

Science League Biology II Exam

January 2014

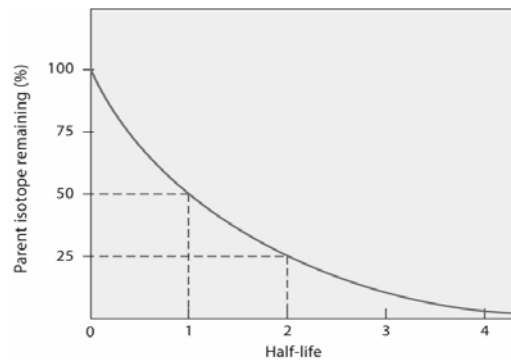
**Choose the answer that best completes the statements or questions below and fill in the appropriate response on the form. If you change an answer, be sure to completely erase your first choice. Please PRINT your name, school, area, and which test you are taking onto the scan-tron.**

1. Evolution of species occurs by means of
  - a. changes in individual organisms
  - b. changes in populations
  - c. overpopulating an area
  - d. extinctions
  
2. Which of the following is the **best test** for the theory of natural selection?
  - a. by exposing a population of rapidly replicating organisms to a selection that kills a large portion of the population over the course of many generations, and comparing the final generation to the final population that was not exposed to the variable.
  - b. by exposing a population of rapidly replicating organisms to a selection that kills a large portion of the population and comparing it to the original population
  - c. observing and comparing an organism's behavior to modern day human behavior
  - d. by finding similarities between fossils and present day organisms
  
3. Stanley Miller constructed an apparatus in which he placed inorganic substances found in earth's primitive atmosphere in a flask and exposed them to an electrical charge. Miller's data of concentration changes during his experiment are found in the table below. What conclusion can he claim from his results?

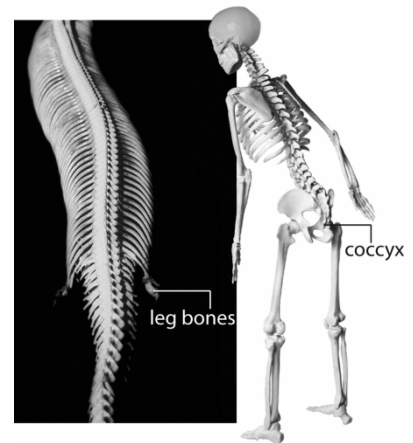
Hours	Ammonia	Amino Acids	Methane	Hydrogen	Water
0	35	0	42	47.9	37.9
25	34	7	39.2	44	33.9
50	28	10.3	35.5	40	34
75	20.1	21.8	29.6	29	28.3
100	18.2	32.2	28.7	25.2	27.2
125	15.1	33.4	22.3	20.1	20.1
150	10.9	33.8	17.	18.2	18.2
175	1	34	2.3	9.3	9.3

- a. The synthesis of any compound requires water.
  - b. Hydrogen was available in high quantities in the primitive atmosphere.
  - c. All inorganic compounds can produce organic compounds using an electrical charge.
  - d. Primitive earth gases, ammonia, methane, hydrogen and water vapor can produce amino acids
- 
4. Hypothesis on the origin of organic molecules, states that clay
    - a. facilitated assembly of early polypeptides
    - b. was present at hydrothermal vents
    - c. provided energy for early metabolism
    - d. needed oxygen to initiate the reaction
  
  5. A rise in oxygen in Earth's air and seas gave a selective advantage to organisms that engaged in which life process?
    - a. aerobic respiration
    - b. fermentation
    - c. photosynthesis
    - d. sexual reproduction
  
  6. The Second Law of Thermodynamics states that the universe tends towards a state of increasing disorder. How is it possible that the earth has evolved ordered living forms from less- ordered nonliving matter?
    - a. Living systems are subject to biological laws not physical laws.
    - b. Living systems are, in reality less ordered than nonliving matter.
    - c. Living systems use energy, such as light, to create limited regions of order.
    - d. Living systems are the exception to the Second Law, proving the law is not universal.

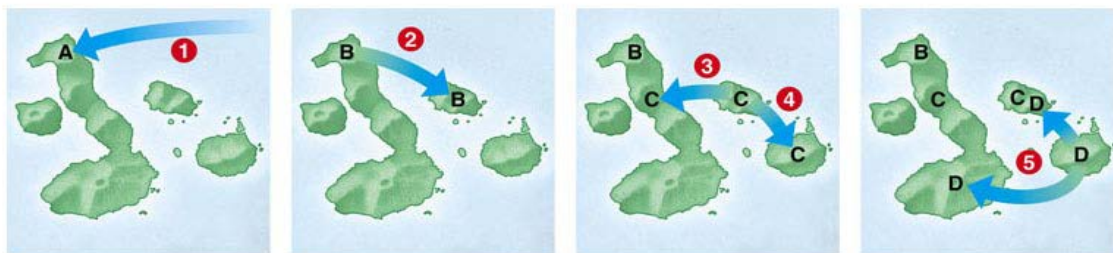
7. The prevalence of iron-sulfide cofactors in organisms supports the hypothesis that life arose \_\_\_\_\_.  
 a. in outer space  
 b. on tidal flats  
 c. near deep-sea vents  
 d. in the upper atmosphere
8. The evolution of \_\_\_\_\_ resulted in an increase in the levels of atmospheric oxygen.  
 a. sexual reproduction  
 b. aerobic respiration  
 c. the noncyclic pathway of photosynthesis  
 d. asexual reproduction
9. If the half-life of a radioisotope is 20,000 years, then a sample in which three-quarters of that radioisotope has decayed is \_\_\_\_\_ years old.  
 a. 15,000  
 b. 26,667  
 c. 30,000  
 d. 40,000
10. What percent of the  $^{14}\text{C}$  in a fossil still remains after three half-lives? (see diagram above)  
 a. 75  
 b. 25  
 c. 12.5  
 d. 6.25



11. The convergence in external morphology of sharks, penguins, and porpoises is attributed to  
 a. reduced genetic variability in these groups.  
 b. selection pressures that are common to these groups.  
 c. reproductive isolation of these groups.  
 d. identical genes in all three groups.
12. The bones labeled in the picture to the right are both  
 a. results of the expression of the *apetalal* gene in an embryo.  
 b. homologous structures.  
 c. analogous structures.  
 d. vestigial body parts.
13. Sexual selection, such as occurs when males compete for access to fertile females, frequently influences aspects of body form and can lead to all the adaptations below **except** \_\_\_\_\_.  
 a. male/female differences  
 b. male aggression  
 c. exaggerated traits  
 d. males having stronger jaws
14. According to Darwin, natural selection is based on the \_\_\_\_\_ found in populations.  
 a. acquired characters  
 b. variations  
 c. similarities  
 d. noncompetitors
15. \_\_\_\_\_ tends to keep populations of a species similar to one another.  
 a. Genetic drift  
 b. Gene flow  
 c. Mutation  
 d. Natural selection



16. A city in New Jersey's council members noticed 20 years ago that rats increased in population. Exterminators were called in and poison bait traps were placed around the city. The population had sharply decreased within the first 3 years and then started to increase. Recently, it has been found, in other cities, that urban rats have developed a resistance to the poisons. The rats' ability to resist poison may be a result of
- rats breeding rapidly before they can eat all the bait present
  - as a result of observing the deaths of other rats that eat poison bait, rats learn to avoid it
  - breeding rapidly with directional selection against the poison
  - rats preferring to eat garbage rather than bait
17. The maintaining of Hardy-Weinberg equilibrium is encouraged
- when sexual selection occurs.
  - when mutations occur.
  - in small populations.
  - when there is no gene flow among different populations.
18. Of 400 people who dwell on a Pacific island, 16 islanders are homozygous recessive for a particular trait that is controlled by simple Mendelian dominance. Assuming the population is in Hardy-Weinberg equilibrium, the number of heterozygous people is closest to
- 32.
  - 64.
  - 128.
  - 256.
19. The number of species on an island depends on the size of the island and its distance from a mainland. Which would have the greatest diversity?
- A small island located far from the main land
  - A small island located close to the main land
  - A large island located far from the main land
  - A large island located close to the main land

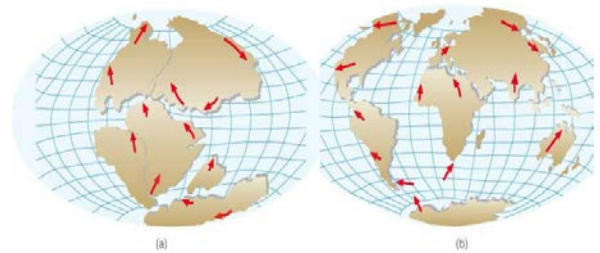


20. The numbers on the above diagram represent speciation events from an ancestral species over time. In the diagram one island was never colonized by any of the species shown. What is the probable reason this island did not evolve new species from species A?
- Ocean currents did not flow to the west side of island. (Assume North is towards the top of the diagram)
  - This island appeared too recently in geologic time.
  - The two islands are too close; therefore competition would occur between the organisms on the two islands.
  - Species A, B, C, D could not find a suitable niche on the island.
21. Although human mothers have an easier time giving birth to small babies than large ones, large babies have a higher post-natal survival rate than do small babies. However, the mothers of large babies have a higher mortality rate than the mothers of small babies. We have observed, however, that the average weight of a human baby has remained at about seven pounds even with modern medical technology. What factor accounts for this observation?
- modern prenatal care
  - the forces of stabilizing selection
  - the limitations of the size of the human womb
  - selection pressure favoring large babies
22. In a certain bird species, clutch size (the number of eggs laid by a female in one breeding season) ranges from four to eight eggs, but the most frequent clutch size is six. This phenomenon is an example of
- sexual selection.
  - stabilizing selection.
  - disruptive selection.
  - directional selection.

23. In some duck species, males are more colorful and flashier than females. This occurs because
- males compete for the attention of other males.
  - males who survive despite being conspicuous are probably vigorous.
  - females choose the males they see first.
  - females blend into their background and can distinguish males from females
24. The sharp reduction of the gene pool and the numbers of a population through a severe epidemic is an example of
- artificial selection.
  - genetic isolation.
  - the bottleneck effect.
  - the founder effect.
25. In the U.S. ulnar polydactyly (having one or more additional digits on the pinky side of the hand) is more common in African Americans than in Ashkenazi Jews, whereas Tay-Sachs disease (a progressive deterioration of nerve cells and of mental and physical abilities that commences around six months of age and usually results in death by the age of four) is more common in Ashkenazi Jews but virtually absent in African Americans. What best accounts for these observations?
- Different selection pressures have favored polydactyly in one population and Tay-Sachs in another.
  - Mutation rates differ among different loci.
  - There is little gene flow between the two populations.
  - Polydactyly is fatal among Jews of Ashkenazi descent.
26. Immigration of individuals into a population in Hardy-Weinberg equilibrium will NOT upset the equilibrium if
- they are beyond the age of reproduction.
  - females and males are in equal proportions.
  - they mate randomly in the new population.
  - they arrive in large numbers.
27. Suppose that when two closely related species interbreed, the resulting embryos spontaneously abort. This would be an example of
- An isolating mechanism
  - Gene flow
  - A founder effect
  - Hybrid vigor
28. There are two types of cicadas which have different life cycles for maturing, 13-year cicadas and 17-year cicadas. Speciation may occur within the same geographic location due to
- gamete compatibility
  - different mating behaviors
  - incompatibility of reproductive body parts.
  - occurrence of temporal isolation
29. Differentiated mating calls between populations of cicada, is a
- behavioral isolating mechanism.
  - temporal isolating mechanism.
  - mechanical isolating mechanism.
  - gametic isolating mechanism.
30. Tasmania, an island off the coast of Australia, has a population of birds *Acanthisa ewingi*, whereas *Acanthisa pusilla* is widespread on the Australian continent. During the ice age, the sea level was low, and *Acanthisa pusilla* invaded Tasmania from Australia, giving rise to *Acanthisa ewingi*. A few thousand years ago, the sea level dropped again and a second invasion of *Acanthisa pusilla* occurred, allowing the two species to coexist but stay reproductively isolated. In this example of allopatric speciation the daughter species formed
- abruptly, through a mutation
  - in proportion to the parental stock.
  - rapidly, but were then reduced by environmental
  - factors.
  - gradually over rather long periods of time.
31. Changes in the Mississippi River caused by earthquakes are thought to have caused speciation by
- divergence.
  - parapatry.
  - allopatry.
  - gene flow.
32. The 30-cm floral tube of *Angraecum*, a kind of orchid, and the 35-cm proboscis of its hawkmoth pollinator most likely arose because of
- preadaptation.
  - adaptive radiation.
  - coevolution.
  - convergent evolution.

33. A biologist studied a grass population growing in an area of erratic rainfall. She found that plants with alleles for curled leaves reproduced better in dry years, and plants with alleles for flat leaves reproduced better in wet years. This would tend to
- preserve the variability in the grass population with small variations in gene frequencies of the heterozygous advantage in the grass population over many generations.
  - cause genetic drift in the grass population with a drastic change in gene frequencies of the heterozygous advantage in the grass population over many generations.
  - cause gene flow in the grass population from neighboring grass populations.
  - drive one population to extinction.
34. Ribosomes can catalyze formation of peptide bonds. This supports the hypothesis that \_\_\_\_\_ .
- an RNA world preceded DNA-based genomes
  - RNA can hold more information than DNA
  - the first protists had RNA as their genetic material
  - all of these
35. Originally dark-colored tree trunks camouflaged a population of moths. Most of the moths in this population were dark in color. A recent population study of moths in the same area found that the number of white moths and dark moths was equal. What best accounts for this change in the distribution of moth body color?
- Light moths developed a different, and more successful mating signal than the dark moths.
  - Volcanic activity discolored the tree trunks.
  - The frequency of the gene for color-blindness in blue jays (moth's predator) increased.
  - All of the above are possible and data need to be collected to determine the cause of the change in moth gene frequency.

36. The animals and plants of India today (Earth below B) are almost completely different from species in nearby Southeast Asia. Early Earth is in drawing letter A, while current Earth is in letter B. How does Earth history account for the differences in the organisms?



- Climates in the two regions are completely different.
  - Life in India was wiped out by ancient volcanic eruptions.
  - India was a separate island continent until relatively recently.
  - India is in the process of separating from the rest of Asia.
37. An evolutionary biologist studying speciation has found two kinds of nocturnal snails active in the same area. The biologist formulated a hypothesis that stated the two snails are not separate species. During the field studies he collected the following observations.

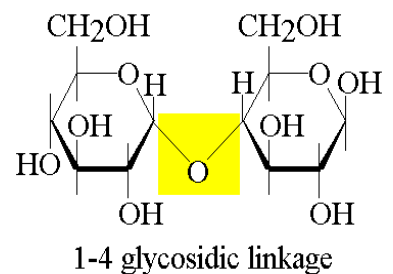
<i>Striped Snails</i>	<i>Unstriped snails</i>
Eat plant materials only	Eat plant and animal matter
Mate on rainy nights	Mate at dawn
Mate April to June	Mate July to September
Eaten by robins and blue jays	Eaten by hawks
Subject to fungal infections	Resistance to fungus infections

Is his hypothesis supported or not supported by the evidence and how would the biologist gain more evidence?

- The hypothesis is supported with the evidence that both snails can compete for the same plants to supply them with the energy to reproduce. Therefore, compare the amount of protein, carbohydrates and lipids consumed by both snails.
- The hypothesis is supported by the evidence by temporal isolation due to mating times of the day and season. Therefore the next step would be to see if they can mate in the fall.
- The hypothesis is not supported by the evidence because one group of organisms has a gene to resist fungal infections. Therefore the scientist should isolate and sequence the resistant gene, and run a blast to identify relatedness to other snails.
- The hypothesis is not supported by evidence. There is a possible temporal reproductive barrier.

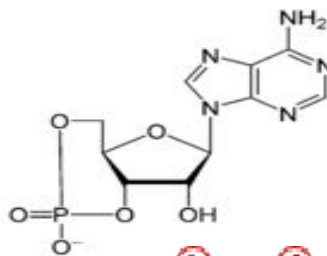
Therefore additional studies are needed to determine whether the populations interbreed.

