Biology II (ZoBot)
Science Curriculum
Francis Howell School District

Board Approved: March 5, 2009

Francis Howell School District

Mission Statement

Francis Howell School District is a learning community where all students reach their full potential.

Vision Statement

Francis Howell School District is an educational leader that builds excellence through a collaborative culture that values students, parents, employees, and the community as partners in learning.

Values

Francis Howell School District is committed to:

- Providing a consistent and comprehensive education that fosters high levels of academic achievement for all
- Operating safe and well-maintained schools
- Promoting parent, community, student, and business involvement in support of the school district
- Ensuring fiscal responsibility
- Developing character and leadership

Francis Howell School District Graduate Goals

Upon completion of their academic study in the Francis Howell School District, students will be able to:

1. Gather, analyze and apply information and ideas.
2. Communicate effectively within and beyond the classroom.
3. Recognize and solve problems.
4. Make decisions and act as responsible members of society.

Science Graduate Goals

The students in the Francis Howell School District will graduate with the knowledge, skills, and attitudes essential to leading a productive, meaningful life.

Graduates will:

- Understand and apply principles of scientific investigation.
- Utilize the key concepts and principles of life, earth, and physical science to solve problems.
- Recognize that science is an ongoing human endeavor that helps us understand our world.
- Realize that science, mathematics, and technology are interdependent, each with strengths and limitations that impact the environment and society.
- Use scientific knowledge and scientific ways of thinking for individual and social purposes.

Course Rationale

Science education develops science literacy. Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. A sound grounding in science strengthens many of the skills that people use every day, like solving problems creatively, thinking critically, working cooperatively in teams, using technology effectively, and valuing life-long learning. Scientific literacy has become a necessity for everyone.

To accomplish this literacy, science courses will reflect the following:

- Develop scientific reasoning and critical thinking skills.
- Extend problem-solving skills using scientific methods.
- Include lab-based experiences.
- Strengthen positive attitudes about science.
- Incorporate the use of new technologies.
- Provide relevant connections to personal and societal issues and events.

Course Description

Biology II (ZoBot) – Course #131280
Credit: 1 unit
Prerequisite: Completion of Biology with a grade of "C" or better recommended or teacher recommendation

This is a rigorous course where students will study the classification, structures and functions, and the life cycles (reproduction) of plants and animals with emphasis on local flora and fauna. Students will learn through lecture, specimen collections, specimen dissection, live specimen lab work and research.

Francis Howell School District
Biology II (ZoBot) Curriculum Writers

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Francis Howell School District
Biology II (ZoBot) Curriculum Map

First Semester: (First and Second Quarter) 15 weeks (6 units)

Plant's Impact on Earth ● Human Use ● Symbiotic Relationships ● Atmospheric Chemistry and Climate **1 week**	**Plant Biochemistry and Cellular Organelles** ● 4 organic macromolecules ● Eukaryotic cellular structures ● Plant systems ● Specifc Plant Cells ● Specific Plant Tissues **3 weeks**	**Plant Growth and Development** ● Meristematic Activity ● Plant Hormones ● Plant Pigments (cryptochrome and phytochrome) **2 weeks**	**Simple Plant Organs** ● Xylem and Phloem ● Vascular Cambium Activity ● Root anatomy and function ● Leaf anatomy and function ● Stem anatomy and function ● Photosynthesis **2.5 weeks**	**Plant Reproduction** ● Plant classification ● Alternation of generation in flowering plants ● Flower, fruit, and seed characteristics **2.5 weeks**
Animal Structure and Development ● Levels of organization ● Body symmetry ● Embryonic development and germ layers ● Body cavities ● Phylogenetic relationships ● Phylogeny construction				

3 weeks				

Francis Howell School District
Biology II (ZoBot) Curriculum Map

Second Semester: (Third and Fourth Quarter) 18 Weeks

Simple Invertebrates	**Cavity Development**	**Developing Segmentation**	**Advanced Invertebrates**	**Phylum Chordata**
● Sponge cellular composition ● Sponge class comparison ● Cnidarian characteristics ● Cnidarian class comparison	● Flatworm germ layer development ● Flatworm structures ● Flatworm class comparison ● Roundworm coelom development ● Roundworm class comparison ● Roundworm structures	● Mollusk characteristics ● Mollusk system comparison ● Mollusk class comparison ● Annelid metamerism and characteristics ● Annelid class comparison	● Arthropodization ● Chelicerata characteristics ● Crustacea characteristics ● Uniramia characteristics ● Metamorphosis ● Echinoderm body plan and structures ● Echinoderm class comparison	● Chordate defining characteristics ● Vertebrate class comparison (adaptations, anatomy, behaviors, interactions, relationships)
2 weeks	**2 weeks**	**3 weeks**	**3 weeks**	**8 weeks**

Content Area:	Course: Biology II (ZoBot)	Strand: Plant's Impact on the Earth
Learner Objectives: ● Plants play essential roles in maintaining Earth's environment and life forms. (C)		

Concepts:

A. Plants are used by people in many ways. (C4)
B. Plants help maintain Earth's atmospheric chemistry and climate. (C5)
C. Many different organisms benefit from their close relationships with plants. (C4)

Students Should Know	Students Should Be Able to
● People use plants as food and food supplements ● Plants and plant products are used as medicines and building materials ● Plants play essential roles in maintaining Earth's climate, atmosphere and organisms. ● Plants and other organisms are involved in beneficial relationships. ● Flowering plants and animals have influenced each other's evolution.	● Describe different ways plants are utilized by people. (C4e) ● Determine the ecological role provided by plants with regard to atmospheric levels of oxygen and carbon dioxide. (C5e) ● Compare and contrast the different relationships between plants and other organisms. (C4b)

Instructional Support

Student Essential Vocabulary					
Plants	Embryophytes	Bacteria	Algae	Fungi	Photosynthesis
Ethnobotany	Agriculture	Greenhouse Gases	Global Warming	Food Webs	Producers
Consumers	Herbivores	Carnivores	Omnivores	Symbiosis	Mutualism
Commensalism	Parasitism	Coevolution	Pollination	Microbes	Monoculture
Polyculture	Natural Selection	Seed Banks	Primary Compounds	Secondary Compounds	Scientific Names
Binomial	Herbaria	Identification Keys	Dichotomous Keys	Phylogeny	Evolutionary Relationships
Cladistics	Biological Niche				

Sample Learning Activities

Learning Activity #1 : (See Appendix – A1, A2)

Plants of the World Web Quest - Students will use the computer lab to explore how humans rely on plants for food, textiles, medicine and shelter.

Web Quest Site: http://www.**district87.org**/staff/bachl/plantsoftheworld

Activity's Alignment	
NSES	C4e
CONTENT	SC3, CA3
PROCESS	1.6 – Discover/ evaluate relationships
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Similarities and differences, Summarizing and note taking
ISTE	3b – Use digital tools to find and use information

Sample Assessments

Assessment #1:

Plants of the World Web Quest Assessment:

1) What ethical dilemmas do ethnobotanists face?
2) What are the four most important food staples worldwide? Where did each originate?

2 points – both answers are correct

1 point – one of the two answers is correct

0 points – none of the answers are correct

Key:

1) *Often the traditional knowledge about the plants can be obtained only by specialists within an indigenous community - for example the shamans, beekeepers, and master fisherman. The ethnobotanist establishes credibility in the community and a relationship with the*

specialists based on trust. Ethnobotanists sometimes obtain information that may even be kept from the rest of the native community. This brings up some ethical issues on ownership to the plant information.

2) *The four most important food staples worldwide are wheat, rice, maize and potatoes. Wheat originated in the Near and Middle East, Rice grew originally in Asia and Africa. Maize is from South and Central America and the potato originally came from the High Andes in South America.*

Assessment's Alignment	
NSES	C4e
CONTENT	SC3
PROCESS	1.6 – Discover and evaluate patterns and relationships
DOK	2 – Skill/Concept
LEVEL OF EXPECTATION	Mastery Level – 85%
ISTE	

Assessment #2: (See Appendix – B2)
Food Chains and Food Webs Assessment:

Assessment's Alignment	
NSES	C4b
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships 3.5 – Reason logically (inductive/deductive)
DOK	3 – Strategic Thinking

Learning Activity #2: (See Appendix – B1)

Introduction to Food Chains and Food Webs - Students will construct a series of food webs and food chains by identifying the different biological niches occupied by a variety of organisms.

