

Name: _____ I.D. #: G

BIOL 230: Intro. Cell & Molecular Biology FINAL EXAMINATION Dr. Nathan Staples
Monday, December 13, 2004

Scantron Instructions:

1. Make sure you have a 100 question, GREEN form!!
2. Use a #2 or HB pencil to complete the form.
3. Write in your name, exam #, and I.D. # on BOTH the scantron & the examination.
4. Fill-in the entire rectangle for the answer you choose.

M/C = _____/132
Essays = _____/ 80
Total = _____/ 200

READ ALL QUESTIONS THOROUGHLY. FOR ALL M/C questions, PICK THE BEST ANSWER.
72 QUESTIONS: 2 or 20 POINTS EACH; 200 points total. (8 total pages = 4, double-sided sheets)
RELAX, CONCENTRATE, AND GOOD LUCK!!

***** IMPORTANT: Turn-in BOTH your signed Scantron and your signed copy of the Exam.**

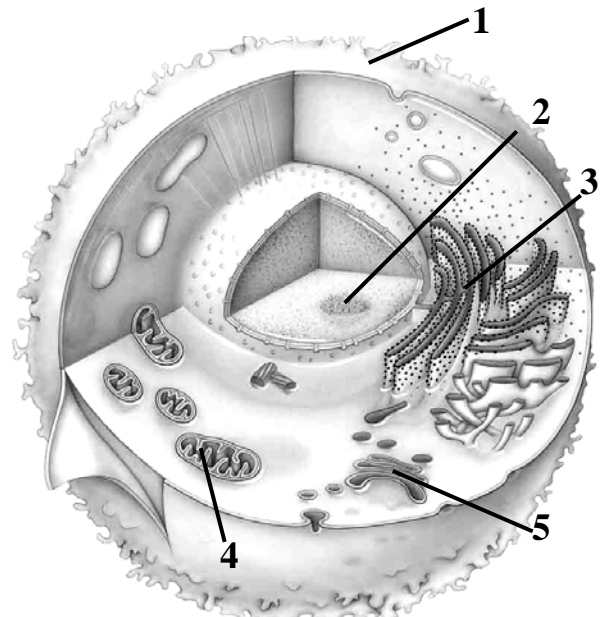
CUMULATIVE M/C (1-33):

1. The part of the atom of greatest biological interest is the
 - a. Proton
 - b. Electron
 - c. Neutron
 - d. Innermost shell
 - e. Just-Gimme-an-"A"-tron! ☺
2. If you place a paper towel in a dish of water, the water will move up the towel by capillary action. What property of water gives rise to capillary action?
 - a. Water molecules ionize
 - b. Water is a good solvent
 - c. Crystal water takes up more space than liquid water.
 - d. Water is polar and can form hydrogen bonds
 - e. Water takes up large amounts of heat when it vaporizes.
3. Carbonic acid and sodium bicarbonate act as buffers in the blood. When a small amount of acid is added to this buffer, the H⁺ ions are used up as they combine with bicarbonate ions. When this happens, the pH of the blood
 - a. Becomes acidic
 - b. Becomes basic
 - c. Doesn't change
 - d. Is reversible
 - e. Ionizes
4. Of the following types of chemical bonds, the strongest is the _____ bond.
 - a. Hydrogen
 - b. Van der waals
 - c. Ionic
 - d. Covalent
 - e. James ☺
5. Polymerization reactions in which proteins are synthesized from amino acids
 - a. Require energy
 - b. Result in the formation of water
 - c. Are condensation reactions
 - d. Are dehydration reactions
 - e. All of the above
6. The portion of a phospholipid that contains the phosphorus group has one or more electric charges. That makes this region of the molecule
 - a. Hydrophobic
 - b. Hydrophilic
 - c. Nonpolar
 - d. Unsaturated
 - e. Saturated
7. When a protein becomes nonfunctional, as a result of a change in its environment and a loss of active structure, it is
 - a. Permanent
 - b. Reversible
 - c. Denatured
 - d. Hydrolyzed
 - e. Dysfunctional in its personal relationships. ☺
8. In DNA molecules
 - a. Purines pair with pyrimidines
 - b. A pairs with C
 - c. G pairs with A
 - d. Purines pair with purines
 - e. C pairs with T
9. Which is present in both prokaryotic and eukaryotic animal cells?
 - a. Chloroplast
 - b. Mitochondrion
 - c. ER
 - d. Nucleus
 - e. Ribosomes
10. The sum total of all the chemical reactions in a living structure is called
 - a. Entropy
 - b. Metabolism
 - c. Energetics
 - d. Enthalpy
 - e. Too many "products" in your hair (But, Nice "Do"!.) ☺