38. Sickle-cell disease is caused by a recessive allele. Roughly one out of every 500 African Americans (0.2%) is afflicted with sickle-cell disease. Using Hardy Weinberg equations, calculate the percentage of African Americans who are carriers of the sickle-cell allele.
- 0.002%
  - 0.02%
  - 8%
  - 96%
39. Which does not support the idea that eukaryotic evolution may have occurred by endosymbiosis?
- All eukaryotic cells have mitochondria.
  - Mitochondria and plastids are self-replicated.
  - Mitochondria and plastids have a single circular DNA molecule.
  - Prokaryotic share genes in common with nuclear DNA in Eukaryotes.
40. A cattle rancher wants to eliminate a recessive trait in his herd. The trait appears at the rate of 1 out of 100 calves. According to Hardy-Weinberg, what percent of the herd is heterozygous for the trait?
- 0.9%
  - 10%
  - 18%
  - 81%

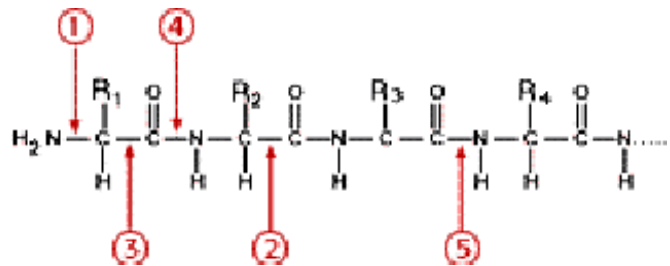


41. What is true about the molecule shown to the right?
- This molecule was formed by a hydrolysis.
  - A water molecule was added to the monosaccharides in the production of this molecule.
  - Enzymes are not necessary to break the glycosidic link.
  - This molecule is a polysaccharide

42. The molecule shown below is a signal molecule often found inside a cell. What is the classification of this molecule?
- carbohydrate
  - lipid
  - nucleotide
  - protein



43. In the molecule below what are the bond sites that represent peptide bonds?
- 1 and 4
  - 2 and 3
  - 4 and 5
  - 3 and 5



44. Each amino acid carries a side chain called **R**-group that can take different chemical forms, but only 20-22 of these forms are commonly found in proteins. Despite their individual chemical differences, amino acids and their **R**-groups can all be put into four different "families" depending on whether their **R**-groups are; acidic, basic, polar - not charged, nonpolar. At the quaternary level, ionized R groups of many cytoplasmic proteins are located on the molecule's surface. What would **not** be true of the amino acids in this final protein structure?
- The amino acid **R**-groups encompassing the outer portion of this protein are strongly hydrophilic
  - R-groups ionize at various pH's to produce a change in the protein structure
  - The protein is stabilized by hydrogen bonds when surrounded by water
  - The amino acid **R**-groups encompassing the outer portion of this protein are strongly hydrophobic

45. A particular protein's shape is a function of its tertiary conformation. This shape

- a. determines the molecule's function
- b. does not allow for interactions with other molecules
- c. is inflexible and will not change regardless of environmental influences
- d. indicates that proteins serve as energy-storage compounds

46. Glycolysis is a highly-conserved process among living organisms. Which of the following best supports the statement?

- a. Glycolysis is an anaerobic process.
- b. Glycolysis is a process that is carried out in the cytoplasm of cells.
- c. Glycolysis is a process that is carried out by virtually every living organism.
- d. Glycolysis is a process that generates a large amount of usable energy for organisms.

47. Adebooye, a researcher at University of Bonn, formulated a hypothesis that leaf age would impact stomata and tichome density in *T. cucumerina* (the *b-light green variety*), a vine-like plant related to cucumber.

After growing plants from seeds, he observed 3 generations of leaves in 3 regions of the plant, the growing stem tips, the second-leaf formation at branch points, and leaves from the bottom of the plant. He counted stomata and trichomes. His counts included both the adaxial surfaces (facing towards the stem axis), and abaxial surfaces (facing away from the stem axis). He noticed that some trichomes were shaped like plain cones whereas others bore globular tips. Below is a copy of his data. What do the data demonstrate?

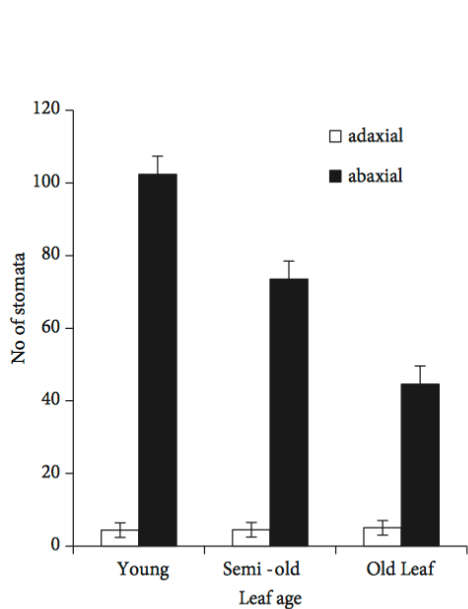


Figure 1. Relationship between leaf age and stomatal count on the adaxial and abaxial leaf surfaces of *T. cucumerina* for the variant B Light-Green morphotype.

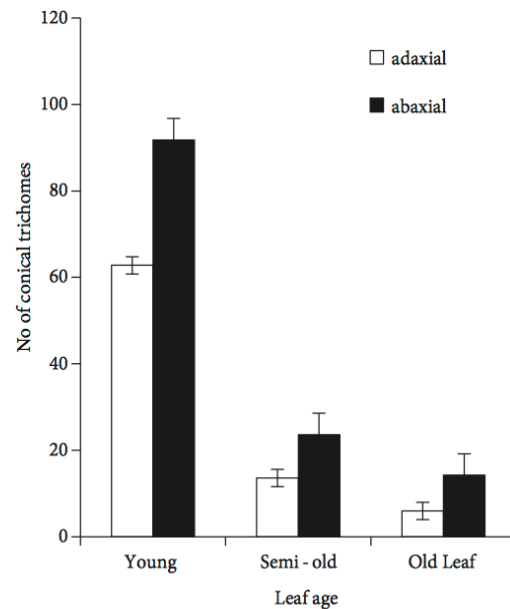


Figure 2. Relationship between leaf age and conical trichome count on the adaxial and abaxial leaf surfaces of *T. cucumerina* for the variant B Light-Green morphotype.

- a. Stomata and trichosome counts are equal for age on abaxial side of the leaves.
- b. Both stomata and trichomes counts located adaxially vary with age but the abaxial remains constant.
- c. Abaxial trichomes outnumber adaxial ones and both varied with age, whereas only abaxial stomates decrease in number with age
- d. Stomata and trichome density are dependent upon each other.

48. Lutz, an earlier researcher on trichomes found that when the plant is under stress, in drought, salty or UV conditions, globular headed trichomes appear. Adebooye, in doing his experiment recorded the following data and proposed a possible function for the globular headed structures on the trichomes. What did his data indicate?

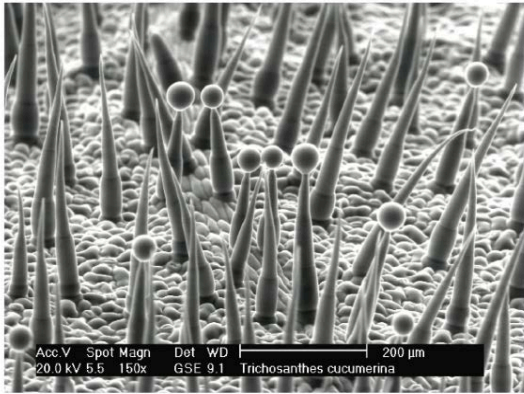


Figure 4. SEM showing a mixture of conical and globular-headed trichomes on a *Trichosanthes cucumerina* leaf.

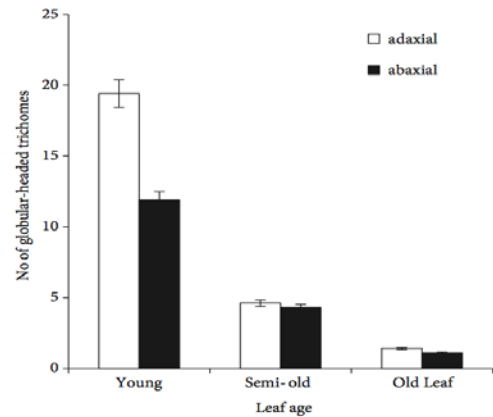


Figure 3. Relationship between leaf age and globular-headed trichome count on the adaxial and abaxial leaf surfaces of *T. cucumerina* for the variant B Light-Green morphotype.

- Globular trichomes are more abundant in young leaves than in old ones.
- Globular trichomes are not needed as the plant ages.
- Globular trichomes must be more important in old leaves than in young leaves.
- Globular trichomes increase in number as a leaf ages.

49. A mycologist examines the life cycle of a plasmodial slime mold and she sees times when the cells are independent living and times when the cells appear to be working together as a mass under different environmental conditions. Knowing that these organisms have existed on earth a long time, she may further look for evidence in this organism for a possible node on a cladogram as to the origin of

- multicellularity
- Krebs Cycle and ETS
- asexual reproduction
- photosynthesis

50. Aquatic species take dissolved oxygen from water. Terrestrial animals evolved in such a way that their respiratory surfaces are inside the body and are not in contact with water. In evolutionary history, in order for animals to make the move from water to land they had to solve the problem of gas exchange by

- keeping the respiratory surface thin
- keeping the respiratory surfaces moist
- having enough capillaries available to all body surfaces.
- keeping the level of oxygen high by panting

51. The carbon atom is the basis for life on earth. Each statement is true for carbon except one. Which is the exception?

- Carbon is found in the ionic state naturally.
- Carbon is found in virtually every compound of biological origin.
- Linkage between carbon atoms allows for chainlike molecules to forming various structures and functions.
- Carbon can form covalent bonds making a tetrahedral shape.

52. In contrast to natural selection, evolution says that

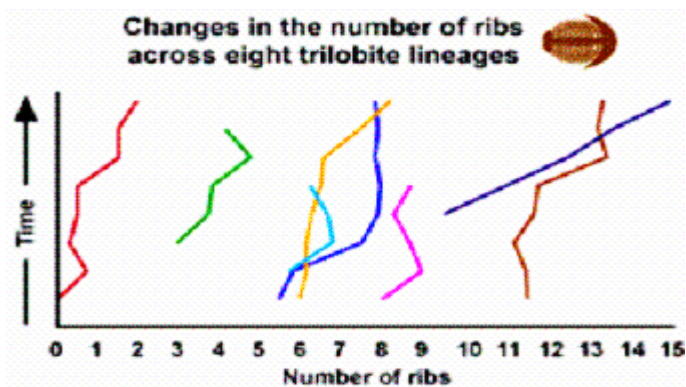
- there is a struggle for existence in nature.
- organisms adapt to their environment
- organisms are related to each other through derived characteristics from common ancestors
- species are unchanged once established in their environment.

53. The degree of genetic relatedness of siblings is:

- 1
- 1/2
- 1/4
- 0



54. Trilobites are animals in the same clade as modern insects and crustaceans. They lived 300 million years ago. The fossil record for changes in trilobite rib number is shown below.



What does the fossil record suggest? The fossil record suggest that

- rib number is a function of the molecular clock.
  - trilobites are responding to developmental genes differently.
  - trilobites did not change rib numbers over time.
  - several linages of trilobites underwent similar increases in segment number over time.
55. Cytochrome c is a molecule that is found in the mitochondria and may indicate the relatedness between organisms. The table below shows the number of differences in the amino acid sequences of cytochrome C between several species as compared to humans.

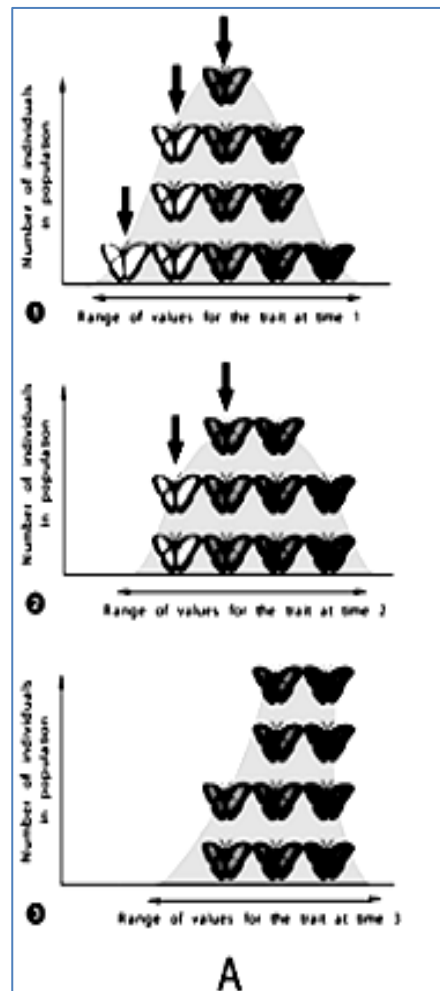
**Comparing cytochrome C of a human to other organisms**

Organism	# of Differences from Humans
Chimpanzee	0
Fruit Fly	29
Horse	6
Gorilla	1
Rattlesnake	14
Red Bread Mold	28
Rhesus Monkey	1
Screwworm Fly	27
Snapping Turtle	15
Tuna Fish	21
Wheat	43
Pigeon	12

Which statement is valid from the data above?

- The gorilla and the Rhesus monkey are the most closely related species shown.
  - Humans and chimpanzees have the same cytochrome C amino acid sequence.
  - Screwworm and bread mold would become a taxon on the phylogenetic tree.
  - Wheat cells do not have mitochondria.
56. An analysis of cytochrome C found that a species of turkey and chicken had zero differences in their amino acid sequence. What does this say regarding speciation?
- The two species are not separate; they are really the same species.
  - The two species are capable of mating and producing viable offspring.
  - The two species have the same cytochrome c but can still be different species due to other possible differences.
  - Cytochrome c was an ideal molecule to determine speciation.

57. Highly conserved genes encode proteins that are essential to the survival of the organism. Which of the following is an example of one of these proteins?
- cytochrome c
  - muscle structural proteins
  - carbohydrate hydrolyzing genes
  - skin pigmentation
58. Research on female ducks show that they respond to two different male mating calls, a low-high honk honk or high-low honk honk. Some ducks produce a mating call that sounds like honkity-honk. The blended honkity-honk is showing a lower reproductive success. What is happening to the mating selection in this population?
- A disruptive selection, will an increase duck populations for the two types of honk-honk mating calls.
  - A heterozygous advantage is stabilized the duck population for the two types of honk-honk mating calls.
  - A direction selection for one type of duck's mating call honk-honk will increase.
  - Female ducks will overlook the mating call and choose ducks be nest building abilities.
59. Arrange these events in order of probable occurrence, from the earliest to the most recent.
- emergence of multicellular organisms
  - Origin of mitochondria
  - Origin of proto-cells
  - emergence of cyclic pathway of photosynthesis
  - Origin of chloroplasts
  - The big bang
- 6, 2, 3, 1, 4, 5
  - 6, 3, 4, 5, 2, 1
  - 6, 1, 2, 5, 4, 3
  - 6, 3, 4, 2, 1, 5
60. The illustration labeled "A" in the drawing below shows selection against
- light-colored butterflies
  - tasty butterflies
  - distasteful butterflies
  - dark-colored butterflies





**NEW JERSEY SCIENCE LEAGUE  
Biology II Exam: White paper test**

**Biology II Answer Key**

**JANUARY 2014 Corrections in ( ) 1-18-2014**

1	B	16	C	31	C	46	C
2	A	17	D	32	C	47	C
3	D	18	C	33	A	48	C (A)
4	A	19	D	34	A	49	A
5	A	20	D	35	D	50	B
6	C	21	B	36	C	51	A
7	C	22	B	37	D	52	C
8	C	23	B	38	C	53	B
9	D	24	C	39	D	54	D
10	C	25	C	40	C	55	B
11	B	26	A	41	A(C)	56	C
12	D	27	A	42	C	57	A
13	D	28	D	43	C	58	A
14	B	29	A	44	D	59	B
15	B	30	D	45	A	60	A

**BCIOLOGY II For all second year and AP level students.**

**January Exam: Big Idea 1: The process of evolution drives diversity and unity of life.**

Evolution, Natural Selection, Artificial Selection, Mechanisms for Evolution, Hardy Weinberg Principles, Genetic Drift, Gene flow, Evidences for Evolution, Blast Genomic Analysis, Cladogram, Evolutionary Trees, Evolution of the Domains, Adaptive Radiation, Island Biogeography Theory, Speciation, Prezygotic and Postzygotic Mechanisms, Hypothesis on Origins of Life, Monomers and Polymers of Biological Molecules

**February Exam: Big Idea 2: Biological Systems utilize free energy and molecular building blocks to grow, reproduce, and to maintain dynamic homeostasis.**

Free Energy and Gibbs Reactions, Enthalpy in Biological Systems, Biological Applications to the Laws of Thermodynamics, Exothermic/Exothermic Reactions, Coupled Reactions, Photosynthesis, Cellular Respiration, Endotherm/Exothermic, Body Temperature Regulation, Cell Types, Surface Area/Volume Ratios, Fluid Mosaic Model of the Membrane, Properties of Water, Osmoregulation, Membrane Transport, Cellular Feedback Mechanisms, Metabolic Processes and Metabolism, Energy in Reproductive Strategies, Behavioral and Physiological Response to Environmental Stress, Ecosystem Energy Pyramid Structure, Food Web Alterations, Population Density, Taxis and Kinesis, Tropisms, Biological Rhythms, Behavioral Biology, Communication and signaling, Developmental genes, Systems in Plants and Animals; Immune, Respiration, Excretion, Digestion, Circulation

**March Exam: Big Idea 3: Living Systems store, retrieve, transmit and respond to information essential to life processes.**

Communication: Signaling, reception, transduction and response, Nervous System, Endocrine System, Reproductive System, DNA and replication, RNA in Protein Production, RNA Types, Cell Cycle and Controls, Mitosis, Meiosis, Application of Mendel's Laws, Mendelian and Nonmendelian Genetics, Genetic Disorders, Cancer, Genetic Engineering Techniques, Nonnuclear Inheritance, Transposons, Gene Regulation, Apoptosis, Developmental Genes, Embryonic Development in Plants and Animals, Signaling Mechanisms, Transmission and Transduction Pathways, Polyploidy, Sex Inheritance, Mutation Effects, Viral Replication, Genetic Variation Processes, Mating Types, Behaviors and Parenting

**April Exam: Big Idea 4: Biological Systems interact, and these systems and their interactions possess complex properties.**

Biological Monomers and Polymers: Structures' relationship to function, Protein Folding, Bonding in Polymers, Enzymes, Coenzymes, Cofactors, Lipid Properties, Subcellular Organelle Function(s) and Interactions, Multifunctional Molecules, Genetic Multiplicity and Flexibility, Organ and System Specialization, Interactions and Coordination in Plants and Animals, Organism Responses Adaptation to Environment, Transpiration, Population: Variation, Growth, Dynamics and Distribution, Exponential and Logistic Population Growth Models, Limiting Factors, Species Richness, Species Diversity, Competition, Bacteria, Fungi, Symbiotic Relationships, Food Webs and Productivity and Energy Dynamics, Keystone species, Exotic and Alien Species Biogeochemical Cycles, Energy

***Dates for 2014 Season***

***Thursday January 9, 2014 Thursday February 13, 2014***

***Thursday March 13, 2014 Thursday April 10, 2014***

**All areas and schools must complete the last exam and mail in the results by April 25<sup>th</sup>, 2014**

***New Jersey Science League***

PO Box 65 Stewartville, NJ 08886-0065

phone # 908-213-8923 fax # 908-213-9391 email [newsjl@ptd.net](mailto:newsjl@ptd.net) Web address: [www.//entnet.com/~personal/njscil/html](http://www.//entnet.com/~personal/njscil/html)

**PLEASE RETURN THE AREA RECORD AND ALL TEAM MEMBER  
SCANTRONS(ALL STUDENTS PLACING 1<sup>ST</sup>, 2<sup>ND</sup>, 3<sup>RD</sup>, AND 4<sup>TH</sup>).**

If you return scantrons of alternates, then label them as ALTERNATES.

