



Comprehensive Curriculum

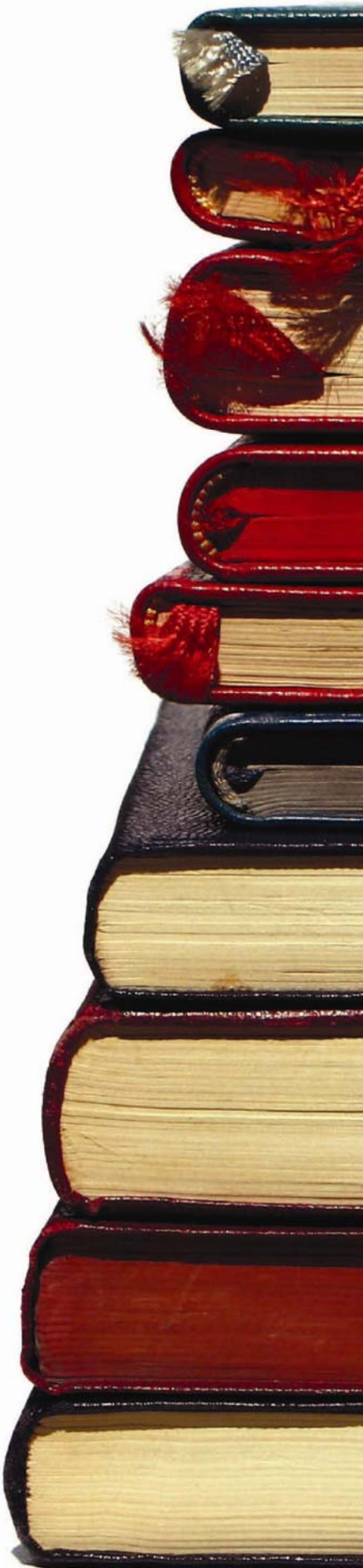
Revised 2008

Biology



Louisiana Department of
EDUCATION

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Biology

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Louisiana Comprehensive Curriculum, Revised 2008 Course Introduction

The Louisiana Department of Education issued the *Comprehensive Curriculum* in 2005. The curriculum has been revised based on teacher feedback, an external review by a team of content experts from outside the state, and input from course writers. As in the first edition, the *Louisiana Comprehensive Curriculum*, revised 2008 is aligned with state content standards, as defined by Grade-Level Expectations (GLEs), and organized into coherent, time-bound units with sample activities and classroom assessments to guide teaching and learning. The order of the units ensures that all GLEs to be tested are addressed prior to the administration of *iLEAP* assessments.

District Implementation Guidelines

Local districts are responsible for implementation and monitoring of the *Louisiana Comprehensive Curriculum* and have been delegated the responsibility to decide if

- units are to be taught in the order presented
- substitutions of equivalent activities are allowed
- GLEs can be adequately addressed using fewer activities than presented
- permitted changes are to be made at the district, school, or teacher level

Districts have been requested to inform teachers of decisions made.

Implementation of Activities in the Classroom

Incorporation of activities into lesson plans is critical to the successful implementation of the Louisiana Comprehensive Curriculum. Lesson plans should be designed to introduce students to one or more of the activities, to provide background information and follow-up, and to prepare students for success in mastering the Grade-Level Expectations associated with the activities. Lesson plans should address individual needs of students and should include processes for re-teaching concepts or skills for students who need additional instruction. Appropriate accommodations must be made for students with disabilities.

New Features

Content Area Literacy Strategies are an integral part of approximately one-third of the activities. Strategy names are italicized. The link ([view literacy strategy descriptions](#)) opens a document containing detailed descriptions and examples of the literacy strategies. This document can also be accessed directly at <http://www.louisianaschools.net/1de/uploads/11056.doc>.

A *Materials List* is provided for each activity and *Blackline Masters (BLMs)* are provided to assist in the delivery of activities or to assess student learning. A separate Blackline Master document is provided for each course.

The *Access Guide to the Comprehensive Curriculum* is an online database of suggested strategies, accommodations, assistive technology, and assessment options that may provide greater access to the curriculum activities. The *Access Guide* will be piloted during the 2008-2009 school year in Grades 4 and 8, with other grades to be added over time. Click on the *Access Guide* icon found on the first page of each unit or by going directly to the url <http://mconn.doe.state.la.us/accessguide/default.aspx>.



Biology Unit 1: The Cell

Time Frame: Approximately three weeks



Unit Description

This unit introduces the students to the basic structure of cells and their differences, stressing the comparison of plant and animal cells, the differences between prokaryotic and eukaryotic cells, transport mechanisms, the role of enzymes, and the characteristics used to define life.

Student Understandings

This unit centers on cell structure and function. With this information students should recognize the structure of cells (prokaryotic and eukaryotic) and their functions with regard to components of plants and animals, their ability to transport water and other substances, their enzymatic properties, and their ability to be defined as living organisms.

Guiding Questions

1. Can students describe the difference between eukaryotic and prokaryotic cells?
2. Can students identify cell organelles and describe the function(s) of each?
3. Can the students describe how cells are affected by varying concentrations of solutions?
4. Can students differentiate among the forms of cell transport?
5. Can students describe the function of an enzyme in a chemical reaction? Can students provide an example?
6. Can students arrange the levels of life from most simple to most complex?

Unit 1 Grade-Level Expectations (GLEs)

| GLE # | GLE Text and Benchmarks |
|---------------------------|---|
| Science as Inquiry | |
| 1. | Write a testable question or hypothesis when given a topic (SI-H-A1) |
| 4. | Conduct an investigation that includes multiple trials and record, organize, and display data appropriately (SI-H-A2) |
| 5. | Utilize mathematics, organizational tools, and graphing skills to solve problems (SI-H-A3) |
| 6. | Use technology when appropriate to enhance laboratory investigations and presentations of findings (SI-H-A3) |

| GLE # | GLE Text and Benchmarks |
|---------------------|---|
| 8. | Give an example of how new scientific data can cause an existing scientific explanation to be supported, revised, or rejected (SI-H-A5) |
| 9. | Write and defend a conclusion based on logical analysis of experimental data (SI-H-A6) (SI-H-A2) |
| 10. | Given a description of an experiment, identify appropriate safety measures (SI-H-A7) |
| 11. | Evaluate selected theories based on supporting scientific evidence (SI-H-B1) |
| Life Science | |
| 1. | Compare prokaryotic and eukaryotic cells (LS-H-A1) |
| 2. | Identify and describe structural and functional differences among organelles (LS-H-A1) |
| 3. | Investigate and describe the role of enzymes in the function of a cell (LS-H-A1) |
| 4. | Compare active and passive cellular transport (LS-H-A2) |
| 5. | Analyze the movement of water across a cell membrane in hypotonic, isotonic, and hypertonic solutions (LS-H-A2) |
| 31. | Compare the levels of organization in the biosphere (LS-H-E3) |

Sample Activities

Activity 1: Safety in the Biology Lab (SI GLE: 10)

Materials List: suggested lab items including goggles, lab aprons, dissecting kits, hot plates, glassware, and other objects chosen by the teacher; video on safety in the lab (optional); Rules of Lab Conduct BLM; Student Safety Contract BLM (one for each student)

Discuss with students the following areas of safety and why each is necessary: goggle use, lab apron and gloves, sharp object use, poison and corrosive chemical use and disposal, animal and plant safety and rules, and hand washing techniques. Teacher-led demonstrations of safety procedures or viewing a video on safety in the lab may be used to address these safety topics. Reinforce student comprehension by using written scenarios or experimental procedures and having students analyze them to identify and correct safety flaws. Distribute a copy of the Rules of Lab Conduct BLM and the Student Safety Contract BLM to each student and emphasize the importance of understanding the rules and signing the contract. (Note: these handouts can be modified to address specific classroom needs and conditions.)

Activity 2: Characteristics of Life (SI GLE: 1)

Materials List: suggested objects include a potted plant, an artificial plant, seeds, a battery operated toy, earthworms or small insects, sea shells, fossils, an egg, a container of yogurt with live bacterial cultures, a flashlight, and other objects chosen by the teacher; computer with Internet access (if available); What is Life? BLM (one for each student)

Before any discussion or reading assignment, have each student complete an *opinionnaire* ([view literacy strategy descriptions](#)) about the characteristics of living entities: this is the What is Life? BLM. At this point, the *opinionnaire* should promote interest in the topic; the emphasis is on students' points of view rather than "correctness" of their opinions. Upon completion of the *opinionnaire*, divide the students into groups of three or four and give each group an object to observe and decide if it is living or non-living. Each group should have reasons for their decision. When all groups have reached a conclusion, write their conclusions and justifications on the board for class discussion. At the conclusion of the discussion or reading assignment, allow the students to correct their *opinionnaire* and amend their definition of living entities based on their new learning. If technology is available, students may visit the following websites for excellent information, activities, and slides shows on the characteristics of life: http://www.resa.net/nasa/biology_systematics.htm, <http://www.slideshare.net/cgales/characteristics-of-life/>, and <http://www.nclark.net/LifeStudy>.

Activity 3: Differentiating Between Various Types of Cells (SI GLEs: 6, 10, 11; LS GLE: 1)

Materials List: microscope; slides; cover slips; living plant specimens; living yeast cells; living cultures of protists such as *Paramecia* or *Euglena*; prepared slides of stained plant tissue; prepared slides of stained animal tissue such as nerve or muscle; prepared slides of stained bacterial cells; diagrams of typical plant, animal, and bacterial cells; computer with Internet access (if available); Differentiating Between Types of Cells BLM (one for each student)

This activity, called a carousel, would follow a review of plant and animal cell structure and function, cell differences, and an introduction to cells and cell theory. The classroom will be set up with six stations. If not previously covered, instruct\review with students how to make wet mounts before starting the rotation. Discuss safety issues, allowing students to identify areas of concern. Divide the students into six different groups of 3 - 4 students per group. Set up the six stations as follows:

Station 1: a microscope, slides, cover slips, and a living plant specimen

Station 2: a microscope, slides, cover slips, and living yeast cells

Station 3: a microscope, slides, cover slips, and a solution of *Paramecia*, *Euglena*, or some other protist

Teacher Note: Students will need to prepare wet mounts of the specimens at stations 1-3.

Station 4: a microscope and a prepared cross section slide of stained, plant tissue

Station 5: a microscope and a prepared slide of stained nervous tissue, muscle tissue, or some other animal tissue

Station 6: a microscope and a prepared slide of stained bacterial cells

Students will have 8-10 minutes to rotate through each station to make observations and record them in a lab notebook. From their observations, students will complete drawings, properly label them, list the differences they observed between the stations, state the major differences between the animal and plant cells, describe the differences between prokaryotic and eukaryotic cells, and label specimens as eukaryotic or prokaryotic. If the activity cannot be completed in one class period, allow for additional time the next day for students to complete. Upon conclusion of the lab activity, instruct the students to complete the *word grid* ([view literacy strategy descriptions](#))

Differentiating Between Different Types of Cells BLM using their drawings and appropriate teacher-selected reading materials. Please note that many student-grade microscopes are not powerful enough to view certain organelles (mitochondria and ribosomes), and the students should also look at diagrams of plant, animal, and bacterial cells to complete the *word grid*. The completed *word grid* can be used by the students for review of important information and vocabulary, and provide a visual summary about key similarities and differences between major cell types.

If technology is available, students may also visit <http://www.cellsalive.com/> for excellent information and animations on plant, animal, and bacterial cells.

Activity 4: Differentiating Between Types of Organelles (SI GLEs: 6, 8, 11; LS_GLE: 2)

Materials List: diagrams of typical plant and animal cells, science learning log

Following Activity 3, distribute diagrams of plant and animal cells and have students correctly identify the organelles by both name and function(s). As a review, students should create an analogy by comparing a cell to a factory. This will assist students in the recall of organelle function (e.g., the nucleus is analogous to the central office (control), the cell wall is analogous to the walls of the factory, the mitochondria are analogous to the power plant or generator, the endoplasmic reticulum is analogous to the hallways, chloroplasts are analogous to the cafeteria). Review the analogies that students have created. Write a few on the board to assist students in learning the functions of the organelles. Reinforce the concept that a scientific theory is accepted only if it is supported by repeated evidence. This is a good opportunity to pose “what if” prompts for the students to reflect upon and write about; “What if” prompts are one category of *SPAWN* writing ([view literacy strategy descriptions](#)) that ask students to think critically about what they have just learned. For example, ask the students to respond to the prompt, “What would happen if scientists discovered life in a form other than a cellular structure?” Another prompt is, “What would happen if the mitochondria no longer functioned?” Write a prompt on the board and allow students 10 – 15 minutes to write a response to the selected prompt in their science *learning log* ([view literacy strategy descriptions](#)). A *learning log* is a notebook in which students record ideas, questions, reactions, and new understandings. This process can lead to further study and alternative learning paths. Allow class time for discussion of student responses to these prompts.

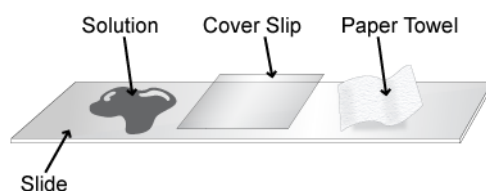
Students can visit the website <http://www.cellsalive.com/> and perform the interactive tasks related to plant and animal cells for identifying cellular organelles and their functions in eukaryotic cells. After students visit website, have them write a one to two paragraph explanation of how new technology/techniques have aided the evolving picture explanation of what we know about organelles and their functions.

Activity 5: The Movement of Materials Into and Out of Cells (SI GLEs: 1, 9, 10; LS GLE: 5)

Materials List: living specimens of red onion or *Elodea* leaves, microscope, microscope slides, cover slips, distilled water, .9% salt solution (1.8 grams of table salt in 198 mL of distilled water), 15% salt solution (30 grams of table salt in 170 mL of distilled water), paper towels, droppers or pipettes

After a discussion and illustration of the structure of a typical cell membrane (e.g., phospholipids bilayer, proteins, channels, carbohydrate chains) and diffusion (including tonicity of solutions), have students perform the following lab activity. Using the microscope and living specimens of *Elodea* or red onion cells, students will determine the effects of hypertonic, hypotonic, and isotonic solutions on a plant cell and predict in what direction water molecules will move when plant cells are exposed to each of the above listed solutions.

Prior to conducting the actual activity, have students discuss safety issues to be addressed. Then students should write a testable hypothesis as to the direction of the movement of water molecules in relation to a cell immersed in each type of solution. Have students prepare a wet mount of an *Elodea* leaf or red onion epidermis and observe at 100X magnification. Students should sketch and describe their observations in writing. Then instruct the students to remove the slide from the microscope stage and place two drops of the 15% salt solution on the slide at the edge of the cover slip. Suggest to the students that they place a small piece of paper towel at the edge of the cover slip (opposite the side where the salt solution was placed) to draw the solution under the cover slip.



After a five-minute wait, students should return the slide to the microscope stage and again sketch and describe their observations at 100X magnification. Have students repeat the procedure a second time using the .9% salt solution and a third time with distilled water. Students should describe and sketch these observations at 100X also. In their lab report, have students write their observations based on cells in hypotonic (distilled water), hypertonic (15% salt solution), and isotonic (.9% salt solution) environments and the direction of the net flow of water.

As a follow up, discuss with students the following scenarios:

- If a dehydrated person goes into the emergency room, which type of solution (isotonic, hypertonic or hypotonic) would the doctor order and why?
- If a person has increased edema (swelling due to excessive fluid buildup), which type of solution would the doctor order?
- Is it possible to drink too much water? What is water intoxication or hyponatremia? Who can experience this condition?

Activity 6: Active and Passive Transport (LS GLE: 4)

Materials List: 3” x 5” index cards, Post – it Notes® or paper cut to 3” x 5” size

After direct instruction on active and passive transportation mechanics and the function of carrier proteins, this activity can be used to enable students to compare and differentiate between active and passive transport processes. Prepare strips of paper or 3” x 5” cards or Post – it Notes®, with each containing a description of either a characteristic of active transport or a characteristic of passive transport. Give students these strips of paper or cards and instruct them to survey related information in their textbook and then place the cards under the headings *active transport* or *passive transport*. Allow 15 minutes for students to complete the activity. On the board, write “active transport” and “passive transport” and go through each description from the pieces of paper, survey the class, and write the responses on the board. This will allow for clarification of misconceptions. Students should come to a consensus as to an agreeable definition of *active transport* and *passive transport*.

Activity 7: Enzyme Action—Bubbles, Bubbles Everywhere (SI GLEs: 1, 4, 9, 10; LS GLE: 3)

Materials List: small disposable plastic cups or test tubes, hydrogen peroxide, distilled water, small pieces of beef liver or raw, white potato, graduated cylinders, computer with Internet access (if available), Experimental Design Assessment Rubric BLM (one for each group of students)

Ask students which cellular organelle is responsible for storing enzymes (*Lysosomes*). Conduct this activity after instruction, with illustrations, that explains to students how enzymes act as catalysts; they enable or speed up reactions without being altered themselves. In this activity, have students work in groups to make observations on the action of the enzyme catalase on hydrogen peroxide (H_2O_2). Provide students with the lab directions or an overview of the investigation and have them work in groups to write a testable hypothesis for the investigation, write questions to be answered, design their own data table for their lab report, and identify appropriate safety measures for this investigation. Before the investigation, assess each group’s design using the Experimental Design Assessment Rubric and make revisions where needed. Using either a small piece of beef liver or a piece of raw potato, have students place a small piece of the liver or potato into approximately 10 mL of distilled water, observe any reaction, and record the results. Have students repeat this three times and observe each time, recording observations. Using the same piece of liver or potato, students will then place the substance into 10 mL of hydrogen peroxide (H_2O_2), remove after two minutes, and observe and record the reaction. Have students repeat the investigation three times (three trials) with the same hydrogen peroxide as used in the first reaction, record observations in a data table, write an analysis of what they observed, write a conclusion relating to the hypothesis, and record possible roles that enzymes may play in cells. To conclude the activity, conduct a full class discussion on the functions of enzymes in a cell. Use teacher created questions to elicit correct examples and responses.

If technology is available, students may visit the following web site for good explanations of enzyme action: <http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/E/Enzymes.html>

Activity 8: Levels of Organization (SI GLE: 5; LS GLE: 31)

Materials List: Post – it Notes® or paper cut into small rectangles

In the previous activities, students have examined cellular organization. Through reading, research, and open discussion in small groups, students use the information they gain as the basis for understanding levels of organization and differentiating among organelles, cells, tissues, organs, systems, organisms, species, populations, communities, ecosystems, and the biosphere. Explain to students that they will be examining the organization of life, progressing from the simplest form to the most complex. Provide student groups with the preceding levels and examples of each level written on paper rectangles or cards or Post – it Notes®. Request that students use the cards to produce a linking, sequential graphic organizer or concentric circles illustrating relationships among the levels of organization. Evaluate each group's graphic organizer for accuracy of information and placement of examples. If available, students should use various software programs that will organize their information.

Sample Assessments

General Guidelines

- The student is to be monitored throughout the work on all activities via teacher observation and lab notebook entries.
- All student-developed products should be evaluated as the unit continues.
- Student investigations should be evaluated with a rubric.
- For some multiple-choice items on written tests, ask students to write a justification for their chosen response.

Assessment techniques should include use of drawings/illustrations/models, laboratory investigations with reports, and laboratory practicals (problem-solving and performance-based assessments); group discussion and journaling (reflective assessment); and paper-and-pencil tests (traditional summative assessments). Assessments could include the following:

General Assessments

- The student will construct a comparative list of the differences between animal, plant, and bacterial cells.
- The student will explain the differences between osmosis and diffusion and give examples.

- The student will answer the following questions: What is a substrate in reference to an enzyme? What is the substrate in the experiment you conducted?
- The student will describe the function of an enzyme and provide two examples of enzymes functioning in cellular metabolism.
- The student will sequence the following terms from the most simple to the most complex:
Tissue, ecosystem, biosphere, organ, population, organelle, biome, community, organism, and cell.

