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Strand	Standards	Concepts	Benchmarks	Unit Name	Course Topic Description
3 Characteristics and Interactions of Living Organisms	**3.1** There is a fundamental unity underlying the diversity of all living organisms	**3.1.A** Organisms have basic needs for survival	Not assessed at this level		
		3.1.B Organisms progress through life cycles unique to different types of organisms	**3.1.B.a** Recognize cells both increase in number and differentiate, becoming specialized in structure and function, during and after embryonic development	Animal Organization	The Reproductive System and Human Development
			3.1.B.b Identify factors (e.g., biochemical, temperature) that may affect the differentiation of cells and the development of an organism	Animal Organization	The Reproductive System and Human Development
		3.1.C Cells are the fundamental units of structure and function of all living things	**3.1.C.a** Recognize all organisms are composed of cells, the fundamental units of life	Cell Structure	Cell Features
			3.1.C.b Describe the structure of cell parts (e.g., cell wall, cell membrane, cytoplasm, nucleus, chloroplast, mitochondrion, ribosomes, vacuole) found in different types of cells (e.g., bacterial, plant, skin, nerve, blood, muscle) and the functions they perform (e.g., structural support, transport of materials, storage of genetic information, photosynthesis and respiration, synthesis of new molecules, waste disposal) that are necessary to the survival of the cell and organism	Cell Structure	The Cell Membrane
				Photosynthesis and Cellular Respiration	Photosynthesi: Food Production
					Cellular Respiration
				Animal Organization	The Nervous and Endocrine Systems
		3.1.D Plants and animals have different structures that serve similar functions necessary for the survival of the organism	Not assessed at this level		
		3.1.E Biological classifications are based	**3.1.E.a** Explain how similarities used	History of Life on	History of Life

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Strand	Standards	Concepts	Benchmarks	Unit Name	Course Topic Description
		on how organisms are related	to group taxa might reflect evolutionary relationships (e.g., similarities in DNA and protein structures, internal anatomical features, patterns of development)	Earth	Lab
				Evolution	Evolution Lab
				Biological Diversity	Plants Lab
					Animals Lab
			3.1.E.b Explain how and why the classification of any taxon might change as more is learned about the organisms assigned to that taxon		
	3.2 Living organisms carry out life processes in order to survive	**3.2.A** The cell contains a set of structures called organelles that interact to carry out life processes through physical and chemical means	**3.2.A.a** Compare and contrast the structure and function of mitochondria and chloroplasts		
			3.2.A.b Compare and contrast the structure and function of cell wall and cell membranes		
			3.2.A.c Explain physical and chemical interactions that occur between organelles as they carry out life processes		
		3.2.B Photosynthesis and cellular respiration are complementary processes necessary to the survival of most organisms on Earth	**3.2.B.a** Compare and contrast photosynthesis and cellular respiration reactions (Do NOT assess intermediate reactions)		
			3.2.B.b Explain the interrelationship between the processes of photosynthesis and cellular respiration		
			3.2.B.c Determine what factors affect the processes of photosynthesis and cellular respiration (i.e., light intensity, availability of reactants, temperature)	Photosynthesis and Cellular Respiration	Photosynthesis Lab
		3.2.C Complex multicellular organisms have systems that interact to carry out life processes through physical and chemical means	Not assessed at this level		

