High School Biology Pacing Guide

REVISED 2009

Pacing Guide is based on 83 days of instruction with seven days for review and exam. The guide is intended as an outline for new Biology teachers. It is also a good activity resource for veteran teachers. All information within is based on North Carolina Standard Course of Study.

Goal 1 addresses scientific investigation. These objectives are an integral part of each of the other goals and are not intended to be addressed separately. Students must be given the opportunity to design and conduct their own investigations in a safe laboratory. The students should use questions and models to formulate the relationship identified in their investigations and then report and share those findings with others.
<table>
<thead>
<tr>
<th>Six Weeks</th>
<th>Unit Title</th>
<th>Goals/Objectives</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Life on a Cellular Level</td>
<td>2.01 2.02 3.01 3.02</td>
<td>15 days</td>
</tr>
<tr>
<td></td>
<td>Inheritance and Molecular Genetics</td>
<td>3.03 3.04</td>
<td>15 days</td>
</tr>
<tr>
<td>Second</td>
<td>Evolutionary Mechanisms</td>
<td>3.05 4.01</td>
<td>10 days</td>
</tr>
<tr>
<td></td>
<td>Energy in a Living System</td>
<td>2.03 2.04 2.05 5.02</td>
<td>15 days</td>
</tr>
<tr>
<td></td>
<td>Interrelationships in Biology</td>
<td>5.01</td>
<td>5 days</td>
</tr>
<tr>
<td>Third</td>
<td>Interrelationships in Biology - continued</td>
<td>5.03 4.04</td>
<td>10 days</td>
</tr>
<tr>
<td></td>
<td>Patterns Among Organisms</td>
<td>4.02 4.03 4.05</td>
<td>13 days</td>
</tr>
<tr>
<td>RBT</td>
<td>Objective</td>
<td>Content Description</td>
<td>Suggested Activities</td>
</tr>
<tr>
<td>-----</td>
<td>-----------</td>
<td>---------------------</td>
<td>----------------------</td>
</tr>
</tbody>
</table>
| B2  | 2.01      | Compare and contrast the structure and functions of the following organic molecules:  
  - Carbohydrates.  
  - Proteins.  
  - Lipids.  
  - Nucleic Acids. (4.0 days) |  
  - Examine the role and importance of organic molecules to organisms.  
  - Examples to investigate include starch, cellulose, insulin, glycogen, glucose, enzymes, hemoglobin, fats, DNA and RNA. *(Distinguish among mono, and polysaccharides - concept not terminology)*  
  - Interpret results of tests for starch (iodine), lipids (brown paper), monosaccharides (Benedict’s Solution), and protein (Biuret’s).  
  - Emphasis should be on functions and subunits of each organic molecule. For example, enzymes are proteins composed of long chains of amino acids that are folded into particular shapes and that shape determines the specific reaction that the enzyme will catalyze. *(The terms condensation reaction, dehydration synthesis and hydrolysis have been deliberately excluded.)* | Testing for bio-molecules: starch, lipids, sugars, and proteins | SAS Web Inquiry: How do structures of carbohydrates affect their functions?  
http://biochemhub.com/biochem/biochemhub.cfm  
Biology hub – many games and puzzles for review – e.g. concentration |
| C3  | 2.02      | Investigate and describe the structure and function of cells including:  
  - Cell organelles.  
  - Cell specialization.  
  - Communication among cells within an organism. (5.5 days) |  
  - Structure and function of: nucleus, plasma membrane, cell wall, mitochondria, vacuoles, chloroplasts, and ribosomes. Students should be able to identify these cell organelles.  
  - Proficient use and understanding of light microscopic techniques. Students should determine total power magnification as well as steps | Creation of cell models  
Microscope experience  
Cell surface area to volume activity | SAS Project: Organelle Functions  
SAS Classroom Activity: How Big Is That Cell?  
SAS Web Inquiry: Why are cells so small?  
SAS Classroom Activity: Where Did All Those Different Cells Come From?  
http://www.cellsalive.com |
| B4 | **3.01** Analyze the molecular basis of heredity including: | Instruction should include: | Investigation of replication, transcription and translation using models. | Interactive plant/animal cell, mitosis, meiosis, cell cycle  
http://www.life.uiuc.edu/cgi-bin/plantbio/cell/cell.cgi  
Virtual plant cell from a University of Illinois project  
http://www.nobelprize.org/medicine/educational/2001/cellcycle.html  
"Work" to regulate cell cycles  
http://www.scienenetlinks.com/Lessons.cfm?DocID=88  
Lesson plan with analogies of cell organelles, worksheets  
Lesson and rubric for designing cell project  
Activity viewing and measuring various types of cells  
Travel brochure of a cell project  
http://www.biology.arizona.edu/cell_bio/tutorials/cells/cells.html  
Tutorial using microscopy to understand cells  
Alternative assessment opportunity based on a forensic activity using a crime scene to develop microscopy skills  
http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookCELL2.html  
Interactive tutorial of cell organelles with many outside links |
| --- | --- | --- | --- | --- |
|  | • DNA Replication | • Structure of DNA as compared to RNA  
• Complementary base pairing | | |
| Protein Synthesis (transcription and translation) | Understanding that the sequence of nucleotides in DNA codes for proteins – the central key to cell function and life. |
|Gene Regulation (5.5 days) | How the process allows daughter cells to have an exact copy of parental DNA. |
| | Understanding of the semi-conservative nature of the replication process. (nature of the process, not the term semi-conservative) |
| | Mutations as a change in the DNA code. |
| | The position of replication within the cell cycle. |
| | The importance of relatively weak hydrogen bonds. |
| | The recognition of protein synthesis as a process of: |
| | Transcription that produces an RNA copy of DNA, which is further modified into the three types of RNA |
| | mRNA traveling to the ribosome (rRNA) |
| | Translation - tRNA supplies appropriate amino acids |
| | Amino acids linked by peptide bonds to form polypeptides which are folded into proteins. |
| | Use of a codon chart to determine the amino acid sequence produced by a particular sequence of bases. |
| | All (with a few exceptions) of an organism’s cells have the same DNA but differ based on the expression of genes. |
| | differentiation of cells in multicellular organisms |
| | cells responding to their environment by producing different types and amounts of |
| | Inquiry Support Activity: What are the effects of various mutations on protein synthesis? (Biology Support Document pages 77-84) |