Activity's Alignment	
NSES	C4b
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships

DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Nonlinguistic representations, Generating and testing hypotheses
ISTE	3b – Use digital tools to find and use information

LEVEL OF EXPECTATION	Mastery Level – 85%
ISTE	

Student Resources	Teacher Resources
Plant Biology, Prentice Hall ©2003 Web Quest Site: www.district87.org/staff/bachl/plantsoftheworld	Plant Biology, Prentice Hall ©2003 Web Quest Site: www.**district87.org**/staff/bachl/plantsoftheworld

Identity Equity and Readiness			
Gender Equity		Technology Skills	
Racial/Ethnic Equity		Research/Information	
Disability Equity		Workplace/Job Prep	

Content Area: Science	Course: Biology II (ZoBot)	Strand: Plant Biochemistry and Cellular Structures

Learner Objectives:

- Plants are composed of smaller distinct molecules (biochemistry) and structures (specific cellular organelles, cells, and tissues). (B,C)

Concepts:

A. Plants are composed of four types of organic molecules: Carbohydrates, lipids, proteins, and nucleic acids. (B2)
B. Plant cells have the general features of eukaryotic cells and additional components. (C1)
C. Plant bodies are composed of organs, tissues, and many types of cells. (C1)
D. Plant tissues are composed of one or more different types of cells. (C1)

Students Should Know	Students Should Be Able to
● There are four types of organic (containing carbon) macromolecules: proteins, carbohydrates, lipids, and nucleic acids. ● Each type of macromolecule is composed of different combinations of elements. ● The structure of each type of macromolecule determines the function of that molecule (e.g., lipids are composed of long carbon chains that are non-polar, which is why they are efficient at creating barriers against water movement). ● Cell walls are primarily composed of cellulose (rigid and supportive) while cell membranes are primarily composed of lipids (permeable and flexible). ● Cell walls are composed of two different layers (primary and secondary) that are created at differing times in the cell's life cycle. ● Two plant systems exist, roots and shoots, and their functions are determined by the different organs, tissues, and specialized cells that compose their structures. ● Simple tissues are composed of only one or two types of cell. ● There are three different simple tissues, each with their own unique characteristics: parenchyma, sclerenchyma, and collenchyma. ● Complex plant tissues are composed of three or more cell types. ● The four complex plant tissues are xylem, phloem, epidermis, and secretory.	● Compare and contrast the elemental composition and general structure of the four types of organic molecules. (B2f) ● Relate the functions of each of the four types of organic molecules to their specific uses in plants. (B2f) ● Compare and contrast the structure and function of a cell wall and a cell membrane. (C1a) ● Explain the physical and chemical interactions that occur between organelles (e.g., plastids, nucleus, cytoskeleton, endoplasmic reticulum, vacuoles, Golgi bodies, mitochondria) as they carry out the life processes of plants. (C1a) ● Describe the organizational hierarchy of plant structures (cell types, tissues, organs, and systems). (C5d) ● Compare and contrast the three simple tissues. (C5d) ● Explain the composition of complex tissues in relationship to the specialized cells they contain. (C1f) ● Compare and contrast the four complex tissues. (C5d)

Instructional Support

Student Essential Vocabulary					
Carbohydrates	Monosaccharides	Disaccharides	Polysaccharides	Lipids	Saturated
Phospholipids	Sucrose	Glucose	Fructose	Galactose	Lactose
Isomer	Hydrophobic	Hydrophilic	Nucleic acid	Nucleotide	Glycerol
Fatty acid	Cellulose	Starch	Monomers	Amino acid	Ribosome
Vacuole	Mitochondria	Plastid	Chloroplast	Amyloplast	Elaioplast
Chromoplast	Endoplasmic reticulum	Middle lamella	Plasmodesmata	Prokaryotic	Eukaryotic
Chromatin	Nucleoplasm	Microtubules	Microfilaments	Peroxisome	Parenchyma
Sclerenchyma	Collenchyma	Xylem	Phloem	Epidermis	Mucilage
Root hair	Stomata	Tracheids	Vessel	Sieve cell	Sieve tube

Sample Learning Activities

Learning Activity #1 : (See Appendix - C1, C2)
Plant Tissue Concept Map Activity:
Students will read a passage in the Plant Biology textbook titled "Plant Tissues Are Composed of One to Several Cell Types" on pages 194-196. After reading the passage, the students will construct a concept map organizing the different tissues discussed into two different categories. They will need to include functions, characteristics, and examples in their concept map. While this could be done as a paper and pencil activity, the Smart Ideas software should be used to make it more powerful and organized. A scoring guide is included along with an example concept map.

Activity's Alignment	
NSES	C5d
CONTENT	SC3, CA3, CA4
PROCESS	1.4 – Organize information using tools 1.6 – Discover/evaluate relationships 1.8 – Organize data and ideas
DOK	2 – Skill/Concept

Sample Assessments

Assessment #1: (See Appendix – C3)
Plant Tissue Quiz:
Students will take a short quiz matching plant tissues based on their function, characteristics, and category, as well as describing functions and comparing different category types. (Key in Appendix)

Assessment's Alignment	
NSES	C5d
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships
DOK	1 – Recall 2 – Skill/Concept
LEVEL OF EXPECTATION	Mastery Level - 75%

INSTRUCTIONAL STRATEGIES	Nonlinguistic Representations
ISTE	1b-use technology to create original works

Learning Activity #2: (See Appendix – D1)
Cell Haiku Activity:
Students will use the information in their textbook (Chapter 7) and their notes to create original Haikus covering 18 different cell organelles/structures specific to plants. A scoring rubric is included.

Activity's Alignment	
NSES	C1a
CONTENT	SC3, CA4
PROCESS	1.10 – Apply information, ideas and skills 2.5 – Produce works in the arts
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Summarizing and note taking
ISTE	

ISTE	

Assessment #2:
Cell Structure Formative:
Questions:

1. Compare and contrast primary and secondary cell walls.
2. Distinguish between the four different types of plastids.
3. Describe the physical characteristics and functions of two different plant organelles not addressed in the first two questions.

Answers:

1. ***Comparison:*** *Both types of cell walls provide protection and support for the cell.*
   Contrasting: *Primary cell walls are laid down first while the plant cell is still growing. Primary cell walls are fixed and will not stretch. Secondary cell walls are laid down after the cell has stopped growing (second). Secondary cell walls are fixed and will not stretch.*

2. ***Elaioplasts****: Colorless plastids responsible for storing oils in the plant.*
   Amyloplasts*: Colorless plastids responsible for storing sugars for the plant.*
   Chromoplast*: Orange, yellow, or red plastids that give the plant color. Helpful in creating structures that will be necessary for pollination and seed dispersal by animals.*
   Chloroplast*: Provides glucose for the plant by engaging in the chemical reaction, photosynthesis. It is green in color.*

3. ***Scoring for each organelle (2 total):***
   2pts – Organelle is correctly described in both structure and function

	1 pt – Organelle is described correctly in only one of the two categories (structure or function) *0 pts – Organelle is not correctly described in either its function or its structure.* *4 pts can be earned on this question.*

Assessment's Alignment	
NSES	C1a
CONTENT	SC3
PROCESS	1.10 – Apply information, ideas, and skills 1.6 – Discover/evaluate relationships
DOK	2 - Skill/Concepts
LEVEL OF EXPECTATION	Mastery Level - 80%
ISTE	

Student Resources	Teacher Resources
Plant Biology, Prentice Hall ©2003 Smart Ideas Software	Plant Biology, Prentice Hall ©2003

Identity Equity and Readiness			
Gender Equity		Technology Skills	
Racial/Ethnic Equity		Research/Information	
Disability Equity		Workplace/Job Prep	

Content Area: Science	Course: Biology II (ZoBot)	Strand: Plant Growth and Development
Learner Objectives: ● Plant growth and development takes place at specific locations. (C)		

Concepts:

A. New plant cells are produced by meristems. (C1)

B. Plant growth is regulated by hormones and pigment-containing molecules. (C6)

Students Should Know	Students Should Be Able to
● Vacuoles take in water and increase in size, which causes the cell to expand as well ● Mitosis only takes place in specific locations of plants called meristems ● Primary meristems increase the length of a plant ● Secondary meristems increase the width or girth of a plant ● The three primary meristems are protoderm, procambium, and ground meristem, and they all eventually become specific mature tissues ● Not all plants possess both primary and secondary meristems, and their final structure is dependent on the activity of the meristems they have ● Hormones are chemicals produced in specific locations that lead to precise responses in other areas of the plant ● Plants produce hormones in response to particular stimuli such as gravity, light, water, physical contact, and temperature. ● Tropisms can be negative (towards a stimulus) or positive (away from a stimulus)	● Compare and contrast cell division and cell elongation as the essential methods of plant growth. (C1d) ● Compare and contrast primary and secondary meristems. (C1d) ● Describe the different primary meristems (e.g. procambium, protoderm, and ground meristem) in reference to what tissues they produce (e.g. epidermis, cortex, pith, and vascular tissue). (C1d) ● Explain the effects of specific plant hormones (e.g. auxin, cytokinin, gibberellin, abscisic acid, and ethylene) on plant growth and responses to stimuli. (C6b) ● Determine the tropic reactions of plants by evaluating the effects of various plant stimuli (e.g. gravity, light, water, touch, and temperature). (C6b) ● Describe how plants sense the amount of light in the environment and respond to seasonal changes. (C6b)

• Cryptochrome reacts with blue light and it regulates plant height and leaf production • Phytochrome reacts with red light and it regulates seed germination • Short-day plants bloom when days are shorter than a critical period • Long-day plants bloom when days are longer than a critical period	

Instructional Support

Student Essential Vocabulary					
Auxin	Tropism	Gibberellin	Cytokinin	Ethylene	Brassinosteroids
Systemin	Salicylic Acid	Phytochrome	Cryptochrome	Short-Day Plant	Long-Day Plant
Apical Dominance	Apical Meristem	Primary Meristems	Protoderm	Epidermis	Ground Meristem
Pith	Cortex	Procambium	Xylem	Phloem	Secondary Meristem
Cork Cambium	Cork	Vascular Cambium	Target Cells	Receptor Proteins	Hormones
Signal Transduction	Gene Expression	Inhibit	Vacuoles		

Sample Learning Activities	**Sample Assessments**
Learning Activity #1 : (See Appendix – E1, E2) **Auxins and Tropisms (Relationship) –** Students will conduct a three part experiment studying the effects of a stimulus (gravity) on the directional growth of corn seeding roots and shoots, as well as the impact that the hormone auxin has on the patterns of growth.	**Assessment #1:** **Auxin/Tropism Lab Exit Questions –** 1. If auxin is the cause of the tropisms in both the roots and the shoots of seedlings, predict the effect of removing the apical meristems of shoots on the growth and development of roots. 2. Given each scenario below, predict the tropic response of the plant. Be sure to identify what plant organ will respond and what tropism you expect to see. A. A potted plant is grown in a greenhouse with equal light on all sides. The experimenter waters the plant along the left side of the pot only for three weeks.