***Dates for 2015 Season***

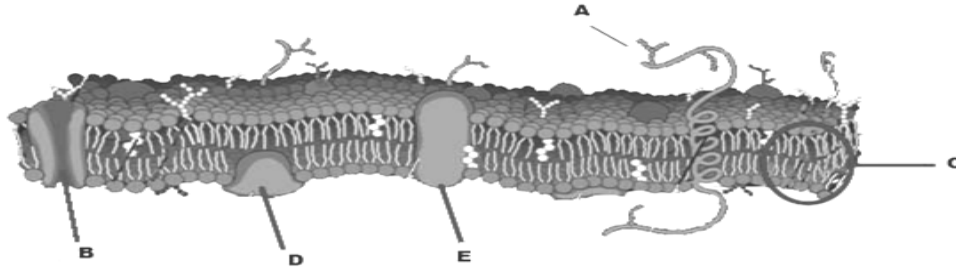
**Thursday January 8, 2015 Thursday February 12, 2015**

**Thursday March 12, 2015 Thursday April 9, 2015**

NJSL Biology II February 2014

Choose the answer that best completes the statements or questions below and fill in the appropriate response on the form. If you change an answer, be sure to completely erase your first choice. Please PRINT your name, school, area, and which test you are taking onto the scan-tron.

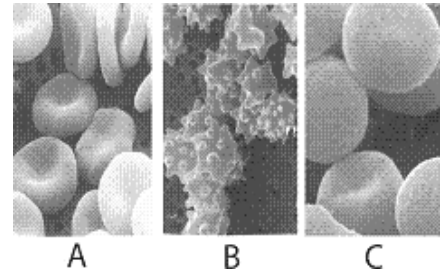
- Cell membranes are composed of a bilipid layer and proteins. These layers are asymmetrical from each other. Which of the following is the most likely explanation?
  - The two sides of a cell membrane face different environments and carry out different functions.
  - Cell membranes communicate signals from one organism to another
  - Proteins can only be associated with the cell membranes on the cytoplasmic side.
  - The cell membrane forms a border between one cell and another forming tightly packed tissues
- What are structures A and E in the diagram below?



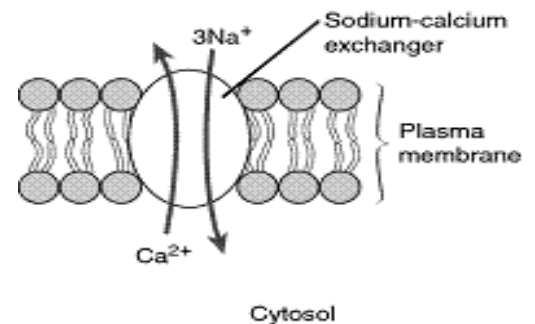
- peripheral proteins, phospholipids
  - an integral proteins, phospholipid
  - phospholipids, oligosaccharides
  - oligosaccharides, integral proteins
- An animal cell lacking oligosaccharides on the external surface of its plasma membrane would likely be impaired in which function?
    - establishing the diffusion barrier to charged molecules
    - attaching to the cytoskeleton
    - transporting ions against an electrochemical gradient
    - cell-cell recognition
  - When a mouse cell and a human cell are fused, the membrane proteins of the two cells become uniformly distributed over the surface of the hybrid cell. This occurs because
    - many proteins can move around within the layers.
    - all proteins in the membrane are peripheral.
    - proteins are asymmetrically distributed within the membrane.
    - all proteins are anchored within the membrane.
  - A single-celled freshwater organism, such as a protistan, is transferred to salt water. Which of the following is likely to happen?
    - The cell bursts.
    - Salt is pumped out of the cell.
    - The cell shrinks.
    - Enzymes flow out of the cell.
  - The rate of diffusion through a semipermeable membrane will be lowest when which of the following are true?
 

I. Concentration gradients are steep	II. Temperatures are low	III. Solutes are small molecules
a. I only	b. II only	c. I and III only
		d. II and III
  - In which of the following would there be the greatest need for osmoregulation?
    - an animal connective tissue cell bathed in isotonic body fluid
    - a plant being grown hydroponically in a watery nutrient mixture
    - a lymphocyte before it has been taken back into lymph fluid
    - cells of a sea anemone when the tide comes in

To the right are red blood cells immersed in fluids of different tonicity.  
Use this picture to answer questions # 8 and 9.



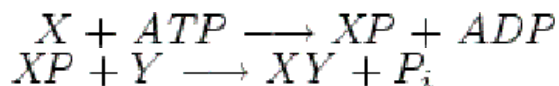
8. The red blood cells in micrograph A are immersed in a (n) \_\_\_\_\_ solution.  
a. hypotonic      b. isotonic      c. hypertonic      d. distilled water
9. The red blood cells in micrograph B are immersed in a (n) \_\_\_\_\_ solution.  
a. hypotonic      b. isotonic      c. hypertonic      d. distilled water
10. The molar concentration of a sugar solution in an open beaker is 0.3M. Calculate the solute potential ( $\psi_s$ ) at 27° C. Use the following formula and chart below to solve the problem below.  
Solute potential ( $\psi_s$ ) =  $-iCRT$      $i$  = the number of particles the molecule will make in water. NaCl produces 2 particles, while glucose produces 1 particle.     $C$  = the molar concentration (from your experimental data),  $R$  = pressure constant, 0.0831 liter bar/mole Kelvin,  $T$  = temperature of the solution in Kelvin ( $K = 273 + ^\circ C$ )
- a. -.09                      b. .09                      c. -7.48                      d. 7.48
11. Constipation, a condition in which the stool is hard and dry, results from the consumption of a substance that
- a. promotes water reabsorption in the large intestine.                      c. speeds up movement of material in the large intestine.  
b. decreases water reabsorption in the small intestine.                      d. stimulates peristalsis.
12. A freshwater animal, *Cambarus*, excretes very dilute urine. Therefore, *Cambarus* lives in an environment that is hypotonic to its body fluids. The net movement of water is from the environment into the animal, as compared to the body fluids, the environment has a
- a. same osmotic potential                      c. higher osmotic potential  
b. lower osmotic potential                      d. no osmotic potential
13. Active transport occurs with additional energy, usually moving molecules
- a. from inside the cell to outside the cell                      c. against the molecule's concentration gradient  
b. to bring about osmotic equilibrium                      d. with the concentration gradient
14. The cell membrane structure that transports the two molecules in the diagram below is called
- a. antiport                      c. symport  
b. uniport                      d. facilitative diffusion channel



15. A nerve cell sends messages to other cells by means of a special transmitter molecules. Membrane enclosed sacs containing transmitter molecules fuse with the nerve cell's plasma membrane and then open releasing the transmitter outside the cell. This is an example of
- a. exocytosis                      c. phagocytosis  
b. endocytosis                      d. facilitative diffusion

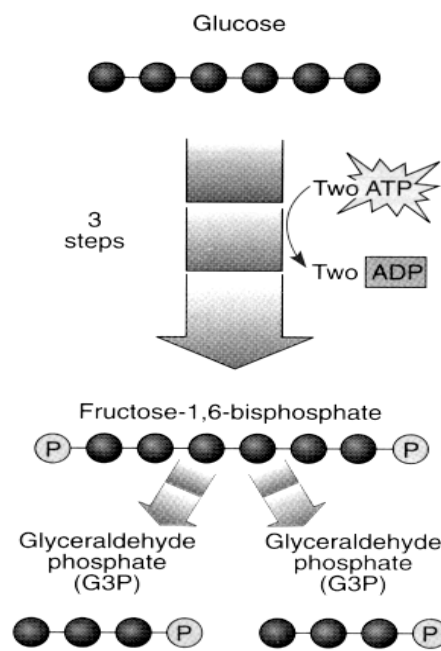
16. In Werner's Syndrome, a disorder characterized by premature aging and cancer, the structure of the nuclear lamina, an array of filaments on the inner surface of the nuclear membrane, is significantly compromised. Therefore in this disease we would observe...
- the loss of all nuclear function
  - a change in the shape of the nucleus
  - failure of chromosomes to carry genetic information
  - the nucleus to accumulate toxic chemicals

17. Regarding the reaction shown below, three of the statements that follow are true. Which one is FALSE?



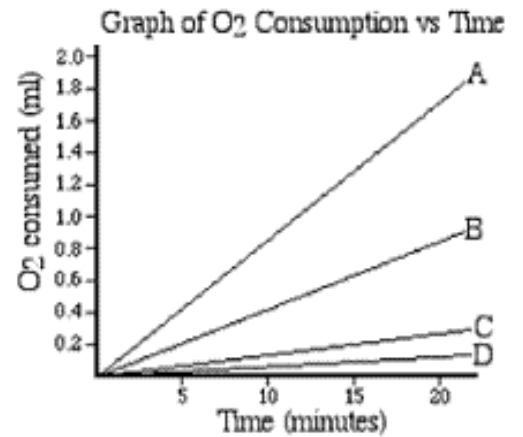
- ATP decomposition supplies free energy needed to make an endergonic to occur.
  - ATP is referred to as the "universal energy currency" due to its role as an intermediate to many reactions.
  - These reactions are both exergonic
  - This reaction demonstrates a coupling of an endergonic reaction to an exergonic reaction for a matter and energy transfer to occurring in the synthesis of XY.
18. What type of role does ATP play in almost all metabolic pathways?
- transfer of energy
  - feedback inhibitor
  - catalytic convertor
  - allosteric changer
19. The inner mitochondrial membrane is highly folded to facilitate
- room for more enzymes of the Kreb's citric acid cycle.
  - anaerobic respiration to occur.
  - more surface area for the electron transport system.
  - photophosphorylation
20. What chemical process is shown in the diagram below?

- Decarboxylation
- Part of the electron transport chain
- Glycolytic substrate-level phosphorylation
- Lactic acid fermentation



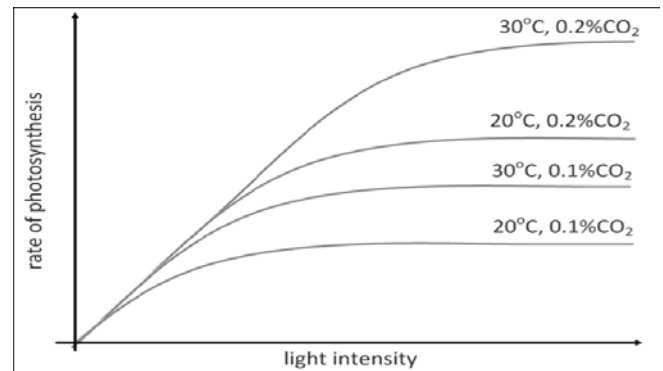
21. The graph below represents data from respirometers in a pea germination experiment involving (A) germinating peas at 20°C, (B) germinating peas at 10°C, (C) nongerminating peas at 20°C, and (D) nongerminating peas at 10°C. Respirometer C contains glass beads to adjust the effects of air pressure readings during oxygen consumption data collection. What statement is supported by the graphed data?

- a. The amount of oxygen consumed by A is twice the amount of oxygen consumed by B.
- b. The rate of oxygen consumed is the same in germinating and nongerminating peas from 0 to 5 minutes.
- c. The rate of oxygen consumed is higher for nongerminating peas at 10°C than at 20°C.
- d. The rate of oxygen consumed in the germinating peas at 10°C at 10 minutes is 0.4 ml O<sub>2</sub>/minute.



22. Using the data in the graph, what does the data demonstrate about the impact of CO<sub>2</sub> concentration on the rate of photosynthesis?

- a. The rate of photosynthesis increases with increased CO<sub>2</sub> concentration.
- b. The rate of photosynthesis decreases with increased CO<sub>2</sub> concentration.
- c. Increasing temperature decreases the rate of photosynthesis.
- d. Light intensity has no effect on the rate of photosynthesis.

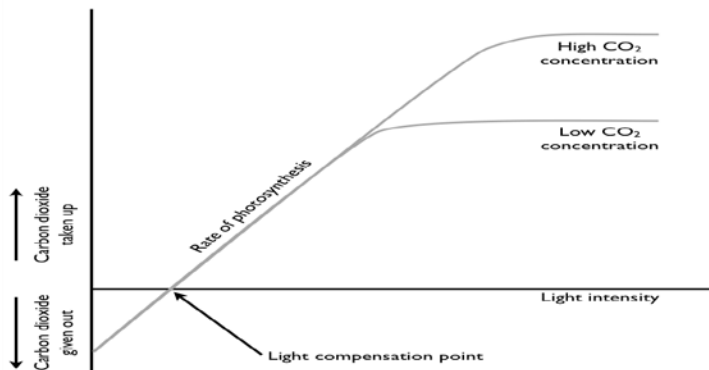


23. Enzymes increase the rate of a given reaction by lowering what kind of energy?

- a. combination      b. activation      c. thermal      d. electrical

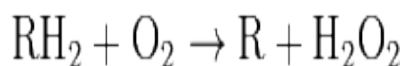
24. To prevent carbon dioxide from being a limiting factor farmers supply their green houses with artificially high concentrations of carbon dioxide and artificial light so they can increase their yields. The graph below shows evidence for their application. When is carbon dioxide not a limiting factor for the rate of photosynthesis?

- a. When light is lacking, carbon dioxide will not increase the rate of photosynthesis
- b. When light and high concentrations of carbon dioxide is available is the rate of photosynthesis increases.
- c. Carbon dioxide increases the rate of light independent reactions.
- d. Photosynthesis cannot occur with both light and carbon dioxide present





25. An example of substrate-level phosphorylation would be
- phosphorylation of ADP by phosphoenolpyruvate
  - hydrolysis of ADP to AMP
  - hydrolysis of phosphoenolpyruvate to pyruvate and phosphate
  - electron transport system
26. Cells with extensive rough endoplasmic reticulum would also probably have
- fewer nucleoli
  - an extra-large nucleus
  - fewer ribosomes
  - an extensive Golgi complex
27. Peroxisome enzymes in liver cells detoxify alcohol (RH<sub>2</sub>) by removing hydrogen atoms and ...
- generating hydrogen peroxide
  - using the hydrogen to break down hydrogen peroxide
  - packing them into secretory vesicles
  - forming water and carbon dioxide



28. In many cells, the nuclear envelope has been shown to be continuous with the membranes of
- the Golgi bodies
  - lysosome
  - endoplasmic reticulum
  - mitochondria
29. In metabolic pathways that are regulated by feedback inhibition, the \_\_\_\_\_ inhibits the activity of the \_\_\_\_\_.
- product; first enzyme
  - first enzyme; product
  - second enzyme; first enzyme
  - last enzyme; first enzyme

30. Allosteric inhibition is generally a result of
- excess substrates.
  - binding regulatory molecules at a site other than the active site.
  - a change in one reactant of the system.
  - binding of the regulatory molecule at the active site.

31. In the diagram to the right, what type of signal is demonstrated in this axon terminus?
- pancrine signal
  - autocrine signal
  - hormonal signal
  - synaptic signal



32. The cells and signaling molecules that initiate inflammatory responses are
- the lymphocytes and the interferons.
  - the dendritic cells and the neurotransmitters.
  - the mast cells and the histamines.
  - the phagocytes and the chemokines

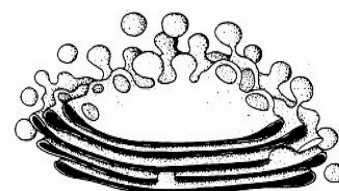
33. When you walk out of a movie theater your eyes need to adapt to the light. Choose the correct sequence of the following events leading to the sensory processing of a stimulus.

- Transmission – the conduction of sensory impulse to CNS
- Transduction- the detection of energy by a sensory receptor
- Integration – the processing by receptors within the CNS
- Amplification – the strengthening of action potential in the sensory pathway to the brain.

- A-B-C-D
- B-C-D-A
- B-D-A-C
- D-A-B-C

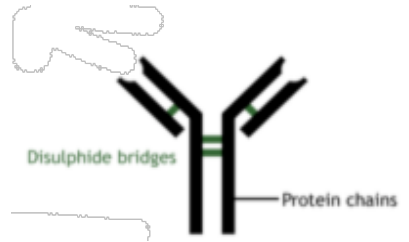
34. What eukaryote organelle shown below is part of the pathway to place identity markers, such as, MHC (major histocompatibility complex on cells)?

- mitochondria
- microtubules
- centriole
- Golgi complex



35. A bone marrow transplant may not be appropriate from a given donor to a given recipient cousin, even though the donor has previously given blood for one of recipient's needed transfusions. The reason the donor/recipient is inappropriate is that
- blood travels everywhere putting markers on every cell they come in contact with, therefore the recipient would lose all self-recognition.
  - recipients must have at least 25% compatibility of their markers and cousins have less.
  - bone marrow produces blood, only blood types are necessary for bone transplants
  - even though donor's blood type is a match to recipient's, MHC protein, the major histocompatibility complex may not be a match.