Inquiry Support Activity: What are the effects of various mutations on protein synthesis? (Biology Support Document pages 77-84)

- American Museum of Natural History, info about the genomic revolution, resource site [http://www.amnh.org/exhibitions/genomics/1_identity/work.html](http://www.amnh.org/exhibitions/genomics/1_identity/work.html)
- Genetic Science Learning Center at Univ. of Utah, build a DNA molecule [http://glsc.genetics.utah.edu/units/basics/builddna/](http://glsc.genetics.utah.edu/units/basics/builddna/)
- Cold Spring Harbor site – includes DNA from the Beginning, a section on eugenics, genetic disorders, DNA (the newest edition) has animations of biotechnology [http://biocrs.biomed.brown.edu/Books/Chapters/Ch%208/DH-Paper.html](http://biocrs.biomed.brown.edu/Books/Chapters/Ch%208/DH-Paper.html)
- Advanced animated demo of protein synthesis [http://dnalc.org](http://dnalc.org)
### B2 3.02 Compare and contrast the characteristics of asexual and sexual reproduction.

**Instruction should include:**
- Recognizing mitosis as a part of asexual reproduction and meiosis as a part of sexual reproduction.
- Similarities and differences between mitosis and meiosis including replication and separation of DNA and cellular material, changes in chromosome number, number of cell divisions, and number of cells produced in complete cycle.
- Putting mitosis diagrams in order and describing what is occurring throughout the process. 
  
  *Students are not expected to memorize the names of the steps or the order of the step names.***

- The sources of variation including:
  - Crossing over.
  - Random assortment of chromosomes.
  - Gene mutation
  - Nondisjunction
  - Fertilization

**Inquiry Support Activity:**
- **Cell Cycle** (Biology Support Document pages 85-87)
- Investigation involving mitosis/meiosis simulations

**SAS InterActivity:**
- Cell Division
  - [http://www.biology.arizona.edu/cell_bio/cell_bio.html](http://www.biology.arizona.edu/cell_bio/cell_bio.html)
- Cell cycle tutorials and a web version of an onion tip lab, some available in Spanish
- Interactive tutorial with pictures of phases
<table>
<thead>
<tr>
<th>RBT</th>
<th>Objective</th>
<th>Content Description</th>
<th>Suggested Activities</th>
<th>Suggested Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2</td>
<td>C3</td>
<td>C4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• Cystic fibrosis, and Huntington’s disease
• Solving and interpreting co-dominant crosses involving multiple alleles.
• A, B, AB and O blood types (alleles: I^A, I^B, and i).
• Determining if parentage is possible based on blood types.
• Recognizing that some traits are controlled by more than one pair of genes.
• This pattern of inheritance is identified by the presence of a wide range of phenotypes (consider examples of skin and hair color).
• An understanding of human sex chromosomes.
• Solving crosses involving sex linked traits (examples: color-blindness and hemophilia.)
• Understand why males are more likely to express a sex-linked trait.
• The importance of the genes being on separate chromosomes as it relates to meiosis.
• How the process of meiosis leads to independent assortment and ultimately to greater genetic diversity.
• Given certain phenotypes suggest an appropriate test cross to determine the genotype of an organism.
• Identifying the genotypes of individuals from a given pedigree. (Students should be able to interpret pedigrees which show phenotype not genotype)
• Solving and interpreting problems featuring monohybrid crosses. (Parental, F1, F2 generations)
• Determining parental genotypes based on offspring ratios.
Assess the impacts of genomics on individuals and society.