Activity's Alignment	
NSES	C6b
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships

DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Cooperative learning Generating and testing hypotheses
ISTE	

Learning Activity #2: (See Appendix – F1, F2)
The Effect of Hormones on Cellular Functions (summary) – Students will take notes from classroom discussion on the effect of hormones on the activity of plant cells. Students will write a summary of the discussion using vocabulary correctly. Students will evaluate a peer's summary and edit it for content. Finally the partnership will work together to create a final, quality description/summary of the effects of hormones on cellular functions.

Activity's Alignment

B. A potted plant is grown in a dark room using one lamp positioned directly to the right of the plant, shining on the side at a completely perpendicular anNSES.

Answer Key:

1. *If the apical meristems are removed from the shoot of a seedling, then the roots will grow at a much slower rate and the patterns will be more erratic than straight down.*

2A. The roots of the plant will grow more on the side with the water. This is positive hydrotropism.
2B. The shoots of the plant will grow towards the light at a right anNSES. This is positive phototropism.

Assessment's Alignment	
NSES	C6b
CONTENT	SC3
PROCESS	1.6 – Discover and evaluate patterns and relationships
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level – 85%
ISTE	

Assessment #2:
Hormone Assessment:

1. Describe the relationship between protein receptors and signal transduction.
2. Explain how gene expression causes specific plant cell responses.

NSES	C6b
CONTENT	SC3, CA4
PROCESS	2.2 – Revise communications 1.6 – Discover/evaluate relationships
DOK	2 – Skill/Concept
INSTRUCTIONAL STRATEGIES	Summarizing and note taking Cooperative learning
ISTE	

2 points – both answers are correct

1 point – one of the two answers is correct

0 points – none of the answers are correct

Key:

1.) Protein receptors attach specific hormones by having complimentary chemical and structural formulas. Each protein receptor initiates a series of specific chemical reactions in the cell that quickly reach the genes inside the cell's nucleus.

2.) Genes code for specific proteins, and proteins can cause specific cellular responses such as growth and death. If specific genes are turned on (expressed) then corresponding plant responses will begin.

Assessment's Alignment	
NSES	C6b
CONTENT	SC3
PROCESS	1.6 – Discover and evaluate patterns and relationships
DOK	2 – Skill/Concept
LEVEL OF EXPECTATION	Mastery Level – 80%
ISTE	

Student Resources	**Teacher Resources**
Plant Biology, Prentice Hall ©2003	Plant Biology, Prentice Hall ©2003 David Attenborough's The Private Life of Plants: Plant Politics © 1995 Biology: The Study of Life. Laboratory Manual. Prentice Hall © 1999

Identity Equity and Readiness			
Gender Equity		Technology Skills	
Racial/Ethnic Equity		Research/Information	
Disability Equity		Workplace/Job Prep	

Content Area: Science	Course: Biology II (ZoBot)	Strand: Simple Plant Organs

Learner Objectives:
- Plants are composed three different fundamental plant organs: roots, stems, and leaves

Concepts:

A. The functions of xylem and phloem are determined by their structure. (C1)
B. The cambium layers of the stem produce new tissues as plants grow in height and diameter. (C1)
C. Different roots systems perform specialized functions. (C3)
D. Leaves are the primary photosynthetic organ in plants. (C1)
E. Photosynthesis converts light energy into chemical energy stored in sugars. (C1)
F. The major tissues of leaves include epidermis, mesophyll, xylem, and phloem. (C1)
G. Leaves perform many functions in addition to photosynthesis. (C1)

Students Should Know	Students Should Be Able to
● Roots perform absorption, anchorage, and storage for plants. ● Stems perform support for other plant structures and the transportation of water, minerals, nutrient, and carbohydrates. ● Leaves serve to cool plants through transpiration and conduct photosynthesis. ● Root tips are subdivided into four regions: root cap, region of cell division, region of cell elongation, and region of cellular maturation. ● Plants absorb water and minerals from the soil at the root hairs. ● The cell membranes of root hairs are selective; using special transport proteins that determine what may and may not enter the plant. ● The vascular cylinder of a root has a layer of endodermis with Casparian strips surrounding it in order to ensure that any molecule that gains entry to the plants vascular tissue goes through the selective cell membranes of the endodermal cells and not between them. ● In addition to their basic functions, some roots have unique, specialized functions such as supporting plant tissues above the ground, exchanging gasses, contracting to pull themselves deeper underground, and parasitizing neighboring plants. ● Monocot and dicot roots can be compared by observing the shape and arrangement of tissues in the vascular cylinder.	● Describe the primary functions of roots, stems, and leaves. (C1f) ● Compare and contrast the functions and characteristics of the four regions of a root tip. (C1f) ● Summarize the process of mineral absorption in roots. (C1d) ● Categorize specialized roots based on their unique structures and functions. (C3e) ● Identify the varied tissue patterns found in monocot and dicot root cross sections. (C3e) ● Distinguish between the tissues produced by primary and secondary meristems in stems. (C1f) ● Compare and contrast monocot and dicot stems according to their vascular bundles. (C3e) ● Make detailed observations about the composition of different wood specimen. (C3e) ● Summarize the processes of transpiration and cohesion as they relate to the movement of water in a plant. (C1d) ● Compare and contrast the tissues produced by vascular and cork cambium layers. (C1f) ● Categorize specialized stems based on their unique structures and functions. (C3e)

• Wood is composed of secondary xylem tissue that is produced by the secondary meristem, vascular cambium. • Plants that lack vascular cambium produce only primary xylem, which stays green and herbaceous throughout its entire life. • Monocot and dicot stems can be distinguished by examining the patterns and shapes of their vascular bundles. • The spring xylem found in wood is thicker and lighter colored than summer xylem, and this alternation gives wood it's ringed patterns. • A trees age can be determined by counting the rings produced through alternating seasonal growth. • Transpiration is the release of water in gaseous form from leaves. • Cohesion is water's ability to stick to one another due to their polar nature. • Vascular cambium produces secondary xylem, or wood, and secondary phloem, or inner bark, while cork cambium produces cork which makes up the outer bark of a tree. • In addition to their basic functions, some stems have unique, specialized functions such as climbing, reproduction, protection, and underground food storage. • Epidermis is a clear tissue found on leaves that secretes cutin, a waxy material, and protects the interior of the leaf. • Palisade mesophyll is located directly below the epidermis, and it has many chloroplasts so that it may perform photosynthesis. • Spongy mesophyll is found below the palisade mesophyll, and it helps the movement of materials to necessary for photosynthesis. • Stomata are specialized epidermal cells that permit the exchange of gasses in a leaf with the outside environment. • Three major types of leaf vein patterns exist: pinnate, palmate, and parallel. • Three major types of leaf arrangement are found in plants: opposite, alternate, and whorled. • Simple leaves are classified as having one undivided blade per petiole, while compound leaves have their blade subdivided into multiple smaller leaflets. • In addition to their basic functions, some leaves have unique specialized structures such as food storage, attracting pollinators, capturing insects for food, and protection.	• Describe the functions of a typical leaf, and relate them to the specific cells and tissues that contribute to those functions. (C1f) • Compare and contrast leaves according to their leaf vein patterns and phyllotaxy. (C3e) • Distinguish between simple and compound leaves. (C3e) • Categorize specialized leaves based on their unique structures and functions. (C3e) • Describe the cause and effect relationship that exists between a plant's environment, leaf color change, and abscission. (C1f)

● Environmental cues such as day length, temperature, and water availability cause plants to break down their chloroplasts, thus revealing other colors such as yellows, oranges, and reds. ● Plants respond to environmental change by engaging in leaf abscission, a hormone driven process by which plants shed their leaves in preparation for harsh winter conditions.	

Instructional Support

Student Essential Vocabulary					
Monocot	Dicot	Photosynthesis	Transpiration	Blade	Petiole
Sessile	Axil	Stipule	Node	Pinnate venation	Palmate venation
Parallel venation	Internode	Whorled	Cuticle	Mesophyll	Stomata
Guard cells	Bulliform	Vascular bundle	Chlorophyll	Carotene	Xanthophyll
Anthocyanin	Betacyanin	Senescence	Abscission	Suberin	Protoderm
Procambium	Ground meristem	Pith	Cortex	Parenchyma	Apical meristem
Tracheids	Vessels	Fibers	Sieve tube	Vascular cambium	Cork cambium
Lenticels	Herbaceous	Ray	Heartwood	Sapwood	Resin canals
Laticifers	Veneer	Amyloplasts	Pericycle	Mycorrhizae	Pneumatophore

Sample Learning Activities

Learning Activity #1 : (See Appendix – G1)

Plant Research and Specimen Project – Students will make observations of plant specimen of Missouri, collect field notes on their observations using correct botanical descriptive terminology, and collect and preserve leaf examples of described specimen. The students will then conduct research in order to identify the common and scientific names of their specimen. Lastly, they will present their collection in an organized and informative way with all information (field observations, example of specimen, and correctly identified name).

Activity's Alignment	
NSES	C3e
CONTENT	SC3, CA4
PROCESS	1.2 – Conduct research 1.8 – Organize data and ideas 1.10 – Discover/evaluate relationships

Sample Assessments

Assessment #1:

Plant research and specimen assessment – The students will be given ten different preserved leaf specimens to work from. Each student will choose three specimens and describe them using correct botany terms (leaf vein patterns, leaf arrangement, leaf textures, etc…). Each student will also correctly write the common name of each of the three specimens. Each of the three leaves they choose will be worth three points, for a total of nine points. See scoring guide below.

2 points— The leaf is described in detail using correct botanical terminology, and it is correctly classified.