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Strand	Standards	Concepts	Benchmarks	Unit Name	Course Topic Description
		3.2.D Cells carry out chemical transformations that use energy for the synthesis or breakdown of organic compounds	**3.2.D.a** Summarize how energy transfer occurs during photosynthesis and cellular respiration (i.e., the storage and release of energy in the bonds of chemical compounds)	Photosynthesis and Cellular Respiration	Cellular Respiration Discussion
			3.2.D.b Distinguish among organic compounds (e.g., proteins, nucleic acids, lipids, carbohydrates) in relation to their role in living systems	The Nature of Science and Biology	Chemistry of Life
			3.2.D.c Recognize energy is absorbed or released in the breakdown and/or synthesis of organic compounds	Photosynthesis and Cellular Respiration	Cellular Respiration
				The Nature of Science and Biology	Chemistry of Life
			3.2.D.d Explain how protein enzymes affect chemical reactions (e.g., the breakdown of food molecules)	Photosynthesis and Cellular Respiration	Enzyme Lab
			3.2.D.e Interpret a data table showing the effects of an enzyme on a biochemical reaction		
		3.2.E Protein structure and function are coded by the DNA (Deoxyribonucleic acid) molecule	**3.2.E.a** Explain how the DNA code determines the sequence of amino acids necessary for protein synthesis	Genetics	RNA Lab
					Biotechnology Lab
			3.2.E.b Recognize the function of protein in cell structure and function (i.e., enzyme action, growth and repair of body parts, regulation of cell division and differentiation)	The Nature of Science and Biology	Chemistry of Life
		3.2.F Cellular activities and responses can maintain stability internally while external conditions are changing (homeostasis)	**3.2.F.a** Explain the significance of semi-permeability to the transport of molecules across cellular membranes		
			3.2.F.b Predict the movement of molecules needed for a cell to maintain		

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Strand	Standards	Concepts	Benchmarks	Unit Name	Course Topic Description
			homeostasis, given concentration gradients of different sizes of molecules		
			3.2.F.c Relate the role of diffusion, osmosis, and active transport to the movement of molecules across semi-permeable membranes	Cell Structure	The Cell Membrane: Quiz 2
			3.2.F.d Explain how water is important to cells (e.g., is a buffer for body temperature, provides soluble environment for chemical reactions, serves as a reactant in chemical reactions, provides hydration that maintains cell turgidity, maintains protein shape)		
		3.2.G Life processes can be disrupted by disease (intrinsic failures of the organ systems or by infection due to other organisms)	Not assessed at this level		
	3.3 There is a genetic basis for the transfer of biological characteristics from one generation to the next through reproductive processes	**3.3.A** Reproduction can occur asexually or sexually	**3.3.A.a** Distinguish between asexual (i.e., binary fission, budding, cloning) and sexual reproduction	Cell Structure	Meiosis and Sexual Reproduction
		3.3.B All living organisms have genetic material (DNA) that carries hereditary information	**3.3.B.a** Describe the chemical and structural properties of DNA (e.g., DNA is a large polymer formed from linked subunits of four kinds of nitrogen bases; genetic information is encoded in genes based on the sequence of subunits; each DNA molecule in a cell forms a single chromosome) (Assess the concepts - NOT memorization of nitrogen base pairs)	Genetics	DNA Lab
			3.3.B.b Recognize that DNA codes for proteins, which are expressed as the heritable characteristics of an organism	Genetics	Mendel and Heredity
					The

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Strand	Standards	Concepts	Benchmarks	Unit Name	Course Topic Description
					Chromosome Theory of Inheritance
			3.3.B.c Recognize that degree of relatedness can be determined by comparing DNA sequences	Genetics	Biotechnology Lab
				Evolution	Evolution and Genetics
			3.3.B.d Explain how an error in the DNA molecule (mutation) can be transferred during replication		
			3.3.B.e Identify possible external causes (e.g., heat, radiation, certain chemicals) and effects of DNA mutations (e.g., protein defects which affect chemical reactions, structural deformities)		
		3.3.C Chromosomes are components of cells that occur in pairs and carry hereditary information from one cell to daughter cells and from parent to offspring during reproduction	**3.3.C.a** Recognize the chromosomes of daughter cells, formed through the processes of asexual reproduction and mitosis, the formation of somatic (body) cells in multicellular organisms, are identical to the chromosomes of the parent cell	Cell Structure	Chromosomes and Cell Reproduction
					Mitosis Lab
			3.3.C.b Recognize that during meiosis, the formation of sex cells, chromosomes are reduced to half the number present in the parent cell	Cell Structure	Meiosis and Sexual Reproduction
					Meiosis Lab
			3.3.C.c Explain how fertilization restores the diploid number of chromosomes		
			3.3.C.d Identify the implications of human sex chromosomes for sex determination	Genetics	The Chromosome Theory of Inheritance