Activity-Specific Assessments

- Activity 4: Card sort with organelles. Have all the organelles and their functions discussed in class on cards or sheets of paper. They should be cut up into individual cards and mixed up. Have enough sets of the cards for students to be in the same groups as used in Activity 1. The students will match the organelles to their functions. Provide students with a sheet of poster paper or newsprint, glue the pairs onto the paper, and present to the class their findings. Students should be graded on accuracy of information.
- Activity 5: To close the activity and for formative assessment, the students will analyze diagrams of cells in each of the three solution types and draw arrows on the diagrams to illustrate the direction water would move in each scenario. The following website may be used for review or reinforcement:
<http://www.scienceman.com/science10/pgs/unit3.html>.
- Activity 7: The students will design an experiment to test the effect of salt on seeds (e.g., Radish or lima bean seeds are easy to find). Be sure to discuss with students independent and dependent variables, and controls during their design of the experiment. In their design, students should soak half of the seeds in salt water and the other half in tap water. Then, have students observe the effects of the water soaking on the seeds. Teacher created rubric (Activity 7 Assessment Rubric BLM) can be used to assess students' experimental design.

Resources

Characteristics of Life. Available online at <http://www.nclark.net/LifeStudy> - Good resource material for teachers: includes *PowerPoint*® presentations, games and puzzles, instructions for lab activities. Additional information is available at <http://www.slideshare.net/cgales/characteristics-of-life/> and http://www.resa.net/nasa/biology_systematics.htm

Cells. Available online at <http://www.scienceman.com/science10/pgs/unit3.html#topic2> - Good information for both teachers and students on the structure and function of cell organelles.

Cells Alive. Available online at <http://www.cellsalive.com/> - An excellent source of short videos, animations, and interactive lessons on the structure of cells and cell activities such as mitosis and meiosis. Appropriate for teachers and students.

Enzyme Action. Available online at

<http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/E/Enzymes.html> - This is a resource for teachers that provides detailed explanations of enzyme structure and activity.

Rubrics. Available online at <http://rubistar.4teachers.org/index.php> - An excellent teacher resource for creating rubrics for all types of assessments.

Biology

Unit 2: Reproduction and Genetics

Time Frame: Approximately four weeks



Unit Description

The unit is designed to incorporate tasks that will introduce students to the basics of cellular reproduction, embryological development, and the mechanisms of inheritance. The processes of mitosis and meiosis and the role of nucleic acids in protein synthesis are explored. Students are introduced to basic patterns of inheritance as well as techniques used in biotechnology.

Student Understandings

Starting with the specialization of cells for growth and reproduction, students should develop an understanding of the concepts of mitosis, meiosis, and embryological development. Students should be able to explain the structure and function of DNA and RNA and relate these to protein synthesis. Using simple genetic crosses and pedigree charts, students should trace traits within a population and make predictions of genotypes and phenotypes.

Guiding Questions

1. Can students compare and contrast the processes of mitosis and meiosis?
2. Can students predict the number of chromosomes in a cell before and after mitosis, and after meiosis? Can they explain the difference in number of chromosomes in meiosis?
3. Can students differentiate between reproduction and growth?
4. Can students explain the relationship between genes, chromosomes, and proteins?
5. Can students determine the function and chemical composition of DNA and RNA?
6. Can students replicate a DNA molecule using the correct chemical compounds and sequence of bases?
7. Can students describe the roles of DNA and RNA in the synthesis of proteins?
8. Can students explain the relationship between DNA and proteins and explain the importance of proteins in the function of living organisms?
9. Can students draw and label the developmental stages of a fertilized cell, beginning with a fertilized animal egg (zygote) and going through to the gastrula phase?
10. Can students differentiate between the terms *genotype* and *phenotype*? Can the students provide examples?
11. Can students complete a simple Punnett square to predict the genotypic and phenotypic ratios in the offspring using genes for a dominant-recessive trait?
12. Can students describe the difference between a monohybrid and a dihybrid cross?

13. Can students read and interpret a pedigree chart? Can the students discern when the pedigree is the most useful tool for identifying patterns of inheritance?
14. Can students cite examples of artificial hybrids, such as ones created via genetic engineering?
15. Can students provide ten examples of useful products, organisms, or processes currently being produced by or used in bioengineering?
16. Can students describe positive and negative aspects of bioengineering?

Unit 2 Grade-Level Expectations (GLEs)

| GLE # | GLE Text and Benchmarks |
|---------------------------|--|
| Science as Inquiry | |
| 5. | Utilize mathematics, organizational tools, and graphing skills to solve problems (SI-H-A3) |
| 7. | Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4) |
| 9. | Write and defend a conclusion based on logical analysis of experimental data (SI-H-A6) (SI-H-A2) |
| 11. | Evaluate selected theories based on supporting scientific evidence (SI-H-B1) |
| 13. | Identify scientific evidence that has caused modifications in previously accepted theories (SI-H-B2) |
| 14. | Cite examples of scientific advances and emerging technologies and how they affect society (e.g., MRI, DNA in forensics) (SI-H-B3) |
| 16. | Use the following rules of evidence to examine experimental results: (a) Can an expert's technique or theory be tested, has it been tested, or is it simply a subjective, conclusive approach that cannot be reasonably assessed for reliability? (b) Has the technique or theory been subjected to peer review and publication? (c) What is the known or potential rate of error of the technique or theory when applied? (d) Were standards and controls applied and maintained? (e) Has the technique or theory been generally accepted in the scientific community? (SI-H-B5) (SI-H-B1) (SI-H-B4) |
| Life Science | |
| 6. | Analyze a diagram of a developing zygote to determine when cell differentiation occurs (LS-H-A3) |
| 7. | Identify the basic structure and function of nucleic acids (e.g., DNA, RNA) (LS-H-B1) |
| 8. | Describe the relationships among DNA, genes, chromosomes, and proteins (LS-H-B1) |
| 9. | Compare mitosis and meiosis (LS-H-B2) |
| 10. | Analyze pedigrees to identify patterns of inheritance for common genetic disorders (LS-H-B3) |

| GLE # | GLE Text and Benchmarks |
|-------|--|
| 11. | Calculate the probability of genotypes and phenotypes of offspring given the parental genotypes (LS-H-B3) |
| 12. | Describe the processes used in modern biotechnology related to genetic engineering (LS-H-B4) (LS-H-B1) |
| 13. | Identify possible positive and negative effects of advances in biotechnology (LS-H-B4) (LS-H-B1) |
| 15. | Compare the embryological development of animals in different phyla (LS-H-A3) |
| 17. | Describe and illustrate how factors affect gene frequency in a population over time and their consequences (LS-H-C3) |

Sample Activities

Activity 1: Comparison of Mitotic Cells (LS GLE: 9)

Materials List: prepared slides of animal mitosis (white fish blastula) and plant mitosis (onion root tips), microscopes, science learning log

Review correct microscopic techniques with students before beginning activity. Provide the students with prepared slides of animal cell division (e.g., white fish blastula) and plant cell division (e.g., onion root tip) and instruct them to examine each under a microscope. From the microscopic observations, the students are to find each phase of mitosis, make appropriate drawings, and label each. In their science *learning logs* ([view literacy strategy descriptions](#)), have the students discuss and list the differences they observed in the mitotic process occurring in the animal blastula as compared to that in the plant. If slides and microscopes are limited, have students rotate through set-ups of these slides and record their observations.

Activity 2: Comparison of Mitosis and Meiosis (SI GLE: 7; LS GLE: 9)

Materials List: diagrams of the stages of mitosis and meiosis or a computer with Internet access, modeling clay, Word Grid for Comparison of Mitosis and Meiosis BLM (one for each student)

Note: Activities 1 and 2 may be done concurrently depending upon the availability of slides and microscopes in the classroom.

The website <http://science.nhmccd.edu/biol/bio1int.htm#cycle> includes animations that can help students understand the differences between mitosis and meiosis. After reaching this site, a variety of suitable links will be displayed. Two good choices are “Cell Cycle Tutorial” from *Cells Alive* and “Mitosis vs Meiosis” from *PBS*. After observing the animations, have each student complete the *word grid* ([view literacy strategy descriptions](#)) found in Word Grid for

Comparison of Mitosis and Meiosis BLM and then summarize the major differences in these two processes. Students should save this grid for use in the think-pair-share activity which follows.

After a classroom discussion of mitosis and meiosis and using the above mentioned animations or other illustrations of these two processes, provide groups of students with modeling clay. Instruct students to role a piece of clay into a snake shape. This represents one chromosome. Then instruct students to make another snake shape. This represents the replication of the chromosome. Have students model the movement of the chromosome during the various phases of mitosis. Provide students with diagrams of mitotic cells (in no particular order). Do the same for meiosis so students can visually see during prophase II there is no replication of chromosomes and haploid cells are the result of that process.

Using the think-pair-share technique, have students individually study diagrams and models to list the differences they observe. Next, have them pair up with partners to discuss and organize the diagrams and models into their particular orders. Last, have the students form groups of four, share the findings of each pair, and through discussion and comparison of each student's completed *word grid*, develop a collaborative list of differences between the two cell processes. Have a student from each group report their list of differences to the entire group. Students should discuss their findings and resolve any differences to conclude this activity; suggest that each student revise their *word grid* as needed and save for review purposes.

Activity 3: A Very Simple Explanation (SI GLEs: 11, 13, 14, 16; LS GLE: 7)

Materials List: computer with Internet access, Molecular Structure of Nucleic Acids BLM (one for each student)

James Watson, an American Geneticist, and Francis Crick, an English Physicist, published a one page scientific article that described the molecular structure of DNA. The article which can be found at <http://www.nature.com/nature/dna50/watsoncrick.pdf> marked a discovery that has been one of the most profound in all of the history of science.

Distribute copies of the Molecular Structure of Nucleic Acids BLM for students to read. Have students discuss the article and comment on its readability and brevity. Students should critique the article based upon when it was first published (1953) and then from the perspective of today, 50 + years later, noting some of the major impacts this knowledge has had on society today. Students should also consider the rules of evidence listed below:

- (a) Can an expert's technique or theory be tested, has it been tested, or is it simply a subjective, conclusive approach that cannot be reasonably assessed for reliability?
- (b) Has the technique or theory been subjected to peer review and publication?
- (c) What is the known or potential rate of error of the technique or theory when applied?
- (d) Were standards and controls applied and maintained?
- (e) Has the technique or theory been generally accepted in the scientific community?

Watson, Crick and Maurice Wilkins shared the Nobel Prize in Physiology & Medicine for their discovery of the molecular structure of DNA. Maurice Wilkins was working independently in a

different lab. Another scientist, Rosalind Franklin, provided quantitative details about the shape and size of the double helix; this data was essential to the Watson-Crick Model of the DNA molecule. However, Franklin died in 1958 and could not be awarded the Nobel Prize posthumously. The race by science notables (Linus Pauling) and the un-notables to make this discovery and win the Nobel Prize has made this an interesting historical event. Some students will enjoy reading the account of this discovery and other interesting, anecdotal information in such books as *The Double Helix* by James Watson and *Rosalind Franklin and DNA* by Anne Sayre.

Activity 4: The Nucleic Acids-DNA and RNA (SI GLE: 7; LS GLE: 7)

Materials List: computer with Internet access (if available), templates of deoxyribose, ribose, phosphate, adenine, thymine, guanine, cytosine, uracil, and hydrogen bonds

If Internet access is available, have students visit the website <http://science.nhmccd.edu/biolint.htm#dna> and then select one of the animations that best suits your teaching style. This site can be used as a follow-up demonstration. If website is not available, provide a thorough discussion of the structure of DNA and RNA and a demonstration of the composition of DNA and RNA molecules. Divide the students into groups and instruct them to prepare paper cutouts or use plastic model pieces of the chemicals that compose DNA and RNA molecules. Be sure to include templates of the following components: deoxyribose, ribose, phosphate, adenine, thymine, guanine, cytosine, uracil, and hydrogen bonds. Issue an adequate number of model pieces to create a short strand of DNA and a complementary RNA strand.

Once the model is complete, discuss and demonstrate to students the nucleic acid biochemical processes of replication of DNA and transcription of DNA into RNA. Then have students use the DNA molecule they built to simulate DNA replication which will yield two identical strands of each side. Also, have students use a template of a single side of a piece of DNA to transcribe it into a complementary mRNA strand. If Internet access is available, the following website has tutorials on replication, transcription, and translation:

http://www.biology.arizona.edu/molecular_bio/problem_sets/nucleic_acids/nucleic_acids_1.html

Class discussion of forensic science evidence collection of DNA from a crime scene could be conducted here to show everyday use of DNA. Explain to students how the use of bodily fluids and hair strands with root tips found at crime scenes are analyzed against suspect DNA. Also, explain to students how DNA fingerprinting (procedure to analyze unknown DNA against known DNA strands) is used in paternity cases. Stress to the students that many career opportunities are open in the field of molecular genetics. DNA investigations are also used for identification of bodies (as is the 911 tragedy), the study of the evolution of human populations, the study of inherited disorders like Alzheimer's Disease, as well as forensics and paternity testing. Interested students may want to research these career opportunities. Someone from the parish DA's office or Sheriff's office who works in forensics might be a potential guest speaker.

Activity 5: Simulating Protein Synthesis (SI GLE: 7; LS GLE: 8)

Materials List: paper models of DNA and RNA from activity 4, paper templates of tRNA and rRNA, codon translation chart, science learning log, computer with Internet access (if available)

Websites for reference, demonstration, or enrichment concerning protein synthesis:

<http://www.accessexcellence.org/AE/ATG/data/released/0151-CharlesZaremba/index.html> or <http://science.nhmccd.edu/biol/biolint.htm#protein>. After reaching the latter site, select the animation that best suits your teaching style.

With the students divided into groups, the teacher should first simulate the mechanism of protein synthesis to demonstrate how DNA, through the production of RNA, determines the sequence of amino acids in a protein. Continuing to use model components of Activity 4, add tRNA and rRNA molecules to allow students to make amino acid chains and thus proteins. Students should use the models of DNA and mRNA made in Activity 3 to produce amino acid chains. Provide students with a written sequence of mRNA codons and a translation chart. Instruct them to use the chart to develop a correctly sequenced list of amino acids in the resulting protein. Excellent background information and practice exercises on protein synthesis can be found at the following website: <http://www.indiana.edu/~ensiweb/connections/conn.ind.html>.

As students read and complete the activity with the model components, have them record important information in a *split-page notetaking* ([view literacy strategy descriptions](#)) format. The Protein Synthesis BLM provides a guide for this process. Recording notes in this manner logically organizes information and ideas from multiple sources and allows inductive and deductive prompting for reviewing and learning the information. In conclusion, have students describe how chromosomes, DNA, RNA, and proteins relate to one another in their science *learning logs* ([view literacy strategy descriptions](#)); the concept of protein synthesis is extremely important in the study of biology.

Activity 6: Basic Embryology and Cell Differentiation (SI GLEs: 5, 7; LS GLEs: 6,

Materials List: illustrations of the stages of human embryological development, science learning log, computer with Internet access (if available)

Display illustrations and discuss with students the various stages of embryological development. If Internet access is available, the following website has an assortment of illustrations: <http://science.nhmccd.edu/biol/ap2int.htm#embryo>. After reaching this site select *Embryonic Development University of Pennsylvania* or any of the other sites that suit your teaching style.

Provide small groups of students with unlabeled diagrams, starting with a fertilized cell (zygote) and terminating with the gastrula stage of the embryo. Have students use notes, text book, and reference materials to provide all appropriate labels, including an identifying label for the stage at which cell differentiation occurs. To conclude activity, lead students in a discussion of how one could research embryonic development. Students should discuss experimentation of embryos, observation of embryos, literature survey of embryonic development, and models. A

SQPL ([view literacy strategy descriptions](#)) activity is an appropriate strategy to introduce the stem cell controversy. In this strategy the teacher generates a statement that causes students to wonder, challenge, and question. An example of such a statement is “Someday soon the living stem cells of embryos may keep adults alive, healthy, and youthful.” (This is from [Clones, Cats, and Chemicals](#), published by NSTA Press in 2004.) Write the statement on the board, overhead, or a handout. Have the students work in pairs to generate two or three questions they would like answered. Compile student generated questions and write on the board and as a class, decide which questions to answer. Add your own questions if important ones were overlooked by the students. Instruct students to record these questions in their science *learning logs* ([view literacy strategy descriptions](#)). Have students read reference materials or search the Internet to answer the questions and record in their science *learning logs*. A good website for information on stem cells is <http://stemcells.nih.gov/info>. As content is covered, allow students to share their answers and continue to record in their science *learning log*; the recorded material can be used for later study. Be sure to discuss the differences between stem cell research using umbilical cord blood and frozen embryos. Discuss the pros and cons of both aspects. Possibly have students bring newspaper or Internet articles discussing the two research opportunities and discuss with class.

Activity 7: Embryological Development (SI GLEs: 5, 7; LS GLE: 15)

Materials List: illustrations of embryological development in humans, illustrations of embryological development in other vertebrate and invertebrate animal phyla, computer with Internet access (if available)

After a discussion on embryological development and Activity 1, divide the class into small groups; provide each group with an illustration of the embryological development of humans, previously cut into single stages. These can be obtained from most biology reference and text books. If Internet access is available, printable diagrams of a frog, starfish, chick, and human embryological development can be obtained at <http://cas.bellarmine.edu/tietjen/Evolution/Species%20Concepts/Hox%20and%20Embryo.htm>.

Instruct the members of each group to organize the illustrations into the proper order, from least organized to most organized. Once completed, have the students explain their sorting of the pictures. Have the students record the similarities and differences of the various developmental stages of the different animals. Conduct a follow-up discussion based on the question, “How does the information from this activity support animal/vertebrate evolution?”

Activity 8: Basic Genetics—The Monohybrid Cross (SI GLEs: 5, 7; LS GLE: 11)

Materials List: small Post-it Notes® or paper cut into small squares

Discuss basic genetic vocabulary along with Mendel’s laws and demonstrate the use of Punnet squares to determine the probability of genotypes and phenotypes. After discussing with students homozygous and heterozygous genotypes in offspring, have the students work with a partner to complete the following exercise. Select one of Mendel’s basic experiments involving

dominant and recessive traits and instruct the students to make cutouts of the basic alleles involved (e.g., T = tall and t = short pea plants). Small squares of paper or small Post-it Notes® can be used for these cutouts. Next, have the students perform a monohybrid cross between a TT X tt, a Tt X Tt, then a Tt X tt. From these crosses, have the students determine the respective ratios for the phenotypes and genotypes. Next, have students complete Punnett squares to determine probability of alleles and traits in offspring of monohybrid crosses. Be sure to include examples of incomplete dominance traits in teacher examples. Use teacher guidance to lead students through the completion of a simple dihybrid cross.

Activity 9: The Pedigree Chart (SI GLEs: 5, 7; LS GLEs: 10, 17)

Materials List: pedigree charts of common human genetic disorders such as hemophilia, red-green color blindness, or polydactyl; computer with Internet access (if available)

Begin with a teacher demonstration of the interpretation of a human pedigree. Divide students into small groups and give each group a pedigree chart and a handout containing the information for a genetic disorder, such as Queen Victoria hemophilia, red-green color blindness, or polydactyly found in most biology textbooks. If Internet access is available, the following two web sites display useable pedigrees: <http://www.biologycorner.com/bio4/notes/pedigrees.php> and www.horton.ednet.ns.ca/staff/selig/handouts/bio12/mengenetics/slpedigrees.pdf. Using this information and the pedigree chart, have students trace the genetic disorder from its origin to a specified time and determine the pattern of inheritance. Have students describe the consequences of the illustrated genetic disorder on the target population. Finally, guide students through a discussion in which students describe factors that could affect the frequency of the defective allele in a population over time. An excellent example is the incidence of polydactyly present in Amish communities of the United States or the incidence of hemophilia in the royal families of Europe compared to the frequencies of these disorders in the general population. Factors such as small, isolated populations and nonrandom mating are evident in these examples.