- Human genome project.
- Applications of biotechnology. (5.0 – 7.0 days)

Instruction should include:
- The reasons for establishing the human genome project.
- Recognition that the project is useful in determining whether individuals may carry genes for genetic conditions and in developing gene therapy.
- Gel electrophoresis as a technique to separate molecules based on size. *(Students are not expected to know the steps of gel electrophoresis in order or great detail. They should be able to interpret the results and have a general understanding of what takes place during the process.)*
- Uses of DNA fingerprinting
- Applications of transgenic organisms (plants, animals, & bacteria) in agriculture and industry including pharmaceutical applications such as the production of human insulin.
- Ethical issues and implications of genomics and biotechnology. (stem cell research and genetically modified organisms)

Electrophoresis lab or simulation.

**Inquiry Support Activity:**
Genetic Detective (Biology Support Document pages 100-109)

**SAS Classroom Activity:**
DNA Fingerprinting: A Simulation
http://onlineethics.org/biology/index.html
Ethical issues in the biological sciences
http://gslc.genetics.utah.edu/units/biotech/gel/
Genetic Science Learning Center, interactive gel electrophoresis simulation
http://gslc.genetics.utah.edu/units/disorders/pedigree/
Genetic Science Learning Center, genetic disorder activity
http://www.amnh.org/exhibitions/genomics
The American Museum of Natural History, The Genomic Revolution, lots of information
http://www.biointeractive.org
Howard Hughes site, Transgenic Fly biointeractive laboratory
http://www.genome.gov/10001772
National Institute of Health, information on the Human Genome Project
http://www.genomenewsnetwork.org
Genome News Network, Genetic Detective Webquest
http://www.hhmi.org/biointeractive/
Bacterial DNA analysis
http://www.ornl.gov/hgmis/publicat/genechoice/
Your Genes, Your Choices raises many of the human issues related to biotechnology
http://ehrweb.aaas.org/ehr/books/
Your genes your choices: exploring the issues raised by genetic research
http://www.cdc.gov/genetics/
Links to information on all sorts of diseases
Browse genetic disorders chromosome by chromosome

Online Mendelian Inheritance in Man—may be most useful to teachers

DNA interactive paternity cases

Stem cell animation as well as other information

Information on stem cells and current research
### Unit Title: Evolutionary Mechanisms
(Aproximately 2 weeks)

<table>
<thead>
<tr>
<th>RBT</th>
<th>Objective</th>
<th>Content Description</th>
<th>Suggested Activities</th>
<th>Suggested Resources</th>
</tr>
</thead>
</table>
| B4  | 3.05      | Examine the development of the theory of evolution by natural selection including:  
  - Development of the theory.  
  - The origin and history of life.  
  - Fossil and biochemical evidence.  
  - Mechanisms of evolution.  
  - Applications (pesticide & antibiotic resistance).  
  (5.5 days) | Instruction should include:  
  - Historical development of the theory of evolution by natural selection.  
  - Biogenesis in contrast to abiogenesis with emphasis on the experiments used to support both ideas.  
  - Early atmosphere hypotheses and experiments.  
  - How the early conditions affected the type of organism that developed (anaerobic and prokaryotic).  
  - Evolution of eukaryotic and aerobic organisms.  
  - Fossils– relative and absolute dating methods  
  - How variations provide material for natural selection.  
  - The role of geographic isolation in speciation.  
  - The importance of the environment in selecting adaptations.  
  - Discuss the evolutionary selection of resistance to antibiotics and pesticides in various species.  
| Inquiry Support Activity: Fishy Frequencies | SAS Classroom Activity:  
Natural Selection  
http://evolution.berkeley.edu  
Univ. of California at Berkley, assistance in the teaching of evolution  
http://www.epa.gov/pesticides/  
Information on pesticides and the issues of their use  
http://www.mnh.si.edu/anthro/humano rigins/  
Smithsonian Institution's Human Origins Program explores the fossil record left by early humans.  
http://www.indiana.edu/~ensiweb/lessons/ns.chips.html  
Version of a selection activity  
http://www.nap.edu/readingroom/boo ks/evolution98/evol6-b.html  
Lesson on evolution - written for middle school but also fits high school biology  
http://www.pbs.org/wgbh/evolution/  
PBS evolution site – lots of teacher materials – on line activities and others “click” the teacher workbook  
http://www.pbs.org/wgbh/evolution/se x/guppy/ed_pop.html  
"Sex and the Single Guppy” How populations change over time |
Students should learn about the changing nature of classification based new knowledge generated by research on evolutionary relationships.

- **History of classification system**
  - Originally two kingdoms (plants and animals). More kingdoms added as knowledge of the diversity of organisms increased.
  - Development of the seven level classification system (KPCOFGS) and binomial nomenclature

  *(The intention is that students understand that classification systems are changed as new knowledge is gathered. Currently, the thinking is 3 Domains with 6-7 kingdoms)*

- **Basis of classification system**
  - Evolutionary phylogeny, DNA and biochemical analysis, embryology, morphology
  - Interpret phylogenetic trees.

- **Only basic differences and similarities should be detailed.**
  - Membrane bound organelles – none in prokaryotes.
  - Ribosomes in both.
  - Contrasts in chromosome structure.
  - Contrasts in size.