36. The picture shows a molecule that binds toxins and signals phagocytosis to occur. This molecule is best identified as a(n)



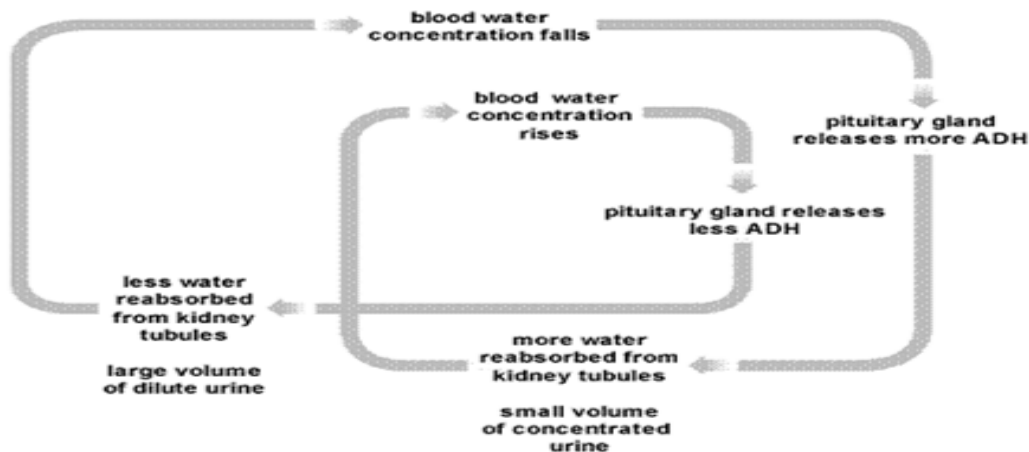
- pathogen
- antibody
- antigen
- antihistamine

37. Tadpoles undergo metamorphosis as they become frogs. An increase of the thyroid hormone in the blood induces a process in which the cells in the tail die. This signaling process is called

- feedback inhibition
- transduction
- morphogenesis
- apoptosis

38. The negative feedback system shown below is osmoregulation. This system controls the water level in the blood and body fluids. ADH is a hormone that causes the kidney to reabsorb water from urine and back into blood. What would not happen when blood water concentration falls?

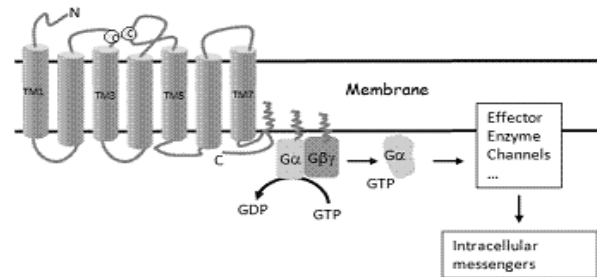
- more water is absorbed from the kidney into the blood stream
- more ADH is produced
- Urine is highly concentrated
- less ADH is produced



39. When a severely dehydrated person is brought to the hospital, an IV of normal saline is started immediately. Distilled water is not used because

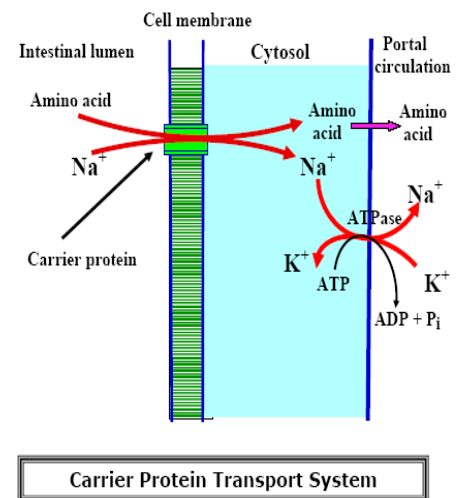
- water would leave the cells of the patient and cause the cells to collapse.
- Nutrients are provided by saline
- water would cause the patient's blood cells to swell and eventually burst.
- saline is economical than pure water.

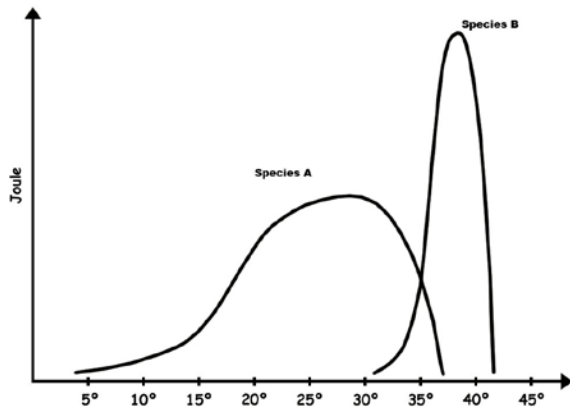
40. Which statement describes the G protein in the diagram of the pathway below?
- G proteins only contain one binding site.
  - G proteins-linked receptors are activated by the seven pass protein complex.
  - When G protein binds to an activated receptor protein, ADP is exchanged for ATP.
  - G proteins usually float free in the cytoplasm without the use of energy



41. After the GTP-bound subunit of the G-protein is separated from the rest of the G protein, it travels until it encounters
- an effector protein
  - an activator
  - an extracellular protein
  - another G protein
42. How does an intracellular signal produce a protein kinase cascade and amplify signals?
- A protein kinase molecule opens cell junctions to amplify the signal.
  - Anytime a kinase is activated, it will trigger thousands of molecules.
  - Second messengers create shortcuts to create multiple cascades
  - Nitric oxide gas opens cell channels, allowing protein kinase molecules to move from cell to cell.
43. Herbivory occurs when parts of plants are consumed by insects or other organisms without killing the plant. The signal pathway against herbivory is described below.  
*Receptor-elicitor binding. traveling of jasmonate through the plasmodesmata, binding the jasmonate to JAZ, resulting in an increase expression of the protease inhibitor, induces a defense system against insects.*  
 What would be the most likely outcome, if a mutation in JAZ interfered with the capacity to bind to jasmonate? Upon herbivore attack;
- jasmonate production would decrease.
  - elicitors would bind to receptors less readily.
  - elicitors would bind to receptors more readily.
  - an increase of protease inhibitors would occur less readily.
44. Sweating is a useful cooling device for humans to regulate temperature because water
- requires a lot of heat energy to change a liquid into its gaseous state
  - ionize easily to react with body acids
  - contains few hydrogen bonds to other water molecules.
  - is a universal solvent
45. In the intestine,  $\text{Na}^+$  and an amino acid bind to the same transport protein that moves the two substances in the same direction from the lumen to the cytosol. This is an example of:

- facilitated diffusion
- Active co- transport
- simple diffusion through an aquaporin
- passive transport



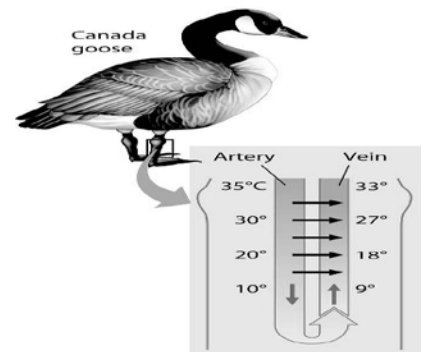


46. The graph above shows energy consumption by 2 species of animals over given temperature ranges. We can conclude that

- a. Species A is an ectotherm and B an endotherm  
 b. Species B is an ectotherm and A an endotherm  
 c. Both A and B are endotherms  
 d. Both A and B are ectotherms

47. Geese can stand on ice and heat loss is minimal. Blood vessels in a bird's leg and feet lie close together and demonstrate a countercurrent exchange to conserve heat. What allows countercurrent exchange to be an efficient process to conserve heat?

- a. increasing the surface area on their leg and feet allows increase in blood volume for energy transfer.  
 b. decrease surface area to allow quick transfer of heat and substances.  
 c. maximizes surface area and minimizes path length for greater energy transfer and diffusion of substances.  
 d. avoid ice water from entering the circulatory system of the duck.



48. Bacteria are able to communicate using signaling molecules released into the environment. Each bacteria cell is able to sense the number of bacteria or cell density from the accumulation of signaling molecules. There are several different classes of signals in which side chains in the molecule vary slightly giving different information. Evidence has shown that mixed populations of bacteria in biofilms can communicate. Quorum sensing plays an important role in

- a. Bacterial languages  
 b. Space Diffusion  
 c. Interspecies cross talk  
 d. Population Explosion

49. In an experiment, five marked pill bugs were placed on the dry side of a choice chamber and five marked pill bugs on the wet side. They collected data as to the number on each side every 30 seconds for 10 minutes. After 6 minutes eight pill bugs were continually on the wet side. After 10 minutes, 8 pill bugs were in the wet side but since they were marked, observations showed that they were not exactly the same pill bugs. They appeared to randomly move into the wet area, spending more time in the area. What type of behavior is shown by the pill bugs?

- a. Positive taxis towards moist areas  
 b. Kinesis only  
 c. Negative taxis towards the dry areas  
 d. Both taxis and kinesis

50. A night-flowering plant curves away from the light during the day. This plant demonstrates

- a. + phototropism  
 b. - phototropism  
 c. + gravitropism  
 d. - gravitropism

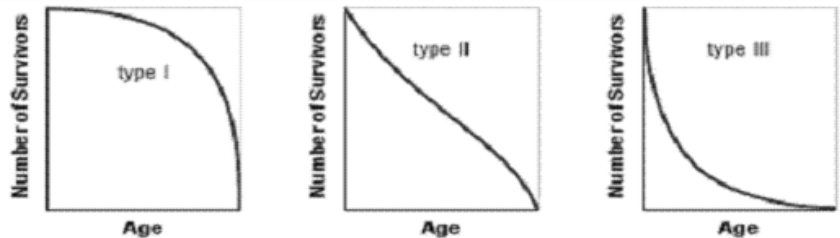
51. Which example below is **not** a biological rhythm?

- a. Ground squirrels gather rations and pack of fat reserves in the fall for cold winters.  
 b. Adult emergence of 17-year cicadas is timed across the entire population.  
 c. Core body temperature cycles from a low during sleep to a high at mid-day and early evening.  
 d. Tides respond to the lunar cycle, when high tide occurs at the full moon.

52. Which behavior would not increase the survival of the species population?
- Birds use a scolding call to warn of a snake in the area
  - Elephants give off a musk smell as they migrate to a new lek
  - Male lions eating their prey first leaving the pride with leftovers
  - Schooling fish form shapes of larger organism to frighten off prey

53. Improvements in medicine have increased the average life span of Americans. Which survivorship curve best communicates this idea?

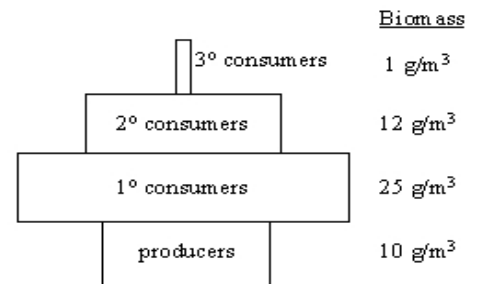
- I
- II
- III
- Not shown



54. Subtraction of which of the following will convert gross primary productivity into net primary productivity?
- energy found in a standing corn crop
  - energy used by autotrophs in respiration
  - energy fixed by photosynthesis
  - all of solar energy

55. An ecologist was measuring the biomass in a lake to calculate energy equivalents in the ecosystem. He became puzzled by the data he collected, shown below. The data appeared unusual compared to the rain forest in which the lake was located. What was the biologist on his team explanation for the data?

- The data were taken in the fall. The lake is in transition to cooler waters and the consumer will balance out by moving out to sea.
- He missed some of the producers in his data because they are microbes.
- Most of the producers are algae, with a short life cycle and rapid reproduction rate that can keep up with consumer demand.
- He counted or weighed the 1° and 2° consumers incorrectly.

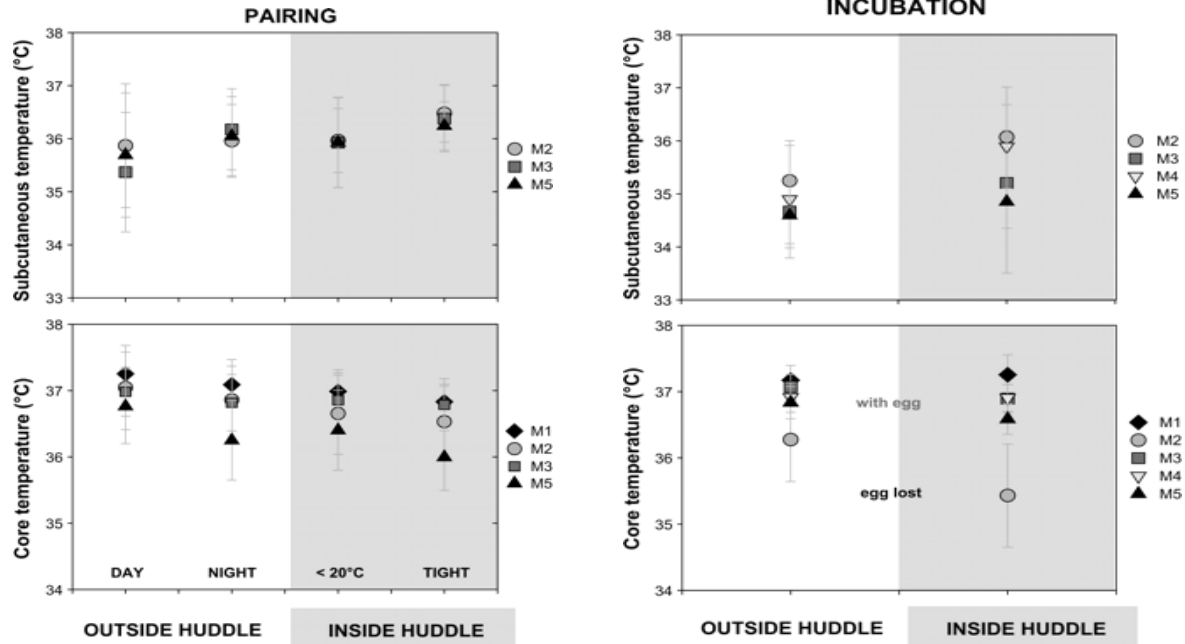


56. A biologist, Caroline Gilbert studied male emperor penguins thermoregulation to estimate huddling behavior effect on egg incubation. Huddling behavior is a group of 60 or more penguins that become close together and produce a wave motion in microseconds not visible to the eye. Some penguins spend time in smaller groups not closely associated or more isolated. Males spend 4 months incubating the eggs. Gilbert used a data logger attached to the feet of male penguins to measure core and subcutaneous temperature, during the mating rituals and during the egg-incubation period. Data were taken both when the penguins were alone and when they were huddled together. **Analyzing Gilbert's data below, what conclusion can be drawn from her experiment?**

The caption for the pairing graph: *Subcutaneous and core temperatures of male emperor penguins associated with nonhuddling (day and night), huddling, and tight huddling episodes during the pairing period.*

The caption for the incubation graphs: *Subcutaneous and core temperatures of male emperor penguins associated with episodes of nonhuddling and huddling during incubation.*

**The problem continues onto the next page.**



- Skin temperature (subcutaneous) temperature increases at night and core temperature lowers allowing for successful incubation.
- Temperature regulation is controlled by external temperature and penguins receive heat from other penguins.
- Huddling behaviors allow penguins to maintain lower core temperatures and higher skin temperature during pairing and higher skin temperatures during incubation of the egg.
- Huddling behavior has no effect on temperature regulation.

57. What idea from the previous question does Gilbert's experiment support?

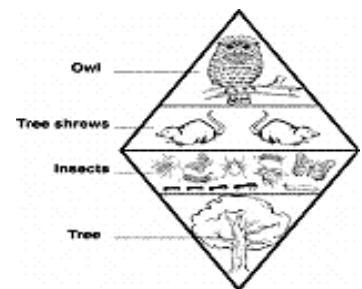
- An organism coordination of behaviors and physical metabolic adaptations to environmental extremes allow for reproductive success.
- Thermoregulation is essential to promote incubation of all eggs.
- Caring parenting behaviors allows for evolutionary success for many generations.
- Diffusion of heat can occur through huddling behaviors.

58. Generally, in terrestrial biomes, which trophic level has the most energy available it?

- producers
- Primary consumers
- Secondary consumers
- herbivores

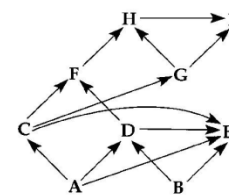
59. In the diagram a single tree will provide 1500 calories per day to the insects per day, how many calories per day would be provided to the owl using the 10% rule?

- 150,000 calories
- 1500 calories
- 150 calories
- 15 calories



60. Below is a generalized sketch of a food web. The arrows indicate the direction of the energy flow. If C were removed, then what would most likely occur?

- A would die out.
- F population would decrease.
- D population would decrease
- H, G, and I would decrease.