Activity 10: Recombinant Gene Technology and Genetic Engineering (SI GLEs: 9, 14; LS GLEs: 12, 13)

Materials List: scissors, tape, colored paper, paper cutouts of DNA sequences, paper model of a plasmid, paper outline of an *E.coli* bacterium, science learning log, Specific Assessment Rubric BLM (one for each group), computer with Internet access (if available)

After a discussion on gene therapy and genetic engineering, divide the students into small groups. Provide each group with a cutout of a segment of a human chromosome (DNA strand showing base sequences) containing various made up genes (DNA segments) such as insulin. Use a different color of paper for each gene included. Following this, instruct the students that their scissors represent a restriction enzyme that will cut the insulin gene from the chromosome. Provide the students with a paper cutout of a bacterial plasmid. (Be sure the plasmid is a different color than the genes being modeled in the first part of this activity.) Using another restriction enzyme, cut the circular plasmid at the indicated site, insert the human insulin gene, and then

tape the segments to reform the circular plasmid. Next, insert the plasmid with the insulin gene into a model (or outline) of an *E. coli* bacterial cell and inform the students that from this point on, every time the bacterial cell divides, the human insulin gene will be replicated along with the bacterial plasmid and passed to the new bacterial cells, and each of these cells will be capable of producing human insulin. If available, consult the website <http://www.sumanasinc.com/webcontent/anisamples/molecularbiology/plasmidcloning fla.html> for a good animation of recombinant DNA and bacterial cloning. Explain that this process, recombinant DNA, can be done with a simulated virus (vector), and that the virus can be used as a way of introducing genetic material into another organism.

Have students read or research to locate examples of genetic engineering and biotechnology in use today. They should record their findings in their science *learning logs* ([view literacy strategy descriptions](#)) for use in the Activity-Specific Assessment for Activity 10. (A suggested rubric for this presentation is available in the Specific Assessment BLM for Activity 10.) Divide the class into two large groups and conduct a discussion of the advantages, disadvantages, and ethics of bioengineering. Instruct one group to take a supportive position and the other to assume a nonsupportive position.

Sample Assessments

General Guidelines

- The student is to be monitored throughout the work on all activities via teacher observation and journal entries.
- All student-developed products should be evaluated as the unit continues.
- Student investigations should be evaluated with a rubric.
- When possible, students should assist in developing any rubrics that will be used.
- For some multiple-choice items on written tests, ask students to write a justification for their chosen response.

Assessment techniques should include use of drawings/illustrations/models, laboratory investigations with reports, and laboratory practicals (problem-solving and performance-based assessments), analysis of scenarios, group discussion and journaling (reflective assessments), and paper-and-pencil tests (traditional summative assessments). Assessments could include the following:

General Assessments

- The student will explain the significance of haploid and diploid cells produced during mitosis and meiosis.
- The student will develop a Venn diagram showing the similarities and differences between mitosis and meiosis.
- The student will describe the relationship among DNA, genes, and chromosomes.

- The student will correctly identify the phenotype and genotypes when given different allele combinations.
- The student will calculate the probability of phenotypes and genotypes when provided with specific crosses (e.g., Tt X tt).
- Given complete and incomplete dominance problems, the student will determine the phenotype of the offspring if a white carnation (WW) to be crossed with a red carnation (RR).
- The student will interpret a pedigree chart and explain how it is used in genetics studies.
- The student will describe what might happen to the resulting protein if some of the nucleic acids in the simulated DNA molecule were reversed.

Activity-Specific Assessments

- Activity 1: Provide students with unlabeled figures of cells undergoing mitosis, in no particular order. Be sure to include figures of all stages. Students will first label each cell stage of mitosis. Next, they will label each cell for its parts (nuclear membrane, nucleus, chromosomes, centrioles, mitotic spindle apparatus, and cell membrane). Then students will number the cells in order of progress.
- Activity 4: Given a sequence of bases on a single side of a DNA strand, students will list the bases on the complementary side of the DNA and then list the sequence of bases in the mRNA strand complementary to the original strand of DNA.
- Activity 8: Using different traits, such as free earlobes (F) versus attached earlobes (f) or tongue rolling (T) versus non-rolling tongue (t) and Punnett squares, students will perform monohybrid crosses to predict the genotypic and phenotypic probabilities for offspring.
- Activity 10: Students in groups will research an area in recombinant gene technology or bioengineering (e.g., plants that are resistant to certain insects, human/animal cloning, stem cell research, mad cow disease) and its impact on modern medicine. With this research, have student groups explain to the class their findings in a poster presentation or a *PowerPoint*® presentation if the technology is available. May be assessed with teacher-made rubric. See the Activity 10 Specific Assessment Rubric BLM for an example of such a rubric.

Resources

- *Access Excellence at the National Health Museum*. Available online at <http://www.accessexcellence.org/>. This has activities and current information for teachers.

- *Biology*. North Harris College Department of Biology. Available online at <http://science.nhmccd.edu/biol/>. This site has animations and interactive tools for both teachers and students.
- *Blueprint of the Body*. Available online at <http://www.cnn.com/SPECIALS/2000/genome>. This contains an interactive genome guide for teachers and students.
- *Cold Spring Harbor Labs*. Available online at <http://www.dnalc.org/home.html>. This site has general information, animations, video clips on “genes in your life.”
- *DNA from the Beginning*. Available online at <http://www.dnafb.org/dnafb/>. This site has information and animations on both classical and molecular genetics.
- *DNA Interactive*. Available online at <http://www.dnai.org/index.html>. This site has lesson plans available to teachers.
- *DNA Learning Center Biology Animation Library*. Available online at <http://www.dnalc.org/ddnalc/resources/animations.html>. This site has animations of molecular biotechnology.
- *Genetic Engineering*. Association of British Pharmaceutical Industry. Available online at <http://www.abpischools.org.uk/>. This site has interactive content for students and teachers.
- *Genetic Science Learning Center*. Available online at <http://gslc.genetics.utah.edu/>. This site contains both the basics of genetics as well as current biotechnology information.
- *Genome News Network (GNN)*. Available online at <http://www.genomenewsnetwork.com/resources/timeline/>. This contains a Genomics Timeline Overview from genes to genomes.
- *Genomics and Disease Prevention*. Available online at <http://www.cdc.gov/genomics/update/current.htm>. This provides a weekly update on human genetic research and disease.
- *Human Genome Project: Exploring Our Molecular Selves*. Available online at <http://www.genome.gov/Pages/EducationKit>. This is an online education kit for understanding the human genome.
- *Meiosis*. Available on line at <http://www.cellsalive.com/meiosis.htm>. This site contains explanations and diagrams of the stages of meiosis.
- *National Cancer Institute—Cancer Facts/Gene Therapy*. Available online at http://cis.nci.nih.gov/fact/7_18.htm. This site describes gene therapy for cancer.
- *National Human Genome Research Institute*. Available online at <http://www.genome.gov/>. This site has FAQs about genetic disorders.
- *The Puzzle of Inheritance: Genetics and the Methods of Science* (1997). Biological Sciences and Curriculum Study. Colorado Springs, CO.
- *Rubrics*. Available online at <http://rubistar.4teachers.org/index.php>. This site enables teachers to design assessment rubrics.
- *Stem Cells*. Available online at <http://stemcells.nih.gov/info>. This website has a wide range of information about stem cells and is appropriate for both teaches and students.

Biology
Unit 3: Traits and Classification of Life

Time Frame: Approximately one and a half weeks



Unit Description

This unit involves students in identifying the characteristics used to define life, as we know it, on planet Earth and the systems used to organize these life forms into various groups (e.g., classification).

Student Understandings

This unit centers on the characteristics of all forms of life. With this information, students should identify similarities and differences in life forms and classify examples according to identifiable traits and place them in the proper taxonomic categories.

Guiding Questions

1. Can students differentiate among the terms *taxonomy*, *classification*, and *nomenclature*?
2. Can students list and describe six kingdoms of organisms?
3. Can students define the term *trait*?
4. Can students list five easily identifiable traits of human beings (*Homo sapiens*)?
5. Can students define and describe a dichotomous key?

Unit 3 Grade-Level Expectations (GLEs)

| GLE # | GLE Text and Benchmarks |
|---------------------------|---|
| Science As Inquiry | |
| 2. | Describe how investigations can be observation, description, literature survey, classification, or experimentation (SI-H-A2) |
| 6. | Use technology when appropriate to enhance laboratory investigations and presentations of findings. (SI-H-A3) |
| 7. | Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4) |
| Life Science | |
| 18. | Classify organisms from different kingdoms at several taxonomic levels, using a dichotomous key (LS-H-C4) |
| 19. | Compare characteristics of the major kingdoms (LS-H-C5) |

| GLE # | GLE Text and Benchmarks |
|-------|--|
| 20. | Analyze differences in life cycles of selected organisms in each of the kingdoms (LS-H-C6) |

Sample Activities

Activity 1: General Classification (SI GLE 7; LS GLE: 18)

Materials List: everyday items for classification, such as different types of buttons, screws, bolts, geometric figures, small toys, and samples of 7-10 different leaves; science learning log; a computer with Internet access (if available)

Divide the class into workable groups. Provide students with various materials to be used to understand the science behind organizing life forms into various groups (i.e., taxa). To start, provide the students with everyday items that can be classified (e.g., a container of various types of buttons, screws, bolts, geometric figures, small toys, or other objects). Using this approach, have students select the traits (characteristics) they are going to use to develop their classification scheme, and then instruct them to put these into a dichotomous key format. Relate this activity to biological classification by concluding with a review of the seven basic taxonomic categories used in classifying organisms and binomial nomenclature, using Man (*Homo sapiens*) as an example. Instruct students to record this information in their science *learning logs* ([view literacy strategy descriptions](#)) for future reference and review.

Upon completion of this activity, have students switch the keys that they developed among the groups and try to classify the everyday items using the keys. Teacher may need to lead a demonstration of one or two examples. Next, extend the classification process to biological specimens by providing small groups of students with 7-10 samples of leaves. Students are to carefully observe each leaf and construct a dichotomous key based on the properties of the leaves (e.g., Is it a simple or compound leaf?). Once students have completed the key, have students switch keys with another group to classify their item and make suggestions on improving the key. As a whole class, determine the best key for these leaves.

If a computer with Internet access is available, there are several on-line lessons and activities addressing classification at the following website: <http://www.nclark.net/Classification>.

Activity 2: Kingdoms and Phyla (SI GLEs: 2, 6, 7; LS GLEs: 19, 20)

Materials List: biology reference and text books, computer with Internet access (if available), presentation software (if available), materials for student handouts, posters, or transparencies, Classification of Organisms BLM (one for each student)

Before beginning activity, have students discuss various ways to research a topic (e.g., through experimentation, literature survey, or classification). Through text readings and Internet

resources, have students research the identifying characteristics of the six major kingdoms and selected phyla from each kingdom, including life cycles of selected organisms and exemplary organisms. Include the life cycle of vectors that carry diseases found in Louisiana; one notable vector is the mosquito that transmits West Nile Encephalitis, Eastern Equine Encephalitis, and a host of other diseases.

Divide the class into small, collaborative groups. Assign a kingdom or phylum to each group of students. Students will summarize their findings in handouts and slide or multimedia presentations and present them to the class. If presentation software is not available, have students construct visuals (i.e. posters, handouts, transparencies) to use in their presentations. Provide each student with a copy of the Classification of Organisms BLM. Students at desks should be recording what they are hearing in the presentations on their Classification of Organism BLM, which is a type of *graphic organizer* ([view literacy strategy descriptions](#)). *Graphic organizers* help students logically organize information from multiple sources and facilitate understanding of key concepts. They are useful in reviewing important details and concepts.

Activity 3: Taxonomic Classification (SI GLE: 7; LS GLEs: 19, 20)

Materials List: representative specimens or illustrations of specimens from the six kingdoms and the major phyla of the kingdoms, Classification of Organisms BLM from activity 2

Divide the class into small, collaborative groups. Provide each group with representative specimens or representations of specimens from the six kingdoms and allow students to use the text, other reference materials, or dichotomous keys to group the organisms into their appropriate kingdoms, phyla, classes, and possibly orders. Next, have them identify, by their scientific names, selected specimens using a taxonomical key. The classroom can be set up in seven stations with specimens or illustrations from each kingdom in a different station. To create an additional station, divide specimens from the animal kingdom into two stations, invertebrates and vertebrates. Groups can rotate through the stations until they have completed all the classification tasks. Review by discussing or recording traits used to classify organisms into major phyla of the kingdoms. Have each student complete the Classification of Organisms *graphic organizer* ([view literacy strategy descriptions](#)) they began in activity 2; this document includes the major phyla of kingdoms, their identifying traits, and examples of organisms in each phylum.

If Internet access is available, an online lesson can be obtained at <http://csdl.tamu.edu/FLORA/tfplab/lab1a.htm>. This site provides information and exercises on taxonomy, classification, nomenclature, and keys.

Sample Assessments

General Guidelines

- Students should be monitored throughout the work on all activities via teacher observation and journal entries.
- All student-developed products should be evaluated as the unit continues.
- Student investigations should be evaluated with a rubric.
- When possible, students should assist in developing any rubrics that will be used.
- For some multiple-choice items on written tests, ask students to write a justification for their chosen response.

Assessment techniques should include use of drawings/illustrations/models and laboratory practicals (problem-solving and performance-based assessments), group discussion and journaling (reflective assessment), and paper-and-pencil tests (traditional summative assessments). Assessments could include the following:

General Assessments

- The student will create a multimedia presentation on a kingdom and phylum.
- The student will determine the best leaf key from amongst those created by class groups.
- Use rubrics to self and peer evaluate student multimedia presentations.

Activity-Specific Assessments

- Activity 1: Upon completion of Activity 1, students will use a dichotomous key. Provide groups of students with 5-7 different fruits and vegetables or other organisms. Allow students to open the fruits or vegetables to investigate fully their composition. Have students use a dichotomous key of fruits and vegetables to determine the classification of each fruit or vegetable based on the key. A dichotomous key for classifying fruits can be found at http://cps.bu.edu/download/gk12/materials/dichotomous_key.doc. If other organisms are used, allow students to examine them in a safe manner and then classify with the appropriate dichotomous key.
- Activity 2: Upon completion of student presentations, teacher will assess student presentations on correctness and completeness of material in presentation. Teacher will then ask the rest of the students in the class content specific questions from each presentation. For an example rubric for this presentation, see Classification Presentation BLM.

- Activity 3: Provide students with characteristics and organisms of the major kingdoms, and students will place these characteristics and organisms into their proper kingdoms.

Resources

- *Basics: Classification, Nomenclature, and Key Making*. Available online at <http://csdl.tamu.edu/FLORA/tfplab/lab1a.htm>
- *Classification lesson plans and interactive activities for students and teachers*. Available at <http://www.nclark.net/Classification>
- *Dichotomous key for classification of fruits*. Available online at http://cps.bu.edu/download/gk12/materials/dichotomous_key.doc
- *Rubrics*. <http://rubistar.4teachers.org/index.php>

Biology
Unit 4: Changes Over Time

Time Frame: Approximately two weeks



Unit Description

The unit introduces students to the basic concepts behind the processes involved in evolution, including natural selection and adaptations.

Student Understandings

Students should develop an understanding of how to examine fossil evidence and other specimens to explain evolutionary patterns. Given a trait or characteristic, students will examine how it evolved to its current status (structure and function). This might include considering the analogous structures, such as arms, flippers, and wings; the scales of reptiles and feathers of birds; the shapes and colorations of flowers or leaves; and heart chambers.

Guiding Questions

1. Can students identify Charles Darwin and what he contributed to the understanding of science?
2. Can students describe two major ideas Darwin put forth in the *Origin of Species*?
3. Can students discern why fossils are important to the understanding of evolution?
4. Can students name one example from the fossil record that supports that evolution has occurred?
5. Can students describe radioactive dating? Can students relate how is it used to determine the age of a fossil?
6. Can students describe how DNA and proteins can be used as evidence to support the theory of evolution?
7. Can students provide some examples and explain how natural selection occurs?
8. Can students explain whether or not the antibiotic resistance of microbes is evidence for evolution?

Unit 4 Grade-Level Expectations (GLEs)

| GLE # | GLE Text and Benchmarks |
|---------------------------|--|
| Science as Inquiry | |
| 6. | Use technology when appropriate to enhance laboratory investigations (SI-H-A3) |

| GLE # | GLE Text and Benchmarks |
|--------------------------------|--|
| 7. | Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4) |
| 8. | Give an example of how new scientific data can cause an existing scientific explanation to be supported, revised, or rejected (SI-H-A5) |
| 11. | Evaluate selected theories based on supporting scientific evidence (SI-H-B1) |
| 13. | Identify scientific evidence that has caused modifications in previously accepted theories (SI-H-B2) |
| Life Science | |
| 14. | Analyze evidence on biological evolution utilizing descriptions of existing investigations, computer models, and fossil records (LS-H-C1) (LS-H-C2) |
| 16. | Explain how DNA evidence and the fossil record support Darwin's theory of evolution (LS-H-C2) |
| 33. | Compare structure to function of organs in a variety of organisms (LS-H-F1) |
| Earth and Space Science | |
| 17. | Determine the relative ages of rock layers in a geologic profile or cross section (ESS-H-C2) |
| 18. | Use data from radioactive dating techniques to estimate the age of earth materials (ESS-H-C2) |
| 22. | Analyze data related to a variety of natural processes to determine the time frame of the changes involved (e.g., formation of sedimentary rock layers, deposition of ash layers, fossilization of plant or animal species) (ESS-H-C5) |

Sample Activities

Activity 1: The Fossil Record as Evidence for Evolution (SI GLEs: 8, 11, 13; LS GLEs: 14, 16; ESS GLEs: 17, 18, 22)

Materials List: illustrations of rock layers including fossils, examples of fossils or illustrations of fossils, science learning log, computer with Internet access (if available), video or CD-ROM depicting Darwin's voyage (optional), Evolution Opinionnaire BLM (one for each student)

Before exploring the topic of evolution, conduct a student *opinionnaire* ([view literacy strategy descriptions](#)) by distributing a copy of the Evolution Opinionnaire BLM to each student. Have students work in pairs to read and discuss each statement, then write reasons for their opinions. Afterward, allow students to share their opinions and encourage debate and discussion of each statement. The *opinionnaire* and discussion serve to heighten students' expectations of the content that follows and provide a bridge to information and ideas about evolution. Follow this activity with direct instruction, a video, or CD-ROM program that includes the story of Darwin's voyage, the development of his theory of evolution, and natural selection. This activity will set the stage for examining the changes in life on Earth over time.

Divide students into small groups and provide them with illustrations depicting rock layers in a geologic profile that includes fossil layers. Provide data from radioactive dating techniques for the fossil layers plus an explanation of radioactive dating and how this is used to determine the approximate age of a fossil. Discuss the estimated age of Earth (4.6 billion years) using radioactive dating data. Instruct students to examine the rock, ash, fossil layers, and rock layers to determine the sequence of life forms illustrated. Have students compare the types of fossils found in each layer. Ask students to observe the variations in the fossils or fossil layers and describe how information obtained from fossils can be used as evidence to support the theory of evolution. Provide students with additional information and illustrations from the fossil record, and instruct them to construct a simple evolutionary timeline based on the available data. The major biological supply companies have kits of fossils and CD-ROMs that supply pictures of the different geologic times. Also, the website <http://www.enchantedlearning.com/subjects/Geologictime.html> provides a detailed geologic time line and the website <http://www.ucmp.berkeley.edu/fosrec/BarBar.html> offers an on-line lesson plan for the study of fossils in rock layers.