*1 point-- The leaf is accurately described, though with little detail **OR** it is incorrectly classified, but not both.*

*0 points— The leaf is not described accurately **and** it is incorrectly identified.*

	2.2 – Revise communications
DOK	2 – Skill/Concept 3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Similarities and differences Summarizing and taking notes
ISTE	3b – Use digital tools to find and use information

Learning Activity #2: (See Appendix – H1)

Structure of Stems Lab – Students will investigate the differences in monocot and dicot stems by observing slides with cross sections of each type of stem. The teacher needs to set up the laboratory with microscopes and prepared slides of monocot stems and dicots stems. Students should make visual representations of each specimen, and label them with the appropriate types of tissues. Students should be able to compare and contrast the different anatomies of the different stem types

Activity's Alignment	
NSES	C3e
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships
DOK	2 – Skill/Concept
INSTRUCTIONAL STRATEGIES	Similarities and Differences
ISTE	

Assessment's Alignment	
NSES	C3e
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships 1.10 – Apply information, ideas, and skills
DOK	2 – Skill/Concept
LEVEL OF EXPECTATION	Mastery Level - 75%
ISTE	

Assessment #2: (See Appendix – H2)

Stem Lab Assessment – Students will answer three written questions covering concepts learned in the lab, as well as label one picture representing a cross section of one of the types of stems observed in the lab.

Assessment's Alignment	
NSES	C3e
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level - 80%
ISTE	

Student Resources	Teacher Resources
Plant Biology, Prentice Hall ©2003	Plant Biology, Prentice Hall ©2003

Identity Equity and Readiness			
Gender Equity		Technology Skills	
Racial/Ethnic Equity		Research/Information	
Disability Equity		Workplace/Job Prep	

Content Area: Science	Course: Biology II (ZoBot)	Strand: Plant Reproduction
Learner Objectives: ● Plants follow a reproductive process dependent on their unique structures. (C)		

Concepts:

A. Modern plants are classified into three major groups: non-vascular, vascular without seeds, and vascular with seeds. (C3)
B. Plant life cycles involve an alternation of generations. (C1)
C. Angiosperms produce new plants utilizing flowers, fruits, and seeds. (C5)

Students Should Know	Students Should Be Able to
● Three major plant groups: non-vascular, vascular without seeds, and vascular with seeds. ● Plants can be subdivided into ten different divisions within the three major groups. ● Angiosperms are a group of flowering plants that produce seeds that are enclosed in fruits. ● Gymnosperms are a group of cone bearing plants that produce seeds that are not enclosed by a vessel. ● Angiosperms can be divided into two groups: monocots and dicots. ● Monocots and dicots can be distinguished through a comparison of their seeds, flowers, leaves, stem and root cross sections, and pollen grains. ● Flowers are composed of sterile parts such as petals and sepals, as well as fertile, gamete producing parts such as pistils and stamen. ● Stamens are male, pollen and sperm producing parts of a flower; Pistils are the female, egg producing parts of a flower. ● Not all flowers have all flower structures present, and examinations of their characteristics help botanists determine what groups they belong to. ● Plants alternate between a haploid gametophyte phase and a diploid sporophyte phase of development. ● The four pollination vectors are wind, water, and animals. ● Groups can be divided into two large groups: fleshy and dry. ● Fruits can be distinguished by examining the endocarp, mesocarp, and exocarp that makes up their surrounding wall. ● Fleshy fruits include berries, pomes, drupes, aggregate fruits, and multiple fruits.	● Classify plants into the three major plant groups based on their physical characteristics. (C3e) ● Compare and contrast angiosperms and gymnosperms. (C3e) ● Distinguish between monocots and dicots within division Anthophyta. (C3e) ● Categorize flower structures into fertile and sterile groups. (C5d) ● Compare and contrast male and female flower structures. (C5d) ● Classify flowers based on their physical characteristics. (C5d) ● Summarize the alternation of generations of flowering plants. (C1f) ● Compare and contrast different pollination vectors. (C5d) ● Make observations on the compositions of differing types of fruits. (C5d) ● Classify fruits into appropriate groups after investigating their physical characteristics. (C5d) ● Compare and contrast different plant strategies for seed dispersal. (C4c)

• Dry fruits can be divided into two main groups: dehiscent and indehiscent. • Plant seeds need to be dispersed in order to reduce the competition between adults and their offspring.	

Instructional Support

Student Essential Vocabulary					
Kingdom	Division	Class	Order	Family	Genus
Species	Vascular	Angiosperm	Gymnosperm	Fascicles	Hypodermis
Resin	Strobili	Carpel	Monocot	Dicot	Peduncle
Sepals	Calyx	Corolla	Perianth	Anther	Filament
Stamen	Pistil	Stigma	Style	Ovary	Ovule
Egg	Receptacle	Staminate	Carpellate	Monoecious	Dioecious
Sporophyte	Gametophyte	Diploid	Haploid	Meiosis	Mitosis
Sporocyte	Integument	Micropyle	Nectary	Pheromone	Apomixis
Exocarp	Endocarp	Mesocarp	Pericarp	Dehiscent	Indehiscent
Hilum	Epicotyl	Hypocotyl	Radicle	Plumule	Scarification
Stratification					

Sample Learning Activities	**Sample Assessments**
Learning Activity #1 : (See Appendix – I1, I2) **Angiosperm Alternation of Generations Activity –** Students will assemble into groups of four and read a short passage (four paragraphs) from p. 351 of the plant biology textbook (passage is included in the appendix, retyped) about the reproductive process of angiosperms. The passage also refers to a diagram in the book, which is included with the retyped passage. Each member of the group will read the first of four paragraphs and take notes. Then with one member taking the role of the leader, the group will create a summary of the events. This process will be repeated for the following three paragraphs, with each student spending one turn as the leader. Once all four	**Assessment #1: (See Appendix – I3))** **Angiosperm Alternation of Generations and Reproduction Assessment –** Two student groups of four will combine into a larger group of eight. Each large group will be assessed on three steps. Labeling of the structures of the reproductive process, the ordering of the steps in the process, and a verbal description of the events of each stage of the process. The diagrams have been included, in color and enlarged, on the reading passage document. These pictures should be printed and laminated so that students can use dry erase markers to label the diagrams in a way so that each student in the group can see it clearly. Once the group is confident that the diagrams are correct, they will raise their

paragraphs have been completed, and the summaries written, the group will use their notes and summaries to label a diagram of the reproductive process.

Activity's Alignment	
NSES	C1f
CONTENT	SC3, CA3
PROCESS	1.6 – Discover/evaluate relationships 2.2 – Revise communications
DOK	2 - Skill/Concept
INSTRUCTIONAL STRATEGIES	Summarizing and note taking Cooperative learning
ISTE	

Learning Activity #2: (See Appendix – J1)
Fruits and Seeds Lab – Students will investigate different fruit and seed types, and make observations about their composition and anatomy. Students will use those observations to compare and contrast different types of fruits and seeds.

Activity's Alignment	
NSES	C5d
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships
DOK	2 - Skill/Concept

hands in order to be assessed. For the second step, the group will arrange the diagrams in order to demonstrate the entire process in order. Lastly, each student in the group should practice explaining what is happening in each of the 8 steps in the cycle. When the group is ready, the teacher will approach the group, chose a student and have them explain the process represented by the card. This will continue for each of the 7 remaining cards until each student has been responsible for randomly explaining the card. Essentially, each student in the group will have to be responsible for all of the information, but they will only communicate one piece of the larger process.

Assessment's Alignment	
NSES	C1f
CONTENT	SC3, CA3
PROCESS	1.6 – Discover/evaluate relationships 2.2 – Revise communications
DOK	2 - Skill/Concept
LEVEL OF EXPECTATION	Mastery Level - 75%
ISTE	

Assessment #2: (See Appendix – J2)
Fruits and Seeds Lab Assessment – Students will use what they have learned about the anatomical comparisons of different types of fruits and seeds to categorize unknown fruits (with rationale supporting their classification).

Assessment's Alignment	
NSES	C5d
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate Relationships
DOK	2 - Skill/Concept

	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Cooperative learning Similarities and differences
ISTE	

LEVEL OF EXPECTATION	Mastery Level - 80%
ISTE	

Student Resources	Teacher Resources
Plant Biology, Prentice Hall ©2003	Plant Biology, Prentice Hall ©2003 David Attenborough's The Private Life of Plants: The Birds and the Bees © 1995

Identity Equity and Readiness			
Gender Equity		Technology Skills	
Racial/Ethnic Equity		Research/Information	
Disability Equity		Workplace/Job Prep	

Content Area:	Course: Biology II (ZoBot)	Strand: Animal Structure and Development
Learner Objectives: ● Animals are classified based on their tissues, systems, and developmental patterns. (C)		

Concepts:

A. Animal germ layers develop in different ways depending on the development of the gastrula. (C1)
B. Animals exhibit different levels of organization and complexity. (C1)
C. Animals display different symmetrical body patterns. (C1)
D. Germ layers are organized into different animal body cavities. (C1)
E. Cephalization provides distinct advantages to an animal in its environment. (C6)
F. Taxonomic characters are used to construct phylogenetic relationships. (C3)