11. The LDL receptor is an integral protein that crosses the plasma membrane, with portions of the protein extending both outside and into the interior of the cell. The amino acid side chains in the region of the protein that crosses the membrane are most likely to be
- Charged
 - Hydrophilic
 - Hydrophobic
 - Carbohydrates
 - Lipids
12. The substrate can form a complex with the enzyme and in some cases this complex is stabilized by
- Hydrogen bonds
 - Covalent bonds
 - Ionic attractions
 - Hydrophobic interactions
 - All of the above
13. Which of the following is NOT a function that can be performed by an enzyme catalyzing a chemical reaction.
- Reduction of the activation energy of the reaction.
 - Shifting the point of equilibrium to favor production of more product than the uncatalyzed reaction.
 - Coupling of an energy-releasing reaction to an energy-absorbing reaction.
 - Specific binding of the reactants at the active site to bring them closer to the transition state.
 - Increasing the speed at which the reaction reaches equilibrium.
14. The end product of glycolysis is
- Pyruvate
 - The starting point before entry into oxidation and the citric acid cycle
 - The starting point before entry into the fermentation pathway
 - A, B and C
 - Really bad muscle aches the "morning after". ☺
15. Which of the following two processes in the metabolism of glucose, when combined, release the equivalent of all six carbons of a glucose molecule as CO₂?
- pyruvate oxidation and the citric acid cycle.
 - glycolysis and pyruvate oxidation.
 - glycolysis and the citric acid cycle.
 - the citric acid cycle and the electron transport chain.
 - glycolysis and the electron transport chain.
16. During aerobic respiration, NADH₂ donates two electrons to ubiquinone (coenzyme Q). When this happens, Q is
- Reduced
 - Oxidized
 - Phosphorylated
 - Aerobic
 - Hydrolyzed
17. The chemiosmotic generation of ATP is driven by
- Osmotic movement of water into an area of high solute concentration
 - The addition of protons to ADP and phosphate via enzymes
 - Passage of phosphates between electron carriers.
 - A difference in H⁺ concentration on both sides of a membrane
 - A new Brita Water Purification System. ☺

For questions 18-20, choose the letter of the subcellular structure (organelle) indicated by each number on the diagram of an Animal Cell below.

- Nucleolus
- Nucleus
- Endoplasmic Reticulum
- Golgi apparatus
- Mitochondrion



18. Which cellular structure is illustrated by #3 in the diagram?
19. Which cellular structure is illustrated by #4 in the diagram?
20. Which cellular structure is illustrated by #5 in the diagram above?
-
21. What would you expect would happen if you removed a plant cell's wall and placed the wall-less cell in a drop of pure water?
- The cell would begin to divide
 - The cell would shrink in size
 - The cell would swell and burst
 - The cell would first swell and then shrink
 - The cell would first shrink and then swell