**NEW JERSEY SCIENCE LEAGUE**  
**Biology II Answer Key: White paper test**  
**FEBRUARY 2014 (corrected)**

1	A	16	B	31	D	46	A
2	D	17	C	32	C	47	C
3	D	18	A	33	C	48	C
4	A	19	C	34	D	49	D
5	C	20	C	35	D	50	B
6	B	21	A	36	B	51	D
7	D	22	A	37	D	52	C
8	B	23	B	38	D	53	A
9	C	24	A	39	C	54	B
10	C	25	A	40	B	55	C
11	A	26	D	41	A	56	C
12	C	27	A	42	D	57	A
13	C	28	C	43	D	58	A(all full)
14	A	29	A	44	A	59	D
15	A	30	B	45	B	60	D

**BCIOLOGY II For all second year and AP level students.**

**January Exam: Big Idea 1: The process of evolution drives diversity and unity of life.**

Evolution, Natural Selection, Artificial Selection, Mechanisms for Evolution, Hardy Weinberg Principles, Genetic Drift, Gene flow, Evidences for Evolution, Blast Genomic Analysis, Cladogram, Evolutionary Trees, Evolution of the Domains, Adaptive Radiation, Island Biogeography Theory, Speciation, Prezygotic and Postzygotic Mechanisms, Hypothesis on Origins of Life, Monomers and Polymers of Biological Molecules

**February Exam: Big Idea 2: Biological Systems utilize free energy and molecular building blocks to grow, reproduce, and to maintain dynamic homeostasis.**

Free Energy and Gibbs Reactions, Enthalpy in Biological Systems, Biological Applications to the Laws of Thermodynamics, Exothermic/Exothermic Reactions, Coupled Reactions, Photosynthesis, Cellular Respiration, Endotherm/Exothermic, Body Temperature Regulation, Cell Types, Surface Area/Volume Ratios, Fluid Mosaic Model of the Membrane, Properties of Water, Osmoregulation, Membrane Transport, Cellular Feedback Mechanisms, Metabolic Processes and Metabolism, Energy in Reproductive Strategies, Behavioral and Physiological Response to Environmental Stress, Ecosystem Energy Pyramid Structure, Food Web Alterations, Population Density, Taxis and Kinesis, Tropisms, Biological Rhythms, Behavioral Biology, Communication and signaling, Developmental genes, Systems in Plants and Animals; Immune, Respiration, Excretion, Digestion, Circulation

**March Exam: Big Idea 3: Living Systems store, retrieve, transmit and respond to information essential to life processes.**

Communication: Signaling, reception, transduction and response, Nervous System, Endocrine System, Reproductive System, DNA and replication, RNA in Protein Production, RNA Types, Cell Cycle and Controls, Mitosis, Meiosis, Application of Mendel's Laws, Mendelian and Nonmendelian Genetics, Genetic Disorders, Cancer, Genetic Engineering Techniques, Nonnuclear Inheritance, Transposons, Gene Regulation, Apoptosis, Developmental Genes, Embryonic Development in Plants and Animals, Signaling Mechanisms, Transmission and Transduction Pathways, Polyploidy, Sex Inheritance, Mutation Effects, Viral Replication, Genetic Variation Processes, Mating Types, Behaviors and Parenting

**April Exam: Big Idea 4: Biological Systems interact, and these systems and their interactions possess complex properties.**

Biological Monomers and Polymers: Structures' relationship to function, Protein Folding, Bonding in Polymers, Enzymes, Coenzymes, Cofactors, Lipid Properties, Subcellular Organelle Function(s) and Interactions, Multifunctional Molecules, Genetic Multiplicity and Flexibility, Organ and System Specialization, Interactions and Coordination in Plants and Animals, Organism Responses Adaptation to Environment, Transpiration, Population: Variation, Growth, Dynamics and Distribution, Exponential and Logistic Population Growth Models, Limiting Factors, Species Richness, Species Diversity, Competition, Bacteria, Fungi, Symbiotic Relationships, Food Webs and Productivity and Energy Dynamics, Keystone species, Exotic and Alien Species Biogeochemical Cycles, Energy

***Dates for 2014 Season***

***Thursday January 9, 2014 Thursday February 13, 2014***

***Thursday March 13, 2014 Thursday April 10, 2014***

**All areas and schools must complete the last exam and mail in the results by April 25<sup>th</sup>, 2014**

***New Jersey Science League***

**PO Box 65 Stewartville, NJ 08886-0065**

**phone # 908-213-8923 fax # 908-213-9391 email [newjisl@ptd.net](mailto:newjisl@ptd.net) Web address: [www://entnet.com/~personal/njscil/html](http://www://entnet.com/~personal/njscil/html)**

**PLEASE RETURN THE AREA RECORD AND ALL TEAM MEMBER  
 SCANTRONS(ALL STUDENTS PLACING 1<sup>ST</sup>, 2<sup>ND</sup>, 3<sup>RD</sup>, AND 4<sup>TH</sup>).**

If you return scantrons of alternates, then label them as ALTERNATES.

***Dates for 2015 Season***

**Thursday January 8, 2015 Thursday February 12, 2015**

**Thursday March 12, 2015 Thursday April 9, 2015**



**NJSL Biology II March 2014**

**Choose the answer that best completes the statements or questions below and fill in the appropriate response on the form. If you change an answer, be sure to completely erase your first choice. Please PRINT your name, school, area, and which test you are taking onto the scan-tron.**

- In general, all cell signaling causes
  - an influx of ions
  - G protein activation
  - a change in receptor conformation
  - increased expression of genes
- Many of the chemical signals reaching a cell deep inside a multicellular organism come from
  - other cells
  - the brain
  - the nervous system
  - the lymphatic system
- Steroid hormones take longer than other hormones to produce their effect. This is because
  - second messengers act slowly
  - they are synthesized in small quantities by their glands
  - they are large molecules and can block blood flow in a vein
  - their target cells must produce a new protein before a response can occur
- The following data was observed for single gene traits A, B, C, and D. Which is the correct order of the genes?

Gene	Crossover Frequency
A-B	5%
A-C	18%
C-D	7%
B-D	30%

- A-B-C-D
  - B-A-C-D
  - D-B-A-C
  - A-D-C-B
- A fruit fly hybrid for both gray body color (Gg) and normal wings (Nn) is mated to a black bodied (gg) and vestigial wings (nn). The fly counts for F1 generation is show below. What does the data indicate?

A	B	C	D
gray normal	black vestigial	gray vestigial	black normal
970	940	192	182

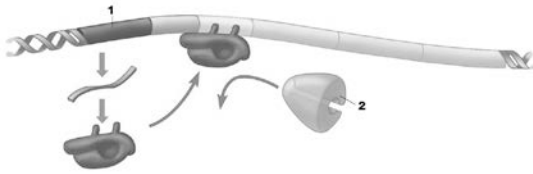
- Genes are located on different chromosomes.
  - Genes are located on the X sex chromosomes.
  - Genes are located on the same chromosome.
  - Genes are located on the same chromosome and crossing over has occurred
- Phenylketonuria (PKU) in humans is caused by a recessive allele. Two normal parents have a child affected with PKU. If this couple has two additional children what is the probability that both of will affected by PKU?
    - 6.25%
    - 12.5%
    - 25%
    - 50%
  - According to the law of independent assortment, how many different gametes are produced by an individual genotype AaBbCCddEeFFGg? All seven genes assort independently.
    - 7
    - 14
    - 16
    - 28
  - Sperm cells of the lab rat, *Rattus norvegicus*, contain 22 chromosomes each. How many **chromatids** does a **somatic** cell in prophase of **mitosis** contain?
    - 11
    - 22
    - 44
    - 88
  - Sperm cells of the lab rat, *Rattus norvegicus*, contain 22 chromosomes each. How many **chromosomes** does a cell in metaphase II of **meiosis** contain?
    - 11
    - 22
    - 44
    - 88

10. The sequence of eight amino acids from four different  $\beta$ -hemoglobins are in the chart below. One of these proteins is normal, the others are mutant alleles. Which of the sequences is normal ?

	Positions							
	1	2	3	4	5	6	7	8
Hb #1	Val	His	Lue	Thr	Pro	Val	Glu	Lys
Hb #2	Val	Try	Lue	Thr	Pro	Glu	Glu	Lys
Hb #3	Val	His	Llue	Thr	Pro	Lys	Glu	Lys
Hb #4	Val	His	Lue	Thr	Pro	Glu	Glu	Lys

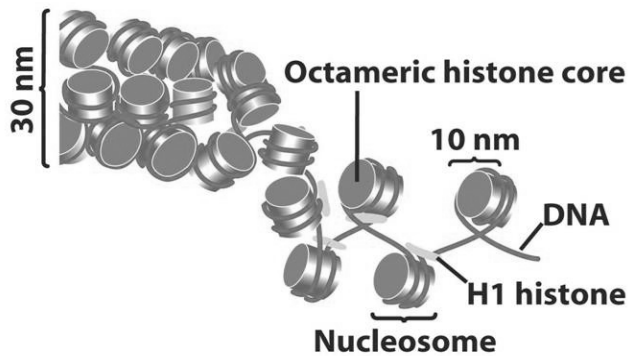
- a. Hb #1                      b. Hb #2                      c. Hb #3                      d. Hb #4

11. In the diagram of a lac Operon below, if 1 points to the regulator gene, then 2 is most likely the



- a. Repressor protein                      b. Structural gene                      c. RNA polymerase                      d. Operator

12. What role does the illustrated process play?



- a. Condensation from chromatin to chromosome                      b. Plasmid replication                      c. Protein denaturation                      d. Operon induction

13. Some scientists want to genetically engineer apples to produce the insecticide pyrethrin. In order to ensure that all offspring from the genetically modified apple tree also produce pyrethrin, they must be sure that the pyrethrin producing and its promoter are found in the cells of what tissue?

- a. foot                      b. stem                      c. leaf                      d. seed

14. Which of the following DNA sequences could be a recognition site for a restriction enzyme that produces “sticky ends” when a DNA digest occurs?

- a. 3'AAATGC 5'  
5'TTTAGC 3'
- b. 3'GGGGGG 5'  
5'CCCCCC 3'
- c. 3'GAATTC 5'  
5'CTTAAG 3'
- d. 3'AATTAT 5'  
5'TTAATA 3'

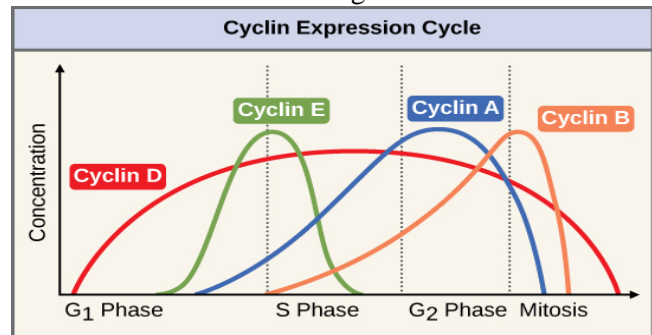
15. Frederick Sanger discovered a method for sequencing the amino acid in a polypeptide. After several protein digests of the polypeptide he could analyze the resulting fragment. He compared overlapping regions to deduce the polypeptide primary structure. Given the overlapping sequences below, what is the primary structure of this 10 amino acid segment of the enzyme lysozyme?

- phe-val-lys-ala-ala-leu-glu-cys-arg-cys
- arg-cys-glu-leu-ala-ala-gly-arg-cys-glu
- lys-val-phe-gly-arg-cys-glu-leu-ala-ala
- lys-val-phe-gly-phe-gly-arg-cys-glu-val

Amino Acids in 5 Fragments
arg-cys-glu
lys-val-phe-gly
cys-glu-leu-ala-ala
lys-val-phe
phe-gly-arg-cys

16. The graph below represent the different cyclins concentration present in the stages of the cell cycle. Which cyclin initiates protein production necessary for G<sub>0</sub> stage termination for mitosis to begin?

- cyclin A
- cyclin B
- cyclin E
- cyclin D



17. Which mechanism of hormonal stimulation would be affected if signaling and hormone released from the hypothalamus was blocked?

- humoral and hormonal stimuli
- hormonal and neural stimuli
- neural and humoral stimuli
- hormonal and negative stimuli

18. How does the flow of genetic information occur?

- Proteins encode information to produce other proteins
- DNA encodes information that is translated into RNA, and RNA encodes information that is translated into a protein which is expressed in an organism
- RNA encodes information to make DNA act as an enzyme to form proteins to make a trait that is expressed
- Amino Acids make proteins which work on DNA for replication of more molecules to do work.

19. A new type of garden tomato plant is the product of two different species of wild tomatoes. The first generation produces vigorous hybrid plants, but the offspring of these hybrids are weak and die. What has occurred?

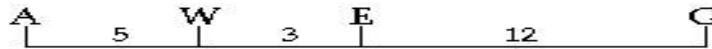
- gamete isolation
- temporal isolation
- hybrid sterility
- hybrid breakdown

20. Which of the following will decrease the genetic variation in a gene pool?

- Selection
- Mutation
- Recombinant DNA
- Diploidy

21. Which of following represents a type of post-translational control during protein synthesis?
- The methylation of DNA bases on histones
  - Insertion of transposons in corn
  - Addition of the 5' cap and 3' poly-A tail
  - Golgi modification to protein folding
22. Which of the following events would most likely cause the greatest change in the polypeptide produced from a DNA's sequence of nucleotides?
- an of a base substitution of a base near the beginning of the sequence
  - the deletion of a base near the beginning of the sequence
  - the addition of base at the end of the sequence
  - the exchange of the first two bases with each other
23. When two dogs meet carry out a 'high-dog, low-dog' ritual in which they take turns holding their heads above each other until one dog becomes winner. The most important reason for this agonistic behavior is to
- recognize kin
  - demonstrate cooperative behavior
  - attract a mate
  - establish dominance without injury
24. A biologist, Spemann grafted a piece of dorsal lip from one amphibian embryo onto the ventral side of a second embryo. A second notochord and neural tube developed at the location of a graft. The experiment proved that
- the dorsal lip can transform into the archenteron
  - the dorsal lip can transform into any organ
  - the dorsal lip is an inducer that causes adjacent tissues to transform into some structure
  - embryonic development does not follow a specific developmental pathway and can be altered.
25. In honey bees, the queen bee fertilizes some eggs and does not fertilize others. Fertilized eggs (2n) become worker bees while unfertilized eggs (n) become drones. What does this demonstrate about parthenogenesis in some organisms?
- Diploid adults can be produced
  - Development of an egg can occurs without fertilization
  - This is a primitive form of reproduction
  - Similar asexual reproduction is carried out by protist.
26. Homeobox or hox genes are master regulatory genes that control the expression of the placement of anatomical structures. These genes are responsible for
- apoptosis
  - egg polarity
  - pattern formation
  - maternal behaviors
27. Stem cells are immortal as long as they express
- Go point genes
  - oncogenes
  - telomerase
  - growth factors
28. Where can control of gene expression in eukaryotic cell occur?
- only at transcriptional level
  - epigenetic and transcriptional, and translational levels
  - epigenetic and transcriptional levels
  - epigenetic and transcriptional, and translational, and post-translational levels

29. On the gene map below, between which genes would you expect the highest cross-over gene frequency?



- a. A and W                      b. A and E                      c. A and G                      d. E and G

30. An individual who harbors a mutation in the SRY gene will most likely

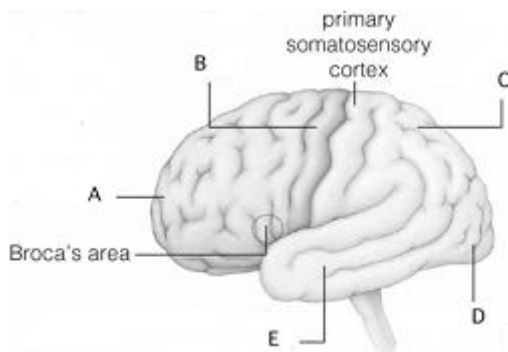
- a. have a male genotype but female phenotype  
b. manifest as a gender chimera  
c. manifest normal male genitalia  
d. develop like a normal male but will be sterile

31. The somatic nervous system can alter activities on its targets, the skeletal muscle, because

- a. its signals bind to receptor proteins on the muscles  
b. it is electrically coupled by gap junctions to muscle cells  
c. its signal reaches the muscle via the blood  
d. its light impulses activate the contraction in the muscle

32. The most ancient paths of information flow in a nervous system are

- a. located in the midbrain.  
b. reflex arcs.  
c. found in the lower part of the brain.  
d. found in the autonomic nervous system.



Use the figure above of the human brain to answer questions # 33, 34, 35.

33. The premotor cortex is located in the lobe indicated by

- a. A.                      b. B.                      c. C.                      d. D.

34. The region responsible for complex learning, intellect, and personality is located in the lobe indicated by

- a. A.                      b. B.                      c. C.                      d. D.

35. The region that controls coordinated movement of skeletal muscles is indicated by

- a. A.                      b. B.                      c. C.                      d. D.

36. How does the process shown in the picture to the right help in identifying bacterial colonies that might contain a gene of interest?

- The process shows the cloning of bacterial cells.
- The process shows bacterial colonies being transferred for replica plating.
- The process shows the rupturing of bacterial cells to harvest their DNA
- The process identifies only cells with the gene in question.



37. The use of RFLPs for "genetic fingerprinting" is based on

- the nucleotide base pairing in the RFLPs.
- the types of nucleotides in the RFLPs.
- differences in tandem repeats among individuals.
- the ratio of purines to pyrimidines in RFLPs.
- bonding patterns between nucleotides in the RFLPs.



38. In the above DNA fingerprinting gel, which individual matches the semen (lane 8, counting from the top) collected after the rape?

- suspect I
- suspect II
- the boyfriend
- bad reading because it matches the female cells

39. Seed banks preserve native seeds from different world regions, mostly to

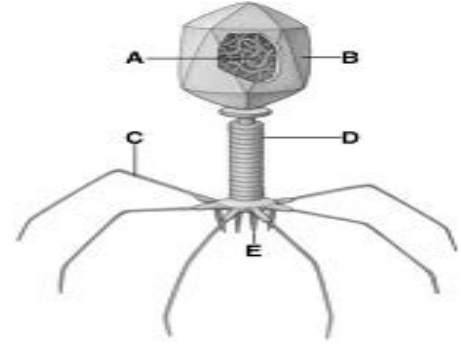
- provide a source of seeds for farmers.
- preserve seeds for museums.
- preserve plant genetic diversity to be tapped by genetic engineers.
- distribute seeds to member seed companies.