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Strand	Standards	Concepts	Benchmarks	Unit Name	Course Topic Description
		3.3.D There is heritable variation within every species of organism	**3.3.D.a** Describe the advantages and disadvantages of asexual and sexual reproduction with regard to variation within a population		
			3.3.D.b Describe how genes can be altered and combined to create genetic variation within a species (e.g., mutation, recombination of genes)	Genetics	Biotechnology Lab
					Mendel and Heredity
			3.3.D.c Recognize that new heritable characteristics can only result from new combinations of existing genes or from mutations of genes in an organism's sex cells	Genetics	Mendel and Heredity
		3.3.E The pattern of inheritance for many traits can be predicted by using the principles of Mendelian genetics	**3.3.E.a** Explain how genotypes (heterozygous and homozygous) contribute to phenotypic variation within a species	Genetics	Mendel and Heredity
			3.3.E.b Predict the probability of the occurrence of specific traits, including sex-linked traits, in an offspring by using a monohybrid cross	Genetics	Mendel and Heredity
			3.3.E.c Explain how sex-linked traits may or may not result in the expression of a genetic disorder (e.g., hemophilia, muscular dystrophy, color blindness) depending on gender	Genetics	Meet the Jeffersons Notebook
					Human Genetic Traits
4 Changes in Ecosystems and Interactions of Organisms with their Environments	**4.1** Organisms are interdependent with one another and with their environment	**4.1.A** All populations living together within a community interact with one another and with their environment in order to survive and maintain a balanced ecosystem	**4.1.A.a** Explain the nature of interactions between organisms in different symbiotic relationships (i.e., mutualism, commensalism, parasitism)		
			4.1.A.b Explain how cooperative (e.g., symbiosis) and competitive (e.g., predator/prey) relationships help maintain balance within an ecosystem		

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Strand	Standards	Concepts	Benchmarks	Unit Name	Course Topic Description
			4.1.A.c Explain why no two species can occupy the same niche in a community		
		4.1.B Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite	**4.1.B.a** Identify and explain the limiting factors that may affect the carrying capacity of a population within an ecosystem	Population Ecology	Biomes Lab
					Community and Ecosystem Dynamics
			4.1.B.b Predict how populations within an ecosystem change in number and/or structure in response to hypothesized changes in biotic and/or abiotic factors	Population Ecology	Community and Ecosystem Dynamics
		4.1.C All organisms, including humans, and their activities cause changes in their environment that affect the ecosystem	**4.1.C.a** Devise a multi-step plan to restore the stability and/or biodiversity of an ecosystem when given a scenario describing the possible adverse effects of human interactions with that ecosystem (e.g., destruction caused by direct harvesting, pollution, atmospheric changes)		
			4.1.C.b Predict and explain how natural or human caused changes (biological, chemical and/or physical) in one ecosystem may affect other ecosystems due to natural mechanisms (e.g., global wind patterns, water cycle, ocean currents)	Population Ecology	The Biosphere and Mass Extinctions
		4.1.D The diversity of species within an ecosystem is affected by changes in the environment, which can be caused by other organisms or outside processes	**4.1.D.a** Predict the impact (beneficial or harmful) a natural environmental event (e.g., forest fire, flood, volcanic eruption, avalanche) may have on the diversity of different species in an ecosystem		
			4.1.D.b Describe possible causes of	Population	The Biosphere