22. The phenotype of an organism is determined:
- Solely by the organism's genotype
 - Solely by the organism's environment
 - Partly by the organism's genotype and partly by its environment
 - By its current mood and the fullness of the moon. ☺
23. The "genetic code" is the correspondence between:
- The sequences of DNAs and the sequences of RNAs
 - The sequences of tRNAs and the sequences of proteins
 - The sequences of tRNAs and the sequences of amino acids
 - The sequences of mRNAs and the sequences of proteins
 - All of the above
24. Methods for the amplification of DNA (PCR) and the analysis of DNA sequences both directly utilize _____.
- RNA polymerase
 - DNA ligase
 - DNA polymerase
 - Reverse transcriptase
 - Restriction enzymes.
25. A library of recombinant DNA molecules:
- May be propagated in bacteria
 - Can be used to identify genes uniquely expressed in a specific disease
 - Can be used to identify a specific gene coding for a specific protein
 - Can be produced using virus or plasmid DNA as a vector
 - All of the above
26. In the genetic code, the "codons" are found on the
- DNA molecules
 - Transfer RNA molecules
 - Messenger RNA molecules
 - Ribosomal RNA molecules
 - Ribosomes
27. The "repressor" regulates the synthesis of enzymes of the lactose operon at the level of:
- replication
 - translation
 - degradation
 - transduction
 - transcription
28. In *E. coli* cells, cyclic AMP
- Can indicate starvation or plenty for the cell
 - Can activate the CRP protein
 - Stimulates RNA Polymerase binding to the *lac* promoter.
 - Signals a scarcity of glucose for the cell
 - All of the above
29. Mating of bacterial cells mediated by the Fertility plasmid is known as:
- Transformation
 - Transduction
 - Conjugation
 - Restriction
 - Trans-substantiation ☺
30. Which statement about DNA replication is INCORRECT?
- Replication of DNA starts at RNA primers.
 - Replication of DNA depends on two different DNA polymerases.
 - Replication of DNA proceeds in opposite directions on the two strands of a replication fork.
 - Replication of DNA is discontinuous on both strands of a replication fork.
 - An RNA polymerase initiates replication of DNA.
31. Bacterial viruses capable of integrating their genomes into the bacterial DNA and delaying lytic replication are called:
- Multifunctional.
 - Combinatorial.
 - Recombinatorial
 - Chromogenic.
 - Lysogenic..
32. Eukaryotic cells and some of their organelles might have derived from prokaryotic cells that underwent phagocytosis without digestion of the phagocytized cell. This mutualistic relationship is explained by the
- Parasite theory
 - Cell theory
 - Evolutionary theory
 - Endosymbiotic theory
 - Chow-Down Theory! ☺
33. RNA processing that must be completed before translation in eukaryotes involves
- The addition of a G cap
 - Polyadenylation
 - Removal of introns
 - Splicing together of exons
 - All of the above
-
- Part IV M/C (34-66):**
34. Allosteric regulation of proteins is involved in which of the following cellular processes?
- Inactivation of an operon Repressor by an inducer.
 - Activation of a membrane Receptor protein kinase in signal transduction.
 - Feedback inhibition of branchpoint enzymes by end product of an anabolic biochemical pathway.
 - Binding of cyclin to CDK to activate the cell cycle.
 - All of the above.

35. Which of the following describes the effect of epinephrine (adrenaline) on the liver?
- Stimulates glucose uptake and acid secretion.
 - Stimulates an ion-channel receptor linked signal cascade.
 - Activates phosphorylase kinase, but inhibits glycogen synthase.
 - Activates glycogen synthase, but inhibits phosphorylase kinase.
 - Makes it taste much better with sautéed onions. ☺
36. Cells receive which of the following signals?
- Light
 - Sound
 - Odorants
 - Hormones
 - All of the above
37. The EnvZ protein of *E. coli* changes shape in response to
- ion concentration.
 - ligand binding.
 - light.
 - sound.
 - O₂.
38. The EnvZ protein undergoes a conformational change to become an active
- channel protein.
 - kinase.
 - phosphorylase.
 - environmental gene.
 - All of the above
39. The OmpR protein is a(n)
- DNA binding protein.
 - channel protein.
 - channel-blocking protein.
 - osmotic pressure-detecting protein.
 - kinase.
40. In general, all mechanisms cell signal transduction cause
- Altered gene expression.
 - An influx of ions.
 - Protein kinase activity.
 - G protein activation.
 - A change in receptor conformation.
41. The major categories of signal receptors are
- inside and outside.
 - enzyme and ion channel.
 - transmembrane and cytoplasmic.
 - protein kinase and cAMP.
 - sensory and molecular.
42. Steroids bind
- to the outer face of transmembrane proteins.
 - to cytoplasmic receptors.
 - within the lipid bilayer.
 - around the nuclear membrane.
 - directly to DNA.
43. Typically, large polar signals interact directly with
- cytoplasmic receptors.
 - transmembrane receptors.
 - G proteins.
 - adenylyl cyclase.
 - calmodulin.
44. Some signal receptors are
- ion channels.
 - protein kinases.
 - G protein-linked.
 - DNA binding proteins.
 - All of the above
45. Protein kinase is
- an enzyme that makes cAMP.
 - the enzyme that makes cGMP.
 - the substrate molecule for kinase.
 - an enzyme that phosphorylates polypeptides.
 - None of the above
46. The receptor-associated proteins called G proteins
- bind GTP.
 - can activate or inhibit an effector.
 - interact with membrane-associated internal proteins to influence their function.
 - A, B, and C
 - Are fit for use by children of all ages. ☺
47. Bacteria typically have _____ while eukaryotes have _____.
- One chromosome that is circular, many that are linear
 - Several chromosomes that are circular, many that are linear
 - One chromosome that is linear, many that are circular
 - Two chromosomes that are circular, eight that are linear
 - None of the above
48. The appropriate decisions to enter the S phase and the M phase of the cell cycle depend on a pair of biochemicals called
- Actin and myosin
 - Cdk's and cyclin
 - Ligand and receptor
 - ATP and ATPase
 - "RED LIGHT" and "GREEN LIGHT"! ☺