40. After initial research using various cell lines, human volunteers are needed to test antiviral drugs because

- viruses can reproduce only in human cells.
- a functioning immune system is necessary to test a response to drugs.
- antiviral drugs are effective only in human cells.
- human cells will not decrease a drug's effectiveness.

Use the figure to the right side for questions # 41 and 42.

41. The figure illustrates a (an)
- prion
  - adenovirus.
  - bacteriophage.
  - HIV virus.

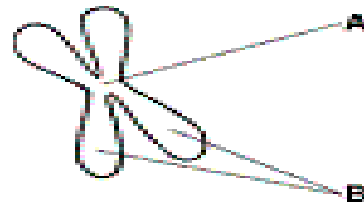


42. The virus attaches to a cell by the structure that is indicated by
- A.
  - B.
  - C.
  - D.



43. In this depiction of transcription above, the \_\_\_\_ strand is \_\_\_\_ because it \_\_\_\_.
- upper; RNA; is single-stranded.
  - lower; RNA; contains uracil.
  - lower; RNA; contains thymine.
  - upper; RNA; has no uracil (U).
44. Which is **false** about the wobble effect of the code? The wobble effect
- explains why and how there can be fewer than 64 kinds of transfer RNA molecules.
  - explains why UCU, UCC, UCA, and UCG all code for serine.
  - indicates that transfer RNA combines with either the small or large subunit of ribosomes.
  - permits certain amino acids to be specified by more than one codon.

45. What is B in the diagram to the right?
- centromeres
  - chromosomes
  - sister chromatids
  - p and q arms

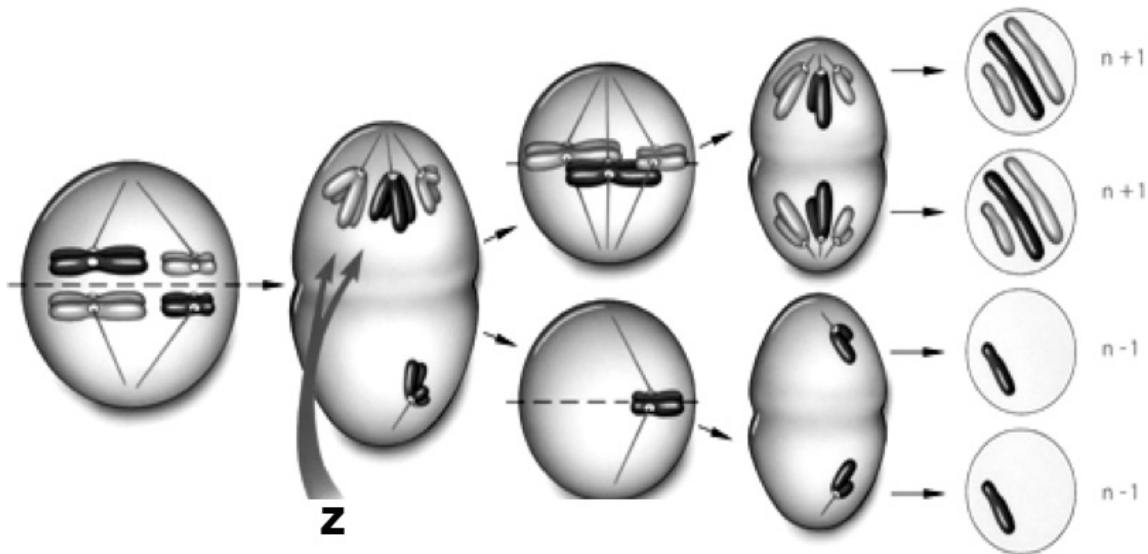
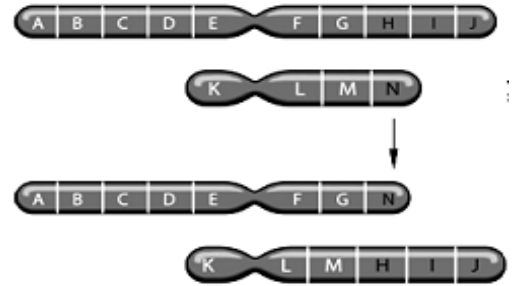


46. Imagine that you are designing an experiment aimed at determining whether the initiation of migratory behavior is largely under genetic control. Out of the options below, the best way to proceed is to;
- perform within-population matings with birds from other populations of different migratory habits. Then rear the offspring in the absence of their parents and observe their migration habits.
  - perform within-population matings with birds from other populations of different migratory habits. Rear the offspring in the lab and observe parental migratory patterns in the offspring.
  - observe genetically distinct populations in the field and observe their migratory patterns for their different migratory habits
  - bring the birds into the lab and observe when they become restless and want to fly.

47. Receptors for neurotransmitters are of primary importance in assuring one-way synaptic transmission because they are found mostly on
- axonal membrane
  - dendritic membrane
  - presynaptic membrane
  - axon hillock

48. An X-linked carrier is a
- homozygous dominant female.
  - heterozygous female.
  - homozygous recessive female.
  - homozygous male.
  - heterozygous male.

49. The figure to the right represents which of the following chromosomal changes?
- inversion
  - deletion
  - duplication
  - translocation



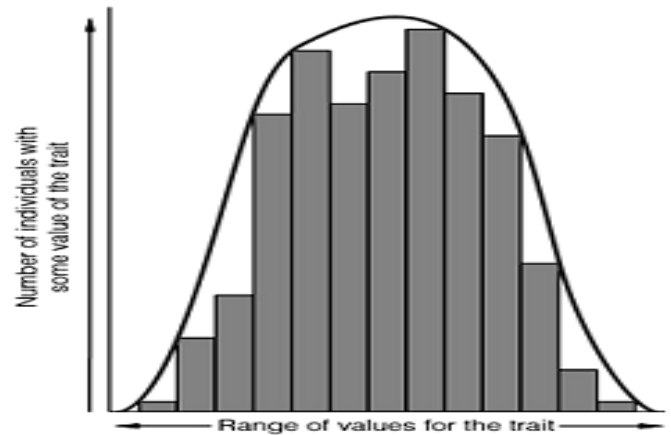
50. The process above (specifically the event at arrow labeled Z) can be responsible for which of the following conditions
- Klinefelters
  - PKU
  - Tay-Sachs
  - Hepatitis
51. Susan, a mother with type B blood, has a child with type O blood. She claims that Craig, who has type A blood, is the father. He claims that he cannot possibly be the father. Further blood tests ordered by the judge reveal that Craig is AA. The judge rules that
- Susan is right, and Craig must pay child support.
  - Craig is right and doesn't have to pay child support.
  - Susan cannot be the real mother of the child; there must have been an error made at the hospital.
  - it is impossible to reach a decision based on the limited data available.



52. All of the genes located on a given chromosome constitute
- a. a karyotype.
  - b. a bridging cross.
  - c. a wild-type allele.
  - d. a linkage group.

53. A graph of phenotypic variation similar to the illustration to the right strongly suggests

- a. incomplete dominance.
- b. codominance.
- c. epistasis.
- d. polygenic inheritance.



54. Height, weight, and eye color are examples of phenotypes that illustrate all BUT
- a. pleiotropy.
  - b. the cumulative phenotypic effect of several gene products
  - c. continuous variation.
  - d. polygenic inheritance.

55. Transcription

- a. involves both strands of DNA as templates.
- b. uses the enzyme DNA polymerase.
- c. results in a double-stranded end product.
- d. produces three different types of RNA molecules.

56. Ribosomal subunits

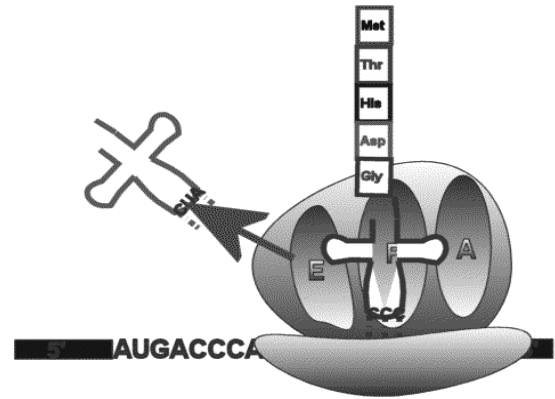
- a. come together in threes to form functional units.
- b. are composed of mRNA and structural proteins.
- c. are synthesized in the cytoplasm.
- d. converge only when mRNA is to be translated.

57. In correct order, the three stages of translation are

- a. initiation, replication, and termination.
- b. elongation, peptide bond formation, and codon-anticodon pairing.
- c. initiation, chain elongation, and termination.
- d. termination, initiation, and replication.

58. Which event of translation shown here would be next?

- a. elongation
- b. peptide bond formation
- c. elongation and peptide bond formation
- d. translocation

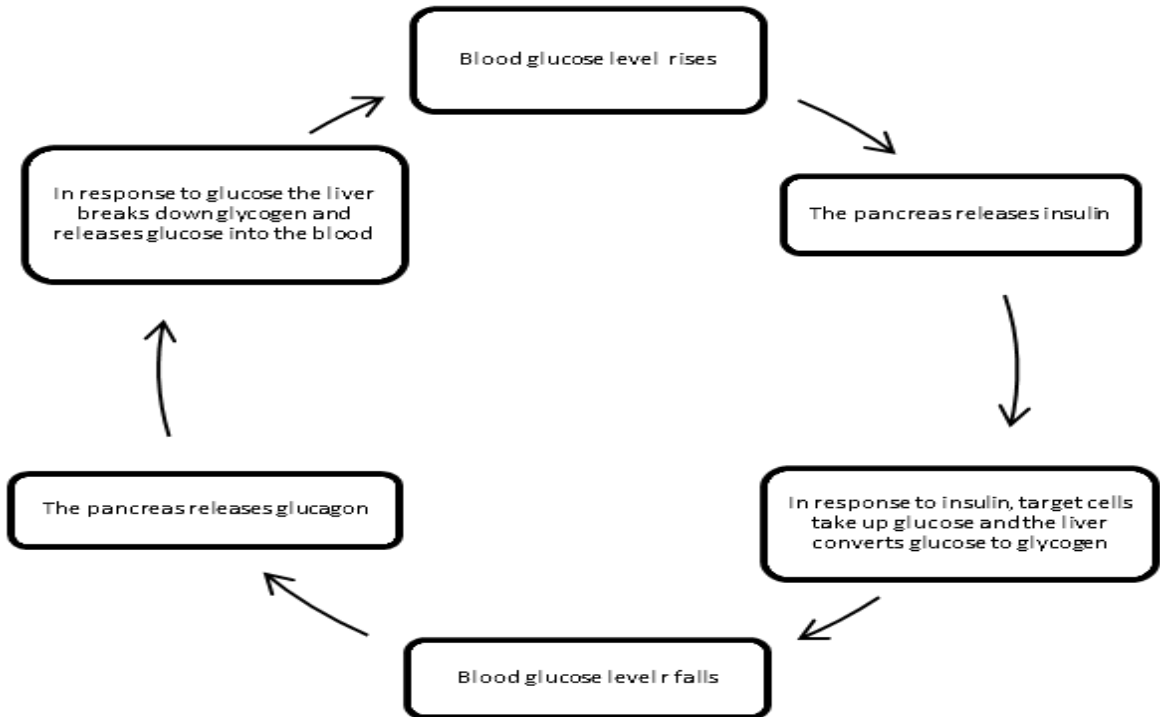


59. A restriction enzyme cuts a 25,700bp segment of DNA into three fragments. Fragment A is 5,800bp and fragment B is 6,600 bp, How long is fragment C, and which of the fragments will move the farthest in an electrophoresis gel?

- a. 12,400bp: fragment A
- b. 12,400bp: fragment C
- c. 13,300bp: fragment A
- d. 13,300bp: Fragment C

60. Hyperglycemia occurs when blood glucose levels rise, while hypoglycemia has low blood glucose levels. Pancreatic tumors can cause excess secretion of glucagon. Type I diabetes results from the failure of the pancreas to produce insulin. Analyzing the diagram below, which one of the following statements about these two conditions is true?

- a. A pancreatic tumor and type I diabetes will have opposite effects on sugar levels
- b. A pancreatic tumor and type I diabetes will both cause hyperglycemia
- c. A pancreatic tumor and type I diabetes will both cause hypoglycemia
- d. Both pancreatic tumor and type I diabetes result in the inability of cells to take up glucose



## Biology II March Answer Section

### MULTIPLE CHOICE

1. ANS: C                      PTS: 1                      KEY: communication  
2. ANS: A                      PTS: 1  
3. ANS: D                      PTS: 1  
4. ANS: B                      PTS: 0  
5. ANS: D                      PTS: 1  
6. ANS: A

A cross of the parents is 1/4. Each of two individual children represents an individual trial and each trial is 1/4 probability therefore,  $1/4 \times 1/4 = 1/16$ .

PTS: 1

7. ANS: C  
2<sup>4</sup>

PTS: 1

8. ANS: D                      PTS: 1  
9. ANS: B                      PTS: 1  
10. ANS: D                      PTS: 1  
11. ANS: C                      PTS: 1  
12. ANS: C                      PTS: 1  
13. ANS: D                      PTS: 1  
14. ANS: C                      PTS: 1  
15. ANS: C                      PTS: 1  
16. ANS: A                      PTS: 1  
17. ANS: B                      PTS: 1  
18. ANS: B                      PTS: 1  
19. ANS: D

The first generation hybrids were produced (a&b are incorrect), but second generation is weak.

PTS: 1

20. ANS: A                      PTS: 1  
21. ANS: D                      PTS: 1  
22. ANS: B                      PTS: 1  
23. ANS: D                      PTS: 1  
24. ANS: C                      PTS: 1  
25. ANS: B                      PTS: 1  
26. ANS: C                      PTS: 1  
27. ANS: C                      PTS: 1  
28. ANS: D                      PTS: 1  
29. ANS: C                      PTS: 1  
30. ANS: A                      PTS: 1  
31. ANS: A                      PTS: 1

32. ANS: B PTS: 1  
33. ANS: A PTS: 1  
34. ANS: A PTS: 1  
35. ANS: B PTS: 1  
36. ANS: B PTS: 1  
37. ANS: C PTS: 1  
38. ANS: A PTS: 1  
39. ANS: C PTS: 1  
40. ANS: B PTS: 1  
41. ANS: C PTS: 1  
42. ANS: C PTS: 1  
43. ANS: B PTS: 1  
44. ANS: C PTS: 1  
45. ANS: C PTS: 1  
46. ANS: A PTS: 1  
47. ANS: B PTS: 1  
48. ANS: B PTS: 1  
49. ANS: D PTS: 1  
50. ANS: A PTS: 1  
51. ANS: B PTS: 1  
52. ANS: D PTS: 1  
53. ANS: D PTS: 1  
54. ANS: B PTS: 1  
55. ANS: D PTS: 1  
56. ANS: D PTS: 1  
57. ANS: C PTS: 1  
58. ANS: D PTS: 1  
59. ANS: C PTS: 1  
60. ANS: B PTS: 1

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**March 2014 (Corrections)**

1	C	16	A	31	A	46	A
2	A	17	B	32	B	47	B
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4	B	19	D	34	A	49	D
5	D	20	A	35	B	50	A
6	A	21	D	36	B	51	B
7	C	22	B	37	C	52	D
8	D	23	D	38	A	53	D
9	B	24	C	39	C	54	B(A)
10	D	25	B	40	B	55	D
11	C	26	C	41	C	56	D
12	C(A)	27	C	42	C	57	C
13	D	28	D	43	B	58	D(C)
14	C	29	C	44	C	59	C
15	C	30	A	45	C	60	B

**BCIOLOGY II For all second year and AP level students.**

**January Exam: Big Idea 1: The process of evolution drives diversity and unity of life.**

Evolution, Natural Selection, Artificial Selection, Mechanisms for Evolution, Hardy Weinberg Principles, Genetic Drift, Gene flow, Evidences for Evolution, Blast Genomic Analysis, Cladogram, Evolutionary Trees, Evolution of the Domains, Adaptive Radiation, Island Biogeography Theory, Speciation, Prezygotic and Postzygotic Mechanisms, Hypothesis on Origins of Life, Monomers and Polymers of Biological Molecules

**February Exam: Big Idea 2: Biological Systems utilize free energy and molecular building blocks to grow, reproduce, and to maintain dynamic homeostasis.** Free

Energy and Gibbs Reactions, Enthalpy in Biological Systems, Biological Applications to the Laws of Thermodynamics, Exothermic/Exothermic Reactions, Coupled Reactions, Photosynthesis, Cellular Respiration, Endotherm/Exothermic, Body Temperature Regulation, Cell Types, Surface Area/Volume Ratios, Fluid Mosaic Model of the Membrane, Properties of Water, Osmoregulation, Membrane Transport, Cellular Feedback Mechanisms, Metabolic Processes and Metabolism, Energy in Reproductive Strategies, Behavioral and Physiological Response to Environmental Stress, Ecosystem Energy Pyramid Structure, Food Web Alterations, Population Density, Taxis and Kinesis, Tropisms, Biological Rhythms, Behavioral Biology, Communication and signaling, Developmental genes, Systems in Plants and Animals; Immune, Respiration, Excretion, Digestion, Circulation

**March Exam: Big Idea 3: Living Systems store, retrieve, transmit and respond to information essential to life processes.** Communication:

Signaling, reception, transduction and response, Nervous System, Endocrine System, Reproductive System, DNA and replication, RNA in Protein Production, RNA Types, Cell Cycle and Controls, Mitosis, Meiosis, Application of Mendel's Laws, Mendelian and Nonmendelian Genetics, Genetic Disorders, Cancer, Genetic Engineering Techniques, Nonnuclear Inheritance, Transposons, Gene Regulation, Apoptosis, Developmental Genes, Embryonic Development in Plants and Animals, Signaling Mechanisms, Transmission and Transduction Pathways, Polyploidy, Sex Inheritance, Mutation Effects, Viral Replication, Genetic Variation Processes, Mating Types, Behaviors and Parenting

**April Exam: Big Idea 4: Biological Systems interact, and these systems and their interactions possess complex properties.** Biological Monomers

and Polymers: Structures' relationship to function, Protein Folding, Bonding in Polymers, Enzymes, Coenzymes, Cofactors, Lipid Properties, Subcellular Organelle Function(s) and Interactions, Multifunctional Molecules, Genetic Multiplicity and Flexibility, Organ and System Specialization, Interactions and Coordination in Plants and Animals, Organism Responses Adaptation to Environment, Transpiration, Population: Variation, Growth, Dynamics and Distribution, Exponential and Logistic Population Growth Models, Limiting Factors, Species Richness, Species Diversity, Competition, Bacteria, Fungi, Symbiotic Relationships, Food Webs and Productivity and Energy Dynamics, Keystone species, Exotic and Alien Species Biogeochemical Cycles, Energy

**Dates for 2014 Season**

**Thursday January 9, 2014 Thursday February 13, 2014**

**Thursday March 13, 2014 Thursday April 10, 2014**

**All areas and schools must complete the last exam and mail in the results by April 25<sup>th</sup>, 2014**

**New Jersey Science League**

PO Box 65 Stewartville, NJ 08886-0065

phone # 908-213-8923 fax # 908-213-9391 email [newjis@ptd.net](mailto:newjis@ptd.net) Web address: [www://entnet.com/~personal/njsdil/html](http://www://entnet.com/~personal/njsdil/html)

**PLEASE RETURN THE AREA RECORD AND ALL TEAM MEMBER  
 SCANTRONS(ALL STUDENTS PLACING 1<sup>ST</sup>, 2<sup>ND</sup>, 3<sup>RD</sup>, AND 4<sup>TH</sup>).**

If you return scantrons of alternates, then label them as ALTERNATES.