Students Should Know	Students Should Be Able to
● There is a hierarchical organization of animal complexity. ● Based on developmental characteristics, bilateral metazoans are divided into two major groups – Protostomia and Deuterostomia. ● Protostomia are characterized by mosaic cleavage and the mouth forming at the blastopore. ● Deuterostomia are characterized by regulative cleavage and the anus forming at the blastopore. ● At gastrulation, cells at an embryos surface move inward to from germ layers (ectoderm, mesoderm endoderm). ● Germ layers formed at gastrulation differentiate into tissues and organs. ● The ectoderm gives rise to the skin and nervous system. ● The mesoderm forms muscular, skeletal, circulatory, reproductive, excretory organs. ● The endoderm gives rise to the alimentary canal, pharynx, lungs, and certain glands. ● There is a tendency for maximum body size to increase within the lines of descent (Cope's Law of phyletic increase). ● There are extracellular and intracellular components of metazoan bodies. ● The levels of organization in organismal complexity include the protoplasmic, cellular, cell-tissue, tissue-organ, and organ-system grades of organization.	● Compare and contrast Protostome and Deuterostome embryonic development. (C1f) ● Describe how gastrulation results in the development of three distinctive germ layers (ectoderm, mesoderm endoderm). (C1f) ● Explain the factors that support Cope's Law. (C3a) ● Distinguish between the levels of organization in organismal complexity. (C1f) ● Distinguish between animal tissues and explain their functions. (C1f) ● Categorize animals based on body symmetry. (C1f) ● Compare the three types of body cavity development found in animals and explain their significance in body function. (C1f) ● Identify the advantages of metamerism and cephalization. (C6a, C6b) ● Evaluate the relatedness of different animals/groups of animals by analyzing potential homologies. (C3d) ● Construct a phylogeny through the analysis of ancestral and derived character states. (C3e)

● Types of animal tissues include epithelial, connective, muscular, and nervous. ● Symmetry refers to balanced proportions or correspondence in size and shape of parts on opposite sides of a median plane. ● Animal body plans include spherical, radial, biradial, and bilateral symmetries. ● Body cavities are a major evolutionary innovation within bilateral animals. ● Body cavity types found in metazoa include acoelomate, pseudocoelomate, and eucoelomate. ● The appearance of metamerism (segmentation) in body plans was a significant evolutionary event. ● Metamerism permits greater body mobility and complexity of structure and function. ● The differentiation of a head end is called cephalization and it is found in bilaterally symmetrical animals. ● Cephalization includes a concentration of nervous tissue and sense organs that gives obvious advantages to an animal moving headfirst through its environment. ● While a homology is a character similarity that results from common ancestry, not all similar characters infer common ancestry (dorsal fins on sharks vs. dorsal fins on dolphins). ● In constructing a phylogeny, characters need to be distinguished between being ancestral or derived. ● Comparisons within a phylogeny should be made in reference to an outgroup, a group of organisms that are phylogenetically close to the group being studied but not within the group itself.	

Instructional Support

Student Essential Vocabulary					
Extracellular	Intracellular	Blastopore	Schizocoelous	Enterocoelous	Ectoderm
Mesoderm	Endoderm	Protostome	Deuterostome	Cells	Tissues
Organs	Organ Systems	Histology	Epithelium	Connective Tissue	Muscle
Nervous Tissue	Asymmetry	Spherical Symmetry	Radial Symmetry	Bilateral Symmetry	Dorsal
Ventral	Anterior	Posterior	Sagittal	Medial	Transverse
Lateral	Acoelomate	Pseudocoelomate	Coelomate	Parenchyma	Mesentery
Peritoneum	Metamerism (Segmentation)	Cephalization	Homologous Structures	Homoplasy	Phylogeny
Adaptive Zones	Comparative Morphology	Molecular Clock	Typological Species Concept	Biological Species Concept	Evolutionary Species Concept
Metazoa					

Sample Learning Activities

Learning Activity #1 : (See Appendix – K1)

Histology Lab – Students will use microscopes to investigate different types of cells. They will record their observations and then make comparisons about their structure and function.

Activity's Alignment	
NSES	C1f
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships
DOK	2 – Skill/Concept
INSTRUCTIONAL STRATEGIES	Cooperative learning, Similarities and differences.

Sample Assessments

Assessment #1: (See Appendix – K2)

Histology Lab Assessment - Students will answer three written questions covering concepts learned in the lab, as well as label one picture representing a cross section of one of the types of tissues observed in the lab.

Assessment's Alignment	
NSES	C1f
CONTENT	SC3
PROCESS	1.6 - Discover/evaluate relationships
DOK	2 – Skill/Concept
LEVEL OF EXPECTATION	Mastery Level – 80%
ISTE	

ISTE	

Learning Activity #2: (See Appendix – L1)
Humbug Activity – Students will demonstrate their understanding of body planes and symmetry by designing and building a "Humbug" from a set of instructions given to them.

Activity's Alignment	
NSES	C1f
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships 3.5 – Reason logically (inductive/deductive)
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Cooperative learning, Nonlinguistic representations
ISTE	

Assessment #2: (See Appendix – L2)
Body Planes and Symmetry Assessment – Students will identify and compare the body planes and symmetry of two animals.

Assessment's Alignment	
NSES	C1f
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level - 80%
ISTE	

Student Resources	Teacher Resources
Integrated Principles of Zoology, McGraw Hill ©2004	Integrated Principles of Zoology, McGraw Hill ©2004

Identity Equity and Readiness			
Gender Equity		Technology Skills	

Racial/Ethnic Equity		Research/Information	
Disability Equity		Workplace/Job Prep	

Content Area:	Course: Biology II (ZoBot)	Strand: Simple Invertebrates
Learner Objectives: ● Simple groups of animals are distinguished by specialized cells and tissues. (C)		

Concepts:

A. Sponges are the simplest group of animals, exhibiting organization at the cellular level only. (C1)
B. Sponges are classified into three different groups: Calcarea, Hexactinellida, and Demospongiae. (C3)
C. The physiological functions of sponges are performed by specialized cells. (C1)
D. Cnidarians exhibit organization at the tissue level. (C1)
E. Cnidarians are classified into four different groups: Anthozoa, Cubozoa, Hydrozoa, and Scyphozoa. (C3)
F. The physiological functions of cnidarians are performed by specialized tissues. (C1)

Students Should Know	Students Should Be Able to
● Physiological functions include feeding, digestion, reproduction, and defense. ● Sponges are asymmetrical filter feeders that are found in Phylum Porifera. ● Members of the Phylum Porifera exhibit the cellular level of organization and can reproduce sexually or asexually. ● Porifera have three types of canal systems: Asconoid, Synconoid and Leuconoid. ● There are three Classes of Porifera: Calcarea, Hexactinellida and Demospongiae. ● Members of the Phylum Cnidaria exhibit the tissue level of organization. ● Cnidaria display radial symmetry and possess special stinging cells called nematocysts. ● Cnidarians can reproduce sexually or asexually. ● There are four Classes of Cnidaria: Hydrozoa, Scyphozoa, Cubozoa and Anthozoa.	● Distinguish the three types of canal systems found in Porifera. (C1f) ● Classify Porifera into three Classes based on types of skeletons. (C3e) ● Classify Cnidaria into four Classes based on body type/shape. (C3e) ● Compare and contrast the symmetry, anatomy and physiology of Porifera and Cnidaria. (C1f) ● Summarize the reproductive processes of Porifera and Cnidaria. (C1f)

Instructional Support

Student Essential Vocabulary					
Porifera	Spicules	Spongin	Ostia	Osculum	Choanocytes
Spongocoel	Asconoids	Synconoids	Leuconoids	Radial canals	Incurrent canals
Prosopyles	Apopyles	Mesohyl	Pinacocytes	Myocytes	Choanocytes
Archaeocytes	Sclerocytes	Spongocytes	Collencytes	Lophocytes	Intracellular
Asexual reproduction	External buds	Gemmules	Micropyle	Sexual reproduction	Monoecious
Parenchymula	Somatic embryogenesis	Calcarea	Hexactinellida	Demospongiae	Collar bodies
Asymmetry	Cnidaria	Radial symmetry	Cnidocytes	Nematocysyts	Polyp
Medusa	Operculum	Cnidocil	Nerve net	Neuromuscular system	Basal disc
Hypostome	Gastrovascular cavity	Buds	Epidermis	Gastrodermis	MesoNSESa
Hydrostatic skeleton	Interstitial cells	Gland cells	Hydroid (Hydra)	Gonangium	Velum
Manubrium	Statocysts	Ocelli	Lappets	Rhopalium	Oral arms
Brachial canals	Gastric pouches	Radial canals	Strobila	Oral disc	Primary septa
Mesenteries	Hermatypic corals	Comb rows/plates	Tentacles	Colloblasts	Collenchyme
Anal canals	Adaptive radiation				

Sample Learning Activities

Learning Activity #1 : (See Appendix – M1)

Sponge, Hydra and Jellyfish Lab – Students working in groups of three or four will use textbooks and microscopes to identify structures of sponges and jellyfish using prepared slides. They will also use microscopes to observe and record the behavior of a live hydra. Students will then identify jellyfish structures through dissection. Students will use their observations and textbooks to answer questions about the structures and behavior of all three organisms.

Activity's Alignment	
NSES	C1f
CONTENT	SC3, CA3

Sample Assessments

Assessment #1: (See Appendix – M2)

Sponge, Hydra and Jellyfish Lab Assessment - Students will use their textbooks and the lab diagrams to explain the structures and processes involved in feeding.

Assessment's Alignment	
NSES	C1f
CONTENT	SC3, CA3
PROCESS	1.6 - Discover/evaluate relationships
DOK	2 – Skill/Concept
LEVEL OF EXPECTATION	80%
ISTE	

PROCESS	1.6 – Discover/evaluate relationships
DOK	2 – Skill/Concept
INSTRUCTIONAL STRATEGIES	Cooperative learning, Similarities and differences
ISTE	

Learning Activity #2: (See Appendix – N1)
Porifera and Cnidaria Data Table – Students will compare information on the characteristics and physiology of Porifera and Cnidaria.

Activity's Alignment	
NSES	C1f
CONTENT	SC3, CA3
PROCESS	1.6 – Discover/evaluate relationships
DOK	2 – Skill / Concept
INSTRUCTIONAL STRATEGIES	Identifying similarities/differences
ISTE	

Assessment #2: (See Appendix – N2)
Porifera and Cnidaria Graphic Organizer – Students will create a graphic organizer showing the similarities and differences between Porifera and Cnidaria. They will also identify a significant contribution of each Phyla.

