

## SC-120 Study Guide

### Part 1. Biochemistry

Atom	pH scale	Lipid
Molecule	Hydrophobic	Carbohydrate
Hydrogen bond	Hydrophilic	Protein
Acid	Polar	Polymer
Base	Enzyme	

1. If solution A has a pH of 8 and solution B has a pH of 9, how much water would you have to add to a liter of solution B to get the same pH as solution A?
2. The following is a biological pathway:



If enzyme B is not present, what will happen to the levels of testosterone, androstenedione and dehydroepiandrosterone?

3. Mary has put soda crackers, water, and amylase (an enzyme that breaks down starch into sugar) in a series test tubes and watches how much sugar appears in the tube. She gets the following results.

Tube	Temperature (°C)	Amount of sugar after 15 mins.
1	10	Very low
2	20	Medium
3	30	High
4	100	None

Explain her findings.

4. Everyone knows “oil and water don’t mix”. Explain why.
5. Some chemical reactions produce heat while others do not. Explain why.
6. Some proteins cross cell membranes, others are partially or fully embedded in the membrane. How does polarity explain this?
7. How does the shape of an enzyme affect its function?

## Part 2. Cells

Cell membrane	Golgi body	Active transport
Cell wall	Lysosome	Facilitated diffusion
Nucleus	Chloroplast	Exocytosis
Ribosome	Organelle	Endocytosis
Mitochondria	Diffusion	Prokaryote
Endoplasmic reticulum	Osmosis	Eukaryote

1. Draw and label the fluid mosaic model of the cell membrane.
2. What cells would contain a lot of mitochondria?
3. What types of cells would contain a lot of golgi bodies?
4. How does the architecture of the following cells differ: an animal, a plant, a bacterium?
5. What is a concentration gradient?
6. Substances can move across the cell membrane in a variety of ways. Distinguish between the methods

	Requires Energy?	Requires Carrier Molecule?	Only water moves?
Diffusion			
Osmosis			
Active transport			
Facilitated diffusion			

7. What part of the cell controls its activities?
8. What are the functions of the cell membrane?

### Part 3. Biological Energy and Metabolism

Oxidation	ATP/ADP/AMP	Glycolysis
Chemical reduction	Phosphorylation	Citric Acid (krebs) cycle
Anabolism	NAD/FAD	Electron transport chain
Catabolism	Aerobic/anaerobic	Photosynthesis
Entropy	Fermentation	C3/C4/CAM
Thylakoid membrane	Photon	Activation energy
Chlorophyll	Lactic acid	Stomates/stomata
Pyruvic acid	Oxygen debt	Cellular respiration

1. Explain the first and second laws of thermodynamics.
2. Which molecule contains more energy, a saturated fat or a sugar? Why? How does this relate to the redox potential of each?
3. Your friend is brewing beer at home he wants to know whether he should keep the yeast under aerobic or anaerobic conditions. Explain your answer.
4. What is the source for virtually all of the energy on earth?
9. Why are C4 plants at an advantage in dry climates, but at a disadvantage in wet climates?
10. How does the second law of thermodynamics explain why poor countries are more likely to eat grain than meat?
11. Both plants and animals must make ATP, compare and contrast how they do it.
12. Where do the following processes take place: Glycolysis, pyruvic acid catabolism, Citric Acid (krebs) cycle, Electron transport chain, light-dependent stage of photosynthesis, light-independent stage of photosynthesis.
13. Which will allow greater plant growth: red light or green light? Why?

## Part 4: Cell Division

Mitosis	Haploid	Centromere
Meiosis	Diploid	Centrosome
Tubulin	Chromosome	Gamete
Cytoskeleton	Homologue	Interphase

1. Describe the stages of mitosis
2. How are meiosis and mitosis the same?
3. How and why are meiosis and mitosis different?
4. Describe the cell cycle.
5. At what point in meiosis do diploid cells become haploid?
6. How is oogenesis different from spermatogenesis?
7. What is the difference between sexual reproduction and asexual reproduction?
8. At what point in the cell cycle does most of a cell's activity take place?
9. What kinds of cells do not undergo mitosis?