- **Compare:**
  - Cellular structures.
  - Unicellular vs. Multicellular.
  - Methods of making/getting food and breaking down food to get energy.
  - Reproduction.

- **Use dichotomous keys to identify organisms.**

Activities might include student-created keys based on observable characteristics (e.g. symmetry)

Use dichotomous keys to identify organisms.

SAS Interactivity: Modern Taxonomy
http://phylogeny.arizona.edu/tree/phylogeny.html
Tree of Life site, evolutionary tree features lots of organisms life
http://www.marietta.edu/~mcshaffd/Pachyderm_Web/pachyderm_web_home.htm
Large store of phyla photos and current classification information
This site links to zoos and other animal related sites.
http://www.naturalia.org/ZOO/indexing.html
This is a virtual zoo site.
http://biodidac.bio.uottawa.ca/
Thousands of pictures for bio teachers
http://biog-101-104.bio.cornell.edu/BioG101_104/tutorials/animals.html
Animal tutorials – these are wonderful online quizzes with immediate feedback
<table>
<thead>
<tr>
<th>RBT</th>
<th>Objective</th>
<th>Content Description</th>
<th>Suggested Activities</th>
<th>Suggested Resources</th>
</tr>
</thead>
</table>
| B4  | 2.03 Investigate and analyze the cell as a living system including:  
  - Maintenance of homeostasis.  
  - Movement of materials into and out of cells.  
  - Energy use and release in biochemical reactions.  
  **(4.0 days)**  
| | • Examples for exploration should include regulation of temperature, pH, blood glucose levels and water balance.  
  • Discussion should include active vs. passive transport, diffusion, osmosis, and the porous nature of the semi-permeable plasma membrane. *(Pinocytosis, phagocytosis, endocytosis, and exocytosis have been deliberately excluded)*  
  • Given different types of cells, students should be able to predict any changes in osmotic pressure that may occur as the cell is placed in solutions of differing concentrations. *(Emphasis is on the processes, not terminology such as hypertonic, isotonic, hypotonic, turgor pressure)*  
  • Examine ATP as the source of energy for cell activities.  
  • Students will describe how cells store and use energy with ATP and ADP molecules. | Osmosis lab / diffusion lab  
**Inquiry Support Activities:**  
Osmosis and the Egg (Biology Support Document pages 48-51)  
How do biological materials respond to acids and bases? *(Buffer lab)* (Biology Support Document pages 52-58)  
Activities that demonstrate when food is burned energy is given off (such as burning a peanut or cheese doodle) | **SAS Model:** Chemiosmosis  
**SAS Interactivity:** Membranes  
**SAS Web Lesson:** Lights…Camera…Action Potential!  
http://science.exeter.edu/jekstrom/WEB/CELLS/Elodea/Elodea.html  
Tutorial on Elodea undergoing plasmolysis  
http://biology.arizona.edu/sciconn/lessons/mccandless/default.html  
Lesson plans by a high school teacher including several osmosis/diffusion lab activities  
Web inquiry and lesson plans to understand cell communication, requires knowledge of nervous and endocrine systems  
http://www.exo.net/~pauld/activities/food/countingcalories.html  
Information about calorimeters and food, link to a peanut demo  
http://www.michigan.gov/scope/0,1607,2C7-155-13497_13503_13506-43904--%2C00.html  
Make a tin can calorimeter  
http://nat.crgq.com/mainnat.html  
Site has a clever nutrition analysis tool – you can enter different foods and get an analysis of those foods – calories, nutrients, etc |
| B2  | 2.04 Investigate and describe the structure and function of enzymes and explain their importance in biological systems. | Instruction should include investigation of:  
• Enzymes as proteins that speed up chemical reactions (catalyst).  
• Enzymes as re-usable and specific. | **Inquiry Support Activity:**  
Properties of Enzymes *(Biology Support Document pages 59-70)* | **SAS InterActivity:** Enzymes  
Enzyme lab using milk, connection to hydrolysis |
<table>
<thead>
<tr>
<th>(3.5 days)</th>
<th>• Enzymes as affected by such factors as pH, and temperature. Students should understand that enzymes are necessary for all biochemical reactions and have a general understanding of how enzymes work.</th>
<th><a href="http://web.jjay.cuny.edu/~acarpi/NSC/index.htm">http://web.jjay.cuny.edu/~acarpi/NSC/index.htm</a> Mainly chemistry but some related information, enhances understanding</th>
</tr>
</thead>
</table>
| **B4 2.05** Investigate and analyze the bioenergetic reactions: | • Aerobic respiration  
• Anaerobic respiration  
• Photosynthesis (3.5 days) | **Inquiry Support Activity:** Yeast Fermentation (Biology Support Document pages 71-76) Inquiry activities which allow students to investigate factors affecting rate of photosynthesis and/or cellular respiration |
| The emphasis should be placed on investigation of: | • Overall equations including reactants and products and not on memorizing intermediate steps of these processes.  
• Factors which affect rate of photosynthesis and or cellular respiration.  
• Comparison and contrast of these processes with regard to efficiency of ATP formation, the types of organisms using these processes, and the organelles involved.  
  ➢ Anaerobic respiration should include lactic acid and alcoholic fermentation. | SAS InterActivity: Photosynthesis  
SAS Classroom Activity: Floating Leaves |
| Instruction should include the comparison of anaerobic and aerobic organisms. (Glycolysis, Kreb’s Cycle, and Electron Transport Chain have been deliberately excluded) (Students are not required to distinguish between light dependent and light independent parts of photosynthesis) | • Investigate the carbon cycle as it relates to photosynthesis and respiration.  
• Analyze food chains, food webs, and energy pyramids for direction and efficiency of energy transfer. | **http://researchmag.asu.edu/stories/power.html** The Power of Green, green chlorophyll that is |
| **B4 5.02** Analyze the flow of energy and the cycling of matter in the ecosystem.  
• Relationship of the carbon cycle to photosynthesis and respiration  
• Trophic levels-direction and efficiency of energy transfer | | **http://www.cvm.umn.edu/depts/raptorcenter/education/lessonplans/** Activities featuring food webs and other ecosystem relationships  
**http://www.marietta.edu/~biol/102/ecosystem.html** From Marietta College on ecosystems with a nice discussion of energy flow, biomass pyramids including exceptions to the usual findings and also bio-magnification. |
<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
<th>Resources</th>
</tr>
</thead>
</table>

