

MORENO VALLEY HIGH SCHOOL BIOLOGY CURRICULUM

Course Title: Biology Course Number: 1711

Department: Science ADS Number: 1711

Prerequisites: None

Length of Course: Year long Credit/PRI Area: .5 per semester Grade Level(s): 9-12

COURSE DESCRIPTION

An interactive, highly hands-on course in general biology. Students are exposed to 'life' from the cellular level right through to complex forms with an emphasis on the interconnectedness of all organism and their environment. Through out the study, students are encouraged to apply critical thinking, ask questions, and explore the nature of science.

SYLLABUS

Topics of Study:

1. What is life
2. Scientific Method
3. Cells
4. RNA & DNA and protein synthesis
5. Genetics and inheritance
6. Fetal pig dissection / exploration of organ systems in vertebrates
7. Chemical energy and life (photosynthesis and cell respiration)
8. Taxonomy and Biodiversity
9. Evolution
10. Ecology

Skills Emphasized

1. Scientific investigation and enquiry using scientific method
2. Reading and understanding scientific literature (becoming scientifically literate)
3. Laboratory skills including utilizing equipment, gathering data, analyzing data via graphing and interpretation
4. Writing for science (formal lab write-ups)
5. Careful observation and quantitative measurement (metric system)

STRATEGIES

A combination of lecture, note taking, textbook reading and internet/smart board utilization fulfills the didactic methodology. Students then explore and apply theory during labs, small group and partner work, projects, presentations based on research and modelling (3 dimensional models representing concepts/processes) which represents the academic coaching aspect of Paidea. This allows for individual, one on one time with students.

ASSESSMENTS

End of unit quizzes
Cumulative exams (usually open note, open text)
Lab participation as well as formal write-ups
One research presentation per quarter
Homework

SUGGESTED TEXTBOOKS AND INSTRUCTIONAL MATERIALS

Biology: The Living Science by Prentice Hall Miller/ Levine
Biology: The Dynamics of Life by Glencoe Science

SUGGESTED TITLES/AUTHORS WEB SITES

www.biology.arizona.edu/cell_bio www.sumanasin.com/webcontent/anisamples/nonmajorsbiology/organelles.html www.ornl.gov/sci/techresources/Human_Genome/home
www.estrellamountain.edu/faculty/farabee/biobk/biobooktoc.html www.whitman.edu/biology/upd/main.html (fetal pig dissection)
<http://academic.scranton.edu/departments/psych/sheep/newsheep/practice/framesheep.html> (sheep brain dissection) www.gene-watch.org
www.sonic.net/~nbs/projects/anthio201/exper (pea experiment - Mendel) <http://sps.k12.ar.us/massengale/biology%20class%20notes2.htm> www.cellsalive.com
www.livescience.com

SEMINAR PIECES / OR USE

Stephen Gould “Ever Since Darwin”
Various articles from scientific journals, namely Popular Science (*The Future of Evolution*, Sept. 05), and Scientific American
Annals of Improbable Research
Roy Abraham Varghese “The Wonder of the World: A Journey from Modern Science to the Mind of God” (various chapters)
Ernst Mayr “One Long Argument: Charles Darwin and the Genesis of Modern Evolutionary Thought” (various chapters)

STRAND I: SCIENTIFIC THINKING AND PRACTICE

CONTENT STANDARD 1: UNDERSTAND THE PROCESSES OF SCIENTIFIC INVESTIGATIONS AND USE INQUIRY AND SCIENTIFIC WAYS OF OBSERVING, EXPERIMENTING, PREDICTING, AND VALIDATING TO THINK CRITICALLY.

A. BENCHMARK: *Use accepted scientific methods to collect, analyze, and interpret data and observations and to design and conduct scientific investigations and communicate results.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
9-12	<ol style="list-style-type: none">1. Describe the essential components of an investigation, including appropriate methodologies, proper equipment, and safety precautions.2. Design and conduct scientific investigations that include:<ul style="list-style-type: none">• testable hypotheses• controls and variables• methods to collect, analyze, and interpret data• results that address hypotheses being investigated• predictions based on results• re-evaluation of hypotheses and additional experimentation as necessary• error analysis.3. Use appropriate technologies to collect, analyze, and communicate scientific data (e.g., computers, calculators, balances, microscopes).4. Convey results of investigations using scientific concepts, methodologies, and expressions, including:<ul style="list-style-type: none">• scientific language and symbols• diagrams, charts, and other data displays• mathematical expressions and processes (e.g., mean, median, slope, proportionality)• clear, logical, and concise communication• reasoned arguments5. Understand how scientific theories are used to explain and predict natural phenomena (e.g., plate tectonics, ocean currents, structure of atom)	<p>1 – 4) Pill bug lab, Chromatography lab, osmosis lab, microscope practice</p> <p>5) Seminar: “The Wonder of Life” chapter 5 from Varghese’s book</p>