Recently, DNA extracted from fossils has added evidence to support the theory of evolution. Provide reference materials and instruct students to research the methods used to extract DNA from fossils as well as the use of the DNA after extraction. The discovery of mitochondrial DNA found in the fossilized remains of Neanderthals is one example of DNA being used in evolutionary biology. Remind students that DNA directs the construction of proteins within cells and that similarity of protein structure in different animal groups is also evidence for evolution. If Internet access is available, the following website has information on DNA in fossils: <http://news.bbc.co.uk/2/hi/science/nature/4260334.stm>.

Refer back to Activity 7 (Embryological Development) in Unit 2 to look at the embryological development of various animals as evidence for evolution. Conduct a follow-up discussion based on the question, “How does the information from fossils, DNA, and embryological development support the evolution of animals?” Have students summarize and record this evidence in their science *learning logs* ([view literacy strategy descriptions](#)).

Activity 2: Evidence for Evolution Based on Organ-System Comparisons (SI GLEs: 6, 7, 8, 11, 13; LS GLEs: 14, 33)

Materials List: models or illustrations of forelimbs of animals from different phyla (e.g., bird, bat, dolphin or seal, dog or cat, horse or sheep, human, and possibly a pterodactyl), illustrations of organ systems in selected organisms (e.g. digestive systems in hydra, grasshopper, worm, bird, and human), science learning log, computer with Internet access (if available)

With students divided into small groups, provide each group with illustrations, diagrams, or models of the forelimbs of various animals from different phyla (e.g., bird, bat, dolphin or seal, dog or cat, horse or sheep, human, and possibly a pterodactyl). These are available in most textbooks, at biology supply companies or can be downloaded from a website such as <http://nsm1.nsm.iup.edu/rgendron/EvolutionOnTheWeb.shtml>. At this site, scroll down to *nothing makes sense in biology except in light of evolution* and click on *homologies*. Next, scroll

down and locate the forearm structures. Instruct the students in each group to carefully observe and study the illustrations and to record and discuss the observed differences and similarities. In addition, ask students to write in their science *learning logs* ([view literacy strategy descriptions](#)) an explanation of how the similarities in skeletal structures support the theory of biological evolution.

Follow the skeletal comparison with an examination of the evolution of organs such as digestive systems (e.g., hydra, grasshopper, worm, bird, and human), breathing mechanisms (e.g., insect, fish, frog, bird, and human), hearts (e.g., earthworm, fish, amphibian or reptile, bird, and human), or central nervous systems (e.g., worm, fish, amphibian, reptile, bird, and mammal). Provide diagrams, transparency illustrations, or models. Have students observe, compare, and record how these structures changed as life evolved and adapted to various environments or niches. Examination of the evolution of either breathing mechanisms or heart chambers as organisms evolved to adapt to life on land, dry habitats, and to warm-blooded organisms that have internal temperature control provides easily interpreted, clear evidence of evolution and the adapted functions of these organs. Conclude with a class discussion of the evidence for evolution provided by organs or systems and have students record this evidence in their science *learning logs*. Be sure to include plant organ systems in your discussion. This activity also serves as a precursor for the study of human organ systems of Unit 6. Allow students to discuss any scientific evidence that does not support Darwin's theory of evolution.

Activity 3: Adaptation (SI GLEs: 6, 7; LS GLE: 14)

Materials List: reference materials on natural selection and adaptations, computer with Internet access (if available), presentation software (optional)

In a teacher-led demonstration/discussion, develop a model that presents evidence as to how natural selection has led to adaptation of certain life forms to particular environments (e.g., the peppered moths in England during the industrial revolution). If Internet access is available, the website <http://www.biologybinder.com> offers a virtual peppered moth activity for students. Assign groups to develop their own model, using research materials from the library such as encyclopedias, scientific magazines, and the Internet. Students can select one of the following to construct their model: bacterial resistance to antibiotics, the emergence of *E. coli* 0157-H7 as a new human pathogenic bacterium, the emergence of life forms from water to a land environment (both plants and animals), adaptations of animals that migrated to polar regions or deserts, adaptations for deep sea dwelling organisms, or other life forms of their choosing. Allow students ample time for research during class. Have students create a lecture or multimedia presentation if the software is available, with figures, transparencies, or slides. Students should explain their model to the class using their lecture or presentation.

Activity 4: Evolution as a Biological Theme (SI GLEs: 6, 7, 11, 13; LS GLE: 14)

Materials List: reference materials on biomes and ecosystems, science learning log, computer with Internet access (if available)

Evolution involves a series of changes, gradual or sporadic, that occur in nature and the universe. Through student research and subsequent class presentations and discussion, students should understand that evolution is a fundamental theme of science.

Divide the class into small groups and assign each group of students a specific biome or ecosystem (e.g., tundra, rainforest, savanna, coral reef, desert, and grassland) and have the students list the characteristics of each. Have students identify a predominant animal that lives in that ecosystem along with its characteristics and its needs. At this point, write the following prompt on the board or overhead for a *SPAWN* ([view literacy strategy descriptions](#)) activity: “You have special powers and are able to alter some of the characteristics of the ecosystem (e.g., grassland becomes desert, desert becomes tundra, and coral reef becomes open ocean). What would you change and what would happen to your animal in this new ecosystem?” Instruct students to copy the prompt in their science *learning logs* ([view literacy strategy descriptions](#)) and allow approximately ten minutes for a written response. Have students in each group share their responses and then discuss with the class evolutionary characteristics of those organisms and what must change in order for that species to survive. A comparison of Darwin’s theories on natural selection, survival of the fittest, and Lamarck’s theory would be applicable at this time. Point out that Darwin had no knowledge of genetics, DNA, mutations, etc., but made his points strictly on observations.

Sample Assessments

General Guidelines

- Students should be monitored throughout the work on all activities via teacher observation and journal entries.
- All student-developed products should be evaluated as the unit continues.
- Student investigations should be evaluated with a rubric.
- When possible, students should assist in developing any rubrics that will be used.
- For some multiple-choice items on written tests, ask students to write a justification for their chosen response.

Assessment techniques should include use of drawings/illustrations/models, laboratory investigations with reports, laboratory practicals (problem-solving and performance-based assessments), analysis of scenarios, group discussion and journaling (reflective assessment), and paper-and-pencil tests (traditional summative assessments). Assessments could include the following:

General Assessments

- The student will explain how fossil evidence supports that evolution has taken place.
- The student will discuss how homologous structures are important in supporting the theory of evolution.

- The student will explain how adaptation supports Darwin’s theory of natural selection.
- The student will apply Darwin’s “survival of the fittest” theory to explain adaptation.

Activity-Specific Assessments

- Activity 2: Provide the students with an illustration of a body system (not previously discussed in class, plant or animal) and its evolutionary pattern along with the organisms that possess that system. Students will analyze the illustrations and explain what specific parts evolved in each organism and why they believe each organism evolved in that manner.
- Activity 3: From each presentation, students will take notes on presentations. Develop questions from student presentations and administer a quiz immediately after as a formative assessment.
- Activity 4: Students will write a short narrative explanation about their animal and the adaptations and possible alterations of characteristics that must be necessary in order for that organism to survive in the new ecosystem.

Resources

- *DNA in fossils*. Available online at <http://news.bbc.co.uk/2/hi/science/nature/4260334.stm>. Describes technology used to extract DNA from fossils.
- *Evolution*. (2003). Chicago, IL: WGBH. Available online at <http://www.pbs.org/wgbh/evolution>. This web site explains many aspects of evolution, including Darwin, change, extinction, and survival.
- *Evolution on the Web for Biology Students*. Available online at <http://nsm1.nsm.iup.edu/rgendron/EvolutionOnTheWeb.shtml>. This site contains information about geologic time scales and evidence supporting evolution.
- “Geologic Time Scale.” *Enchanted Learning*. Available online at <http://www.enchantedlearning.com/subjects/Geologictime.html>. This site has information on geologic time scales and pivotal events.
- *Mitochondrial DNA in fossils*. Available online at <http://www.talkorigins.org/faqs/homs/mtDNA.html>. This site has information on mitochondrial DNA found in Neanderthals
- Pojeta, J. and Springer, D. A. (2001). *Evolution and the Fossil Record*. Alexandria, Virginia: American Geological Institute and The Paleontological Society. Available online at <http://www.agiweb.org/news/evolution>. This is a “non-technical” introduction to evolution.
- *Teaching About Evolution and the Nature of Science*. National Academy of Science. (1998). Washington, D.C: National Academy Press. Available online at

- www.nap.edu/readingroom/books/evolution98. This site has lesson plans for teachers that include student activities and investigations.
- *Radioactive dating of fossils, including C-14 dating and other methods.* Available online at <http://science.howstuffworks.com/carbon-14.htm>

Biology

Unit 5: Balance in Nature

Time Frame: Approximately three weeks



Unit Description

This unit engages students in exploring the importance of biogeochemical cycles in the environment and the significance of maintaining balance within these cycles. The activities explored in this unit include the cycling of oxygen, carbon dioxide, and adenosine triphosphate (ATP) during photosynthesis and cellular respiration. Other cycles that are explored include water, nitrogen, and phosphorous. Activities in this unit also investigate trophic levels and energy flow within ecosystems.

Student Understandings

Students should be able to explain the dynamics of the process of maintaining a balance within ecosystems and the role chemical processes (photosynthesis and cellular respiration) play in this regard. Students are expected to have a general knowledge about various cycles (e.g., water, energy, and ATP) and how they function around a continuing effort to achieve and maintain equilibrium. Students are also expected to recognize food and energy hierarchy within an ecosystem.

Guiding Questions

1. Can students illustrate the flow of carbon and oxygen in these cycles?
2. Can students analyze balanced equations of photosynthesis and aerobic respiration to explain the relationship between these two processes?
3. Can students explain the function of ATP in the cells of living organisms?
4. Can students analyze a food web in order to trace the flow of energy in the ecosystem shown?
5. Can students interpret a food and energy pyramid and explain why there is less biomass at each level from the base to the top of the food pyramid?
6. Can students explain why the Sun is vital to all ecosystems?
7. Can students recognize the dynamics of a population and analyze the consequences of the loss of organisms in its food supply or the impact of the loss of one of its predators?
8. Can students analyze a scenario to identify positive and negative effects of human actions on an ecosystem?

Unit 5 Grade-Level Expectations (GLEs)

| GLE # | GLE Text and Benchmarks |
|--------------------------------|---|
| Science as Inquiry | |
| 1. | Write a testable question or hypothesis when given a topic (SI-H-A1) |
| 2. | Describe how investigations can be observation, description, literature survey, classification, or experimentation. (SI-H-A2) |
| 3. | Plan and record step-by-step procedures for a valid investigation, select equipment and materials, and identify variables and controls (SI-H-A2) |
| 4. | Conduct an investigation that includes multiple trials and record, organize, and display data appropriately (SI-H-A2) |
| 5. | Utilize mathematics, organizational tools, and graphing skills to solve problems (SI-H-A3) |
| 7. | Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4) |
| 9. | Write and defend a conclusion based on logical analysis of experimental data (SI-H-A6) (SI-H-A2) |
| 10. | Given a description of an experiment, identify appropriate safety measures (SI-H-A7) |
| 15. | Analyze the conclusion from an investigation by using data to determine its validity (SI-H-B4) |
| Life Science | |
| 23. | Illustrate the flow of carbon, nitrogen, and water through an ecosystem (LS-H-D1) (SE-H-A6) |
| 24. | Analyze food webs by predicting the impact of the loss or gain of an organism (LS-H-D2) |
| 25. | Evaluate the efficiency of the flow of energy and matter through a food chain/pyramid (LS-H-D2) |
| 26. | Analyze the dynamics of a population with and without limiting factors (LS-H-D3) |
| 27. | Analyze positive and negative effects of human actions on ecosystems (LS-H-D4) (SE-H-A7) |
| 28. | Explain why ecosystems require a continuous input of energy from the sun (LS-H-E1) |
| 29. | Use balanced equations to analyze the relationship between photosynthesis and cellular respiration (LS-H-E1) |
| 30. | Explain the role of adenosine triphosphate (ATP) in a cell (LS-H-E2) |
| Earth and Space Science | |
| 1. | Describe what happens to the solar energy received by Earth every day (ESS-H-A1) |
| 2. | Trace the flow of heat energy through the processes in the water cycle (ESS-H-A1) |
| 3. | Describe the effect of natural insulation on energy transfer in a closed system (ESS-H-A1) |

| | |
|-----|---|
| 13. | Explain how stable elements and atoms are recycled during natural geologic processes (ESS-H-B1) |
| 15. | Identify the sun-driven processes that move substances at or near Earth's surface (ESS-H-B2) |

Activity 1: The Cycling of Oxygen, Carbon Dioxide, and ATP During Photosynthesis and Cellular Respiration (LS GLEs: 23, 28, 29, 30; ESS GLEs: 1, 2, 3, 15)

Materials List: illustration of the water cycle, Photosynthesis Process Guide BLM (one for each student), computer with Internet access (if available)

Review with students the components of balanced chemical equations; symbols, reactants, products, subscripts, coefficients, and yield arrows. Begin by displaying an illustration of the water cycle. Lead students through the process of tracing water molecules and energy through the steps in this cycle; be sure to trace the flow of heat energy through the cycle as well. Explain that the cycling of oxygen, carbon dioxide and energy will be examined in this activity. A *process guide* ([view literacy strategy descriptions](#)) will facilitate understanding of photosynthesis; have each student complete a Photosynthesis Process Guide BLM during the following class discussions and activities. *Process guides* help students focus on important information and ideas, making their reading and listening more efficient and are useful for review. When students complete their process guides, allow time for them to pair up and review the material in preparation for quizzes and other class activities.

Discuss with students the process of photosynthesis. From this discussion, have each student develop a simplified model or diagram that demonstrates the role of oxygen, carbon dioxide, ATP, and enzymes during photosynthesis. Ask students how photosynthesis and radiant energy transfer are affected by natural insulation such as clouds and shading from trees and bushes. Discuss what happens to the solar energy received by the Earth every day and emphasize that only a small percentage of the energy is captured during photosynthesis. Emphasize that photosynthesis is a sun-driven energy process and is dependent on light energy. Discuss conditions needed for optimum photosynthetic activity.

Conclude the activity by having students record and analyze balanced chemical equations for photosynthesis and aerobic respiration (e.g., cellular respiration); analyze for energy transfer and determine the relationship between these two processes. Be sure that students include the role of enzymes in these processes. Use this conclusion to introduce and explain aerobic and anaerobic respiration as energy processes and relate to ATP production and use in cells. If Internet access is available the following web site offers a simple, animated explanation of ATP and ADP: <http://student.cbcemd.edu/biotutorials/energy/atpan.html>.

Activity 2: Photosynthesis, Respiration, and the Cycling of Carbon Dioxide and Oxygen
(SI GLEs: 1, 3, 4, 5, 9, 10, 15; LS GLEs: 23, 28, 29, 30)

Materials List: straws, beakers, test tubes, aquarium plants such as *Elodea*, small animals such as snails or guppies or tadpoles, water, a light source, bromthymol blue, safety goggles, illustrations of the oxygen and carbon dioxide cycles, science learning logs, Cellular Respiration Process Guide BLM (one for each student)

Prior to this activity, help students to identify safety concerns when using animals in the classroom and discuss the ethical treatment of animals. Remind students to wear safety goggles when working with chemicals.

Begin the activity by having a student blow through a straw into a beaker containing a small amount of bromthymol blue (BTB) indicator in solution. Have students propose an explanation for the color change observed. (BTB turns yellow in the presence of carbon dioxide.) Provide a review or direct instruction, if needed, on the process of cellular respiration to assist students in understanding the source of CO₂ and its relation to the observed color change. (Note: cellular respiration is understood to be aerobic unless otherwise stated.) A *process guide* ([view literacy strategy descriptions](#)) will facilitate student comprehension of cellular respiration and its relationship to photosynthesis. Distribute a Cellular Respiration Process Guide to each student and instruct them to complete the guide during class discussions and activities. Again, be sure to create opportunities for students to review the information in the process guides to reinforce understanding of cellular respiration and photosynthesis.

Have the class work in small groups to develop an experimental design that will demonstrate the importance of photosynthesis and cellular respiration in the production and cycling of oxygen and carbon dioxide. Include questions that students would like answered by conducting this activity and assist students in formulating a testable hypothesis. Group designs may differ, but all should include steps that would identify components of a good investigation such as safety issues, the identification of independent and dependent variables, controls and the use of multiple trials. Students will need some guidance and access to appropriate materials in order to design their investigation. Suggested materials might include test tubes, aquarium plants such as *Elodea*, small aquatic animals such as snails or guppies or tadpoles, water, a light source, and bromthymol blue. Instruct each group to write a detailed procedure for teacher review and approval before experimentation. Then allow each group to set up and run their investigation (in the presence of a good light source) for several class periods. Have students predict color changes for each tube and maintain individual daily observations in an organized table or chart. After completion of the investigation, allow students to discuss their observations with other group members, analyze their data, and then state and defend a valid conclusion. Instruct students to write a lab report in which they include their hypotheses, materials, procedures, observations, and conclusions.

Conclude this activity by showing illustrations of the oxygen and carbon cycles and balanced chemical equations of photosynthesis and aerobic respiration. Have students trace the oxygen and carbon through the processes and organisms illustrated, along with the production of ATP. Briefly remind the students about the role of ATP in a cell and emphasize that oxygen, carbon

dioxide and water are recycled but that energy is not; thus there is a continuous need for the Sun's energy.

Propose the following scenario: A half million acres of forested land in an underdeveloped country is being cleared for future commercial use. Using your results from this activity, what might be the impact on the carbon dioxide levels in the atmosphere at this site and how might the carbon cycle be affected, if at all? Instruct students to write a response to this scenario in their science *learning logs* ([view literacy strategy descriptions](#)).

Activity 3: Important Cycles in the Ecosystem (SI GLEs: 7; LS GLEs: 27; ESS GLEs: 13, 15)

Materials List: poster paper, transparency film, markers, reference materials on biogeochemical cycles, computer with Internet access (if available)

With the class divided into small working groups, provide each group with a different cycle to research (nitrogen, phosphorus, carbon, and oxygen). If the class size is large, allow more than one group to investigate the same cycle. Provide students with either poster paper and markers or transparency film and markers. Each group is to use their textbook, Internet (if available), and/or supplemental materials provided by the teacher to investigate the cycle given to them. Students should diagram the cyclical process based upon their research findings—noting, in particular, how each component (element, compound, etc.) is produced, where it comes from, how it is recycled and continually replenished through geological processes. The role of natural geologic events (for example, uplifting, weathering, and erosion) and Sun-driven processes that move substances at or near Earth's surface should be included in the diagrams. Once completed, have each group of students present their findings to the class. Lead a discussion of the various effects that human production of some of these components can have on the ecosystem. For example, the increase in atmospheric carbon dioxide has been linked to high fossil fuel use, and the clearing of forested areas for commercial/residential growth reduces the number of trees that can convert carbon dioxide into oxygen.

Activity 4: Food Chains and Trophic Levels (LS GLEs: 24, 26, 27)

Materials List: old magazines, scissors, glue or tape, 3 x 5 note cards, string

After students have been introduced to the following terms: *producers*, *decomposers*, *trophic levels*, *autotrophs*, *heterotrophs*, *herbivores*, *carnivores*, *omnivores*, and *primary*, *secondary*, and *tertiary consumers*, and the teacher has demonstrated interpretation of food chains and food webs, conduct the following activity. Have students create a food chain, using a note card for each individual organism. Students should find a picture of the organism from old magazines and paste the picture onto one side of the card. (Students can also draw organisms on the cards, if desired.) On the back of the card, students should label the organism with one or more of the following terms that describe the organism: *producer*, *decomposer*, *autotroph*, *heterotroph*, *herbivore*, *carnivore*, *omnivore*, and *primary*, *secondary*, and *tertiary consumer*. Cards may

have more than one word (e. g., *consumer* and *herbivore* would apply to a rabbit). Once they have completed that task, have students present their food chains to the class. Connect cards with string and hang throughout classroom. Identify the trophic levels that are present (producers as well as primary, secondary, and tertiary consumers).