49. In plant cells, cytokinesis is accomplished by the formation of a(n)
- Aster
 - Membrane furrow
 - Equatorial plate
 - Cell plate
 - Spindle
50. During meiosis, the sister chromatids separate during
- Anaphase II
 - Anaphase I
 - The S phase
 - Synapsis
 - Telophase II
51. The exchange of genetic material between chromatids on homologous chromosomes occurs during
- Interphase
 - Mitosis and meiosis
 - Prophase I
 - Anaphase I
 - Anaphase II
52. The process of "programmed cell death" is called
- Necrosis
 - Apoptosis
 - Lysis
 - Cellular suicide
 - Mission Impossible Syndrome ☺
53. Incomplete dominance occurs when
- Chromosomes are deleted
 - Heterozygotes synthesize a reduced amount of an enzyme, producing an intermediate phenotype
 - The genes fail to segregate
 - The law of independent assortment is upheld
 - One gene is epistatic to the other
54. When a given trait is the result of multigene action, one of the genes may mask the expression of one or all other genes. This phenomenon is termed
- Epistasis
 - Epigenesis
 - Codominance
 - Incomplete dominance
 - None of the above
55. If surviving, an adult human with XO sex chromosomes will be phenotypically _____, and an adult fruit fly with XO sex chromosomes will be phenotypically _____.
- Male; Male
 - Male; Female
 - Female; Male
 - Female; Hermaphroditic
 - Female; Female

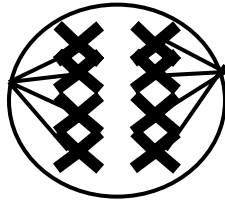
For questions 56-57: Imaginary Schmoos live in geographically separated groups and rarely interbreed. On one occasion, two from the different groups did mate. A big-footed white schmoos mated with a small-footed brown schmoos. Three offspring resulted: one big-footed brown schmoos and two small-footed brown schmoos.

56. Which statement about the inheritance of color in schmoos is most likely to be correct?
- Brown is dominant to white
 - White is dominant to brown
 - White and brown are codominant
 - You cannot reach any conclusions
 - We will never find out, since that Hanna-Barbera cartoon was thankfully cancelled. ☺
57. If big feet (B) in schmoos is dominant to small feet (b), what is the genotype of the big-footed white parent schmoos with respect to the foot gene?
- bb
 - BB
 - Bb
 - A and B
 - A and C
-
58. In humans, a widow's peak is caused by a dominant allele, W and a continuous hairline, by a recessive allele w . Short fingers are caused by a dominant allele S and long fingers, by a recessive allele s . Suppose a woman with a continuous hairline and short fingers and a man with a widow's peak and long fingers have three children. One child has short fingers and a widow's peak, one has long fingers and a widow's peak, and one has long fingers and a continuous hairline. What are the genotypes of the parents?
- Female was $wwSS$; male $WWss$
 - Female was $wwSs$; male $Wwss$
 - Female was $wwSs$; male $WWss$
 - Female was $WwWs$; male $WssS$
 - None of the above
59. In cocker spaniels, black color (B) is dominant over red (b), and solid color (S) is dominant over spotted (s). If the offspring from crossing $BBss$ and $bbSs$ individuals (F1 progeny) are then mated with each other, what fraction of their offspring (F2) will be expected to be black and spotted? Assume the genes are unlinked. (Hint: do BOTH crosses)
- 1/16
 - 9/16
 - 1/9
 - 3/16
 - 3/4