## Part 5: DNA and Protein Synthesis

DNA	Codon	Sense strand
mRNA, tRNA, rRNA	Anticodon	Anti-sense strand
Mutation	Nucleotide	Complimentary base
Apoptosis	Transcription	Hydrogen bond
Cancer	Translation	
Double helix	Replication	

1. Here is an “anti-sense” strand of DNA. After replication, what would the “sense” strand be like?

A T G C C A C A T C G A T A T T A A

2. Now transcribe the DNA to get mRNA.
3. What would the polypeptide chain be like after translation (you can use a table to determine this)?
4. What would happen if I removed the first A from the “anti-sense” strand of DNA?
5. Summarize the differences between DNA and RNA
6. Describe DNA replication.
7. Describe transcription.
8. Describe translation.
9. How does the cell fix some mutations?
10. How does a cancer cell differ from a regular cell?
11. If the DNA in a cell in your lung is damaged by smoking, will this mutation get passed on to your children?

## Part 6. Genetics

Homozygous	Gene	Linkage
Heterozygous	Allele	Epistasis
Dominant	Sex linked/X-linked	Pleiotropy
Recessive	Somatic/autosomal	Co-dominant
Karyotype	Additive variation	Incomplete dominance

1. Make a Punnet square to show what happens when two corn plants that are both heterozygous for albinism (an autosomal recessive) are crossed. What proportion of the offspring, on average, will be albinos?
2. Some recessive diseases, like Tay-Sachs, kill all of the homozygous recessive individuals long before they have a chance to have children. How does the gene for this disease stay in the population?
3. Assume that in cats, having an extra toe each front paw is a recessive trait. Assume that having no tail is also a recessive trait. Mocha has no tail, but the normal number of toes. Funny Face has an extra toe on each front paw, but has a normal tail. What is the genotype of each animal? If more than one genotype is possible, write out all of the possibilities.
4. In horses, white coat (W) and red coat (R) are both dominant. A strawberry roan has a coat containing both white and red fur. If you breed a strawberry roan mare with a white stallion, what proportion of their offspring will be each color (red, white, and roan)?
5. Sickle-cell anemia illustrates incomplete dominance. It can be deadly for those who are homozygous recessive. Heterozygotes have the sickle-cell "trait" and may have few or no symptoms. If two people with the "trait" have children, what is the chance (on average) of their child having the full anemia?
6. Hemophilia is an X-linked trait. Queen Victoria was a carrier of the disease. Her husband was healthy.
  - a. What chance did each of her daughters have for being hemophiliacs?
  - b. What chance did each of her sons have for being hemophiliacs?
  - c. What chance did her daughters have for being carriers?
  - d. What chance did her sons have for being carriers?
7. You are breeding gerbils for sale. The more exotic they look, the more you can charge. Assume that the following three traits are **somatic** (not X-linked) and **recessive**: Black fur, short tail, dwarf. If you cross two gerbils that are heterozygous for each of these traits, what is the probability that you will get a black gerbil with a short tail that is a dwarf?

## Part 7. Natural Selection

Natural selection  
Hypothesis  
Theory

Microevolution  
Macroevolution  
Fitness

Species

1. Describe how natural selection has created diseases that are resistant to antibiotics.
2. Why do lethal mutation stay in the population at low levels? Why don't they disappear?
3. What is the relationship between natural selection and evolution?
4. Does evolution have a future goal?
5. Evaluate the following statement: We are putting a lot of additives in our food, so we will see adaptation in our grandchildren that allow them to eat additives without being harmed.
6. Why are lethal genes almost always recessive?

## Part 8. Ecology

Food Pyramid  
Carnivore  
Herbivore  
Ecosystem/Biome

Succession  
Community  
Nutrient  
Sustainability

Greenhouse effect  
Biological Magnification  
Ozone Depletion  
Biodiversity

1. How does the movement of energy through a biological community differ from the movement of nutrients?
2. Why do we see tons of algae, a bunch of algae-eating fish, but few fish-eating fish in a pond?
3. Use the concept of succession to explain why ranchers burn their grazing lands periodically.
4. Describe some possible effects of global warming.
5. Describe some of the problems that radioactive wastes might cause for living things.
6. We fertilize our lawns and farms to increase their productivity. Why are there major ecological problems when our water gets fertilized (eutrophication)?