Ask students to consider and discuss what effect(s) a decrease in one of the biotic and/or abiotic factors might have on the population. Have students select one of the organisms in their food chain and determine how it could serve as a limiting factor. Be sure to include abiotic factors such as temperature, amount of water, and shelter.

After presentations, have students combine various food chains into food webs. Lead a class discussion with students describing how humans can serve as a limiting factor in food chains.

Activity 5: Energy Flow in Ecosystems (SI GLE: 7; LS GLEs: 24, 25, 26, 27)

Materials List: diagram of the nitrogen cycle, legumes with root nodules (optional), small potted plants, nitrogen fertilizer, reference materials on the nitrogen cycle, computer with Internet access (if available)

Once students have constructed their food webs from Activity 4, have them discuss what might happen in their ecosystem if a pesticide were applied in an uncontrolled manner that completely removed one of their trophic levels. For example, if they had small birds feeding on grasshoppers, and hawks feeding on the small birds, what would happen if the grasshopper population was severely reduced by a pesticide?

Next, provide each group with the student created diagram of the nitrogen cycle from Activity 3. Using these diagrams, resources and textbooks, have students trace the flow of nitrogen through the ecosystem illustrated and their food chain. As a class project, grow small potted plants with and without nitrogen fertilizer to determine experimentally the effect of nitrogen on the growth of plants. A detailed description of this project is available at http://www.sciencebuddies.org/mentoring/project_ideas/PlantBio_p012.shtml. If possible, exhibit a legume with nodules on its roots and explain its relationship to the nitrogen cycle.

As students conduct their research and interpret the diagrams, have them answer the following questions:

- Why is nitrogen so important to plants? For what do they use it?
- How does nitrogen return to the soil from animals (two ways)?
- Explain the importance of bacteria in the nitrogen cycle.
- What are legumes and nodules?
- What are algal blooms and what is the role of nitrogen in this occurrence?

In addition, using either additional pictures or ones from their food web, have groups construct an ecological pyramid of at least four trophic levels. Have students label producers; label and categorize consumers as primary, secondary, or tertiary. Using the numbers 1, 10, 100, 1,000,

etc., indicate the levels of energy (biomass or Calories) stored at each trophic level. Ask students to compose and record a group consensus as to the efficiency of energy transfer from one level to the next, moving up the pyramid. If a computer with Internet access is available, additional information on the transfer of energy in food webs can be found at http://www.arcytech.org/java/population/facts_foodchain.html.

Activity 6: Human Impact (SI GLEs: 2; LS GLEs: 26, 27)

Materials List: news stories, magazine articles, video segments, or other selected scenarios or stories that feature an ecosystem or an environment that has been impacted by human actions, using local or regional examples, if possible; science learning logs; computer with Internet access (if available)

Ask students to brainstorm ways they know that man has impacted an ecosystem. Take all suggestions. Discuss with students the various investigations to determine how humans have impacted the environment. Explain that investigations may include observation, description, literature survey, classification, or experimentation; in this activity the students will be utilizing a survey of literature. Provide students with news stories, magazine articles, video segments, or other selected scenarios or stories that feature an ecosystem or an environment that has been impacted by human actions, using local or regional examples, if possible. Examples are restoration efforts, development of super highways, new housing and commercial development, logging by clear cutting, water and air pollution, the effects of agricultural runoff on waterways, coastal erosion, paving animal habitats, animal preserves, and reforestation. Have students read and analyze the information in these stories to explain the positive and negative impacts from human actions. If Internet access is available, the following website offers information about how people impact the planet as well as consequences of overpopulation: <http://www.populationeducation.org>.

In a class discussion or as part of the activity, ask students to examine how humans are a limiting factor for other populations. Conclude the activity with a *SPAWN* ([view literacy strategy descriptions](#)) prompt that asks students to reflect on and think critically about human impact on the environment. One appropriate prompt from the W or What If category of *SPAWN* is “What if humans were to conquer all their natural enemies and have no limiting factors. Predict the consequences of the resulting exponential growth of the human population.” Instruct students to write responses in their science *learning logs* ([view literacy strategy descriptions](#)) and then share and discuss responses as a class.

Sample Assessments

General Guidelines

- The student is to be monitored throughout the work on all activities via teacher observation and journal entries.

- All student-developed products should be evaluated as the unit continues.
- The student investigations should be evaluated with a rubric.
- When possible, students should assist in developing any rubrics that will be used.
- For some multiple-choice items on written tests, ask students to write a justification for their chosen response.

Assessment techniques should include use of drawings/illustrations/models and laboratory investigations with reports (problem-solving and performance-based assessments), group discussion and journaling (reflective assessment), and paper-and-pencil tests (traditional summative assessments). Assessments could include the following:

General Assessments

- The student will explain if plants carry out aerobic respiration and if so, when.
- The student will explain how plants use carbon dioxide during the photosynthetic process.
- Using a balanced ecological pyramid, the students will determine if there are more tertiary consumers or secondary consumers, and have students explain their answer.
- The student will answer the following question and provide an explanation: Is the intervention of human beings in an ecosystem always bad?
- The student will explain why decomposers and bacteria are so important to an ecosystem and provide two reasons for each.
- The student will determine why ecosystems require a continuous input of energy from the sun.
- When students are given a diagram of an ecological pyramid, they will label producers, label and categorize consumers as primary, secondary, or tertiary; and, using the numbers 1, 10, 100, 1,000, etc., indicate the levels of energy stored at each trophic level.

Activity-Specific Assessments

- Activity 1: Students will determine if it is true that plants could exist on Earth without animals, but animals could not exist without plants. In their explanations they should include balanced chemical reactions of photosynthesis and cellular respiration.
- Activity 2: Students will explain why the bromthymol blue either did or did not change color in each of the trials in Activity 2. Name the energy processes that caused the observed color changes and write balanced chemical equations for photosynthesis and aerobic cellular respiration, with energy relationships.
- Activity 5: Students will study the ecosystem around the school and make drawings of the various producers, consumers, and decomposers. Then the students will develop a food web incorporating their drawings and food pyramids using the food chains. The food webs and pyramids should be assessed for completeness and

accuracy of information. A minimum of three trophic levels should be properly identified and the relationship between all levels as well as the importance of decomposers should be evident.

Resources

- *ATP/ADP*. A simple, animated explanation of ATP and ADP available online at <http://www.biologyinmotion.com/atp/>
- *Food chains*. Information and explanation of terms about food webs available at <http://library.thinkquest.org/11353/food.htm?tqskip=1>
- *Plant Growth and Nitrogen*. Suggestions on experimental growth of plants using nitrogen fertilizers available online at http://www.sciencebuddies.org/mentoring/project_ideas/PlantBio_p012.shtml
- *Population Connection*. Teaching materials and activities available online at http://www.populationeducation.org/index.php?option=com_content&view=article&id=59&Itemid=10
- *Population Growth and Balance*. Information and activities on population growth available online at <http://www.arcytech.org/java/population>

Biology

Unit 6: The Human Body—Its Structures, Systems, Balance, and Health

Time Frame: Approximately twelve weeks



Unit Description

This unit introduces students to the structure and systems of the human body. This unit will examine the interaction of the various systems, how a balance (homeostasis) is maintained within the systems, and factors that affect the health and proper functioning of the systems (e.g., drugs, alcohol, disorders, and disease organisms).

Student Understandings

The human body is to be understood as a living organism, and students should be provided information and experiences that will enable them to explain the structure and function of the body systems, major organs, and processes that maintain homeostasis and life. Students will be able to describe the connections between the system, diseases and conditions of that system, and the importance of health maintenance.

Guiding Questions

1. Can students describe the functions of the human body systems?
2. Can students identify and locate the major organs of each body system?
3. Can students discuss the functions of the major organs of the body systems?
4. Can students describe how the various systems of the human body interact?
5. Can students identify mechanisms that maintain the balance, called *homeostasis*, within each system? Can students provide some specific examples?
6. Can students name and explain the functions of the components of the human immune system?
7. Can students differentiate between active and passive immunity?
8. Can students explain the relationship between vaccinations and immunity?
9. Can students provide specific examples of fitness and health maintenance strategies that might affect each of the systems studied and that might result in a longer life span?

Unit 6 Grade-Level Expectations (GLEs)

| GLE # | GLE Text and Benchmarks |
|---------------------------|---|
| Science as Inquiry | |
| 2. | Describe how investigations can be observation, description, literature survey, classification, or experimentation (SI-H-A2) |
| 6. | Use technology when appropriate to enhance laboratory investigations and presentations of findings (SI-H-A3) |
| 7. | Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4) |
| 10. | Given a description of an experiment, identify appropriate safety measures (SI-H-A7) |
| 14. | Cite examples of scientific advances and emerging technologies and how they affect society (e.g., MRI, DNA in forensics) (SI-H-B3) |
| Life Science | |
| 32. | Analyze the interrelationships of organs in major systems (LS-H-F1) (LS-H-E3) |
| 33. | Compare structure to function of organs in a variety of organisms (LS-H-F1) |
| 34. | Explain how body systems maintain homeostasis (LS-H-F2) |
| 39. | Compare the functions of the basic components of the human immune system (LS-H-G3) |
| 40. | Determine the relationship between vaccination and immunity (LS-H-G3) |

Sample Activities**Activity 1: From Cells to Tissues (SI GLEs: 6, 10)**

Materials List: microscopes, prepared slides of epithelial tissue, muscle tissue, nerve tissue, and connective tissue, Vocabulary Self-Awareness BLM (one for each student), computer with Internet access (if available)

During this unit on The Human Body, have students maintain a *vocabulary self-awareness* ([view literacy strategy descriptions](#)) chart. Distribute a copy of the Vocabulary Self-Awareness BLM to each student and provide a list of targeted words at the beginning of each activity. This first one will target terms related to tissues. Ask students to rate their understanding of each word with either a “+” (understand well), a “√” (limited understanding or unsure), or a “-” (don’t know). Over the course of the unit activities, students should return to the chart and add new information to it. The goal is to replace all the check marks and minus signs with a plus sign. By continually revisiting the vocabulary charts, students have multiple opportunities to practice and extend their growing understanding of key terms related to the topic of the human body. Be sure to add important terms to the chart at the beginning of each activity in this unit.

Before beginning this investigation, have students help identify safety issues to be considered when using a microscope. Be sure to review and discuss correct usage with students, as well.

After a discussion of the biological meaning of *tissue* and a description of the four tissue types, have students rotate in small groups, through microscopic stations of prepared slides of *epithelial tissue, muscle tissue, nerve tissue, and connective tissue*. Have students sketch each tissue and record the major function(s) of each type of tissue. If a microscope and prepared slides are not available, have the students or teacher access the website <http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/artaug02/gohisto.html>. Select Histology I on the table to view excellent colored photographs of the four types of tissues.

For activity summary and closure, teacher-guided questioning is essential in helping students make meaning of their hands-on experiences. It is during this class discussion that direct instruction should be reviewed, as needed, on tissue types and on differentiation through the use of diagrams or illustrations, with continual reference to the human body. Sample discussion topics include

- Name one organ or system where each of the four tissues can be found in the human body.
- What is unique about nerve tissue? For example, can it reproduce if it is damaged? Explain.
- Of the four tissues studied, which is the most widely distributed throughout the human body?
- Name four types of connective tissues found in the knee.

Activity 2: The Brain, Nerve Fibers, and the Neuron (SI GLEs: 6, 7, 14; LS GLE: 33)

Materials List: meter stick or tape measure; illustrations, videos, CD-ROMS, or transparencies of the nervous system; Nerve Impulse Process Guide BLM (one for each student); science learning log; computer with Internet access (if available)

Incorporate the use of technology by using videos, CD-ROMs, website animations, and/or transparencies to explore the nervous system. After a classroom discussion of basic nerve structure and signal impulses, have each group select a nerve pathway in one of the members of their group (e.g., the nerve from the spine to the fingertip or big toe) and have them measure the length in meters. Explain that the length of axons in adult humans can measure more than a meter; the longest motor neuron reaches from the toes to the base of the spine.

A *process guide* ([view literacy strategy descriptions](#)) will facilitate understanding of nerve impulses; have each student complete a Nerve Impulse Process Guide BLM during the following class discussions and activities. *Process guides* help students focus on important information and ideas, making their reading and listening more efficient and are useful for review. When students complete their *process guides*, allow time for them to pair up and review the material in preparation for quizzes and other class activities. After completion of the *process guides*, instruct students to write a summary, with sketches, in their science *learning logs* ([view literacy strategy descriptions](#)), explaining how the signal travels along a myelinated neuron. Their

explanation should include the ion distribution in neurons, role of the sodium/potassium pump, the importance of Schwann cells, transmission of the nerve impulse across the synapse (space between the neurons,) and the role of neurotransmitters. Direct instruction or modeling may be necessary in order for students to comprehend the sodium-potassium pump. Divide the class into small groups and have each group develop and present a model or demonstration illustrating how these mechanisms work. A good understanding of this process can be obtained from the website <http://science.nhmccd.edu/biol/ap1int.htm#nervous> . Explore any of the choices appropriate to this activity; *Several Neuron Animations* by Gary Matthews has many good examples.

For activity closure, teacher-guided questioning and class discussion are essential in helping students make meaning of their hands-on experiences and their textbook or Internet studies.

Sample discussion topics include

- Explain how nerves and muscles interact based on signal impulse discussion.
- Do other vertebrates have similar systems? Compare the structure of the organs to their function.
- Prepare a list of specific neurotransmitters and discuss their relationship to nervous system disorders. Examples include the link between dopamine and Parkinson's disease as well as the link between low levels of serotonin and depression.
- What are endorphins? How do they act?
- Discuss what opium, morphine, and endorphins have in common.
- What scientific advances are there to help people with neurological disorders that include misfiring or loss of signals?
- What is multiple sclerosis and how is this disorder related to myelination of neurons?

Activity 3: The Nervous System/Brain, Peripheral, and Autonomic Systems (SI GLEs: 6, 7, 14; LS GLEs: 32, 33, 34)

Materials List: diagrams or prepared transparencies of the brain structure of various vertebrates or other members of the animal kingdom, diagrams, and/or videos of the human central nervous system; diagram of the human brain; diagram of the lobes of the cerebrum; poster materials, blank transparencies, or presentation software (optional); computer with Internet access (if available)

Begin this activity by showing diagrams, prepared transparencies, or other media illustrating the brain structure of various vertebrates or other animals. Diagrams of fish, amphibian, reptile, bird, and mammal brains are readily available. Instruct students to observe these diagrams and describe the differences they observe. Next use diagrams, video segments, and direct instruction to explore the structures and functions of the components of the human central nervous system. Have students differentiate among the *brain stem*, *cerebellum*, and the *cerebrum* and describe the major functions of each. Use a diagram of the lobes of the cerebrum and have students identify them by name and describe the major functions of each lobe. Students should link current understanding of the brain to specific scientific advances and emerging technologies such as computer-driven neuroimaging and brain-healing nanotechnology.

Assign each student group a specific section of the peripheral and autonomic nervous system, and instruct them to prepare a presentation for the class on the anatomy and function of the assigned system. If Internet access is available the following website has information on all parts of the human nervous system:

http://en.wikibooks.org/wiki/Human_Physiology/The_Nervous_System#Overview_of_the_entire_nervous_system. This presentation can be a poster, computer slide show, or student-generated transparencies. Also instruct each group to develop a demonstration on a reflex common to humans (e.g., tapping the knee to produce the jerking reflex, eye blinking).

For activity closure, teacher-guided questioning and class discussion are essential in helping students make meaning of their hands-on experiences and their textbook, video, or Internet studies. Sample discussion topics include

- Discuss the role of the nervous system as a mechanism for survival among various organisms (e.g., the reflex action).
- Compare the sizes of the cerebrum of a shark, frog, bird, cat, and human. Discuss the significance of the size differences.
- Explain the role of the nervous system in the “fight or flight” mechanism.
- Differentiate between sensory and motor neurons. Give some examples for each.
- Explain this statement: The autonomic nervous system enables the central nervous system to govern most of the body’s homeostasis. Give some examples to support your explanation.
- Complete a Venn diagram comparing the sympathetic and parasympathetic nervous systems.
- Describe how the pituitary gland connects the nervous and endocrine systems.
- Provide examples of the roles played by components of the nervous system.

Activity 4: The Endocrine System (SI GLE: 2; LS GLEs: 32, 34)

Materials List: freezer paper, newsprint rolls, or large sheets of art paper; colored markers; reference materials on the endocrine system; Endocrine System BLM (one for each student)

Begin by reviewing the definition of *homeostasis* and explain that the endocrine system is primarily responsible for maintaining homeostasis. Explain that the endocrine system maintains homeostasis and long-term control using chemical signals and feedback mechanisms. The endocrine system works in parallel with the nervous system to control growth and maturation along with homeostasis. Describe a specific example of homeostasis in the human body; a good example is the maintenance of glucose levels in the blood through the release of insulin by the pancreas.

To continue this activity, have students describe how investigations are not just experimental but can be observational, descriptive, or involve a review of literature; this activity will be based on a review of literature. Have students read and research to determine the glands and organs in the endocrine system, the functions of each gland, and the primary hormones produced by each. Distribute the Endocrine System BLM to each student and instruct them to complete this *graphic organizer* ([view literacy strategy descriptions](#)) of the information they researched. *Graphic*

organizers help students logically organize information from multiple sources and facilitate understanding of key concepts. They are useful in reviewing important details and concepts. Next, using freezer paper, newsprint rolls, or large sheets of art paper, have student groups draw an outline of one of their members to represent the outline of a human body. Distribute markers or colors and instruct the groups to draw and label the endocrine glands in the appropriate locations on their body outlines. To complete the activity, instruct them that they are to attach their *graphic organizer* to their body outlines. The student products may be displayed by taping them to the walls or in the halls. Conclude with a discussion of common disorders of endocrine glands such as diabetes, hypothyroidism, and edema and problems associated with athletes taking steroids to promote muscle mass.

Activity 5: The Skeletal System (SI GLEs: 6, 7; LS GLEs: 32)

Materials List: miniaturized replica of a human skeleton or a paper pattern of the human skeleton, computer with Internet access (if available)

With the class divided into small, workable groups, provide each group with a miniaturized replica of a human skeleton (available from most biological supply houses) or a paper pattern of the human skeleton to be cut and assembled. Instruct each group to locate and identify the major bones of the human body, including the specific types of joints (e.g., ball and socket, hinge).

For activity closure, teacher-guided questioning is essential in helping students make meaning of their hands-on experiences and their textbook, video, or Internet studies. It is during this class discussion that direct instruction of tendons, ligaments, and cartilage should be included as needed on the skeletal system. If Internet access is available, access the following website for explanations and animations of the interaction between bones, tendons, and ligaments: http://kidshealth.org/teen/your_body/body_basics/bones_muscles_joints.html. At this site click on the *Body Basics: Muscles and Joints* icon.

Through the use of diagrams or illustrations of other vertebrates, comparisons can be made, culminating with comparison to the human body. Sample discussion topics include

- Name five different types of joints in the human body and give an example for each.
- What is the relationship between the long bones of the human body and blood cell production? Explain.
- How do fractures and sprains differ?
- How does the skeleton of an infant differ from the skeleton of an adult, other than in size?
- What is unique about the bottom two pairs of ribs in the human being?
- Explain what osteoporosis is, what usually causes it, and how it can be prevented.
- What is the relationship of calcium, vitamin D, and bone?