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B. BENCHMARK: *Understand that scientific processes produce scientific knowledge that is continually evaluated, validated, revised, or rejected.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
9-12	1. Understand how scientific processes produce valid, reliable results, including: <ul style="list-style-type: none"> • consistency of explanations with data and observations • openness to peer review • full disclosure and examination of assumptions • testability of hypotheses • repeatability of experiments and reproducibility of results. 2. Use scientific reasoning and valid logic to recognize: <ul style="list-style-type: none"> • faulty logic • cause and effect • the difference between observation and unsubstantiated inferences and conclusions • potential bias 3. Understand how new data and observations can result in new scientific knowledge. 4. Critically analyze an accepted explanation by reviewing current scientific knowledge. 5. Examine investigations of current interest in science (e.g., superconductivity, molecular machines, age of the universe). 6. Examine the scientific processes and logic used in investigations of past events (e.g., using data from crime scenes, fossils), investigations that can be planned in advance but are only done once (e.g., expensive or time-consuming experiments such as medical clinical trials), and investigations of phenomena that can be repeated easily and frequently.	1 – 6) Students watch program “Myth Busters” - identify and report on steps in scientific method using investigation from program

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BENCHMARK: *Use mathematical concepts, principles, and expressions to analyze data, develop models, understand patterns and relationships, evaluate findings, and draw conclusions.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
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GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
9-12	<ol style="list-style-type: none"> 1. Create multiple displays of data to analyze and explain the relationships in scientific investigations. 2. Use mathematical models to describe, explain, and predict natural phenomena. 3. Use technologies to quantify relationships in scientific hypotheses (e.g., calculators, computer spreadsheets and databases, graphing software, simulations, modeling). 4. Identify and apply measurement techniques and consider possible effects of measurement errors. 5. Use mathematics to express and establish scientific relationships (e.g., scientific notation, vectors, dimensional analysis). 	1 -5) Genotype/phenotype survey of family and peers during Genetics unit – subsequent graphical representation of data in poster form

STRAND I: CONTENT OF SCIENCE
CONTENT STANDARD 2: LIFE SCIENCE: UNDERSTAND THE PROPERTIES, STRUCTURES, AND PROCESSES OF LIVING THINGS AND THE INTERDEPENDENCE OF LIVING THINGS AND THEIR ENVIRONMENTS.

A. BENCHMARK: *Understand how the survival of species depends on biodiversity and on complex interactions, including the cycling of matter and the flow of energy.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
9-12	<p>Ecosystems</p> <ol style="list-style-type: none"> 1. Know that an ecosystem is complex and may exhibit fluctuations around a steady state or may evolve over time. 2. Describe how organisms cooperate and compete in ecosystems (e.g., producers, decomposers, herbivores, carnivores, omnivores, predator-prey, symbiosis, mutualism). 3. Understand and describe how available resources limit the amount of life an ecosystem can support (e.g., energy, water, oxygen, nutrients). 4. Critically analyze how humans modify and change ecosystems (e.g., harvesting, pollution, population growth, technology). <p>Energy Flow in the Environment</p> <ol style="list-style-type: none"> 5. Explain how matter and energy flow through biological systems (e.g., organisms, communities, ecosystems), and how the total amount of matter and energy is conserved but some energy is always released as heat to the environment. 6. Describe how energy flows from the sun through plants to herbivores to carnivores and decomposers. 7. Understand and explain the principles of photosynthesis (i.e., chloroplasts in plants convert light energy, carbon dioxide, and water into chemical energy). <p>Biodiversity</p>	<p>1 – 4) Ecological stories taken from the book “ The Mystery of the Mummified Pigs” Students read and answer questions, including graphing to predict trends in populations based on ecological factors</p> <p>5 – 6) Student created energy flow charts, food webs and trophic level charts</p> <p>7) Chromatography lab</p>

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>8. Understand and explain the hierarchical classification scheme (i.e., domain, kingdom, phylum, class, order, family, genus, species), including:</p> <ul style="list-style-type: none"> • classification of an organism into a category • similarity inferred from molecular structure (DNA) closely matching classification based on anatomical similarities <p>similarities of organisms reflecting evolutionary relationships.</p> <p>9. Understand variation within and among species, including:</p> <ul style="list-style-type: none"> • mutations and genetic drift • factors affecting the survival of an organism • natural selection. 	<p>8) Student design dichotomous key for group of specimens</p> <p>9) PBS film “The Falling Lakes” /follow-up discussion</p>

STRAND I: CONTENT OF SCIENCE

CONTENT STANDARD 2: LIFE SCIENCE: UNDERSTAND THE PROPERTIES, STRUCTURES, AND PROCESSES OF LIVING THINGS AND THE INTERDEPENDENCE OF LIVING THINGS AND THEIR ENVIRONMENTS.