Assessment's Alignment	
NSES	C1f
CONTENT	SC3
PROCESS	1.6 – Discover and evaluate patterns and relationships
DOK	2 – Skill / Concept
LEVEL OF EXPECTATION	80%
ISTE	

Student Resources	Teacher Resources
Integrated Principles of Zoology, McGraw Hill ©2004	Integrated Principles of Zoology, McGraw Hill ©2004 Video, "The Shape of Life – Origins", by Sea Studios Foundation © 2002 Video, "The Shape of Life – Life on the Move", by Sea Studios Foundation © 2002

Identity Equity and Readiness			
Gender Equity		Technology Skills	

Racial/Ethnic Equity		Research/Information	
Disability Equity		Workplace/Job Prep	

Content Area:	**Course: Biology II (ZoBot)**	**Strand: Cavity Development**
Learner Objectives: ● Flatworms and roundworms demonstrate the early stages of body cavity and organ development. (C)		

Concepts:

A. Flatworms are the simplest group of animals that possess all three germ layers. (C1)
B. The physiological functions of flatworms are coordinated by organs working together in simple systems. (C1)
C. Flatworms are classified into three different groups: Turbellaria, Cestoda, and Trematoda. (C3)
D. Roundworms are the first group of animals to exhibit a simple body cavity. (C1)
E. The physiology of the roundworm demonstrates a transition from simple to more complex organ systems. (C1)
F. Roundworms are classified into three main groups: Ascaris, Filaria, and Trichina. (C3)
G. Most Classes of flatworms and roundworms exhibit parasitic habits. (C4)

Students Should Know	Students Should Be Able to
● Physiological functions include feeding, digestion, reproduction, and defense. ● Members of the Phylum Platyhelminthes are triploblastic acoelomates that exhibit bilateral symmetry, cephalization and the organ-system level of organization. ● Members of the Phylum Platyhelminthes may be free-ling or parasitic. ● There are four Classes of Platyhelminthes: Turbellaria, Trematoda, Monogenea and Cestoda. ● Members of the Phylum Nematoda exhibit a pseudocoel and a complete mouth-to-anus digestive tract. ● Members of the Phylum Nematoda may be free-ling or parasitic. ● There are two Classes of Nematoda: Rhabditea and Enoplea.	● Identify the development of a true coelom and degrees of body segmentation (C1f) ● Classify Platyhelminthes into four Classes based on anatomy and lifestyle.(C3e) ● Classify Nematoda into two Classes based on anatomy and lifestyle.(C3e) ● Compare and contrast the anatomy, physiology and behavior of Platyhelminthes and Nematoda. (C1f, C6a, C6b) ● Evaluate the impact on an organism or ecosystem caused by the parasitic members of the Phyla Platyhelminthes and Nematoda. (C4c) ● Summarize the reproductive processes of Platyhelminthes and Nematoda (C1f)

Instructional Support

Student Essential Vocabulary					
Acoelomate	Triploblastic	Bilateral	Parenchyma	Tegument	Pharynx
Pharyngeal Sheath	Gastrovascular Cavity	Extracellular Digestion	Protonephridia	Flame Cells	Ganglia
Ocelli	Auricles	Proglottid	Scolex	Strobila	Germinative Zone
Proboscis	Pseudocoel	Coelom	Peritoneum	Hydrostatic Pressure	Cuticle
Collagen	Nerve Chords	Sensory Papillae	Nurse Cell	Microfilariae	

Sample Learning Activities	Sample Assessments
Learning Activity #1 : (See Appendix - O1) **Flatworm and Roundworm Lab –** Students will observe the anatomy and behavior of a living flatworm (Planaria). Students will then perform partial dissections on the Planaria and observe and record any regeneration of body parts that occur. Students will also examine prepared slides of a roundworm (Trichinella.)	**Assessment #1:** **Flatworm and Roundworm Lab Formative –** **Questions:** 1. Explain how a flatworm can survive without a circulatory system or a respiratory system. 2. Describe the nervous system of a planarian. 3. Compare the body plan of a flatworm to that of a nematode. ***Answers:*** *1. None of the flatworm's cells are very far from the external environment. Therefore, the cells can exchange materials directly with the environment. In addition, they have a large surface area for their volume.* *2. Cerebral ganglia at the anterior end form a simple brain. They receive information from sensory cells and transmit signals to the muscles along a ladder like arrangement of nerves.*

Activity's Alignment	
NSES	C1f, C6a, C6b
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships
DOK	2 – Skill/ Concept
INSTRUCTIONAL STRATEGIES	Cooperative learning, Summarizing & note taking
ISTE	

3. *Flatworms are flattened and have one or no digestive opening. They are acoelomates, lacking a body cavity.*

   Nematodes are round and have a mouth and anus. They are pseudocoelomates, having a body cavity partially lined by mesoderm.

Assessment's Alignment	
NSES	C1f
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships
DOK	2 – Skill/ Concept
LEVEL OF EXPECTATION	Mastery Level – 85%
ISTE	

Learning Activity #2: (See Appendix - P1, P2)

"Do Parasites Rule the World" Article and Summary – Students will read an excerpt from the non-fiction article, "Do Parasites Rule the World" about the impact of a particular parasite on organisms living in a salt marsh ecosystem. Each student will then use a Marzano frame summary to help the students evaluate the article. Excerpt is in the Appendix; the article comes from Discover Magazine, August, 2000.

Activity's Alignment	
NSES	C1f, C4c
CONTENT	SC3, CA3
PROCESS	1.6 – Discover/evaluate relationships
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Summarizing and note-taking, Nonlinguistic representations

Assessment #2: (See Appendix - P3)

Parasite Life Cycle Concept Map – In the computer lab, each student will use the SMART Ideas™ Concept-Mapping Software to create a concept map that outlines and describes the life cycle of a parasitic fluke and the hosts it interacts with as described in the article, "Do Parasites Rule the World?" See the Scoring Guide in the Appendix.

Assessment's Alignment	
NSES	C1f, C4c
CONTENT	SC3
PROCESS	1.6 – Discover and evaluate patterns and relationships 2.2 – Apply information and ideas
DOK	3 – Strategic Thinking

ISTE		LEVEL OF EXPECTATION	Mastery Level – 80%
		ISTE	

Student Resources	Teacher Resources
Integrated Principles of Zoology, McGraw Hill ©2004 Do Parasites Rule the World?, Carl Zimmer, Discover Magazine, August, 2000. SMART Ideas™ Concept-Mapping Software, SMART Technologies ULC.	Integrated Principles of Zoology, McGraw Hill ©2004 Video, "The Shape of Life – The First Hunter", by Sea Studios Foundation © 2002 Do Parasites Rule the World?, Carl Zimmer, Discover Magazine, August, 2000. SMART Ideas™ Concept-Mapping Software, SMART Technologies ULC.

Identity Equity and Readiness			
Gender Equity		Technology Skills	
Racial/Ethnic Equity		Research/Information	
Disability Equity		Workplace/Job Prep	

Content Area:	Course: Biology II (ZoBot)	Strand: Developing Segmentation
Learner Objectives: ● Molluscs and segmented worms exhibit specific divisions of the body into a series of segments. (C)		

Concepts:

A. Molluscs demonstrate the first true, fully lined body cavity. (C1)
B. Segmentation and all animal organ systems are present and functional in Phylum Mollusca (C1)
C. Molluscs are classified into three different groups: Gastropoda, Bivalvia, and Cephalopoda. (C3)
D. Segmented worms show repetition of the organ systems throughout each body division. (C1)
E. Segmented worms are classified into three different groups: Oligochaeta, Polychaeta, and Hirudinea. (C3)

Students Should Know	Students Should Be Able to
● Physiological functions include feeding, digestion, reproduction, and defense. ● Members of the Phylum Mollusca are true coelomates that are characterized by the presence of a fleshy mantle, muscular foot, and radula. ● There are eight Classes of Molluscs: Caudofoveata, Solenogastres, Monoplacophora, Polyplacophora, Scaphopoda, Gastropoda, Bivalvia and Cephalopoda. ● Members of the Phylum Annelida exhibit a true coelomic cavity and a primitive metamerism with comparatively few differences between the different somites. ● There are three Classes of Annelids: Polychaeta, Oligochaeta and Hirudinea.	● Identify the development of a true coelom and degrees of body segmentation (C1f) ● Classify Molluscs into eight Classes based on body/shell arrangement. (C3e) ● Classify segmented worms into three Classes based on the presence or absence of parapodia, setae and other morphological features. (C3e) ● Compare and contrast the anatomy, physiology and behavior of Molluscs and segmented worms. (C1f, C6a, C6b) ● Summarize the reproductive processes of Molluscs and segmented worms. (C1f)

Instructional Support

Student Essential Vocabulary					
Protostome	Head-foot	Visceral mass	Mantle	Mantle cavity	Gills / Ctenidia
Shell (Valve)	Radula	Foot	Prismatic layer	Nacreous layer	Open circulatory system
Metanephridia	Nephrostome	Nervous system	Trochophore	Veliger	Torsion
Univalve	Apex	Whorl	Columella	Dextral	Sinistral
Operculum	Planospiral	Conispiral	Osphradium	Filter feeder	Umbo
Lamellae	Suprabranchial chamber	Style sac	Crystalline style	Glochidium larva	Boring
Gas chambers	Siphuncle	Funnel / Siphon	Branchial hearts	Chromatophores	Ink gland
Sepia	Hectocotylus	Bivalve	Segments	Annuli	Metamerism
Metameres / Somites	Setae	Prostomium	Pygidium	Schizocoel	Peritoneum
Mesenteries	Septa	Hydrostatic skeleton	Parapodia	Peristomium	Nephrostome
Calciferous glands	Crop	Gizzard	Intestine	Chloragogen tissue	Dorsal vessel
Aortic arches	Ventral vessel	Metanephridia	Nephridiopore	Cerebral ganglia	Connectives
Ventral nerve chord	Giant axons	Clitellum	Cocoon	Sensillae	

Sample Learning Activities

Learning Activity #1 : (See Appendix - Q1)

Mollusc Lab – Students will observe the characteristics of the phylum Mollusca and observe the features that separate them into classes. Students will also identify and label the parts of a clam.