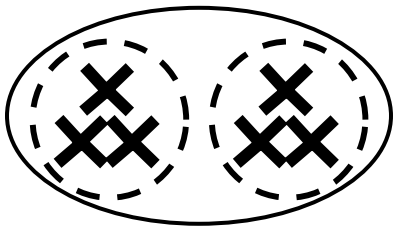
60. In tomatoes, tall is dominant to short, and smooth fruits are dominant to hairy fruits. A plant homozygous for both dominant traits is crossed with a plant homozygous for both recessive traits. The F₁ progeny are test-crossed with the following results: 68 tall, smooth fruits; 72 dwarf hairy fruits; 32 tall, hairy fruits; and 28 dwarf smooth fruits. These data indicate that the genes are
- On different chromosomes
 - Linked, but do not cross over
 - Linked, and show 15% recombination
 - Linked, and show 30% recombination
 - Linked, and show 60% recombination

61. Remembering that white eyes is a recessive, sex-linked trait, if a white-eyed female fruit fly is mated with a red-eyed male, their offspring should be
- 50% red-eyed, 50% white-eyed for both sexes
 - all white eyed for both sexes
 - all white-eyed males, all red-eyed females
 - all white-eyed females, all red-eyed males
 - 50% red-eyed males, 50% white-eyed males, all red-eyed females

62. During interphase, the following cell has a diploid number of eight chromosomes (4 homologous pairs). At which stage of nuclear division is the following cell?
- Mitotic Anaphase
 - Mitotic Telophase
 - Meiotic Anaphase I
 - Meiotic Metaphase II
 - Meiotic Anaphase II

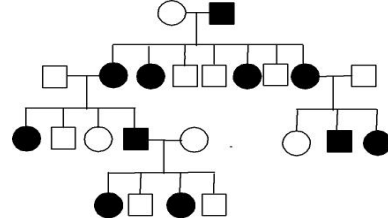


63. During interphase, the following cell has a diploid number of six chromosomes (three homologous pairs). At which stage of nuclear division is the following cell?
- Mitotic Prophase
 - Mitotic Anaphase
 - Meiotic Anaphase I
 - Meiotic Telophase I
 - Meiotic Telophase II

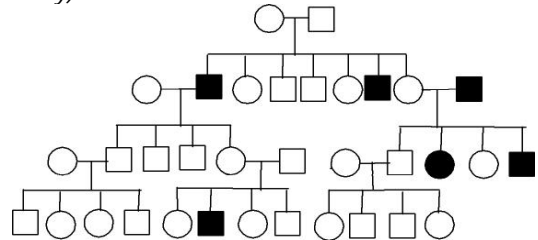


64. The Achoo Syndrome, reflexively sneezing when suddenly exposed to sunlight, is an X-linked dominant trait [for the sake of this test question]. A sunlight-sneezing man marries a non-sunlight-sneezing woman. What proportion of the male progeny will show the sunlight-sneezing trait (Achoo Syndrome)?
- None (0%)
 - 1/4 (25%)
 - 1/2 (50%)
 - 3/4 (75%)
 - all (100%)

65. What is the *most likely* mode (pattern) of inheritance of the following rare human genetic disease?



- Autosomal Recessive
 - Autosomal Dominant
 - X-linked Recessive
 - X-linked Dominant
 - Y-linked Dominant
66. What is the *most likely* mode (pattern) of inheritance of the following, moderately rare human genetic disease? (*hint: think carefully about the impact of genotypes marrying into the family*)



- Y-linked Dominant
- Y-Linked Recessive
- X-linked Dominant
- X-linked Recessive
- Autosomal Dominant

CUMULATIVE Portion: Short Essays (40 pts total): Answer ONLY TWO of the following questions BRIEFLY but COMPLETELY. Use diagrams when helpful.

67. (20 pts) Describe 4 unique properties of **water** that make it so valuable to living systems, although it is an “inorganic” molecule itself.

68. (20 pts) List 5 differences between **Prokaryotic** and **Eukaryotic cells**.

69. (20 pts) Describe **energetic coupling** within a living cell, and give an example. Use diagrams if helpful.

Part IV Portion: Short Essays (40 pts total): Answer ONLY TWO of the following questions BRIEFLY but COMPLETELY. Use diagrams when helpful.

70. (20 pts) Diagram and compare/contrast **Cytokinesis** (cytoplasmic division) in plant cells and in animal cells. What kinds of cellular factors, such as cytoskeleton and membrane dynamics, are involved in each?

71. (20 pts) Describe the differences between **particulate inheritance** and **blending inheritance**? How did Mendel's experiments specifically disprove one of these theories, and prove the other?

72. (20 pts) Describe/diagram the differences between **direct** and **indirect signal transduction** mechanisms, and give a specific example of how each might result in changes in gene expression and cellular activity.