B. BENCHMARK: Understand the genetic basis for inheritance and the basic concepts of biological evolution.

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
9-12	<p>Genetics</p> <p>1. Know how DNA carries all genetic information in the units of heredity called genes, including:</p> <ul style="list-style-type: none"> • the structure of DNA (e.g., subunits A, G, C, T) • information-preserving replication of DNA • alteration of genes by inserting, deleting, or substituting parts of DNA. <p>2. Use appropriate vocabulary to describe inheritable traits (i.e., genotype, phenotype).</p> <p>3. Explain the concepts of segregation, independent assortment, and dominant/recessive alleles.</p> <p>4. Identify traits that can and cannot be inherited.</p> <p>5. Know how genetic variability results from the recombination and mutation of genes, including:</p> <ul style="list-style-type: none"> • sorting and recombination of genes in sexual reproduction result in a change in DNA that is passed on to offspring • radiation or chemical substances can cause mutations in cells, resulting in a permanent change in DNA. <p>6. Understand the principles of sexual and asexual reproduction, including meiosis and mitosis.</p>	<p>1 – 3, 5, 7) Rebops activity: Students randomly choose chromosomes, as in actual zygote formation, and ‘create’ an organism using the chromosomal blueprint.</p> <p>4) Human Genetic disorder research project</p> <p>6) Meiosis and Mitosis model activity – in class lab using beads</p>

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>7. Know that most cells in the human body contain 23 pairs of chromosomes including one pair that determines sex, and that human females have two X chromosomes and human males have an X and a Y chromosome.</p> <p>Biological Evolution</p> <p>8. Describe the evidence for the first appearance of life on Earth as one-celled organisms, over 3.5 billion years ago, and for the later appearance of a diversity of multicellular organisms over millions of years.</p> <p>9. Critically analyze the data and observations supporting the conclusion that the species living on Earth today are related by descent from the ancestral one-celled organisms.</p> <p>10. Understand the data, observations, and logic supporting the conclusion that species today evolved from earlier, distinctly different species, originating from the ancestral one-celled organisms.</p> <p>11. Understand that evolution is a consequence of many factors, including the ability of organisms to reproduce, genetic variability, the effect of limited resources, and natural selection.</p> <p>12. Explain how natural selection favors individuals who are better able to survive, reproduce, and leave offspring.</p> <p>13. Analyze how evolution by natural selection and other mechanisms explains many phenomena including the fossil record of ancient life forms and similarities (both physical and molecular) among different species</p>	<p>8 – 10) Origin of Life study including Stanley Millers experiement, Animation of Lynn Margulis’ theory of endosymbiosis (cd-rom), and evolution unit</p> <p>11 – 12) Seminar “Ever Since Darwin” - various pieces</p> <p>13) Discovery film series “Walking with...” (Cavemen, Dinosaurs)</p>

STRAND I: CONTENT OF SCIENCE
CONTENT STANDARD 2: LIFE SCIENCE: UNDERSTAND THE PROPERTIES, STRUCTURES, AND PROCESSES OF LIVING THINGS AND THE INTERDEPENDENCE OF LIVING THINGS AND THEIR ENVIRONMENTS.

C. BENCHMARK: *Understand the characteristics, structures, and functions of cells.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
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GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
9-12	<p>Structure and Function</p> <ol style="list-style-type: none"> 1. Know that cells are made of proteins composed of combinations of amino acids. 2. Know that specialized structures inside cells in most organisms carry out different functions, including: <ul style="list-style-type: none"> • parts of a cell and their functions (e.g., nucleus, chromosomes, plasma, and mitochondria) • storage of genetic material in DNA • similarities and differences between plant and animal cells • prokaryotic and eukaryotic cells. 3. Describe the mechanisms for cellular processes (e.g., energy production and storage, transport of molecules, waste disposal, synthesis of new molecules). 4. Know how the cell membrane controls which ions and molecules enter and leave the cell based on membrane permeability and transport (i.e., osmosis, diffusion, active transport, passive transport). 5. Explain how cells differentiate and specialize during the growth of an organism, including: <ul style="list-style-type: none"> • differentiation, regulated through the selected expression of different genes • specialized cells, response to stimuli (e.g., nerve cells, sense organs). 6. Know that DNA directs protein building (e.g., role of RNA). <p>Biochemical Mechanisms</p> <ol style="list-style-type: none"> 7. Describe how most cell functions involve chemical reactions, including: <ul style="list-style-type: none"> • promotion or inhibition of biochemical reactions by enzymes • processes of respiration (e.g., energy production, ATP) • communication from cell to cell by secretion of a variety of chemicals (e.g., hormones). 	<p>1 – 2) Internet web-site ‘Cells Alive’ and corresponding worksheets</p> <p>3 – 4) CD-ROM Biology today and tomorrow chapters 3 & 4</p> <p>5) Seminar “On Heroes and Fools in Science” discarded theories of ‘preformationists’ and ‘epigeneticists’</p> <p>7) Foldable project: compare, contrast and link the processes of Photosynthesis and Cell Respiration</p>

STRAND III: SCIENCE AND SOCIETY
CONTENT STANDARD: UNDERSTAND HOW SCIENTIFIC DISCOVERIES, INVENTIONS, PRACTICES, AND KNOWLEDGE INFLUENCE, AND ARE INFLUENCED BY, INDIVIDUALS AND SOCIETIES.