Activity's Alignment	
NSES	C3e
CONTENT	SC3
PROCESS	1.6 – Discover /evaluate relationships
DOK	2 – Skill/ Concept
INSTRUCTIONAL STRATEGIES	Cooperative learning, Similarities and Differences

Sample Assessments

Assessment #1: (See Appendix - Q2)

Mollusc Lab Formative – Students will take a short 3 question formative assessing the structure, function and classification of Molluscs.

Assessment's Alignment	
NSES	C3e
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships
DOK	2 – Skill/ Concept
LEVEL OF EXPECTATION	Mastery Level – 85%
ISTE	

ISTE	

Learning Activity #2: (See Appendix - R1)

Earthworm Lab – Students will observe the movements of a living earthworm. Students will also examine the external adaptations and behaviors of an earthworm.

Activity's Alignment	
NSES	C6a, C6b
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships 3.5 – Reason logically (inductive/deductive)
DOK	2 – Skill/ Concept
INSTRUCTIONAL STRATEGIES	Cooperative learning
ISTE	

Assessment #2:

Earthworm Lab Formative –

1. How would the setae aid the animal in burrowing?

2. Explain how the earthworm's reaction to a flashlight would exhibit behavior related to survival.

3. How is the earthworm's behavior when placed on top of loose, moist soil related to soil fertility?

Answers:

1. The setae help the earthworm pull itself into the soil.

2. The reaction is a response to "hide" in order to escape exposure to predators, the elements, etc.

3. As the earthworm burrows into the soil, it creates tunnels that aerate the soil. This makes the soil less dense and allows water, oxygen and nutrients to permeate the soil.

Assessment's Alignment	
NSES	C6a, C6b
CONTENT	SC3
PROCESS	1.6 – Discover and evaluate patterns and relationships 3.5 – Reason logically (inductive/deductive)
DOK	2 – Skill/ Concept
LEVEL OF EXPECTATION	Mastery Level – 85%
ISTE	

Student Resources	Teacher Resources
Integrated Principles of Zoology, McGraw Hill ©2004	Integrated Principles of Zoology, McGraw Hill ©2004

	Video, “The Shape of Life – Survival Game”, by Sea Studios Foundation © 2002 Video, “The Shape of Life – Explosion of Life”, by Sea Studios Foundation © 2002

Identity Equity and Readiness			
Gender Equity		Technology Skills	
Racial/Ethnic Equity		Research/Information	
Disability Equity		Workplace/Job Prep	

Content Area:	Course: Biology II (ZoBot)	Strand: Advanced Invertebrates
Learner Objectives: ● Arthropods and Echinoderms have developed the most complex specialized structures of all invertebrates. (C)		

Concepts:

A. The appearance of an exoskeleton with many unique jointed appendages characterizes Arthropods. (C3)

B. Phylum Arthropoda is the largest and most diverse group of invertebrates divided into three large subphyla: Chelicerata, Crustacea, and Uniramia. (C3)

C. Most Arthropods undergo a change in body plan throughout their life cycle. (C1, C6)

D. Arthropods exhibit complex behavioral patterns. (C6)

E. Echinoderms exhibit unique structures and an advanced form of development while reducing the complexity of most organ systems. (C1)

F. Echinoderms are classified into five major groups: Asteroidea, Ophuroidea, Echinoidea, Holothuridea, and Crinoidea. (C3)

Students Should Know	Students Should Be Able to
● Arthropodization entails a hardening of the outer cuticle, the loss of motile cilia, and the loss of a hydrostatic skeleton. ● Tagmata are the segments formed from fused somites. ● Arthropods can impact humans in both positive and negative ways. ● Exoskeletons are composed of three distinct layers (epicuticle, exocuticle, and endocuticle) that form in a particular order during metamorphosis. ● Arthropods use a unique respiratory system, the tracheal system. ● Metamorphosis enhances the rate of survival for arthropods by reducing the amount of competition within species. ● Subphylum Chelicerata is characterized by having two tagmata, 6 pairs of appendages, and no antennae. ● Within subphylum Chelicerata exists four different specific orders, each with their own unique characteristics and behaviors.	● Use the defining characteristics of Phylum Arthropoda to compare and contrast them with the other invertebrate phyla. (C3e) ● Describe the composition of the arthropod exoskeleton. (C1d) ● Explain how arthropod characteristics such as a hardened exoskeleton, metamorphosis, and jointed appendages contribute to the size and diversity of the phylum. (C3b) ● Compare and contrast the three subphyla (Chelicerata, Crustacea, and Uniramia) by examining their body segments, appendages, and ecological niches. (C3b, C3e, C6b) ● Specifically compare and contrast millipedes and centipedes. (C3b, C3e) ● Evaluate the importance of metamorphosis on the success of insect survival. (C1d)

● Subphylum Crustacea is characterized by having two tagmata, two pairs of antennae, and many branched appendages. ● Crayfish are prime examples of crustaceans that possess specialized, branched appendages. ● Subphylum Uniramia is characterized by having three distinct tagmata, one pair of antennae, and unbranched appendages. ● Uniramia is the largest sinNSES grouping of animals, consisting of a tremendous variety of centipedes, millipedes, and insects. ● Insects are the only invertebrate group that possesses two pairs of wings, and therefore the power of flight. ● Insects have well developed systems (digestive, excretory, respiratory, reproductive, circulatory, nervous) that have specific functions and organs. ● Insect behaviors included metamorphosis, reproductive strategies, diapause, and unique defensive tactics. ● Echinoderms are the only deuterostome (mouth develops second) invertebrate phylum. ● Echinoderms are bottom dwelling, oceanic organisms with radial symmetry. ● Echinoderms are separated into five different classes (Asteroidea, Crinoidea, Echinoidea, Holothuroidea, and Ophuroidea) depending on their structural, physiological, and behavioral characteristics. ● Members of class Asteroidea begin life as a bilaterally symmetrical larva before undergoing metamorphosis into a radially symmetrical adult. ● Echinoderms have fewer systems than comparably advanced invertebrates. ● Phylum Echinodermata is the only phylum to possess a water vascular system that serves to assist in movement, respiration, excretion, and circulation, and this system serves to reduce the total number of systems needed for survival. ● Echinoderms have a unique dermal endoskeleton. ● Echinoderms can reproduce through both sexual and asexual means. ● The nervous system of echinoderms consists of two interconnected systems: the oral system and the aboral system.	● Explain observations of behavioral phenomena in insects in terms of the different behavioral characteristics found in the phylum. (C6b) ● Describe the evolutionary advancements of phylum Echinodermata. (C3a) ● Compare and contrast the unique water vascular system with the systems of other invertebrates. (C1f) ● Describe the feeding and digestive processes of class Asteroidea. (C1b, C1f) ● Classify echinoderms into one of five classes (Asteroidea, Ophuroidea, Echinoidea, Holothuroidea, and Crinoidea) through an analysis of anatomical structures and ecological niches. (C3b, C3e)

Instructional Support

Student Essential Vocabulary					
Tagmata	Exoskeleton	Cuticle	Chitin	Ecdysis	Segmentation
Carapace	Telson	Book gills	Uropods	Proboscis	Cephalothorax
Abdomen	Chelicerae	Fangs	Pedipalps	Walking legs	Malphighian tubules
Maxillae	Simples eyes	Sensory setae	Rostrum	Slit sense organs	Silk glands
Hemocoel	Gills	Exopod	Endopod	Antennae	Mandibles
Flexors / Extensors	Pericardial Sinus	Excretory tubule	Bladder	Tergum	Sternum
Tactile hairs	Green glands	Metamorphosis	Ganglia / Ganglion	Maxillary glands	Serial homology
Statocyst	Gastric mill	Fascicle	Suspension feeders	Gastroliths	Spiracles
Tracheae	Mimicry	Sensilla	Tracheal system	Entomology	Sclerites
Pheromones	Holometabolous	Hemimetabolous	Nymphs	Diapause	Spines
Radial nerve	Water-Vascular system	Pentamerous symmetry	Endoskeleton	Aristotle's lantern	Radial nerve
Sucker	Deuterostome	Ambulacral groove	Tube feet (Podia)	Pyloric ceca	Ampulla
Pedicellariae	Papulae	Madreporite	Ossicles	Nerve ring	Lateral canals
Stone canal	Ring canal	Radial canals	Tiedemann's bodies		

Sample Learning Activities	Sample Assessments
Learning Activity #1 : (See Appendix – S1)	**Assessment #1:**

Cricket Behavior Lab – Students will study territorial and chirping behavior by observing crickets in an aquarium. They will then form hypotheses to explain what they have observed.

Activity's Alignment	
NSES	C6b
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Summarizing and note taking , Generating and testing hypotheses
ISTE	

Exit Assessment Question for Cricket Behavior Lab – Identify an aggressive behavior that you observed during the cricket behavior lab and hypothesize as to the function of the behavior.

See Scoring Guide on next page.

4 points-- The response describes the behavior observed and it includes a description of a reasonable adaptive value, or biological basis for the behavior.

3 points-- The response includes a description of a behavior observed and a potential adaptive value, or biological basis for the behavior, and the student attempts to relate them but they are not reasonably related.