### Unit Title: Interrelationships in the Biosphere

(Approximately 3 weeks – 1 week in 2nd six weeks and 2 weeks in 3rd six weeks)

<table>
<thead>
<tr>
<th>RBT</th>
<th>Objective</th>
<th>Content Description</th>
<th>Suggested Activities</th>
<th>Suggested Resources</th>
</tr>
</thead>
</table>
| B4  | 5.01 Investigate and analyze the interrelationships among organisms, populations, communities and ecosystems. | • Techniques of field ecology.  
• Abiotic and biotic factors.  
• Carrying capacity (6.0 days) | • Students should be able to identify and describe symbiotic relationships.  
➢ Mutualism  
➢ Commensalism  
➢ Parasitism  
• Students should be able to identify and predict patterns in Predator /prey relationships.  
• Use field ecology techniques such as sampling and quadrant studies to determine species diversity and changes over time.  
• Explain how abiotic and biotic factors are related to one another and their importance in ecosystems.  
• Analyze how limiting factors influence carrying capacity (e.g. food availability, competition, harsh winter).  
• Interpret population growth graphs. | **Inquiry Support Activity:** Campus Field Study (Biology Support Document pages 129-133) | **SAS Interactivity:** Stream Ecology  
[http://www.cvm.umn.edu/depts/raptorcenter/education/lessonplans/Predator-Prey activity](http://www.cvm.umn.edu/depts/raptorcenter/education/lessonplans/Predator-Prey activity) |
| B5  | 5.03 Assess human population and its impact on local ecosystems and global environments:  
• Historic and potential changes in population.  
• Factors associated with those changes.  
• Climate Change.  
• Resource use.  
• Sustainable practices/stewardship. | Instruction should include:  
• Analyze human population growth graphs (historical and potential changes). (See 5.01)  
• Factors influencing birth rates and death rates.  
• Effects of population size, density and resource use on the environment.  
• Discussion of human impact on local ecosystems:  
➢ Acid rain  
➢ Habitat destruction | **Inquiry Support Activity:** Environmental Factors that Affect the Hatching of Brine Shrimp (Biology Support Document pages 134-137) | [www.enviroliteracy.org](http://www.enviroliteracy.org)  
Lesson plans and item bank of environmental items  
[www.prb.org](http://www.prb.org)  
Population Reference Bureau, lots of information  
[http://www.epa.gov/globalwarming/index.html](http://www.epa.gov/globalwarming/index.html)  
The EPA has a large website devoted to global warming. The educator's page provides links to other resources.  
[http://www.census.gov/ftp/pub/ipc/w](http://www.census.gov/ftp/pub/ipc/w) |
B4 4.04 Analyze and explain the interactive role of internal and external factors in health and disease:
• Genetics.
• Immune response.
• Nutrition.
• Parasites.
• Toxins.

(4.0 days)

- Introduced non-native species.
- How changes in human population affects populations of other organisms.
- Discussion of factors that influence climate:
  - Greenhouse effect (related to carbon cycle and human impact on atmospheric CO₂)
  - Natural environmental processes (e.g. volcanoes)
- Investigation of the direct and indirect impact of humans on natural resources (e.g. deforestation, pesticide use and bioaccumulation research)
- Examples of sustainable practices and stewardship.

Use of case studies to analyze the role of genetics and environment in human health.

