

# Cell Biology - Training Guide (2005)

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## Cell Biology Content Areas

### **Eukaryotic and Prokaryotic Cell Structure and Function**

- ❖ Differences between eukaryotic and prokaryotic cells
- ❖ Cell organelles and their functions
- ❖ Plant cells vs. animal cells
- ❖ Passive vs. active transport
- ❖ Surface area to volume ratio

### **Biological Molecules**

- ❖ Endergonic vs. exergonic reactions
- ❖ Catabolism vs. anabolism
- ❖ Monomers vs. polymers for major body chemicals as proteins, fats, carbohydrates and nucleic acids

### **Enzymatic Reactions**

- ❖ Characteristics of enzymes
- ❖ Cofactors
- ❖ Effects of temperature and acid on enzyme activity
- ❖ Inhibition by other chemicals
- ❖ Reaction rates

### **Cellular Respiration**

- ❖ Aerobic vs. anaerobic respiration
- ❖ Glycolysis
- ❖ Krebs cycle
- ❖ Electron transport

### **Photosynthesis**

- ❖ Light dependent reactions
- ❖ Light independent (dark) reactions
- ❖ Factors affecting photosynthesis rates

### **Cell Cycle**

- ❖ Phases of the cell cycle – synthesis and mitosis
- ❖ Synthesis (Interphase) – G1, S(synthesis), G2
- ❖ Mitosis – prophase, metaphase, anaphase, telophase and time spent in each phase
- ❖ Plant vs. animal
- ❖ Effect of cancer on cell cycle
- ❖ Cells which lose ability to reproduce as muscle, nerve cells

### **Meiosis**

- ❖ Meiosis vs. mitosis
- ❖ First division vs. second division
- ❖ Egg vs. sperm

### **DNA Replication**

- ❖ Characteristics of DNA
- ❖ Differences between DNA and RNA
- ❖ Replication

### **Protein Synthesis**

- ❖ Transcription
- ❖ Translation

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### **Process Skills and Tasks Which Might Be Tested**

|                          |  |
|--------------------------|--|
| <b>Methods</b>           | <ul style="list-style-type: none"><li>* Understanding techniques used in studying cells as electrophoresis, DNA probes cell fractionation, radioactive tracers, spectrophotometry, centrifugation, computer imaging, photography of cells.</li></ul>   |
| <b>Lab Safety</b>        | <ul style="list-style-type: none"><li>* Distinguishing "safe" behaviors vs. "unsafe" behaviors, identifying safety symbols related to experiments , evaluating situations -- what to do "if" or what's wrong.</li></ul>  |
| <b>Microscopy</b>        | <ul style="list-style-type: none"><li>* Understanding of parts of microscope &amp; their function, magnification, appearance of images, resolution, changes in field with magnification, types of microscopes and their uses.</li><li>* Understanding the different types of microscopes, their uses, and their differences.</li><li>* Using types of light microscopes to perform a requested task.</li><li>* Determining the three dimensions of a cell</li><li>* Determining length, width, depth, area, and volume of cells.</li><li>* Interpreting electron micrographs of cell organelles.</li></ul> |
| <b>Lab Equipment</b>     | <ul style="list-style-type: none"><li>* Identifying pieces of lab equipment and their functions.</li><li>* Identifying appropriate pieces of equipment to perform a specific task.</li></ul>   |
| <b>Measurement</b>       | <ul style="list-style-type: none"><li>* Identifying the capacity, range, and increments of measuring devices used to study cells .</li><li>* Converting units within the metric system.</li></ul>  |
| <b>Calculations</b>      | <ul style="list-style-type: none"><li>* Using measurements to determine area, volume, percentages, probabilities.</li><li>* Using area and sample number to determine density of a sample.</li><li>* Understanding and using statistics to analyze data.</li></ul>   |
| <b>Chemical Analysis</b> | <ul style="list-style-type: none"><li>* Using reagents for chemical analysis.</li></ul>  |
| <b>Observations</b>      | <ul style="list-style-type: none"><li>* Using senses to notice specific features.</li><li>* Identifying similarities and differences in features.</li><li>* Identifying qualitative and quantitative changes in conditions.</li><li>* Using observable properties to classify objects, organisms or events.</li></ul>  |
| <b>Inferences</b>        | <ul style="list-style-type: none"><li>* Formulating assumptions based upon observations.</li><li>* Distinguishing between observations and inferences.</li></ul>   |
| <b>Problem</b>           | <ul style="list-style-type: none"><li>* Using observations to propose a testable question.</li></ul>   |

- Hypothesis**
- \* Proposing a hypothesis for a given problem.
  - \* Identifying statements presented along with a set of data as.
    1. logical hypothesis
    2. illogical hypothesis of contrary to data
    3. not a hypothesis, but a restatement of data
    4. reasonable hypothesis, but not based on data
- Predictions**
- \* Predicting the results for a proposed lab test or setup.
  - \* Selecting predictions based upon previously observed patterns.
- Design Analysis**
- \* Analyzing designs for experiments relative to problem, identifying variables & constants, procedure analysis , proper control of variables, types of data collected, basic assumptions used, time period for the test.
- Procedures**
- \* Analyzing procedures for flaws in design.
  - \* Arranging steps of procedures in the appropriate order.
  - \* Determining the repeatability of a procedure.
  - \* Identifying an appropriate procedure to test a problem.
- Graphing**
- \* Interpreting line, bar, and pie graphs.
  - \* Identifying the title, source, independent variable & dependent variables, and the legend.
  - \* Predicting data points not included in a given graph.
  - \* Preparing a line, bar or pie graph to represent a set of data.
  - \* Scaling each axis for a line graph.
  - \* Making predictions or inferences based upon the data on a graph.
- Analysis of Data**
- \* Identifying data which supports or rejects a hypothesis.
  - \* Identifying discrepancies between stated hypothesis and actual data.
  - \* Identifying types of error in the data as experimental and random.
  - \* Determining the validity of experimental data.
  - \* Interpreting charts and diagrams.
- Conclusions**
- \* Selecting the most logical conclusion for given experimental data.
  - \* Accepting or rejecting hypotheses based upon data analysis.
  - \* Proposing a new hypothesis for rejected hypotheses.
  - \* Proposing a future test for inconclusive results.