**Dates for 2015 Season**

**Thursday January 8, 2015 Thursday February 12, 2015**

**Thursday March 12, 2015 Thursday April 9, 2015**

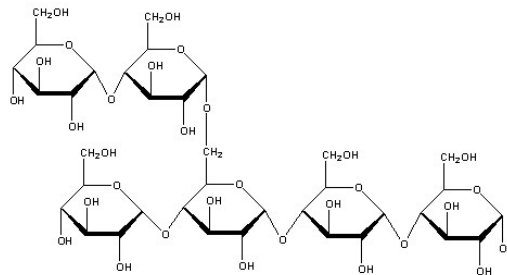
NJSL Biology II April 10, 2014

Choose the answer that best completes the statements or questions below and fill in the appropriate response on the form. If you change an answer, be sure to completely erase your first choice. Please PRINT your name, school, area, and which test you are taking onto the scan-tron.

1. What type of amino acid side chain would you expect to find on the surface of a protein embedded in the lipid-rich environment of a cell membrane?  
a. Acidic                      b. Hydrophobic                      c. Hydrophilic                      d. Basic
2. The side chain of leucine is a hydrocarbon. In a folded protein, where would you expect to find leucine?  
a. In the interior, near the iron in the heme group                      c. On the exterior of an enzyme found in the stomach  
b. On the exterior of a protein embedded in a membrane                      d. Located anywhere within a protein.
3. Elastase and trypsin are enzymes that catalyze hydrolysis of peptide bonds. Elastase only cuts next to alanine, whereas trypsin only cuts next to lysine. What allows the enzymes specificity?  
a. Elastase is a protein and trypsin is not                      c. The active sites for the two enzymes are different.  
b. Hydrolysis of alanine requires water, while trypsin does not.                      d. The elastase reaction is exergonic while trypsin is an endergonic reaction.

4. A section of the molecule amylopectin is drawn below. What is the branching linkage between the two carbohydrate chains?

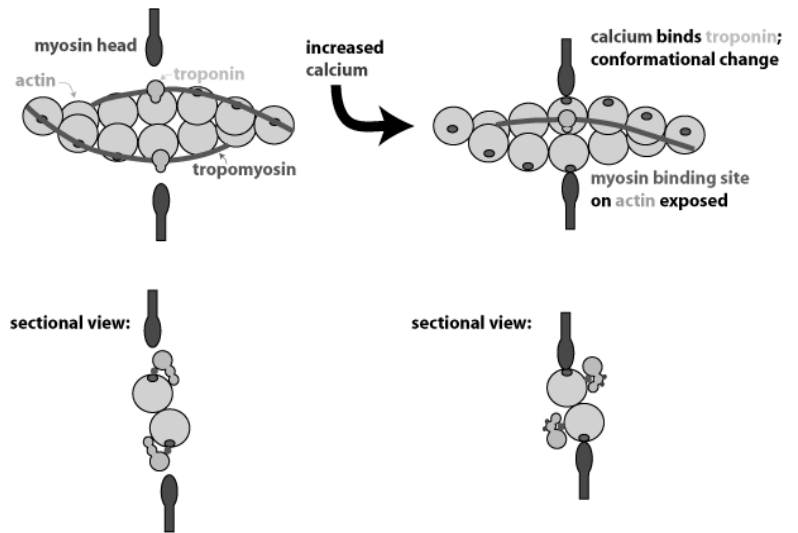
- a. alpha -1, 6 glycosidic bond
- b. alpha -6, 1 peptide bond
- c. alpha-1, 5 glycosidic bond
- d. alpha -5, 1 peptide bond



5. Which classification of macromolecules would have the following functions?  
cell compartmentalization, calorie reserve, thermal insulation, organ protection, buoyancy  
a. carbohydrates                      b. lipids                      c. proteins                      d. nucleic acids
6. What characteristic of membranes enables two vesicles to fuse together, forming a secondary vesicle within a cell?  
a. when the ratio of phospholipids to proteins is 24/1                      c. the lengths of the fatty acid chains on the phospholipids are constant  
b. ability of the phospholipid to flip flop and trade places with other phospholipids in the membrane                      d. capacity of lipids to associate and maintain a bilipid layer in the cytoplasm
7. What mechanism accounts for the spontaneous capillary action of water movement in the xylem of a plant?  
a. Pumping of water into the phloem  
b. Active transport of water  
c. Negative water pressure in the xylem  
d. Cohesion of water molecule and hydrogen bonding

8. Examine the diagram below. What is the role of  $\text{Ca}^{+2}$  in the control of muscle contraction?

- a. Causes depolarization of the T tube system
- b. Changes the conformation of troponin, and exposing myosin-binding sites
- c. Changes the conformation of myosin heads, causing microfilaments to slide
- d. Blocks ATP binding sites on myosin heads, for muscle relaxation



9. Wild turkeys have white breast muscles that are capable of explosively speedy flight reaction, but can only go a short distance at that speed. Muscles used for this action

- a. are fast-twitch muscles
- b. have high reserves of glycogen
- c. are slow-twitch muscles
- d. have low rates of ATPase activity

10. Tay-Sachs disease is known as a storage disease. In this disease, an enzyme used to digest lipids is absent, leading to an excessive accumulation of lipids in the brain. Which organelle of the cell has malfunctioned in this disease?

- a. centrioles
- b. peroxisome
- c. golgi complex
- d. lysosomes

11. According to the  $R_f$  values given in the table below, which pigment would migrate the fastest on chromatography paper?

Pigment	$R_f$
Beta carotene	1.250
Chlorophyll a	1.015
Chlorophyll b	0.985
Xanthophyll	1.125

- a. Beta carotene
- b. Chlorophyll a
- c. Chlorophyll b
- d. Xanthophyll

12. Transpiration against the force of gravity is possible in trees 100 m tall because

- a. water is actively transported from roots to leaves
- b. evaporation from stomata pulls water up through the tree
- c. high pressure in the soil pushes the water up
- d. gravity creates an upward pressure in the xylem

13. Which of the following is most influential in determining the actual evapotranspiration rate of a biotic community?

- a. the number of plants and how much moisture they lose.
- b. plant biomass and plant water content
- c. wind speed and the frequency of wind gusts.
- d. solar radiation, temperature, and water availability.

14. A disease that destroys cytoskeleton will probably interfere with
- active transport
  - cell division
  - glycolysis
  - osmosis

15. Which statement correctly describes the major histocompatibility complex (MHC), which are associated with immune response? Which of the following best exemplifies a system in which one gene can produce a diverse population of products?

- major histocompatibility complex (MHC)
- catalase
- insulin
- amylopectin

16. *Emiliana huxleyi*, (Ehux) plays a role in all seas, from polar oceans to tropics. These haptophytes are free-floating, eukaryotic photosynthetic algae that sequester carbon dioxide and contribute to the base of marine food chains. When they proliferate, their massive algal blooms are turquoise. Two thirds of Ehux's genes are shared among all strains in the bloom. This core genome allows Ehux to thrive under low levels of phosphorus and iron, which are often in short supply in the ocean. The other third of its genes are present in one strain but not all strains. This variable gene pool allows Ehux to use varying forms of nitrogen and other elements from other biochemical cycles. What does this description of a pan genome found in Ehux demonstrate?

- The stability of the species
- The genome does not have plasticity.
- The specificity of algal cell to continue to provide energy in the food chain
- The flexibility of the genome to adapt and exploit diverse, changing ocean environments

17. Inorganic atoms, such as zinc ions bind to enzymes at a site other than the active site making conformational changes in the enzyme, are

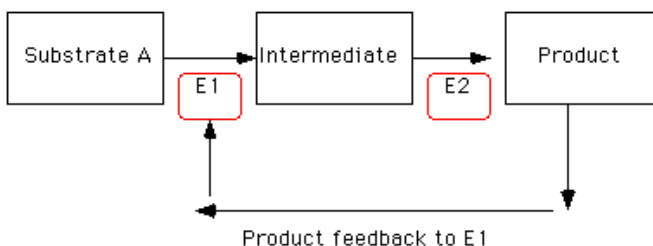
- cofactors
- coenzymes
- substrates
- isoenzymes

18. Generally, the effect of an enzyme on a reaction is all of the following **except**:

- Reaction rate will be faster at the same temperature.
- More total product will form from the same amount of reactant.
- The number of effective collisions among substrate molecules increases.
- The amount of kinetic energy necessary for the substrate to react decreases.

19. In the flow chart below, what would happen if enzyme two (E2) were not available?

- E1 would not function
- Substrate would not bind to E1
- The intermediate would build up
- Product would form rapidly



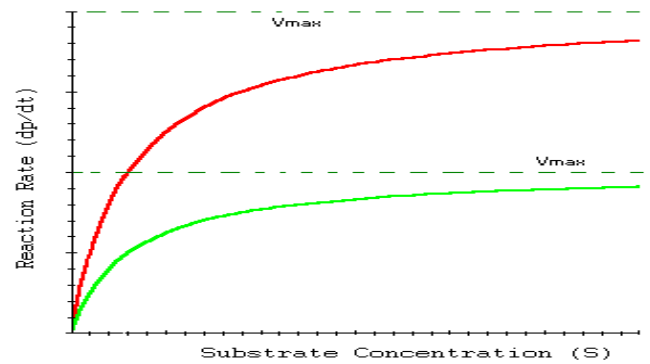
20. What does the diagram in question 19 illustrate?

- competitive inhibition
- noncompetitive inhibition
- coenzyme bonding
- single replacement reaction



21. The graph below shows an enzymatic reaction under two different conditions. What condition is most likely responsible for the upper line on the graph?

- a. increasing temperature
- b. constantly changing the pH
- c. adding to the enzyme concentration
- d. adding to the substrate concentration



22. How can we keep the rate of an enzyme-catalyzed reaction constant?

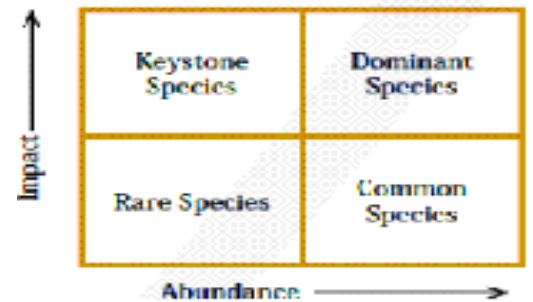
- a. Continually add more enzyme
- b. Continually add more substrate
- c. Continually increase temperature periodic intervals
- d. Continually remove accumulating product

23. How does a coenzyme differ from an enzyme? Coenzymes

- a. are active outside a cell only
- b. are specific to one reaction
- c. always carry a high energy phosphate
- d. bind to the active site

24. In the rocky intertidal of the Northwest Pacific, the starfish (*Pisaster ochraceus*) is an efficient predator of the mussel, (*Mytilus californicus*). The mussel is able to compete for resources successfully and reproduces rapidly. Predation by the starfish keeps the mussel population at moderate levels, allowing other macro invertebrates to persist in the environment. The decline of starfish population will inadvertently increase the mussel population, resulting in a decline in the numbers of macro invertebrates. Use the table below to determine the type of species the starfish is in this community

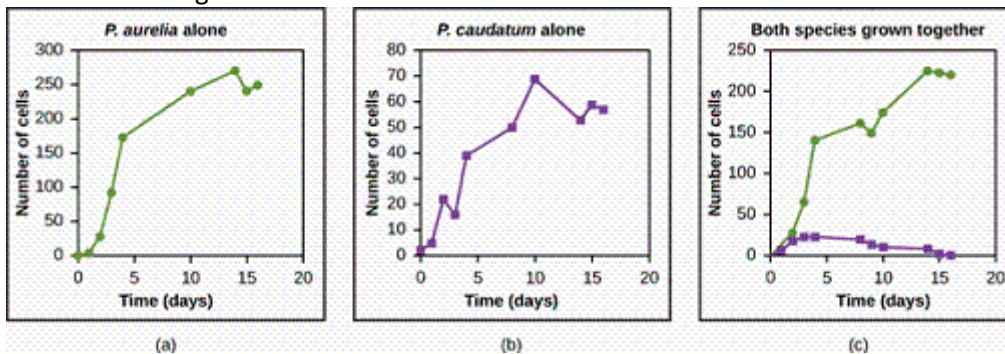
- a. Keystone
- b. Dominant
- c. Rare
- d. Common



25. Exotic species of organisms have been accidentally introduced into well-established native fresh water ecosystems in recent years and have undergone explosive growth. Which of the following best describes a possible reason for such a population explosion?

- a. They found many unoccupied niches
- b. New mutations made them more successful in the new niche
- c. They have a few enemies in the new niche
- d. They can coexist with the native species occupying the same niche

26. Refer to the graphs below of the results of experiments with two species of *Paramecium* grown alone and then together. Which of the following best describes the relationship between these two species of *Paramecium* grown in culture together?



- When both species occupy the same niche and *P. aurelia* out competes *P. caudatum*
- P. caudatum* is more successful than *P. aurelia* when grown together
- P. aurelia* is a predator of *P. caudatum*
- P. caudatum* uses food supplies more efficiently than *P. aurelia*.

27. If two species are competing and extinction of one species occurs, which of the following is a possible explanation?

- One species avoids competing by migrating to a different environment.
- One species is more successful at utilizing available resources.
- One species evolves into an entirely new species in order to survive.
- The two species have different food requirements.

28. Evidence shows that some grasses benefit from being grazed. Which of the following terms would best describe this plant-herbivore interaction?

- commensalism
- competition
- mutualism
- predation

29. A relationship exists between whales and small pilot fish that swim with them. The pilot fish eat the whale's left-over food and in the process clean the baleen filters in the mouths of the whales. What type of relationship do they have?

- commensalism
- mutualism
- parasitism
- predation

30. Organisms living in dark interiors of a caves rely on the ingestion of dead organic matter that washes in from the surface. These organisms are

- carnivores
- detritivores
- herbivores
- omnivores

31. Vultures feed on carrion, often eating decayed meat. What adaptation might you reasonably expect a vulture to have to protect itself from the bacteria found in a rotting carcass?

- an active population of mass cells
- high amylase secretions in the mouth
- unusually acidic stomach secretions
- low concentrations of lysozyme in saliva

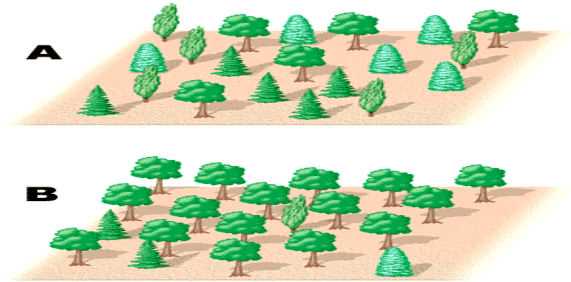
32. Which of the following is an adaptation found in flatworms allowing them to live in a gastrointestinal tract of a mammal?

- large size
- highly branching gastrovascular cavity with many enzymes
- an oxygen transport system
- absorption of nutrients through body surface

33. Species richness increases
- on islands that are small and distant from the mainland
  - with distance from the North Pole towards the equator
  - as the altitude up a mountain increases
  - as depth increases in the ocean

34. Which diagram below demonstrates high species richness and lower species diversity?

- A only
- B only
- Both diagrams
- Not evident



35. Consider two forests: one is an undisturbed old-growth forest, while the other has recently been logged. In which forest are species likely to experience exponential growth, and why?