SAS InterActivity: Disease Dynamics
http://www.psych.umn.edu/psychlabs/mts/special.htm
University of Minnesota's site for twin studies
The National Institute on Alcohol Abuse and Alcoholism presents a discussion of the genetics of alcoholism. Helpful to teachers and more advanced students.
http://faculty.washington.edu/chudler/alco.html
Information about the effects of alcohol on the body and links to pages on fetal alcohol syndrome.
http://www.pbs.org/wgbh/nova/cancer/
This site allows you to watch the whole video (Cancer Warrior)

ww/idbpvr.html
Interactive population pyramids.
http://www.ibiblio.org/lunarbin/world pop
A world population clock.
http://www.wadsworth.com/sociology _d/virtual/12.html#
Virtual tour of population issues with an assignment for students parts of which teachers may find suitable for high school students.
http://www.epa.gov/pesticides/
EPA's Office of Pesticide Programs.
http://www.epa.gov/surf3/
EPA "Surf Your Watershed" site with information on watershed indicators including nitrogen runoff.
http://www.cvm.umn.edu/depts/rapto rcenter/education/lessonplans/
Bio-accumulation activity, aquatic issues
make antibodies, other T cells kill infected cells.)
- Passive and active immunity.
- Vaccines.
- Teachers should emphasize aspects of nutrition that contribute to:
  - Optimal health.
  - Poor nutrition (obesity, malnutrition and specific deficiencies.)
- Teachers should focus on the general life cycle (not specific details), vector, systems and treatments for malarial parasite (*Plasmodium*)
- Understand effects of environmental toxins
  - Lead
  - Mercury

http://www.cancer.org/docroot/home/index.asp
The American Cancer Society site for information.
http://nobelprize.org/educational_games/medicine/immunity/immune-detail.html
how the immune system works
http://www.cdc.gov/
The Centers for Disease Control and Prevention.
<table>
<thead>
<tr>
<th>RBT</th>
<th>Objective</th>
<th>Content Description</th>
<th>Suggested Activities</th>
<th>Suggested Resources</th>
</tr>
</thead>
</table>
| B4  | 5.01 Investigate and analyze the interrelationships among organisms, populations, communities and ecosystems  
• Techniques of field ecology  
• Abiotic and biotic factors  
• Carrying capacity (6.0 days) | • Students should be able to identify and describe symbiotic relationships  
➢ Mutualism  
➢ Commensalism  
➢ Parasitism  
• Students should be able to identify and predict patterns in Predator /prey relationships.  
• Use field ecology techniques such as sampling and quadrant studies to determine species diversity and changes over time.  
• Explain how abiotic and biotic factors are related to one another and their importance in ecosystems.  
• Analyze how limiting factors influence carrying capacity (e.g. food availability, competition, harsh winter).  
• Interpret population growth graphs.                                                                                                                                                                                                                                                                                                                      | Inquiry Support Activity:  
Campus Field Study (Biology Support Document pages 129-133) | SAS Interactivity:  
Stream Ecology  
http://www.cvm.umn.edu/depts/raptorcenter/education/lessonplans/  
Predator- Prey activity                                                                 |
| B5  | 5.03 Assess human population and its impact on local ecosystems and global environments:  
• Historic and potential changes in population  
• Factors associated with those changes.  
• Climate Change.  
• Resource use  
• Sustainable practices/ stewardship. (4.0 days) | Instruction should include:  
• Analyze human population growth graphs (historical and potential changes) (See 5.01)  
• Factors influencing birth rates and death rates.  
• Effects of population size, density and resource use on the environment.  
• Discussion of human impact on local ecosystems:  
➢ Acid rain  
➢ Habitat destruction  
➢ Introduced non-native species.  
• How changes in human population affects populations of other                                                                                                                                                                                                                                                                                     | Inquiry Support Activity:  
Environmental Factors that Affect the Hatching of Brine Shrimp (Biology Support Document pages 134-137) | www.enviroliteracy.org  
Lesson plans and item bank of environmental items  
www.prb.org  
Population Reference Bureau, lots of information  
http://www.epa.gov/globalwarming/index.html  
The EPA has a large website devoted to global warming. The educator's page provides links to other resources.  
http://www.census.gov/ftp/pub/ipc/www/idbpyr.html  
Interactive population pyramids.  
http://www.ibiblio.org/lunarbin/world. |
organisms.
- Discussion of factors that influence climate:
  - Greenhouse effect (related to carbon cycle and human impact on atmospheric CO₂)
  - Natural environmental processes (e.g. volcanoes)
- Investigation of the direct and indirect impact of humans on natural resources (e.g. deforestation, pesticide use and bioaccumulation research)
- Examples of sustainable practices and stewardship.

| B4 | **4.04** Analyze and explain the interactive role of internal and external factors in health and disease:
  | Genes.
  | Immune response.
  | Nutrition.
  | Parasites.
  | Toxins.
  | (4.0 days) |
| --- | --- |
| **Focus should be on the interactive role of genetics and the environment** in determining a specific response including:
  | Sickle cell anemia and malaria
  | Lung/mouth cancer and tobacco use
  | Skin cancer, vitamin D, folic acid and sun exposure
  | Diabetes (diet/exercise and genetic interaction).
  | PKU and diet
  | Instruction should include basic understanding of:
  | Function and relationship of T-cells, B-cells, antibodies/antigens.
  | (Overview only of different types and roles of T and B cells: role of memory cells, B cells make antibodies, some T cells help B cells make antibodies, other T cells kill infected cells.)
  | Passive and active immunity.
  | Vaccines.
| **Use of case studies to analyze the role of genetics and environment in human health.** |