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**Sample Stations for Content Areas**

**EUKARYOTIC & PROCARYOTIC CELL STRUCTURES**

- \* Using models, photographs, or illustrations of structures such as organic molecules and cell organelles, identify the structure and describe its function or role in life processes.
- \* Identifying differences between prokaryotic & eukaryotic cells.
- \* Analyzing studies used to determine key pieces of current knowledge.
- \* Identifying types of microscopes -light vs. electron - uses, capacities, limits
- \* Identifying cell types and their functions
- \* Identifying electron micrographs of organelles - function, identification of parts, and chemical mechanisms.
- \* Understanding and interpreting the role of cell membranes structures and surface specialization.

**CELL STRUCTURE AND FUNCTION**

- \* Comparing surface area to volume ratio of various cells.
- \* Using a light microscope, estimate cell size and determine the 3-dimensional shape of cells. Relate the size and shape of a cell to its function.
- \* Making measurements to calculate surface area to volume relationships. Relate SA/VOL relationships to cell structure and function.
- \* Analyzing or making predictions concerning osmosis, diffusion and cell transport.
- \* Using mechanisms that control of cell size to explain shapes modifications in cells
- \* Analyzing cell cultures

**BIOLOGICAL MOLECULES**

- \* Identifying substances such as gelatin, vitamin C, glucose, butter, and cornstarch using reagent tests.
- \* Identifying key organic chemicals and their role in cell operation.

**PHOTOSYNTHESIS AND CELLULAR RESPIRATION**

- \* Calculating the energy content of food from data obtained from calorimeters. Relating the energy content of food molecules to the flow of energy and the cycling of matter that occur during photosynthesis and cellular respiration in ecosystems.
- \* Drawing conclusions about the relationship between photosynthesis and cellular respiration from data collected on the production/uptake of oxygen and carbon dioxide by green plants and animals. Predict how changing the environment of a plant or animal might affect the rate of photosynthesis or respiration.
- \* Interpreting photosynthesis & cellular respiration experiments or their data.
- \* Understanding and interpreting data concerning enzymes and their role in cell activities
- \* Analyzing and comparing the ATP production in aerobic and anaerobic respiration

**CELL CYCLE AND MEIOSIS**

- \* Using photographs or illustrations of mitosis and meiosis, identify major events that occur in these processes and relate these events to cell and organism continuity.
- \* Comparing & analyzing data - stages of mitosis & meiosis their similarities and differences
- \* Analyzing cell cycle data–timing for normal vs. abnormal cells
- \* Understanding and interpreting information on prokaryotic cell reproduction and DNA operation

**DNA REPLICATION AND PROTEIN SYNTHESIS**

- \* Using a mRNA codon chart, determine amino acid sequences when given DNA nucleotide base sequences.  
Relating base sequences to protein structure, genotype, and phenotype and recognize that changes in DNA base sequences (mutations) may alter genotype and phenotype.
- \* Interpreting DNA structure & replication diagrams or sequences as well as Okazaki fragments
- \* Comparing the kinds of RNA – their production and processing
- \* Interpreting Translation data and amino sequences

## Cell Biology - 2005 Internet Resources

Cell Structure and Function Resources

<http://www.kensbiorefs.com/cellstructure.html>

Cell Chemistry Resources

<http://www.kensbiorefs.com/cellchem.html>

Cell and Molecular Biology On-line

<http://www.cellbio.com/>

MIT Cell Biology Hypertextbook

<http://web.mit.edu/esgbio/www/cb/cbdir.html>

Cell Biology – University of Texas Medical Branch

<http://cellbio.utmb.edu/cellbio>

Cell Biology Lab Manual Outline plus Online links

<http://www.gac.edu/~cellab>

Online Biology Book

<http://gened.emc.maricopa.edu/bio/bio181/BIOBK/BioBookTOC.html>

<http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookTOC.html>

Harvard University, Dept. of Molecular & Cell Biology – Biology Links

<http://golgi.harvard.edu/BioLinks.html>

Cell Biology Resources for Educators

<http://falcon.jmu.edu/~ramseyil/cellbiology.htm>

Cell Biology Resources – NC State

<http://www.ncsu.edu/sciencejunction/terminal/imse/lowres/1/cellbiology.htm>

Biology Web Resources for Teachers and Students

<http://www.kensbiorefs.com/index.html>

Cell Structure and Function: Excellent resource with notes, charts and animated diagrams

<http://www.biology.eku.edu/RITCHISO/301notes1.htm>

<http://www.biology.eku.edu/RITCHISO/301syl.htm>