- Logged, because the various populations are stimulated to a higher reproductive potential.
- Logged, because the disturbed forest affords more resources for increased specific populations to grow.
- Old growth, because of stable conditions that would favor exponential growth of all species in the forest.
- Exponential growth is equally probable in old-growth and logged forests.

36. Which of the following causes populations to shift most quickly from an exponential to a logistic population growth?

- decreased death rate
- increased birth rate
- removal of predators
- competition for resources

37. Which of the following groups would be most likely to exhibit uniform dispersion?

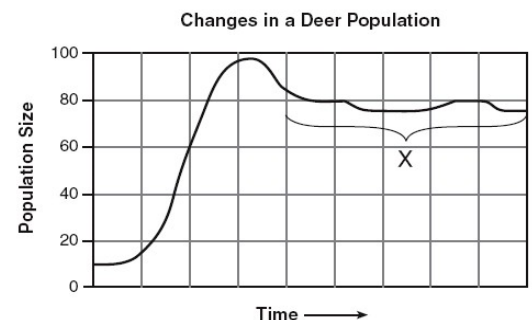
- moths flight to light at night
- trout seeking deep cold waters
- cattail growth at the edge of a pond
- red squirrels defending their territories

38. A biologist recorded 15 white-tailed deer, *Odocoileus virginianus*, per square mile in one woodlot and 25 per square mile in another woodlot. What was the biologist comparing?

- carrying capacity
- density
- dispersion
- fecundity

39. Ten deer were introduced to an island where they were previously absent, and population counts were taken over nine years. The changes in deer population are shown below. What is the most likely explanation for the fluctuating of the deer population at X?

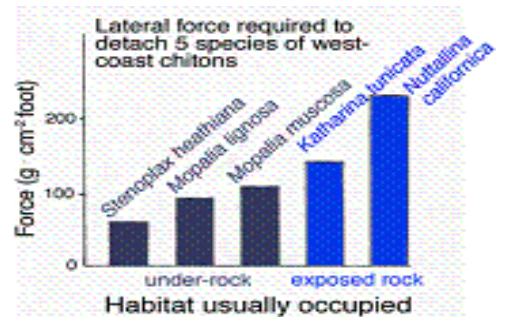
- When a population becomes too dense, it declines
- Deer have begun to migrate to other islands
- The deer population has reached carrying capacity
- The deer habitat is being destroyed.



40. Studies of a community of ground squirrels show that immigrants move 3 km from where they are born and mix into another population. The new population consists of 1%-8% of the males and 0.7%-6% of the females from other populations. On an evolutionary scale, why is this significant?
- The immigrants provide a source of genetic diversity for the other populations
  - Those individuals that emigrate to these new populations are looking for less crowded conditions with more resources.
  - Gradually, the populations of ground squirrels will move from a clumped to a uniform population pattern of dispersion.
  - These immigrants make up for the deaths of individuals, keeping the other populations' size stable.

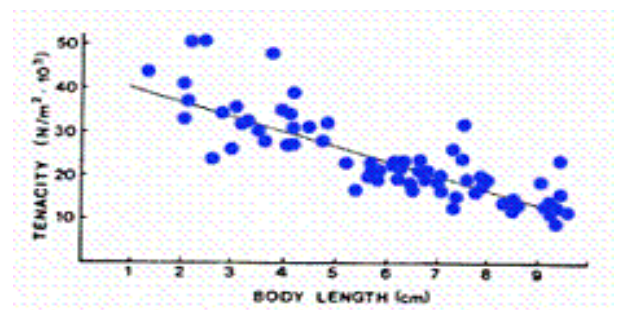
41. A population of ground squirrels has an annual per capita birth rate of 0.06 and an annual per capita death rate of 0.02. Calculate an estimate of the number of squirrels added to a population of 1,000 squirrels in one year.
- 20
  - 40
  - 400
  - 1200

42. Chiton, a marine mollusks also known as sea cradles use a foot to hold onto substratum. Their tenacity is defined as the ability to cling to the substratum under the force of wave exposure. Five chiton species from two different habitats types in the Pacific Ocean were tested. The data is shown below. What do the results indicate?



- Species inhabiting protected under-rock habitats cling to the substratum less tightly than species inhabiting wave-exposed substrate.
  - Species inhabiting wave-exposed substrate cling less tightly than species found in the under-rock habitats.
  - Tenacity is not an adaptation of a chiton based on habitat.
  - Tenacity is developed when the chiton is exposed to strong waves.
43. A second study of the chitons tested one species, *Katharina tunicata*. Biologists predicted larger body size would have greater tenacity. Body size was determined by length of foot. The data are shown in the graph below. What does the evidence indicate?

- The hypothesis is supported
- The hypothesis is not supported
- Sample size is too varied
- More information is needed.



44. Which of the following would be a density-independent factor inhibiting population growth?
- A limited number of suitable nest sites for a particular bird species in a given area
  - The incidence of malaria increased with population
  - An unexpected drought that kills plant seedlings
  - Large aggregations of guppies that attract predators

45. In a population of 400 gray foxes, the per capita birthrate in a particular time period is 0.07, and the per capita death rate is 0.14. What is the actual number of foxes born in this time period, and is the per capita growth rate negative or positive?

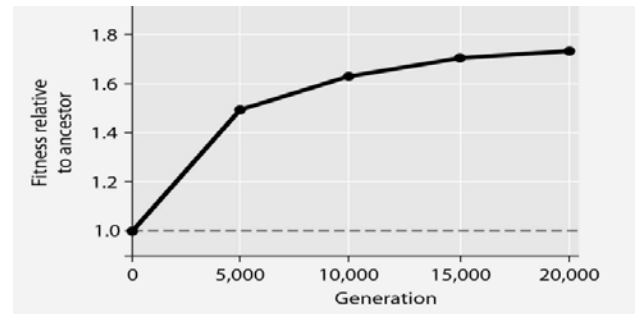
- a. 7 & positive      b. 7 & negative      c. 28 & positive      d. 28 & negative

46. Starting from a single individual, at the end of 2 hours, what is the size of a population of bacteria that reproduces by binary fission every 20 minutes? (Assume unlimited resources and no mortality.)

- a. 18      b. 128      c. 512      d. 1,024

47. In an eight-year experiment, 12 populations of *E. coli*, each begun from a single cell, were grown in low-glucose conditions for 20,000 generations. Each culture was introduced to fresh growth medium every 24 hours. Occasionally, samples were removed from the populations, and their fitness in low-glucose conditions was tested against that of members sampled from the ancestral (common ancestor) *E. coli* population. Results are shown in the graph below. Which of the following, if it occurs in the absence of any other type of adaptation listed here, is least reasonable in terms of promoting bacterial survival over evolutionary time in a low-glucose environment?

- a. increased reliance on glycolytic enzymes  
 b. increased ability to survive on simple sugars, other than glucose  
 c. increased ability to synthesize glucose from amino acid precursors  
 d. increased efficiency at transporting glucose into the cell from the environment



48. If all fungi were removed from a given ecosystem, then which group of organisms should benefit most?

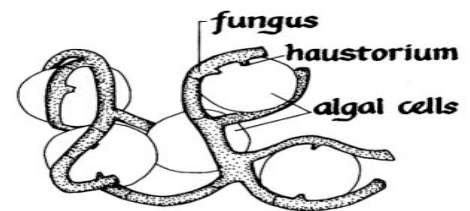
- a. plant      b. prokaryotes      c. algae      d. animals

49. A fungal spore germinates; giving rise to a mycelium that grows outward into the soil surrounding the site where the spore originally landed. Which of the following accounts for the fungal movement, as described here?

- a. mycelial flagella      c. breezes distributing spores  
 b. karyogamy      d. cytoplasmic streaming in hyphae

50. What symbiotic relationship is illustrated in the picture to the right.

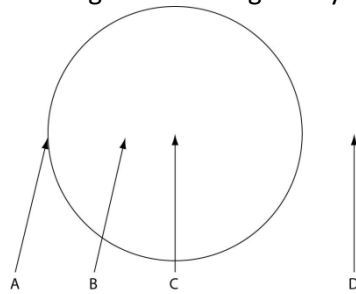
- a. rhizome      b. lichen  
 c. mistletoe      d. mycorrhizae



51. Which of the following obtain energy by oxidizing inorganic substances for energy to fix carbon dioxide?

- a. photoheterotrophs      c. chemoheterotrophs  
 b. photoautotrophs      d. chemoautotrophs

52. For the next 4 questions, use the diagram of a fungal fairy ring as viewed from the sky.



What is the most probable location of the oldest portion of this mycelium?

- a. A                      b. B                      c. C                      d. D

53. At which location in the diagram is the mycelium currently absorbing the most nutrients per unit surface area, per unit time?

- a. A                      b. B                      c. C                      d. D

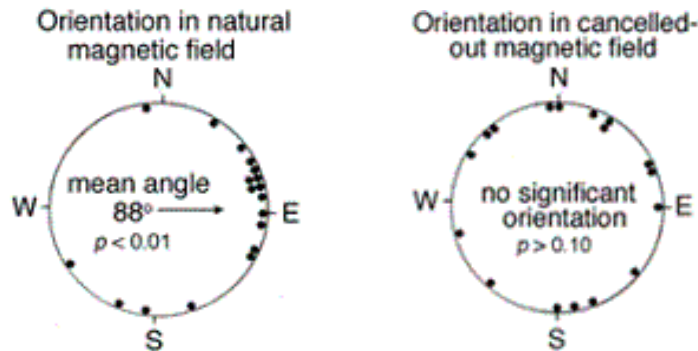
54. At which location in the diagram of the fungal fairy ring should one find the lowest concentration of fungal enzymes, assuming that the enzymes do not diffuse far from their source, and that no other fungi are present in this habitat?

- a. A                      b. B                      c. C                      d. D

55. Assume that all four locations are 0.5 m above the surface. On a breezy day with prevailing winds blowing from left to right, where should one expect to find the highest concentration of free basidiospores in an air sample?

- a. A                      b. B                      c. C                      d. D

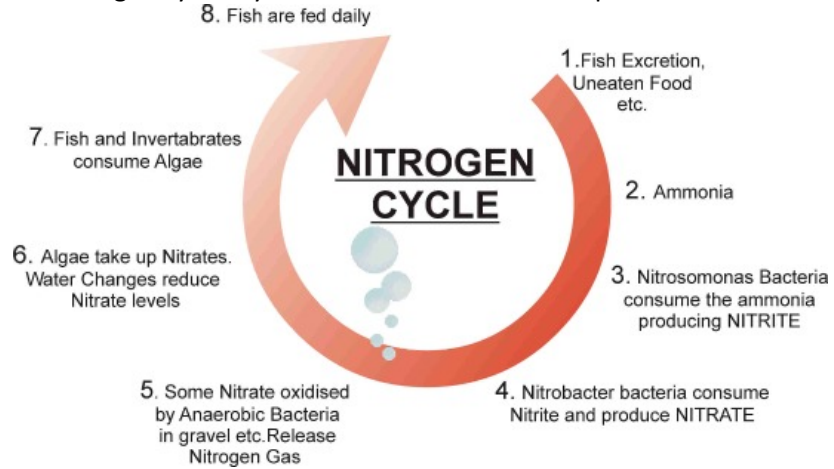
56. An investigation was performed to determine if the nudibranch *Tritonia diomedea* is able to perceive the direction of the earth's magnetic field. In one test, for example, animals were placed in a circular tank filled with seawater for 90min, with a magnet placed in earth's natural position. In a second set up, the experiment kept all factors the same except positioning the magnet in horizontally instead of flat. In the diagram below, the dots represent the location of the nudibranchs at the end of 90 minutes. What do the data illustrate?



- a. Nudibranchs have a positive trophic response to the magnetic field.  
 b. Nudibranchs orient themselves in a magnetic field.  
 c. The earth's magnetic field has no influence on Nudibranchs  
 d. There is no response to the magnetic field

57. Which biogeochemical cycle does **not** include a major path in which the substance cycles through the atmosphere?  
 a. water cycle      b. carbon cycle      c. nitrogen cycle      d. phosphate cycle

58. What would happen to the nitrogen cycle if you added more fish to an aquarium?



- a. Nitrate levels would increase      c. Fish size would increase  
 b. Nitrite levels would decrease      d. Bacterial population would decrease

59. Which of the following provides the best evidence of a biodiversity crisis?

- a. climate change      c. high rate of extinction  
 b. decrease in regional productivity      d. increasing pollution levels

60. Which of the following is the most direct threat to biodiversity?

- a. habitat destruction      c. overexploitation of selected species  
 b. increased levels of atmospheric carbon dioxide      d. the depletion of the ozone layer





**NEW JERSEY SCIENCE LEAGUE**  
**Biology II Answer Key: White paper test**  
**April 2014**

**Record the number correct onto the area record (Corrections)**

1	B	16	D	31	C	46	C(all full)
2	B	17	A	32	D	47	A
3	C	18	B	33	B	48	B
4	A	19	C	34	B	49	D
5	B	20	A&B	35	B	50	B
6	D	21	C	36	D	51	D
7	D	22	B	37	D	52	C
8	B	23	D	38	B	53	A
9	A	24	A	39	C	54	D
10	D	25	C(A)	40	A	55	D
11	A	26	A	41	B	56	B
12	B	27	B	42	A	57	D
13	D	28	C	43	B	58	A
14	B	29	B	44	C	59	C
15	A(all full)	30	B	45	D	60	A

**BCIOLOGY II For all second year and AP level students.**

**January Exam: Big Idea 1: The process of evolution drives diversity and unity of life.**

Evolution, Natural Selection, Artificial Selection, Mechanisms for Evolution, Hardy Weinberg Principles, Genetic Drift, Gene flow, Evidences for Evolution, Blast Genomic Analysis, Cladogram, Evolutionary Trees, Evolution of the Domains, Adaptive Radiation, Island Biogeography Theory, Speciation, Prezygotic and Postzygotic Mechanisms, Hypothesis on Origins of Life, Monomers and Polymers of Biological Molecules

**February Exam. Big Idea 2: Biological Systems utilize free energy and molecular building blocks to grow, reproduce, and to maintain dynamic homeostasis.** Free

Energy and Gibbs Reactions, Enthalpy in Biological Systems, Biological Applications to the Laws of Thermodynamics, Exothermic/Exothermic Reactions, Coupled Reactions, Photosynthesis, Cellular Respiration, Endotherm/Exothermic, Body Temperature Regulation, Cell Types, Surface Area/Volume Ratios, Fluid Mosaic Model of the Membrane, Properties of Water, Osmoregulation, Membrane Transport, Cellular Feedback Mechanisms, Metabolic Processes and Metabolism, Energy in Reproductive Strategies, Behavioral and Physiological Response to Environmental Stress, Ecosystem Energy Pyramid Structure, Food Web Alterations, Population Density, Taxis and Kinesis, Tropisms, Biological Rhythms, Behavioral Biology, Communication and signaling, Developmental genes, Systems in Plants and Animals; Immune, Respiration, Excretion, Digestion, Circulation

**March Exam: Big Idea 3: Living Systems store, retrieve, transmit and respond to information essential to life processes.** Communication:

Signaling, reception, transduction and response, Nervous System, Endocrine System, Reproductive System, DNA and replication, RNA in Protein Production, RNA Types, Cell Cycle and Controls, Mitosis, Meiosis, Application of Mendel's Laws, Mendelian and Nonmendelian Genetics, Genetic Disorders, Cancer, Genetic Engineering Techniques, Nonnuclear Inheritance, Transposons, Gene Regulation, Apoptosis, Developmental Genes, Embryonic Development in Plants and Animals, Signaling Mechanisms, Transmission and Transduction Pathways, Polyploidy, Sex Inheritance, Mutation Effects, Viral Replication, Genetic Variation Processes, Mating Types, Behaviors and Parenting

**April Exam: Big Idea 4: Biological Systems interact, and these systems and their interactions possess complex properties.** Biological Monomers

and Polymers: Structures' relationship to function, Protein Folding, Bonding in Polymers, Enzymes, Coenzymes, Cofactors, Lipid Properties, Subcellular Organelle Function(s) and Interactions, Multifunctional Molecules, Genetic Multiplicity and Flexibility, Organ and System Specialization, Interactions and Coordination in Plants and Animals, Organism Responses Adaptation to Environment, Transpiration, Population: Variation, Growth, Dynamics and Distribution, Exponential and Logistic Population Growth Models, Limiting Factors, Species Richness, Species Diversity, Competition, Bacteria, Fungi, Symbiotic Relationships, Food Webs and Productivity and Energy Dynamics, Keystone species, Exotic and Alien Species Biogeochemical Cycles, Energy

**Dates for 2014 Season**

**Thursday April 10, 2014**

**All areas and schools must complete the last exam and mail in the results by April 25<sup>th</sup>, 2014**

**New Jersey Science League**

PO Box 65 Stewartville, NJ 08886-0065

phone # 908-213-8923 fax # 908-213-9391 email [newjsl@ptd.net](mailto:newjsl@ptd.net) Web address: [www.entnet.com/~personal/njscl/html](http://www.entnet.com/~personal/njscl/html)

**PLEASE RETURN THE AREA RECORD AND ALL TEAM MEMBER  
 SCANTRONS(ALL STUDENTS PLACING 1<sup>ST</sup>, 2<sup>ND</sup>, 3<sup>RD</sup>, AND 4<sup>TH</sup>).**

If you return scantrons of alternates, then label them as ALTERNATES.

**Dates for 2015 Season**

**Thursday January 8, 2015 Thursday February 12, 2015**

**Thursday March 12, 2015 Thursday April 9, 2015**