- SAS InterActivity: Disease Dynamics
  - [http://www.psych.umn.edu/psylabs/mtfs/special.htm](http://www.psych.umn.edu/psylabs/mtfs/special.htm)
  - University of Minnesota's site for twin studies
  - The National Institute on Alcohol Abuse and Alcoholism presents a discussion of the genetics of alcoholism. Helpful to teachers and more advanced students.
  - [http://faculty.washington.edu/chudler/alco.html](http://faculty.washington.edu/chudler/alco.html)
  - Information about the effects of alcohol on the body and links to pages on fetal alcohol syndrome.
  - This site allows you to watch the whole video (Cancer Warrior)
  - The American Cancer Society site for information.

  - Virtual tour of population issues with an assignment for students parts of which teachers may find suitable for high school students.
  - [http://www.epa.gov/pesticides/](http://www.epa.gov/pesticides/)
  - EPA's Office of Pesticide Programs.
  - [http://www.epa.gov/surf3/](http://www.epa.gov/surf3/)
  - EPA "Surf Your Watershed" site with information on watershed indicators including nitrogen runoff.
  - Bio-accumulation activity, aquatic issues.

- PopCurve
  - A world population clock.
  - Virtual tour of population issues with an assignment for students parts of which teachers may find suitable for high school students.
  - [http://www.epa.gov/pesticides/](http://www.epa.gov/pesticides/)
  - EPA's Office of Pesticide Programs.
  - [http://www.epa.gov/surf3/](http://www.epa.gov/surf3/)
  - EPA "Surf Your Watershed" site with information on watershed indicators including nitrogen runoff.
  - Bio-accumulation activity, aquatic issues.
<table>
<thead>
<tr>
<th>Teachers should emphasize aspects of nutrition that contribute to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Optimal health.</td>
</tr>
<tr>
<td>➢ Poor nutrition (obesity, malnutrition and specific deficiencies.)</td>
</tr>
<tr>
<td>Teachers should focus on the general life cycle (not specific details), vector, systems and treatments for malarial parasite (<em>Plasmodium</em>)</td>
</tr>
<tr>
<td>Understand effects of environmental toxins</td>
</tr>
<tr>
<td>➢ Lead</td>
</tr>
<tr>
<td>➢ Mercury</td>
</tr>
<tr>
<td><a href="http://nobelprize.org/educational_games/medicine/immunity/immune-detail.html">http://nobelprize.org/educational_games/medicine/immunity/immune-detail.html</a> how the immune system works</td>
</tr>
</tbody>
</table>
## Unit Title: Patterns Among Organisms
*(Approximately 2½ weeks)*

<table>
<thead>
<tr>
<th>RBT</th>
<th>Objective</th>
<th>Content Description</th>
<th>Suggested Activities</th>
<th>Suggested Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>B4</td>
<td>4.02</td>
<td>Analyze the processes by which organisms representative of the following groups accomplish essential life functions specified below. The focus is on physiology rather than on the names of parts.</td>
<td>Observe representative organisms from the specified groups.</td>
<td><a href="http://animaldiversity.ummz.umich.edu/site/index.html">Inquiry Support Activity: Organism Newspaper Project</a> (Biology Support Document pages 117-124)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Unicellular protists, annelid worms, insects, amphibians, mammals, non-vascular plants, gymnosperms and angiosperms.</td>
<td><em>Teachers should help students compare and contrast how the organisms listed accomplish the essential life functions specified below. The focus is on physiology rather than on the names of parts.</em></td>
<td><a href="http://animaldiversity.ummz.umich.edu/site/index.html">http://animaldiversity.ummz.umich.edu/site/index.html</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Transport – how organisms get what they need to cells; how they move waste from cells to organs of excretion.</td>
<td><em>Transport – how organisms get what they need to cells; how they move waste from cells to organs of excretion.</em></td>
<td><a href="http://arbl.cvmbs.colostate.edu/hbooks/pathphys/endocrine/basics/control.html">http://arbl.cvmbs.colostate.edu/hbooks/pathphys/endocrine/basics/control.html</a> This is a link to Colorado State's Endocrinology Hypertextbook - has a nice animation and discussion of feedback loops.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Excretion – how organisms get rid of their waste and balance their fluids (pH, salt concentration, water).</td>
<td><em>Excretion – how organisms get rid of their waste and balance their fluids (pH, salt concentration, water).</em></td>
<td><a href="http://animaldiversity.ummz.umich.edu/site/index.html">http://animaldiversity.ummz.umich.edu/site/index.html</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Nutrition – how organisms break down and absorb foods.</td>
<td><em>Nutrition – how organisms break down and absorb foods.</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Synthesis – how organisms build necessary molecules.</td>
<td><em>Synthesis – how organisms build necessary molecules.</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reproduction – sexual versus asexual, eggs, seeds, spores, placental, types of fertilization.</td>
<td><em>Reproduction – sexual versus asexual, eggs, seeds, spores, placental, types of fertilization.</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Growth and development – metamorphosis, development in egg or in uterus, growth from seed or spore.</td>
<td><em>Growth and development – metamorphosis, development in egg or in uterus, growth from seed or spore.</em></td>
<td></td>
</tr>
</tbody>
</table>