A. BENCHMARK: *Examine and analyze how scientific discoveries and their applications affect the world, and explain how societies influence scientific investigations and applications.*

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
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GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
9-12	<p>Science and Technology</p> <ol style="list-style-type: none"> 1. Know how science enables technology but also constrains it, and recognize the difference between real technology and science fiction (e.g., rockets vs. antigravity machines; nuclear reactors vs. perpetual-motion machines; medical X-rays vs. Star-Trek tricorders). 2. Understand how advances in technology enable further advances in science (e.g., microscopes and cellular structure; telescopes and understanding of the universe). 3. Evaluate the influences of technology on society (e.g., communications, petroleum, transportation, nuclear energy, computers, medicine, genetic engineering) including both desired and undesired effects, and including some historical examples (e.g., the wheel, the plow, the printing press, the lightning rod). 4. Understand the scientific foundations of common technologies (e.g., kitchen appliances, radio, television, aircraft, rockets, computers, medical X-rays, selective breeding, fertilizers and pesticides, agricultural equipment). 5. Understand that applications of genetics can meet human needs and can create new problems (e.g., agriculture, medicine, cloning). 6. Analyze the impact of digital technologies on the availability, creation, and dissemination of information. 7. Describe how human activities have affected ozone in the upper atmosphere and how it affects health and the environment. 8. Describe uses of radioactivity (e.g., nuclear power, nuclear medicine, radiometric dating). <p>Science and Society</p> <ol style="list-style-type: none"> 9. Describe how scientific knowledge helps decision makers with local, national, and global challenges (e.g., Waste Isolation Pilot Project [WIPP], mining, drought, population growth, alternative energy, climate change). 10. Describe major historical changes in scientific perspectives (e.g., atomic theory, germs, cosmology, relativity, plate tectonics, evolution) and the experimental observations that triggered them. 11. Know that societal factors can promote or constrain scientific discovery (e.g., government funding, laws and regulations about human cloning and genetically modified organisms, gender and ethnic bias, AIDS research, alternative-energy research). 12. Explain how societies can change ecosystems and how these changes can be reversible or irreversible. 13. Describe how environmental, economic, and political interests impact resource management and use in New Mexico . 14. Describe New Mexico 's role in nuclear science (e.g., Manhattan Project, WIPP, national laboratories). 	<ol style="list-style-type: none"> 1) Analysis of 2 articles: one pseudo science and one authentic 2) Microscopic observation of cells (osmosis activity, cross section of leaf) 3 – 4) Current event research project 5) Seminar: The Future of Evolution : Popular Science Sept 05 6) Human Genome project web-site and documentary 7) Green house gasses animation CD-ROM chapter 30 Biology today and tomorrow 9, 13 – 14) Current event research project 10) HHMI web site “Evolution” lecture 1 11) Human Genome documentary “ The race for the Genome”

GRADE	PERFORMANCE STANDARDS	ILLUSTRATIONS
	<p>Science and Individuals</p> <p>15. Identify how science has produced knowledge that is relevant to individual health and material prosperity.</p> <p>16. Understand that reasonable people may disagree about some issues that are of interest to both science and religion (e.g., the origin of life on Earth, the cause of the Big Bang, the future of Earth).</p> <p>17. Identify important questions that science cannot answer (e.g., questions that are beyond today's science, decisions that science can only help to make, questions that are inherently outside of the realm of science).</p> <p>18. Understand that scientists have characteristics in common with other individuals (e.g., employment and career needs, curiosity, desire to perform public service, greed, preconceptions and biases, temptation to be unethical, core values including honesty and openness).</p> <p>19. Know that science plays a role in many different kinds of careers and activities (e.g., public service, volunteers, public office holders, researchers, teachers, doctors, nurses, technicians, farmers, ranchers).</p>	<p>15) Human genetic disorder individual research project and poster</p> <p>16 – 17) Seminar: “The Wonder that is Life” from Varghese’s book</p> <p>18) Human Genome documentary</p> <p>19) “Action in Ecology” project : Students identify a local ecological problem and contact an agency involved in it’s solution, including the type of research / data retrieval / technology / scientists / branches of science.</p>