Activity 6: The Structure of Bone (SI GLEs: 7; LS GLEs: 32, 33)

Materials List: illustrations of different vertebrate skeletal systems, prepared slides or diagrams of microscopic cross-sections of bone and cartilage, microscopes, diagrams of a cross-section of a long bone, Internet access (if available)

As an introductory activity, ask the students to observe the skeletal system of different vertebrates and describe the similarities and differences. Then lead the students in a review of the functions of bones and the skeletal system. Allow the students to brainstorm a list of functions that are the same in both humans and other animals they have studied or observed.

Next, with the students assigned to small, workable groups, provide each group with prepared slides and microscopes or diagrams of microscopic cross-sections of bone and cartilage. Have students locate and describe the function of osteocytes, Haversian canals, nerves, blood vessels and red and yellow bone marrow.

Provide each group of students with a diagram of a cross section of a long bone. In their science *learning logs*, ([view literacy strategy descriptions](#)) have students draw, label, and describe the functions of the following structures: *periosteum*, *compact bone*, *spongy bone*, *red marrow*, *yellow marrow*, *Haversian canals*, *osteocytes*, and *cartilage*. If Internet access is available, the following website has diagrams and explanations of these terms:

http://kidshealth.org/teen/your_body/body_basics/bones_muscles_joints.html. Click on *Body Basics: Bones* after arriving at the website.

For activity closure, teacher-guided questioning is essential in helping students make meaning of their hands-on experiences and their textbook/Internet studies. It is during this class discussion that direct instruction should be included as needed. Sample discussion questions include:

- What part of the bone produces red blood cells?
- What do osteocytes do?
- What is the difference between cartilage and bone? What is the major difference between the skeleton of a shark and the adult human skeleton?
- What are the functions of cartilage, ligaments, and tendons in the human skeletal system?
- What is bursitis? How does it differ from arthritis?
- What is the relationship between exercise, diet, and bone density?

Activity 7: The Muscle System (LS GLEs: 32, 33)

Materials List: microscopes; prepared slides or diagrams of cardiac, smooth, and skeletal muscle; reference materials on muscle tissues; reference materials with diagrams on muscle contraction; diagrams of the major human muscles; computer with Internet access (if available)

Explain to students that muscle tissue has the ability to contract and relax and therefore bring about movement in various parts of the body. To prepare students for study of muscle tissue, divide them into groups and instruct them to examine prepared slides (under the microscope) or

diagrams of *cardiac, smooth, and skeletal muscle*. From their observations, they are to sketch each type and describe the major differences among the three types of muscle tissue. Using reference materials, instruct the students to find the locations and functions of the three different muscles tissues in the human body.

After observation of muscle tissue at the microscopic level, provide direct instruction on the mechanism of muscle contraction. Using appropriate reference materials and diagrams, explain how a motor neuron synapses with a muscle cell to initiate contraction. If Internet access is available, the following website offers explanations and animations of muscle contraction: <http://health.howstuffworks.com/muscle2.htm>.

Provide each group of students with a diagram of the major human muscles. If Internet access is available, the following website has diagrams and information on human muscle anatomy: <http://predator.pnb.uconn.edu/~wwwpnb/virtualtemp/muscle/Muscle-Anatomy-Pages/Anatomy-Pages/MuscleAnatomyintropage.html>. Instruct the students to bend their elbows to a ninety degree angle while holding the arm out to the side and pointing down. Then straighten the arm. Using diagrams of the arm, ask students to identify the flexor and extensor muscles, as well as the origin and insertion points. Next, have students identify the flexor and extensor muscles of the upper leg. Explain to the students that most skeletal muscles work in opposing pairs: the biceps and the triceps are good examples of opposing muscles in the upper arm.

For activity closure, teacher-guided questioning is essential in helping students make meaning of their hands-on experiences and their textbook and Internet studies. During this class discussion, direct instruction should be included as needed on the muscular system. Through the use of diagrams/illustrations of other vertebrates, comparisons can be made, culminating with comparison to the human body. Sample discussion topics include

- Describe the major difference between skeletal, smooth, and cardiac muscle.
- What are the functions of the muscular system?
- What is meant by the origin of a muscle? The insertion?
- When one lifts weights, or “bulks up,” does the muscle tissue form new cells to make the muscles larger? Explain.

Activity 8: Introduction to Anatomy: Vertebrate Dissection (SI GLEs: 6, 10, 14; LS GLEs: 32, 33)

Materials List: preserved vertebrates for dissection (frog, fetal pig, or cat), dissection tools, disposable gloves, safety goggles, hand lenses, science learning log, computer with Internet access (if available)

Explain to the class that the dissection and examination of a vertebrate will occur over a period of time as the unit study progresses. Indicate that the vertebrate dissected will serve as a hands-on example for comparison to the human body. Comparison to other vertebrates will be studied via diagrams or illustrations. Virtual dissection may be substituted for real dissection.

Prior to beginning the laboratory experience, ask the entire class to identify safety measures that should be considered during dissection and compile a list on the board; emphasize measures such as exercising care when using sharp instruments, wearing latex (rubber if allergic to latex) gloves, and properly disposing of materials. After a discussion of safety issues, demonstrate how to prepare the vertebrate for dissection for examination of the internal organs and systems. An alternative to real dissection is virtual dissection. A good resource to demonstrate virtual frog dissection can be found at <http://frog.edschool.virginia.edu/> and a virtual pig dissection is found at <http://www.whitman.edu/biology/vpd/main.html>.

With the students working in small groups, provide each group with a preserved vertebrate (e.g., frog, pig, or cat). The vertebrate to be dissected should be selected by the teacher. Each group will examine and identify all the external features of the vertebrate. They should examine with the “naked eye” and with hand lenses such things as the skin, body covering, number of appendages, ears, eyes, teeth, and other structures. Students should record their findings, including drawings, in their science *learning logs* ([view literacy strategy descriptions](#)).

For activity summary and closure, teacher-guided questioning is essential in helping students to make meaning of their hands-on experiences and their textbook or Internet studies. Sample discussion topics include

- Define the term *organ*.
- What is meant by *organ system*? Give two examples of organ systems in the human body.
- To date, what human organs have been successfully transplanted from one human to another?
- Lead a discussion of new medical technologies, for example organ transplantation. When an organ is successfully transplanted from one human being to another, what is the most common problem that has to be addressed to ensure that the recipient (i.e., the person who received the organ) maintains the organ? Why is this a problem?

Activity 9: A Closer Look at the Organs/Organ Systems/Respiratory and Circulatory Systems (SI GLEs: 6, 7, 14; LS GLEs: 32, 33, 34)

Materials List: preserved vertebrate from Activity 8, dissection tools, safety goggles, disposable gloves, diagrams of hearts of various vertebrates or other animals, model of human heart (optional), diagram of the human heart (one per group), science learning log, computer with Internet access (if available)

To introduce the circulatory system, use diagrams to review the evolution of the heart in the animal kingdom or in the chordate phylum. Diagrams of the hearts of fish, amphibians, birds, and mammals are readily available. Instruct students to observe the diagrams and discuss the progression from one to four chambers. Allow students to propose explanations for this progression. As a class, list the functions of the circulatory system that are common to the entire animal kingdom.

After class instruction of the circulatory system, return to the laboratory dissection. There, have each group label figures of the lungs, heart, and some major veins and arteries of the vertebrate. An alternative to the dissection is to use a model of a human heart to locate chambers, valves, aorta, and vena cava. The members of each group are to discuss blood flow through the heart and lungs and draw arrows on a heart diagram to show the pathway by which blood flows through the four-chambered heart to and from the heart and lungs. While tracing the flow of blood, instruct the students to locate and identify the sinoatrial node and the atrioventricular node and describe their functions. If possible, have students visit the following website: <http://medmovie.com/mmdatabase/flash/0016a.swf>. Allow each group to explore the chosen site and write a summary of the blood flow in their science *learning log* ([view literacy strategy descriptions](#)) or on a diagram worksheet. All students should identify the four chambers and the valves through which the blood flows. If Internet access is not available for students, provide reference materials that describe blood flow through the heart and lungs.

After students have studied the pathway of blood to and from the heart and lungs, ask them to demonstrate their understanding of this concept by completing a *RAFT* ([view literacy strategy descriptions](#)) writing assignment. This form of writing is useful in explaining processes and gives students the freedom to craft writing that is both creative and informative. Ask students to work in pairs to write the following RAFT:

R – role of the writer is a deoxygenated red blood cell seeking to become oxygenated.

A – audience to whom the RAFT is being written is neighboring red blood cells.

F – form the writing will take is a friendly letter recounting the sites visited on the trip through the heart and lungs.

T – topic of the writing will be a narrative description of all the locations visited by the writer (the deoxygenated red blood cell) as it leaves the right atrium in a deoxygenated condition and returns to the left atrium in an oxygenated condition.

The writer should describe all of the chambers and valves along the way as well as the exchange of gases (carbon dioxide for oxygen) in the lungs.

Ask student pairs to share their letters with the class by reading them aloud. The *RAFT* assignment should be evaluated for inclusion of all major chambers and valves and accuracy of information.

For activity closure, teacher-guided questioning is essential in helping students make meaning of their hands-on experiences and their textbook or Internet studies. It is during class discussion that direct instruction should be included as needed on the respiratory and circulatory systems. Through the use of diagrams or illustrations of other vertebrates, comparisons can be made, culminating with a comparison to the human body. The following are sample discussion topics:

- Locate and name the major artery leading from the heart.
- What is the purpose of the vena cava?
- Name three types of vessels in the circulatory system and describe the function of each.
- What are the major structural differences between arteries and vein?
- How does smoking damage the circulatory system?
- What are alveoli, and why are they important to the respiratory system?

- Explain how the respiratory and circulatory systems work together to maintain body homeostasis.
- How does regular exercise make the heart and lungs healthier? Explain.
- What is coronary blockage? What causes it? Discuss two emerging medical methods for correcting this problem.
- How does asthma affect the respiratory system? The circulatory system?

Activity 10: Blood Cells and Blood Pressure (SI GLEs: 6, 7; LS GLEs: 32, 34)

Materials List: microscopes, prepared slides of human blood or diagrams of human blood cells, sphygmomanometer, computer with Internet access (if available)

Divide the class into small working groups and provide each group with a microscope, prepared slides of human blood, and a sphygmomanometer (i.e., blood pressure cuff). Instruct each group to examine the prepared slide of human blood under the microscope and make drawings of all the different blood cells. Have students describe the function of all components found in blood: plasma, red blood cells, white blood cells, and platelets. This can be accomplished in a table or chart. If prepared slides are not available, have students label the cell types on a diagram of blood cells or visit <http://www.getbodysmart.com/ap/circulatory/menu/circulatory.html> for tutorials on components of blood. If time allows have each group go to http://nobelprize.org/educational_games/medicine/landsteiner/index.html and participate in the blood typing game. Note: Click on “Yes” to get to the game.

Once this exercise is completed, discuss with students, how blood pressure is measured, the normal range of blood pressure, and demonstrate the method for taking blood pressure and have each group take the blood pressure of each member in their group. Next, have each group determine the average blood pressure for their group. Time permitting, instruct each group to select a member from their group, determine the resting blood pressure of this individual, have the individual perform a moderate exercise for two minutes, take the individual’s blood pressure again, and prepare a graph demonstrating the difference between the resting and active blood pressure. To obtain further insight into all aspects of blood pressure, visit http://www.victoriacollege.edu/dept/bio/Animations/iworx/blood_pressure.html.

For activity closure, teacher-guided questioning is essential in helping students to make meaning of their hands-on experiences with their textbook and Internet studies. It is during this class discussion that direct instruction should be included as needed on blood cells, blood types, and blood pressure. Sample questions include

- What percentage of human blood is plasma?
- What is iron deficiency anemia? What compound, found in red blood cells, is affected by this disorder?
- Where are red blood cells produced, and what is their average lifespan?
- What are some common causes of high blood pressure? How can this condition be prevented and/or controlled?
- What type of blood cell will increase when a person has a bacterial infection?

- During a blood transfusion, what will happen if a Type A person receives Type O blood? Explain.
- What will happen if a person's platelet level drops below normal? How will this affect the homeostasis of the entire organism?
- Prepare a list of blood disorders and diseases and discuss their causes and treatments. Some examples are iron deficiency anemia, hemophilia, leukemia, sickle cell anemia, and thalassemia.

Activity 11: The Anatomy of the Digestive System (SI GLEs: 7, 10; LS GLEs: 32, 33, 34)

Materials List: preserved vertebrate from Activity 8 or diagram of the vertebrate's digestive system, dissection tools, disposable gloves, safety goggles, diagram of the human digestive system, computer with Internet access (if available)

After class instruction of the digestive system, return to the laboratory dissection and review appropriate safety procedures. Have the initially assigned groups dissect the digestive system of the vertebrate, identify all the parts, and describe the function of each. If specimens are not available, provide students with diagrams of the digestive system for this activity. Parts to be identified are mouth, teeth (if present), epiglottis, esophagus, stomach, small intestine, villi, pancreas, liver, gall bladder, and colon. Display a diagram of the human digestive system and have students compare it to the digestive system of their vertebrate. Next, assign each group a specific part of the digestive system and instruct them to prepare a demonstration (with explanations) to be made to the rest of the class. The following are some things that could be incorporated into their demonstrations:

- Have each student continue to chew a small piece of bread until they notice a sweet taste, then have them explain their observations and discuss why we seldom sense the sweet taste of bread when we eat it.
- Demonstrate the average volume of saliva a person produces in one day by pouring an equal amount of water into a large container.
- Demonstrate peristalsis by placing a small marble in one end of a piece of clear plastic tubing, then squeezing the tube just above the marble to force it through the tubing. Placing some butter or mineral oil on the marble will facilitate its movement as well as point out the significance of the need for our food to be moistened.
- Cut a piece of aluminum foil into a six-inch by six-inch piece and keep it flat. Take another piece of aluminum foil and cut it into a ten-inch by ten-inch piece or larger; then crumple it so that it now measures six inches by six inches at the base. This will simulate the villi of the small intestines and demonstrate the importance of surface area.
- Pour some mineral oil into a beaker containing water and observe the results. Next, add some liquid detergent to the beaker and observe the results. Relate this to emulsion that occurs when bile enters the small intestines.
- Another task might be to cut a piece of string the length of the average small and large intestines and stretch it out on the floor to demonstrate the length and volume these two parts of the digestive system occupy in our body.

The above are suggestions that will hopefully stimulate the groups to generate their own ideas and simulations to be used in their presentations. Make sure students identify all safety issues in their simulations before starting.

For activity closure, teacher-guided questioning is essential in helping students make meaning of their hands-on experiences and their textbook and Internet studies. During this class discussion direct instruction should be included as needed on digestion and comparing other vertebrates, culminating with the human body. Discussion topics include

- Explain the function of the epiglottis in the digestive system.
- Which acid is produced in the stomach? Why is it important to digestion?
- What does the bacterium *Helicobacter pylori* have to do with stomach ulcers?
- Where does most of the chemical digestive process take place?
- Explain the function of the pancreas in digestion.
- Explain the major function of the liver in digestion.
- Why are villi important structures in the small intestine?
- What are two functions of the colon?
- How does the colon contribute to the maintenance of fluid balance (homeostasis) in the body?
- What is the average length of the alimentary canal? Why do you think it is so long?
- Lead students in a discussion of someone with a colostomy. How do they think this will affect their digestive processes?
- Prepare a list of digestive system disorders and diseases and discuss their causes and treatments. Some examples are heart burn and GERD, irritable bowel syndrome, colitis, and Crohn's disease.

Additional interactive opportunities can be found at the <http://science.nhmccd.edu/biol/ap2int.htm#digest> website; allow students to explore any of the choices appropriate to this activity.

Activity 12: The Excretory (Urinary) System (SI GLEs: 6, 7, 14; LS GLEs: 32, 33, 34)

Materials List: preserved vertebrate from Activity 8 or video clips, CD-ROMs, or diagrams of the vertebrate's urinary system; dissection tools; disposable gloves, safety goggles, model or diagram of the urinary system and cross section of the kidney; prepared slide or diagram of a nephron; microscopes; diagram of a kidney dialysis machine; computer with Internet access (if available)

In a class discussion, compile a class list of all organs of the body involved in excreting wastes, including the excretory system (i.e., kidneys, liver, colon, lungs, and skin). After eliciting student suggestions of the wastes removed by each organ, explain that this activity will focus on the urinary system. Dissection, video clips, CD-ROMs, or diagram worksheets may be used to explore the urinary system. If returning to the laboratory dissection, have the initially assigned groups dissect the excretory system of the vertebrate, identify all the parts, and discuss their functions among themselves. Place on display a model or diagram of the urinary system and cross section of the kidney. Instruct each group to examine a prepared slide of a nephron under

the microscope or a diagram of a nephron. From this observation, they are to make a drawing or label a diagram of a complete nephron, label all parts, and identify where reabsorption of water and nutrients takes place. Provide each group with a diagram of a kidney dialysis machine and instruct them to explain how it works, being sure to stress the concept of osmosis/dialysis and the homeostatic condition that must be maintained in the kidney. Discuss other scientific advances in this field that have contributed to better health. Guide students to an understanding that electrolytes and fluid balance, in addition to blood pH, are maintained through the urinary tract working in conjunction with the pituitary gland located in the brain region.

For activity closure, teacher-guided questioning is essential in helping students make meaning of their hands-on experiences and their textbook and Internet studies. It is during this class discussion that direct instruction should be included as needed on the excretory system, comparing other vertebrates and culminating with the human body. Sample discussion items include

- On average, the human heart pumps five liters of blood per minute and approximately one-fourth of this volume goes through the kidneys. Based on this information, calculate the volume of blood that is filtered by the kidneys each day.
- Describe the functions of the kidneys.
- What causes kidney stones?
- How does the pituitary gland regulate fluid balance?
- Explain how peritoneal dialysis is used when the kidneys fail.
- Explain the most important waste in urea and why it is vital to excrete this substance.

For additional information, go to the <http://science.nhmccd.edu/biol/ap2int.htm#urinary> website, and then explore any of the choices appropriate to this activity.

Activity 13: The Reproductive System (SI GLEs: 6, 7; LS GLEs: 32, 33, 34)

Materials List: preserved vertebrate from Activity 8 or diagram of the vertebrate's reproductive system, dissection tools, disposable gloves, safety goggles, illustrations of the reproductive system of several different animals, unlabeled diagrams of the human male and female reproductive systems, science learning log, computer with Internet access (if available)

Returning to the laboratory dissection, have the initially assigned groups dissect and study the reproductive system of the vertebrate. Instruct members of the group to identify all the parts and discuss their functions among themselves. Direct groups to observe illustrations of the reproductive systems of another organism from the animal kingdom.

Next, provide each group with unlabeled diagrams of the human male and female reproductive systems. Instruct them to label all parts and discuss how the human reproductive systems differ from those of the vertebrate they dissected.

With the students working in the initially assigned groups, instruct each group to prepare a written report in their science *learning logs* ([view literacy strategy descriptions](#))

discussing the difference in how fertilization is accomplished in fish, frogs, earthworms, clams, snails, and flowering plants and how it is different or similar to the mechanism in human fertilization.

Following are other exercises that can be included: Note: Items needed for all of these suggested exercises are not included in the Materials List at the beginning of this activity as it will be at the discretion of the teacher which, if any of these, will be utilized.

- Examination of an unfertilized chicken egg. Use eggs that have clean uncracked shells and keep them refrigerated until used. Instruct students to wash hands with hot, soapy water before and after they come into contact with eggs and use disposable gloves when handling eggs. Provide each group with one egg and instruct them to carefully crack it open and deposit the contents into a petri dish. Using a hand lens, have them observe and identify all parts of the egg (charts and websites are available as resource guides). Wash and rinse all equipment and work surfaces after examination of the eggs.
- Observation of the process of fertilization and early embryological development of sea urchin eggs obtained from biological supply houses. Using appropriate magnification, the students can observe, draw, and label the various stages of development.
- If possible, view and discuss the movie/video *The Miracle of Life*. Before using this video in class, check for school district approval.