| B5  | 4.03      | Assess, describe and explain adaptations affecting survival and | Investigation that includes the observation of structural adaptations | [SAS InterActivity: Disease Dynamics](http://commtechlab.msu.edu/sites/dlc-) |
|     |           | • Focus should be on structural adaptations from organisms that are listed in 4.02, particularly: | | |

---

*(5.0 days)*
reproductive success.
• Structural adaptations in plants and animals (form to function).
• Disease-causing viruses and microorganisms.
• Co-evolution.
(3.5 days)

- Feeding adaptations.
- Adaptations to ensure successful reproduction.
- Adaptations to life on land.
- Instruction should include:
  - Structure of viruses.
  - Mutation of viruses and other microorganisms.
  - Variety of disease causing (pathogenic) agents (viruses, bacteria) including:
    o HIV
    o Influenza
    o Smallpox
    o Streptococcus (strep throat)

- Emphasis should be on the relationship between angiosperms and their pollinators.

| B4  | 4.05 Analyze the broad patterns of animal behavior as adaptations to the environment.
|     | Innate behavior.
|     | Learned behavior.
|     | Social behavior.
|     | (4.5 days) |
|     | • Taxes and instincts, including:
|     |   - suckling (instinct)
|     |   - insects moving away from or toward light (taxis)
|     |   - migration, estivation, hibernation
|     | • Focus should be on various types of learned behavior including:
|     |   - Habituation
|     |   - Imprinting
|     |   - Classical conditioning (e.g. Pavlov’s dog –stimulus association)
|     |   - Trial and error (focus on concept of trial and error learning not term operant conditioning).
|     | • Focus should be on communication, territorial defense, and courtship, including:
|     |   - Communication within social structure using pheromones (ex: bees and ants).
|     |   - Courtship dances.
|     |   - Territorial defense (ex: Fighting Fish).

### Inquiry Support Activity: Animal Responses to Environmental Stimuli (Biology Support Document pages 125-128)

- http://www.animalbehavior.org/ABS/Education
- Web cams of animals. Not all of good quality.
- http://www.nczoo.org/
The North Carolina Zoo.
- http://nationalzoo.si.edu/default.cfm
  National zoo has easy to use Web Cams.
  Activity that simulates the advantages of mimicry
  Journey North: migration data and activities

me/zoo/
This is a microbial zoo site with lots of information about microbes presented in an entertaining manner
http://www.microbes.info/
User friendly information – more than just microbes
http://vm.cfsan.fda.gov/~mow/intro.html
"Bad Bug Book" – wonderful source for studying “germs”
NC DPI
http://www.dpi.state.nc.us/curriculum/science/units/high/
http://www.dpi.state.nc.us/docs/curriculum/science/scos/2004/biology/supportdocument.doc#General_Biology_Resources

http://www.sciencenews.org/
   Science News Online - the For Kids section of this website has great summaries with links to the next level.
http://www.sciencedaily.com/
   Science Daily New Site
http://www.pbs.org/teachersource/sci_tech.htm
   PBS site with materials for students and teachers
http://www.accessexcellence.org/RC/
   Information, laboratories and activity ideas
http://www.discover.com/
   Discover Magazine site
http://si.edu/resource/faq/start.htm
   The Smithsonian Encyclopedia
http://www.biology.arizona.edu/
   The Biology Project, activities and current information
http://www.enc.org/
   Eisenhower National Clearinghouse
http://www.educationplanet.com/
   Useful links
http://www.hhmi.org/biointeractive/
   Useful for teachers and students
http://www.biologymad.com/
   Numerous subject modules
http://www.esp.org/foundations/genetics/classical/
   Original scholarly papers – e.g. Mendel and Darwin
http://biotech.icmb.utexas.edu/search/dict-search.html
   Biology dictionary
http://biodidac.bio.uottawa.ca/
   Pictures useful for biology teachers
http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/
   On-line text – useful for teachers
Research in the news
http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookTOC.html

On line biology text
http://www.hhmi.org/lectures/
Howard Hughes lectures
http://science.nhmccd.edu/biol/bio1int.htm
Animation links on various biology topics
http://www.s-cool.co.uk/topic_index.asp?subject_id=3
Similar to a textbook online
http://www.biozone.co.uk/links.html
Large number of quality links
http://www.wiley.com/legacy/college/boyer/0470003790/animations/animations.htm
Interactive animated tutorials – fairly advanced
http://www.johnkyrk.com/
Animations of a large variety of biology topics
http://www.marcopolo-education.org/
Features lessons, some are interactive or animated