - Metabolism, carbon oxidation, $+\Delta G$, energy releasing.
- 38) The plasma membrane sodium/potassium pump is an example of an active transport permease. Which of the following is not a characteristic of such an enzyme?
- the enzyme will have transmembrane α -helical protein domains
 - the enzyme will transport sodium and potassium ions down the concentration gradient
 - the enzyme will use energy from ATP to drive a conformational change
 - it will allow the movement of the ions through the non-polar region of the membrane
 - it will be synthesized by ribosomes attached to the endoplasmic reticulum
- 39) Which of the following best describes the folding of a protein in the cytoplasm?
- Protein folding is an energy requiring process that utilizes large amounts of ATP
 - Proteins fold spontaneously and form large numbers of covalent bonds between amino acid R-groups.
 - Protein folding gives rise to the primary structure of a protein and is assisted by ribosomes.
 - Proteins fold into their lowest energy conformation. This is driven by the interaction of polar R-groups and water.
 - both a and c.

- 40) Internal membrane systems in cells
- result in eukaryotic cells having to be larger in order to contain them
 - provide organizing structures for complex enzymatic pathways
 - function to keep certain compartments physiologically different from others
 - are generally only composed of phospholipid molecules
 - b and c are both right, but not a and d.
- 41) What is the template in the process of transcription?
- Polysaccharide
 - RNA
 - Protein
 - DNA
 - Lipid
- 42) $N=6$ in kangaroos. In a kangaroo's testes, two cells have just been formed at the end of meiosis I. How many chromatids does each of these cells contain?
- 6
 - 12
 - 3
 - 24
 - 48
- 43) Which of the following is true about homologs?
- They normally contain identical alleles.
 - They normally contain the same genes.
 - They normally have identical DNA sequences.
 - They are formed by replication of a single chromosome.
 - None of the above.
- 44) A dominant allele
- is the most common one in the population
 - prevents the recessive allele from being transcribed
 - produces the normal phenotype
 - changes the DNA sequence of other alleles to match its own
 - produces the same phenotype whether one or two copies are present
- 45) Which is true in codominance, but not in incomplete dominance?
- The heterozygote has a different phenotype from either homozygote
 - Both alleles code for active enzymes
 - One allele codes for an active enzyme, and the other codes for an inactive protein
 - The homozygote is more fit than the heterozygote
 - The heterozygote's phenotype is quantitatively intermediate to the homozygotes' phenotypes.

- 46) A gene affecting color vision (C/c) is on the X chromosome. Individuals without a C allele are red-green colorblind. A man with normal vision marries a normal woman whose father was colorblind. Which of the following children could they NOT produce?
- colorblind male
 - male with normal vision
 - colorblind female
 - female with normal vision
 - any male offspring
- 47) In turkeys, alleles of two different unlinked genes (A and B) code for an enzyme that is required to make melanin in the feathers. The alleles a and b code for inactive proteins. The reaction involved is substrate-limited, and either enzyme is sufficient. If two $AaBb$ turkeys are crossed, what will be the frequency of albino turkeys in the progeny?
- $1/4$
 - $7/16$
 - $4/16$
 - $1/16$
 - $3/16$
- 48) You have a mutant *E. coli* strain that produces β -galactosidase with or without lactose present. Which of the following mutations could be responsible?
- mutant *lacZ* codes for inactive enzyme
 - mutant *lacI* codes for inactive repressor
 - mutant *lacO* is an abnormal operator site
 - either a or b
 - either b or c