For activity closure, hold a teacher-led class discussion that includes direct instruction as needed to ensure student understandings of the reproductive system, reproduction, and fertilization.

Sample discussion topics and questions follow:

- Prepare a list of five common sexually transmitted diseases, including their cause and treatment. Be sure to include HIV/AIDS.
- In general, far more sperm are released by all life forms than are needed for fertilization. For example, the human ejaculate contains 300-400 million sperm and only one is required to fertilize the egg. Explain why so many more sperm are released than needed.
- Identify the primary organs in the human male and female reproductive systems.
- Discuss the differences between the egg and sperm of the human being.
- Discuss the major methods of birth control.
- In artificial hormone replacement therapy, why do you think there is such a concern over the hormones affecting other organ systems? (Upset homeostasis)
- What is an ectopic pregnancy?
- What is fetal alcohol syndrome? Explain.
- What are some of the advances in reproductive medicine?

For an alternative activity, go to the <http://science.nhmccd.edu/biol/ap2int.htm#reproductive> website, and then explore any of the choices appropriate to this activity.

Activity 14: The Immune System (SI GLEs: 6, 7, 14; LS GLEs: 32, 39)

Materials List: reference materials on the human immune system, reference materials on HIV and AIDS, computer with Internet access (if available)

Explain to students that they are to be the general in charge of troops in a war. Set up an analogy between war and the action of the human immune system. Allow students to work in pairs and use all available reference materials. A good source is the <http://science.nhmccd.edu/biol/ap2int.htm#lymph> website which offers a variety of useful links. At that site “The Humoral Immune Response” and “The Cellular Immune Response” provide explanations and animations of the immune response. After research, instruct each student pair to submit a battle plan that identifies four ways that the enemy (infectious agents) can penetrate the body’s defenses. Students should then outline the roles of the first, second, or third lines of defense, and identify troops (skin, basophils, macrophages, neutrophils, T-cells, B-cells) involved in each line of defense. At the end of their battle plans, ask students to describe how the lymphatic system collaborates with the immune system.

For activity closure, hold a teacher-led class discussion that includes direct instruction as needed to ensure student understandings of the immune system. Using appropriate reference materials, ask students to identify the components of the immune system that are compromised by the HIV virus. Discuss as a class how acquired immune deficiency syndrome (AIDS) affects all the body due to an ineffective immune system. If Internet access is available, the following websites have information on HIV and AIDS: <http://en.wikipedia.org/wiki/HIV> and <http://www.aids.org/factSheets/101-what-is-aids.html>. Additional topics of interest include explanation of autoimmune disorders such as lupus and rheumatoid arthritis. A good source of information about these disorders can be found at <http://www.nlm.nih.gov/medlineplus/ency/article/000816.htm>. Also discuss with students current and future immunosuppressant therapies for transplant patients; emphasize the necessity for these therapies as well as the many side effects.

Activity 15: Types of Immunization (SI GLEs: 7, 14; LS GLE: 40)

Materials List: reference materials on types of immunity and immunizations, poster paper and markers, computer with Internet access (if available)

Divide the class into four research groups and assign each group one of the following categories of immunities: (1) artificially, actively acquired, (2) artificially, passively acquired, (3) naturally, actively acquired, and (4) naturally, passively acquired. Instruct each group to research their assigned topic and prepare a poster and oral presentation for the class. The report should include who receives the antigen (any substance that causes a specific immune response), who or what produces the antibody, the duration of the immunity, the side effects and consequences of being exposed to the same antigen again, and an example for each type of immunity (e.g., hepatitis A immunization verses hepatitis B immunization, immunization received by a baby from its mother, or immunization as a result of exposure to an infected person).

Following oral presentations of each group, employ the *professor know-it-all* ([view literacy strategy descriptions](#)) strategy. Each group is now knowledgeable in their area of research and can provide “expert” answers to their peers about the content. The content includes information listed above. Call a group to the front of the room to serve as the know-it-alls; invite questions from the other students and encourage both factual and higher level questions. Make sure the students and teacher ask for corrections if the *professor know-it-alls* answers need elaboration or amending. After about five minutes, have a new group of students take their place at the front of the class and continue the process of students questioning students. This strategy serves to review content and resolve issues about important concepts.

Conclude with a class discussion. Sample items for discussion include

- Why does an infant not retain the immunity that it received from its mother?
- Discuss the pros and cons of immunization.
- Discuss with students the new baby immunization that is seven in one. Describe the pros and cons of using seven vaccinations in one setting.
- Debate the controversy between childhood vaccination and the increase in Autism. Present evidence that both supports and refutes the existence of any correlation between the two events.

Sample Assessments

General Guidelines

- The student is to be monitored throughout the work on all activities via teacher observation and *science learning log* entries.
- All student-developed products should be evaluated as the unit continues.
- The student investigations should be evaluated with a rubric.
- When possible, students should assist in developing any rubrics that will be used.
- For some multiple-choice items on written tests, ask students to write a justification for their chosen response.

Techniques will include making observations, log/data collection entries, report writing and presentation (problem-solving and performance-based assessments), group discussion and journaling (reflective assessment), and paper-and-pencil tests (traditional summative assessments). Assessments could include the following

General Assessments

- The student will take content exams after every major organ system.
- The student will provide accurate and detailed data entry and illustration labels for hands-on/virtual dissection performance.
- The student will be assessed via performance-based laboratory practicals for each system.
- The student will be assessed via diagram labeling.

- The student will be assessed via multimedia presentations of system by assigned groups.
- The student will be assessed via accurate descriptions of system and organ functions.

Activity Specific Assessments

- Activity 2: On content exam, ask students specific questions from student presentations on the transmission of a nerve impulse. Example questions: what is a resting potential, what is an action potential, and what is the role of the sodium-potassium pump?
- Activity 3: On content exam, ask students specific questions from student presentations about the peripheral and autonomic nervous system. Example questions: where are the peripheral and autonomic nerves located in the body and what are the roles of each set of nerves in maintaining proper body functioning?
- Activity 9: Provide each group with a diagram of a sheep or cow heart and have students locate the following parts (at a minimum): pericardium, atria, septum, ventricles, valves, vena cava, and aorta.
- Activity 11: Have each student create a flow chart or sequential diagram of the digestive system using the following structures: stomach, mouth, large intestine, esophagus, and small intestine. Students should place the structures in the proper order and give a general description of the digestive activity that occurs in each part.

Resources

- *Biology*. Instructional Fair, Inc. Grand Rapids, Michigan.
- *Biology: a wide variety of animations and tutorials on human anatomy and physiology*. North Harris College Department of Biology. Available online at <http://science.nhmccd.edu/biol/#>
- *The Body Tissue: information and photographs of tissue types*. Available online at <http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/artaug02/gohisto.html>
- *Cells of the Blood*. Available online at <http://www-micro.msb.le.ac.uk/MBChB/bloodmap/Blood.html>
- *Comparative Mammalian Brain Collections*. Available online at <http://www.brainmuseum.org>
- *Endocrine System: an interactive tutorial on the endocrine system*. Available online at <http://www.innerbody.com/image/endoov.html>
- *Gallery of Neurons: photos of different neurons*. Available online at <http://faculty.washington.edu/chudler/gall1.html>
- *Human Defenses: animations and interactive tutorials on the immune system*. Available online at <http://science.nhmccd.edu/biol/ap2int.htm#lymph>

- *Immune System: information on all aspects of the human immune system.* (March 2001). Available online at <http://uhaweb.hartford.edu/BUGL/immune.htm>
- *Interaction of the Nervous System with Other Body Systems.* Available online at <http://faculty.washington.edu/chudler/organ.html>
- *The Online Biology Book: includes chapters on systems of the human body.* Available online at <http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookTOC.html>
- *The Secret Life of the Brain: offers a three-dimensional tour of the brain.* Available online at <http://www.pbs.org/wnet/brain/3d>
- *Virtual Pig Dissection.* Available online at <http://www.whitman.edu/biology/vpd/main.html> <http://mail.fkchs.sad27.k12.me.us/fkchs/vpig> and
- *The Whole Brain Atlas offers imagery of the brain.* Available online at <http://www.med.harvard.edu/AANLIB/home.html>

Biology
Unit 7: Health and Disease

Time Frame: Approximately four weeks



Unit Description

In this unit the student will explore areas related to maintaining good health through recognition of causes, symptoms, treatments, and prevention of major diseases. Mechanisms of disease transmission and the role of the human immune system will also be investigated.

Student Understandings

Good health is dependent on the proper care and attention to the needs of the body. Students will be able to describe the causes, symptoms, treatments, and preventions of major communicable and noncommunicable diseases; students will be able to recognize the role of viruses, bacteria, and other pathogens in causing diseases. In addition, students will be able to describe the basic components of the immune system. Students will be able to discuss technological advances that have improved diagnosis and treatment of diseases and disorders.

Guiding Questions

1. Can students describe the mechanism of disease transmission and processes of infection?
2. Can students describe viruses?
3. Can students discern if antibiotics are effective for treatment of viral infections? Can students explain why a physician might prescribe an antibiotic, knowing that the patient has a viral infection?
4. Can students explain why certain bacteria become immune/resistant to certain antibiotics? Can students explain why this is a problem?
5. Can students define the term *germ theory*? Can students provide examples?

Unit 7 Grade-Level Expectations (GLEs)

| GLE # | GLE Text and Benchmarks |
|---------------------------|---|
| Science as Inquiry | |
| 1. | Write a testable question or hypothesis when given a topic (SI-H-A1) |
| 2. | Describe how investigations can be observation, description, literature survey, classification, or experimentations (SI-H-A2) |
| 3. | Plan and record step-by-step procedures for a valid investigation, select equipment, and materials, and identify variables and controls (SI-H-A2) |

| GLE # | GLE Text and Benchmarks |
|---------------------|---|
| 4. | Conduct an investigation that includes multiple traits and record, organize, and display data appropriately (SI-H-A2) |
| 6. | Use technology when appropriate to enhance laboratory investigations and presentations of findings (SI-H-A3) |
| 7. | Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4) |
| 9. | Write and defend a conclusion based on logical analysis of experimental data (SI-H-A6, SI-H-A2) |
| 10. | Given a description of an experiment, identify appropriate safety measures (SI-H-A7) |
| 11. | Evaluate selected theories based on supporting scientific evidence (SI-H-B1) |
| 12. | Cite evidence that scientific investigations are conducted for many different reasons (SI-H-B2) |
| 14. | Cite examples of scientific advances and emerging technologies and how they affect society (e.g., MRI, DNA in forensics) (SI-H-B3) |
| Life Science | |
| 21. | Compare the structures, functions, and cycles of viruses to those of cells (LS-H-C7) |
| 22. | Describe the role of viruses in causing diseases and conditions (e.g., AIDS, common colds, smallpox, influenza, warts) (LS-H-C7) (LS-H-G2) |
| 37. | Explain how fitness and health maintenance can result in a longer human life span (LS-H-G1) |
| 38. | Discuss mechanisms of disease transmission and processes of infection (LS-H-G2) (LS-H-G4) |
| 39. | Compare the functions of the basic components of the human immune system (LS-H-G3) |
| 41. | Describe causes, symptoms, treatments, and preventions of major communicable and noncommunicable diseases (LS-H-G4) |
| 42. | Summarize the uses of selected technological developments related to the prevention, diagnosis, and treatment of diseases or disorders (LS-H-G5) |

Sample Activities

Activity 1: Bacteria (SI GLEs: 4, 9, 10; LS GLE: 41)

Materials List: disposable Petri dishes with nutrient agar, moistened cotton swabs, safety goggles, marking pens, tape, hand lens, bleach or autoclave (if available), microscopes, prepared slides of bacteria, Lab Report Rubric BLM (one for each student), computer with Internet access (if available)

Explain to students that they are to conduct an investigation to determine the presence of bacteria in various locations throughout the room and the school. Ask students to propose reasons why

testing for the presence of bacteria on common surfaces is important; discuss with students the ability of certain pathogenic bacteria to live on surfaces such as kitchen counters, wood or plastic cutting boards, and stainless steel implements and surfaces. Pathogenic strains of *E. coli* and *Salmonella* are two common examples that can live on surfaces and if ingested can cause severe food poisoning. The potentially fatal MRSA (methicillin-resistant *Staphylococcus aureus*) bacterium can live on many surfaces including desk tops and can readily be transmitted to humans.

Before beginning the activity, review with students proper lab safety procedures, including hand washing techniques, when working with microorganisms. Ask the entire class to identify safety measures that should be considered during this investigation and compile a class list on the board; be sure to include proper disposal of cultures when the activity is completed. Their supplies will include Petri dishes containing nutrient agar, moistened cotton swabs, and marking pens. Distribute a Lab Report Rubric to each student and explain that they will submit a written lab report at the conclusion of this activity. Discuss with students the elements of the lab report and explain each component if necessary.

Working in small groups, have students select three areas they wish to test and then record a hypothesis as to the area that will provide the most contamination. Caution students to pay attention to teacher instructions for this investigation very carefully.

Each Petri dish is to be divided into four equal parts and the quadrants marked off and numbered on the base of the Petri dish. The teacher should demonstrate the preparation of the Petri dishes and proper procedures when using a swab to gather samples from a test area. Help the class design a data table and instruct the students to record on their data tables the locations to be tested and the corresponding number of the quadrants of nutrient agar to be smeared. Students are instructed to test only three areas, and their fourth quadrant is to be left untouched as a control. Review the function of the control.

Following contamination of Petri quadrants, have students seal the lids on their Petri dishes with tape and store the dishes in a warm location in the room. Have students use hand lenses to examine their Petri dishes daily for four or five days and record observations. Prior to the conclusion of the investigation, have students record analyses of their observational data and write conclusions about whether their data supported their hypotheses in their lab report. Follow correct procedure for disposal of contaminated Petri dishes. Glass or permanent Petri dishes should be autoclaved or soaked in bleach solution; disposable Petri dishes should be discarded following school system regulations for their removal. Use disposable Petri dishes, when possible.

An alternative, if supplies are not available, is to have students observe slides of bacteria using microscopes and classify them by shape, linking, and clustering. Most common bacteria are rod-shaped, spherical, or spiral; an excellent source of information and photographs can be found at the following website:

<http://student.cbcemd.edu/courses/bio141/lecguides/unit1/shape/shape.html>.

Following this engagement activity, provide instruction on bacteria, their requirements for life and growth, basic types (shapes), methods of reproduction, gram positive and gram negative, and methods of prevention of growth of these bacteria. Also, discuss with students symptoms of common bacterial infections, treatment of these infections, and whether they are communicable or not.

Activity 2: Viruses (SI GLEs: 7, 11; LS GLEs: 21, 38)

Materials List: reference materials and/or videos on viruses, computer with Internet access (if available)

After textbook readings, Internet readings, videos, and simulations such as those found at <http://www.cellsalive.com/phage.htm> or <http://www.Tulane.edu/~dmsander/garryfavweb.html>, use probing questions and direct instruction as needed to elicit from students an understanding of what viruses are and how they differ from living cells. Review the cell theory and traits of life, and then ask students why viruses are not considered to be living. Have students sketch a model virus and label the basic components. Next, have students analyze diagrams of lytic and lysogenic cycles for viruses and then construct a Venn diagram comparing the two cycles. A Venn diagram is a type of *graphic organizer* ([view literacy strategy descriptions](#)) that helps students logically organize information and facilitates understanding of key concepts. Here the Venn diagram will aid in comparison of the two cycles and will be useful for student review of important details. Discuss the various ways that viruses can damage cells and why lysogenic virus infections are so difficult to treat. Have students provide examples of diseases caused by viruses and allow for discussion of how the diseases are transmitted and how they affect the body. Discussion of HIV should be included and emphasized as well.

Activity 3: The Immune System (LS GLE: 39)

Materials List: 3 x 5 inch index cards or small squares of paper, Use of Antibiotics BLM (one for each student), computer with Internet access (if available)

After a discussion of the immune system, its parts, and cells associated with it, create a card sort activity to help students visualize the immune cells. A card sort is a type of *graphic organizer* ([view literacy strategy descriptions](#)); *graphic organizers* help students logically organize information from multiple sources and facilitate understanding of key concepts. They are useful in relating important details and concepts. Be sure to include pictures of *T and B cells* and *macrophages*, and diagrams of *antibodies*, and *antigens*. The card sort should contain the picture or diagram, the vocabulary term, and the definition of the term. Instruct students to match a picture with the word and definition of the word. Once students have completed the card sort, have students compare the roles of B cells and T cells in the immune response.

As a follow-up to the card sort, ask student groups to discuss the use of prescribed antibiotics by the medical community for bacterial infections. In their discussion, have students include (1) what are antibiotics, (2) why certain bacteria become immune/resistant to certain antibiotics, (3)

if and how bacterial resistance can be resolved, (4) what new methods of antibiotic treatment are being used, (5) why most viruses do not respond to antibiotics but do respond to antiviral drugs such as Tamiflu® and to interferon, (6) some possible reasons doctors prescribe antibiotics for a viral infection, such as a cold, and (7) a possible personal story of antibiotic use. Discuss with the students the advent of “super bugs” such as drug resistant staph infections (methicillin-resistant *Staphylococcus aureus* or MRSA). If Internet access is available, the following website has information on this strain of bacteria: <http://www.webmd.com/a-to-z-guides/methicillin-resistant-staphylococcus-aureus-mrsa-overview>.

After students have discussed in groups, distribute the Use of Antibiotics BLM to each student. Have one person from each group share with the class his/her discussion and instruct the students to record important information in a *split-page notetaking* ([view literacy strategy descriptions](#)) format, using the Use of Antibiotics BLM handout. Recording notes in this manner logically organizes information from multiple sources and facilitates students’ review of concepts. Demonstrate how students can study from their notes by covering information in the right column and using the prompts in the left column try to recall the covered information. Students can also use their notes to quiz each other in preparation for tests.

Activity 4: The Disease Chain (SI GLEs: 7, 14; LS GLEs: 22, 38, 39, 41, 42)

Materials List: large paper clips (six for each group); reference materials on microbial diseases; paper suitable for pamphlets; Health and Disease Pamphlet Rubric BLM (one for each group); computer with Internet access (if available); computer software for creating pamphlets (if available)

Before beginning this activity, briefly describe the *germ theory* (the theory that certain diseases are caused by microorganisms) and the role of Louis Pasteur in developing this theory. Emphasize that this theory was highly controversial when first proposed, but is now accepted in modern medicine and healthcare. Explain the idea that any microbial disease cycle can be viewed as a chain composed of six links. Using this model, students can study each link making up the chain and determine the cause, host relationship, transmission, and most economical methods of control. The six links are

1. Agent—this can be a bacterium, virus, fungus, protozoan, etc.
2. Reservoir/source—this is where the disease agent is found (e.g., air, water, food, intestinal tracts).
3. Exit—this is how the agent escapes from the reservoir/source (e.g., reproductive system, digestive system, draining wound).
4. Transmission—this is how, after exiting from the reservoir, the agent makes its way to a new host.
5. Entry—this is how, after being transmitted, the agent enters the new host (e.g., respiratory system, broken skin, and reproductive system).
6. New host—this is how the new host responds once the agent enters (e.g., immune system defense mechanisms, medical intervention, and state of health).