2 points—The response includes a description of a behavior OR an adaptive value, or biological basis, but there is no connection made between the two.

1 point – Either a behavior is described or an adaptive value is examined, but both do not appear in the answer.

0 points—Little attempt made.

Assessment's Alignment	
NSES	C6b
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships 1.7 – Evaluate information
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery - 80%
ISTE	

Assessment #2: (See Appendix – T2)
Echinoderm Class Comparison Assessment: After completing the echinoderm comparison chart, the student will be given a short, three question

Learning Activity #2: (See Appendix – T1)
Echinoderm Class Comparison – Students will compare the characteristics of the classes in the phylum Echinodermata.

Activity's Alignment	
NSES	C3e
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships
DOK	3 – Strategic Thinking, 2 – Skill / Concept
INSTRUCTIONAL STRATEGIES	Identifying similarities and differences
ISTE	

assessment where they will use their researched, descriptive information (they can use the chart on the assessment) to identify the class of three different, unique examples.

Assessment's Alignment	
NSES	C3e
CONTENT	SC3
PROCESS	1.10 – Apply information, ideas and skills
DOK	2 – Skill/Concept
LEVEL OF EXPECTATION	Mastery - 75%
ISTE	

Student Resources	Teacher Resources
Integrated Principles of Zoology, McGraw Hill ©2004	Integrated Principles of Zoology, McGraw Hill ©2004 Video, "The Shape of Life – The Conquerors", by Sea Studios Foundation © 2002 Video, "The Shape of Life – Ultimate Animal", by Sea Studios Foundation © 2002

Identity Equity and Readiness			
Gender Equity		Technology Skills	
Racial/Ethnic Equity		Research/Information	
Disability Equity		Workplace/Job Prep	

Content Area: Science	Course: Biology II (ZoBot)	Strand: Phylum Chordata

Learner Objectives:

- Phylum Chordata is the most advanced and diverse phylum in the animal kingdom. (C)
- Phylum Chordata can be subdivided into two main groups: aquatic chordates and terrestrial chordates. (C)

Concepts:

A. Chordates have four unique defining characteristics: a hollow notochord, a dorsal nerve cord, pharyngeal pouches, and a post anal tail. (C3)
B. All chordates demonstrate variations of the four defining characteristics within their unique body plan. (C3)
C. Different chordate groups possess specific adaptations that are suited to their ecological niche. (C3)
D. Aquatic chordates are classified into three different groups: Agnatha, Chondricthyes, and Osteichthyes. (C3)
E. Terrestrial chordates are classified into four different groups: Amphibians, Reptilia, Aves, and Mammalia. (C3)

Students Should Know	Students Should Be Able to
● Chordates possess four unique characteristics: a hollow notochord, a dorsal nerve cord, pharyngeal pouches, and a post anal tail. ● A hollow notochord provides internal structure and support, and in many chordates it becomes the backbone/spine at maturity. ● The dorsal hollow nerve cord connects the brain with the body's nerves and it becomes the spinal cord in advanced chordates.	● Use the defining characteristics of chordates to compare and contrast them with other animal phyla. (C3e) ● Identify the various chordate classes based on examinations of their variations of the four general chordate characteristics, their unique physical structures, and organizational body plan. (C3e) ● Describe specific adaptations in each chordate class, and relate those adaptations to survival in their ecological niche. (C3e)

● Pharyngeal pouches are shared by all chordates in the embryonic stage, during maturity they either disappear or become gill slits. ● In order for an animal to survive in its niche, it must possess specific adaptations that facilitate its survival. ● Agnathans, jawless fish, are characterized by possessing a cartilaginous skeleton and no true hinged jaw. ● Chondricthyes, cartilaginous fish, have a skeleton composed of cartilage, and they have powerful hinged jaws. ● Osteicthyes, bony fish, have a skeleton composed of bone, and they have hinged jaws. ● The majority of amphibians spend the early portion of their life as an aquatic organism, while the latter, adult, time is spent living terrestrially. ● Amphibians possess both aquatic characteristics (gills, webbing) as well as terrestrial characteristics (lungs, appendages, eardrums) at different points in their development. ● Amphibians are ectothermic, they possess a three chambered heart, and they have moist skin adapting themselves for surviving in moist environments. ● Reptiles are ectothermic, with three to four heart chambers, dry skin, and amniotic eggs permitting survival in dry environments. ● Birds are endothermic, with four heart chambers, feather insulated skin, and amniotic eggs facilitating survival in a wide variety of ecological niches. ● Mammals are endothermic, with four heart chambers, hair, and predominantly placental reproduction enabling them to survive in an extreme variety of habitats. ● Each animal class has unique structural characteristics (feathers, scales, hair, mammary glands, Jacobsen's organ, etc..) that permit classification into very small, specific groups.	● Compare and contrast the three aquatic chordate groups according to their skeletal composition and jaw structure. (C3e) ● Evaluate how amphibian characteristics and development are used to support its importance as a transitional class. (C3e) ● Classify the terrestrial chordates according to body temperature regulation, circulatory characteristics, niche, integument, and unique structural adaptations. (C3e) ● Identify the unique structural characteristics of each chordate class. (C3e) ● Identify the unique behavioral characteristics of each chordate class. (C6b)

Instructional Support

Student Essential Vocabulary					
Notochord	Pharyngeal pouches	Vertebrate	Anadromous	Olfactory	Placoid Scales
Lateral Line	Spiracles	Teleosts	Operculum	Countershading	Chromatophores
Ectothermic	Endothermic	Serous Glands	Xanthophores	Iridophores	Melanophores
Nictitating membrane	Eustachian tubes	Amplexus	Estivation	Amniotic egg	Allantois
Amnion	Chorion	Osteoderms	Anapsids	Diapsids	Synapsids
Carapace	Plastron	Septum	Glottis	Oviparous	Ovoviviparous
Viviparous	Neurotoxin	Hemotoxin	Paleognathae	Neognathae	Preening
Pygostyle	Cloaca	Stalling	Precocial	Altricial	Heterodont
Homodont					

Sample Learning Activities	Sample Assessments
Learning Activity #1 : (See Appendix – U1, U2)	**Assessment #1: (See Appendix – U3)**

Chordate Survey Dissection Activity: This is a two and a half week activity. Students will be split by the teacher into five different groups. Each group will be responsible for a different chordate representative (Lamprey, Shark, Turtle, Pigeon, and Rabbit). Each group of students will receive a packet of instructions (see appendix) specific to their animal which will include a list of structures/organs that the students must identify and state the function of each structure/organ. Each group will use provided dissection manuals to conduct their dissection and locate information regarding functions. After the dissections are complete (4 days), the students will receive the assignment requiring the group to create an original work (packet) containing diagrams, pictures, and a correct listing of the structures and functions of the animal (assignment, scoring guide, and an example are included in the appendix). The students will need two days with internet capable computers to create the packet. Finally, the students will begin a rotation by which one group teaches the other groups (two groups for 25 minutes, and then switch) the structures and functions of the animal. Each student will receive a packet of the information created by the instructing group.

Activity's Alignment	
NSES	C3e
CONTENT	CA3, CA4, SC3
PROCESS	1.6 – Discover/evaluate relationships 1.10 – Apply information, ideas and skills 2.1 – Plan and make presentations
DOK	2 – Skill/Concept 3 – Strategic Thinking 4 – Extended Thinking
INSTRUCTIONAL STRATEGIES	Similarities and Differences Summarizing and Note taking Cooperative Learning
ISTE	1b-use technology to create original works 3b- use digital tools to find and use information

Learning Activity #2: (See Appendix V1)

Survey of Vertebrates Dissection Lab Practicum: At the completion of the activity, students should be assessed on their knowledge of the key structures and functions of the representative animals (each representing a different chordate class). Included in the appendix is one such lab practicum, with a key. They will also compare and contrast the circulatory system of five different organisms that were studied.

Assessment's Alignment	
NSES	C3e
CONTENT	SC3
PROCESS	1.10 – Apply information, ideas and skills 1.6 – Discover/evaluate relationships
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	Mastery Level - 75%
ISTE	

Assessment #2: (See Appendix V2)

Fish Morphology and Behavior Lab: In this laboratory activity the students will analyze the behaviors and structures of a common bony fish (representative of class Osteichthyes). They will observe their general behavior, as well as their respiratory rates in comparison to environmental changes (temperature). After collecting and recording the data, students will graph the results and draw conclusions from the data.

Activity's Alignment	
NSES	C6b
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships 3.5 – Reason logically (inductive/deductive)
DOK	3 – Strategic Thinking
INSTRUCTIONAL STRATEGIES	Similarities and Differences
ISTE	

Fish Morphology and Behavior Exit Assessment: In this formative the students will answer four short questions where they will extend their analyses into new scenarios. They will also need to be able to interpret graphs and justify their responses.

Assessment's Alignment	
NSES	C6b
CONTENT	SC3
PROCESS	1.6 – Discover/evaluate relationships 3.5 – Reason logically (inductive/deductive)
DOK	3 – Strategic Thinking
LEVEL OF EXPECTATION	80%
ISTE	

Student Resources	Teacher Resources
Integrated Principles of Zoology, © 2004 An Illustrated Dissection Guide to the Shark, David H. Hall, © 1999 An Illustrated Dissection Guide to the Lamprey, Barbara Shields, © 2000 An Illustrated Dissection Guide to the Shark, David H. Hall, © 2000 The Taxonomy and Physiology of the Pigeon, Lisa K. Hyatt, © 2004 Laboratory Anatomy of the Rabbit, Charles A. McLaughlin, © 1990	Integrated Principles of Zoology, © 2004

Identity Equity and Readiness			
Gender Equity		Technology Skills	
Racial/Ethnic Equity		Research/Information	
Disability Equity		Workplace/Job Prep	