Information on any of the common microbial diseases can be found on the Centers for Communicable Diseases and Prevention website <http://www.cdc.gov> (see Diseases and Conditions). Divide the class into workable groups and assign each group a disease of current interest (e.g., AIDS, hepatitis A, influenza, staphylococcus infections, West Nile, small pox, Lyme disease, *E. coli* infection, strep throat, salmonella food poisoning, mononucleosis, sexually transmitted diseases, and MRSA). Select some that are currently a problem in Louisiana or of current interest to students. Provide each group with six large paper clips, which will represent each link in the disease chain, and then have them research the information for their assigned disease. Once completed, they are to make a presentation to the class in which they identify the characteristics for each link in the chain and then demonstrate, by removing the specific links, where it is best to control the disease. This latter part will be a challenge since control must be economical, practical, and not harm the host. Ask students to include in their presentation any new technological developments being used in diagnosis or treatment of the disease they research. They are to prepare a bi-fold or tri-fold pamphlet containing a summary of the information on their disease, its symptoms, its prevention, and recommended treatments. (If available, computer software can be used to create these pamphlets.) Distribute a copy of the Health and Disease Pamphlet Rubric to each group; this rubric details the criteria for evaluating the pamphlets. Groups will issue a copy of their handout to each class member at the time of their presentations.

The following two websites offer excellent information for the students to review for their presentation: <http://faculty.ccc.edu/tr-infectioncontrol/situation1.htm> and http://www.wisc-online.com/objects/index_tj.asp?objID=NUR1603. The latter website offers an interactive explanation of the chain of infection. There are many others; just type “chain of infection” into any search engine and select sites that are appropriate for your lesson plan. Bingo or a *Jeopardy*-type game could be used to review the information on diseases as a conclusion.

Activity 5: School Health Day Activity (SI GLE: 6; LS GLEs: 37, 38, 41, 42)

Materials List: reference materials on health issues, paper suitable for pamphlets, Health and Disease Pamphlet Rubric BLM (one for each group), computer with Internet access (if available), computer software for creating pamphlets (if available)

If possible, talk with the school nurse or a public health official about health issues prevalent in your school and community. An alternative is to have the students generate a list of health issues troubling teenagers (e.g., obesity, exercise and physical fitness, drug or alcohol abuse, steroid use, use of caffeine as a stimulant, smoking, sexually-transmitted diseases, healthy diet, eating disorders such as anorexia and bulimia, and regular dental and doctor checkups). The class is to conduct a school health day based on the information provided. Divide students into groups and instruct each group to create a pamphlet on one of the identified issues. (If available, computer software can be used to create these pamphlets.) Distribute a copy of the Health and Disease Pamphlet Rubric to each group; this rubric details the criteria for evaluating the pamphlets. In these pamphlets, students should explain to their peers how fitness and health maintenance can result in a longer and healthier life. Information can be obtained from a variety of websites (one is http://www.dmoz.org/Kids_and_Teens/Health/Teens/) and student health or biology textbooks. Along with the above-created pamphlets, students could give out their disease

pamphlets (created in activity 3) on this day to interested participants. Other science classes at the school could rotate through a central place (e.g., lobby, gym, or library) and obtain pamphlets from students. This not only allows for student-to-student teaching, but also tackling issues that are difficult to discuss as a whole class.

A closing activity is to employ the *professor know-it-all* ([view literacy strategy descriptions](#)) strategy. Each group is now knowledgeable in their area of research and can provide “expert” answers to their peers about the content. The content includes symptoms, treatments, and preventions of diseases as well as health and fitness maintenance. Call a group to the front of the room to serve as the know-it-alls; invite questions from the other students and encourage both factual and higher level questions. Make sure the students and teacher ask for corrections if the *professor know-it-alls* answers need elaboration or amending. After about five minutes, have a new group of students take their place at the front of the class and continue the process of students questioning students. This strategy serves to review content and resolve issues about important concepts.

Activity 6: A Look at Fungi (SI GLEs: 1, 2, 3, 9, 12; LS GLE: 38)

Materials List: reference materials on fungi; safety goggles, food items (e.g., wheat/white bread, oranges, apples, pickles, grapes, cheeses, celery, lettuce, and tomatoes); disposable cups or small plastic bags; hand lenses; microscopes; microscope slides and slip covers; Lab Report Rubric BLM from Activity 1 (one for each student)

Before beginning activity, survey students to see who is seriously allergic to molds and would need to avoid participating directly in the laboratory investigation. Those students should use reference materials to research the different types of fungi and their functions in the environment and their uses in society. Discuss with all students how a fungal investigation can be done by observation, description, literature survey, classification, or experimentations.

In this activity, students will be conducting an experiment by growing fungi on different surfaces and making observations over a period of several days. Discuss with students ways to protect themselves or other organisms from fungal growths as well as proper disposal of fungi infected materials. After basic instruction of the structure, function, and requirements for growth of some of the more familiar fungi such as bread mold, mushrooms, and mildew, discuss with students some of the more common fungal infections such as ringworms, nail fungus, and plant mildew. Before continuing, have students cite reasons that scientific investigations are conducted (e.g., to gain knowledge of subject, test new hypothesis, verify results previously obtained, and curiosity).

Distribute a Lab Report Rubric to each student and explain that they will submit a written lab report at the conclusion of this activity. Discuss with students the elements of the lab report and explain each component if necessary. Explain that in this activity, they are going to design and carry out an experiment to test some conditions that are necessary for fungal growth on food items. Instruct students to brainstorm a list of possible conditions and then discuss factors such as moisture, light, and amount of available air. Emphasize that the source of the fungi are spores that are ever present in the environment. After student groups have designed an experiment to

test one of these conditions, check for inclusion of a hypothesis, materials and procedure, controls, independent and dependent variables, and safety precautions. Then allow students to carry out their experiment. (Students will be growing fungi on the surfaces of food items either in bags or cups or in the dark or with a light source.) Provide students various breads, fruits, cheese, and vegetables (e.g., wheat/white bread, oranges, apples, pickles, grapes, cheeses, celery, lettuce, tomatoes) to serve as substrates for fungal growth. Provide students with baggies or cups to test the effects of ventilation on the growth of the fungi. Also provide students a dark and a light location to test the effects of light on the growth of the fungi. Then allow students to carry out their experiment.

Over the next few days, have students observe their substrates to determine if growth occurred or not. Be sure students record observations for each day, gross/macrosopic observations with hand lens, microscopic observations with a microscope, amount of growth, and odor or flies (if present). At the end of the investigation, instruct students to analyze their data and write a valid conclusion stating whether the results supported the hypothesis. Note: a description of lab procedures for growing fungi can be found at http://herbarium.usu.edu/fungi/FunFacts/moist_chamber.htm.

Once again, discuss with students the proper way to dispose of materials after the experiment is concluded. Discuss with students ways to protect themselves or other organisms from fungal growths.

Sample Assessments

General Guidelines

- The student is to be monitored throughout the work on all activities via teacher observation and science *learning log* entries.
- All student-developed products should be evaluated as the unit continues.
- The student investigations should be evaluated with a rubric.
- When possible, students should assist in developing any rubrics that will be used.
- For some multiple-choice items on written tests, ask students to write a justification for their chosen response.

Techniques will include making observations, log/data collection entries, report writing, and presentation (problem-solving and performance-based assessments), group discussion and journaling (reflective assessment), and paper-and-pencil tests (traditional summative assessments). Assessments could include the following:

General Assessments

- The student will determine if it is possible for a person to be overweight but suffer from malnutrition and explain the answer.

- The student will determine what the agent of hepatitis A is, how it is typically transmitted, and how the transmission of hepatitis A is different from that of hepatitis B.
- Ask students if antibiotics should be used to treat a viral infection. If not, why might a physician prescribe an antibiotic to a patient who has a viral disease?
- The student will determine the best methods for controlling the transmission of AIDS, gonorrhea, hepatitis A, hepatitis B, infectious mononucleosis, and strep throat.
- The student will determine how most antibiotics control or eliminate bacteria.
- The student will determine why anthrax can exist in a dormant stage and occur again after conditions are favorable and consider what its adaptation for survival is.

Activity-Specific Assessments

- Activity 1: Students will turn in a formal lab report with hypothesis, materials, procedure, variables, data collected, and conclusion for activity. Use a rubric to evaluate students' reports; one available rubric is the Lab Report Rubric BLM for Activity 1 and 6. An alternative rubric can be created at <http://rubistar.4teachers.org/index.php>.
- Activity 4 and 5: Use a rubric to grade students' disease pamphlets. One available rubric is the Health and Disease Pamphlet Rubric BLM for Activity 4 and 5 or create a rubric at <http://rubistar.4teachers.org/index.php>.
- Activity 6: Students will write a detailed lab report which includes experimental design with hypothesis, materials and procedure, controls and variables, data collected, and a conclusion for the activity. Use a rubric to evaluate students' reports; one available rubric is the Lab Report Rubric BLM for Activity 1 and 6. A different rubric may be created at <http://rubistar.4teachers.org/index.php>. For students allergic to mold, have them write a 2 - 3 page report on fungi, including types, reproduction, and functions in society.

Resources

- *Access Excellence at the National Health Museum* provides information and resources about health issues. Available online at <http://www.accessexcellence.org/HHQ/>
- *Cells Alive* provides information on cell biology, microbiology, and immunology. Available online at <http://www.cellsalive.com>
- *Centers for Disease Control and Prevention* provides information on a wide variety of health concerns. Available online at <http://www.cdc.gov/>
- *The Chain of Infection* provides an animated explanation of the chain of infection. Available online at http://www.wisconline.com/objects/index_tj.asp?objID=NUR1603

- *Infection Control for Nursing Students, City Colleges of Chicago* provides practical information on the spread of diseases. Available online at <http://faculty.ccc.edu/tr-infectioncontrol/situation1.htm>
- *Virology* provides the Big Picture Book of Viruses. Available online at <http://www.Tulane.edu/~dmsander/garryfavweb.html>
- *Virtual Museum of Bacteria* provides a tutorial on bacteria. Available online at <http://www.bacteriamuseum.org/map.shtml>

Biology
Unit 8: Patterns of Behavior

Time Frame: Approximately three weeks



Unit Description

This unit will focus on the effects various stimuli can have on organism behavior. Both plants and animals will be included, with an emphasis on how responses relate to the survival of the species.

Student Understandings

Organisms (plants and animals) react to stimuli in different ways and in varying amounts. Students will be able to explain plant and animal responses to stimuli and relate the survival value of these responses.

Guiding Questions

1. Can students differentiate between innate behavior and learned behavior?
2. Can students define the term, pheromones? Can students describe the role they play in animal behavior? Can students provide examples?
3. Can students explain why a bird will ignore a rabbit in its territory, but aggressively attempt to discourage a member of its own species?
4. Can students cite the advantages and disadvantages of social living? Can students provide some examples?
5. Can students describe examples of behaviors that enable organisms to survive?

Unit 8 Grade-Level Expectations (GLEs)

| GLE # | GLE Text and Benchmarks |
|---------------------------|--|
| Science as Inquiry | |
| 1. | Write a testable question or hypothesis when given a topic (SI-H-A1) |
| 3. | Plan and record step-by-step procedures for a valid investigation, select equipment and materials, and identify variables and controls (SI-H-A2) |
| 4. | Conduct an investigation that includes multiple trials and record, organize, and display data appropriately (SI-H-A2) |
| 6. | Use technology when appropriate to enhance laboratory investigations and presentations of findings (SI-H-A3) |
| 9. | Write and defend a conclusion based on logical analysis of experimental data (SI-H-A6) (SI-H-A2) |

| GLE # | GLE Text and Benchmarks |
|---------------------|--|
| 10. | Given a description of an experiment, identify appropriate safety measures (SI-H-A7) |
| 12. | Cite evidence that scientific investigations are conducted for many different reasons. (SI-H-B2) |
| 15. | Analyze the conclusion from an investigation by using data to determine its validity (SI-H-B4) |
| Life Science | |
| 35. | Explain how selected organisms respond to a variety of stimuli (LS-H-F3) |
| 36. | Explain how behavior affects the survival of species (LS-H-F4) |

Sample Activities

Activity 1: Response of a Plant to Light Stimulus—Phototropism (SI GLEs: 9, 15; LS GLEs: 35, 36)

Materials List: plant seeds such as beans or radish seeds, small containers, potting soil, water, a light source, Plant Tropisms BLM (one for each student)

Divide the class into workable groups (four students per group). Provide each group with several plant seeds, such as beans or radish seeds, and all other materials needed to grow a plant (e.g., container, soil, and water). Instruct the groups to design a lab activity to test plant response to light stimulus. They must include identification of dependent and independent variables, controls, and a data table. Group designs should have approval from the teacher before students begin the activity. Students' designs should include placing several plants in sunlight and several in the dark. The amount of soil, watering, number of seeds, and measurement method should all be kept constant. Once the plants are growing, the groups should make scheduled observations and record their results. After one week, the cups should be rotated 180 degrees and students should continue to make observations and record results for at least another week. Following this part of the investigation, each member of each group is to submit a lab report which must stress the significance of the observed behavior to the survival of the plant.

Explain to the students that plants respond to environmental stimuli by moving toward or away from the stimulus; these plant movements are called *tropisms*. Instruct the students to research the major tropisms, the stimulus involved in each, and a specific example of each. Provide students with a copy of the Plant Tropisms BLM and instruct them to record this information in the *graphic organizer* ([view literacy strategy descriptions](#)). *Graphic organizers* help students logically organize information from multiple sources and facilitate understanding of key concepts. They are useful in reviewing important details and concepts. Upon completion of this organizer discuss the survival benefits of each tropism.

Activity 2: Investigating Animal Behavior (SI GLEs: 1, 3, 4, 9, 10, 15; LS GLEs: 35, 36)

Materials List: living invertebrate organisms, such as mealworms, planaria, crickets, or earthworms; appropriate stimuli; Lab Report Rubric BLM (one for each student); computer with Internet access (if available)

Discuss safety issues with students on use of animals in the classroom before beginning the activity. Explain to students that each group is to design an investigation to test the behavior or responses of an invertebrate organism, such as a mealworm, earthworm, planaria, or cricket to a variety of stimuli. Examples of stimuli that students can investigate are response to light and dark, response to a variety of food sources, response to the introduction of a weak acid into the environment, response to a light touch with a toothpick, response to mild temperature variation, response to the introduction of color to their environment, or response to agitation or turbulence. Each student may choose his/her own stimulus and have it approved by the instructor. The investigation is enhanced if each group investigates a response to a different stimulus. Instruct groups that they are to select the stimulus to be investigated, write testable hypotheses, and design their investigations. Help students identify the independent and dependent variables as well as environmental factors which need to be controlled. Their design should include step-by-step procedures, materials, and appropriate data tables. After teacher approval, allow students to conduct multiple-trial investigations, record and analyze data, and state conclusions. Provide each group a copy of the Lab Report Rubric for their lab reports. After all lab reports have been turned in, have each group report its results and use data to justify their conclusions. Be sure to require students to explain why they think their responses happen in nature and relate these to survival of that species. Encourage other groups to analyze the data provided for each conclusion reported and assess the validity of each group's conclusion.

An excellent on-line lesson plan is available at http://www.accessexcellence.org/AE/AEC/AEF/1994/peebles_behavior.html. This module allows students to investigate animal behavior using “a variety of teaching strategies including videos, observation, experimentation, class discussion, reading essays and popular science articles, and journal development.” Another on-line lesson plan is available at <http://www.biologycorner.com/worksheets/isopod.html>; this site gives detailed instructions for investigations with isopods or “rolly pollys.” Additional links to a variety of animal behavior resources can be found at <http://asab.nottingham.ac.uk/web/societies.php>.

Activity 3: Social Structure and Behavior (SI GLE: 6; LS GLEs: 35, 36)

Materials List: reference materials and/or videos on animal behavior, science learning log, computer with Internet access (if available)

To introduce this activity, utilize the *SQPL* ([view literacy strategy descriptions](#)) strategy to develop questions that students would like to have answered in the following activity and discussion. In this strategy the teacher generates a statement that causes students to wonder, challenge, and question. An example of such a statement is “Social behavior is more important than individual behavior to insure the survival of the species.” Write the statement on the board,

overhead, or a handout. Have the students work in pairs to generate two or three questions they would like answered. Compile student generated questions and write on the board and as a class, decide which questions to answer. Add your own questions if important ones were overlooked by the students. Instruct students to record these questions in their science *learning logs* ([view literacy strategy descriptions](#)). Next have students observe behaviors of pets, birds or other animals in or around the school, or even of their classmates. Allow the students to describe the behaviors they observe and then classify as individual or social behavior. Explain to the students that social behaviors include formation of hierarchies, development of communications, territoriality, altruism, and other types of behaviors

Show the class a video such as the NOVA video on honeybees found at <http://www.pbs.org/wgbh/nova/bees>; several videos are available at this site. (There are many other videos on animal behavior that can be used instead.) After observing the video, students are to answer the questions they posed in the *SQPL* activity and submit written observational summaries stressing the various aspects of social behavior observed in the video. Conduct a culminating discussion in which students identify the adaptive nature of social behaviors and how these may enable species to survive. Be sure to include discussion about the role and importance of pheromones in animal behavior. Students should use their *science learning logs* to record all answers and summaries.

Activity 4: Innate and Learned Behavior (SI GLE: 12; LS GLEs: 35, 36)

Materials List: reference materials on innate and learned behavior of organisms, computer with Internet access (if available)

Discuss with students why scientists conduct investigations. Have students cite evidence that scientific investigations are conducted for many different reasons, and that behavioral studies are often conducted to help scientists form hypotheses about behaviors that adapt a species to its environment. These behaviors are both innate and learned.

In a class discussion with students, explain innate behavior of organisms versus learned behavior. Innate behavior examples include spiders spinning first web, hatched birds begging for food, and mammals searching for nipple for milk. Learned behavior examples include Pavlov's dog/food/bell experiment, Skinner's box experiment, and migration of geese. Divide the students into small groups and instruct each group to use reference materials or the Internet (if available) to identify five types of innate behavior and five types of learned behavior. Each group will share their research with the class. To facilitate this activity and discussion, have students create a *graphic organizer* ([view literacy strategy descriptions](#)) to compare innate behavior with the different forms of learned behavior discussed in class. Include at least one example of each kind of behavior in the *graphic organizer* and tell why each is important for species survival.

Sample Assessments

General Guidelines

- Students should be monitored throughout the work on all activities via teacher observation and journal entries.
- All student-developed products should be evaluated as the unit continues.
- Student investigations should be evaluated with a rubric.
- When possible, students should assist in developing any rubrics that will be used.
- For some multiple-choice items on written tests, ask students to write a justification for their chosen response.

Techniques will include observations, log/data collection entries, report writing and presentation (problem-solving and performance-based assessments), group discussion and journaling (reflective assessment), and paper-and-pencil tests (traditional summative assessments). Assessments could include the following:

General Assessments

- Provide students with lists or descriptions of organisms, stimuli, and the organisms' response. Students will classify the response behaviors as innate or learned and have them identify the response behaviors that are related to survival of the organism.
- Students will answer the following questions: In the beehive, what is the waggle dance? How does this behavior relate to survival for the bee colony?
- Students will answer the following question: Are the responses of carnivorous plants behavioral? Explain.

Activity Specific Assessments

- Activity 1: After discussion of lab activity set-up and conclusion with lab reports, students will explain the advantages phototropism provides to the survival of a plant.
- Activity 2: Use a rubric to evaluate students' reports; one available rubric is the Lab Report Rubric BLM for Activity 2. Different rubrics can be developed at <http://rubistar.4teachers.org/index.php>.
- Activity 4: Students will respond to the following: Although the members of many animal species derive benefits from living in social groups, members of other species live alone. What might be the adaptive advantage of solitary living?

Resources

- *Animal behavior lesson plans*. Available online at http://www.accessexcellence.org/AE/AEC/AEF/1994/peebles_behavior.html
- *Investigations with isopods*. Available online at <http://www.biologycorner.com/worksheets/isopod.html>
- *Links to a variety of animal behavior resources*. Available online at <http://asab.nottingham.ac.uk/web/societies.php>
- *NOVA on Honey Bees*. Available online at <http://www.pbs.org/wgbh/nova/bees/>