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Strand	Standards	Concepts	Benchmarks	Unit Name	Course Topic Description
			extinction of a population	Ecology	and Mass Extinctions
	4.2 Matter and energy flow through an ecosystem	**4.2.A** As energy flows through the ecosystem, all organisms capture a portion of that energy and transform it to a form they can use	**4.2.A.a** Illustrate and describe the flow of energy within a food web		
			4.2.A.b Explain why there are generally more producers than consumers in an energy pyramid		
			4.2.A.c Predict how energy distribution and energy use will be altered due to changes in a food web		
		4.2.B Matter is recycled through an ecosystem	**4.2.B.a** Explain the processes involved in the recycling of nitrogen, oxygen, and carbon through an ecosystem	Population Ecology	The Biosphere and Mass Extinctions
			4.2.B.b Explain the importance of the recycling of nitrogen, oxygen, and carbon within an ecosystem	Population Ecology	The Biosphere and Mass Extinctions
	4.3 Genetic variation sorted by the natural selection process explains evidence of biological evolution	**4.3.A** Evidence for the nature and rates of evolution can be found in anatomical and molecular characteristics of organisms and in the fossil record	**4.3.A.a** Interpret fossil evidence to explain the relatedness of organisms using the principles of superposition and fossil correlation	History of Life on Earth	History of Life Lab
			4.3.A.b Evaluate the evidence that supports the theory of biological evolution (e.g., fossil records, similarities between DNA and protein structures, similarities between developmental stages of organisms, homologous and vestigial structures)	Evolution	Descent with Modification: Opposing Theories Notebook
		4.3.B Reproduction is essential to the continuation of every species	**4.3.B.a** Define a species in terms of the ability to breed and produce fertile offspring	Biological Diversity	Taxonomy, Quiz 1
			4.3.B.b Explain the importance of reproduction to the survival of a species (i.e., the failure of a species to reproduce will lead to extinction of that	Evolution	Evolution and Genetics

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Strand	Standards	Concepts	Benchmarks	Unit Name	Course Topic Description
			species)		
		4.3.C Natural selection is the process of sorting individuals based on their ability to survive and reproduce within their ecosystem	**4.3.C.a** Describe how variation in characteristics provides populations an advantage for survival	Evolution	Evolution and Genetics
			4.3.C.b Identify examples of adaptations that may have resulted from variations favored by natural selection (e.g., long-necked giraffes, long-eared jack rabbits)	Evolution	Evolution and Genetics
			4.3.C.c Explain how genetic homogeneity may cause a population to be more susceptible to extinction (e.g., succumbing to a disease for which there is no natural resistance)	Evolution	Evolution and Genetics
			4.3.C.d Explain how environmental factors (e.g., habitat loss, climate change, pollution, introduction of non-native species) can be agents of natural selection	Evolution	Evolution and Genetics
					Reproductive Isolation Notebook
			4.3.C.e Given a scenario describing an environmental change, hypothesize why a given species was unable to survive		
7 Scientific Inquiry	**7.1** Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning, and critical thinking	**7.1.A** Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation	**7.1.A.a** Formulate testable questions and hypotheses	The Nature of Science and Biology	The Scientific Method Lab
			7.1.A.b Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment	The Nature of Science and Biology	The Scientific Method Lab
			7.1.A.c Design and conduct a valid experiment		

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Strand	Standards	Concepts	Benchmarks	Unit Name	Course Topic Description
			7.1.A.d Recognize it is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature)	Genetics	Biotechnology and the Genetics Revolution
			7.1.A.e Acknowledge some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using the standard experimental "scientific method" due to the limits of the laboratory environment, resources, and/or technologies		
			7.1.A.f Acknowledge there is no fixed procedure called "the scientific method", but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations	The Nature of Science and Biology	The Scientific Method Lab
			7.1.A.g Evaluate the design of an experiment and make suggestions for reasonable improvements	The Nature of Science and Biology	Science and the Scientific Method
		7.1.B Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations	**7.1.B.a** Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders)	The Nature of Science and Biology	The Scientific Method Lab
				Photosynthesis and Cellular Respiration	Enzyme Lab
			7.1.B.b Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force		

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			(weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second		
			7.1.B.c Determine the appropriate tools and techniques to collect, analyze, and interpret data	The Nature of Science and Biology	The Scientific Method Lab
			7.1.B.d Judge whether measurements and computation of quantities are reasonable		
			7.1.B.e Calculate the range, average/mean, percent, and ratios for sets of data		
			7.1.B.f Recognize observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results)	Genetics	RNA Lab
		7.1.C Evidence is used to formulate explanations	**7.1.C.a** Use quantitative and qualitative data as support for reasonable explanations (conclusions)	The Nature of Science and Biology	The Scientific Method Lab
				Photosynthesis and Cellular Respiration	Enzyme Lab
			7.1.C.b Analyze experimental data to determine patterns, relationship, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable)	The Nature of Science and Biology	The Scientific Method Lab
				Photosynthesis and Cellular Respiration	Enzyme Lab
			7.1.C.c Identify the possible effects of errors in observations, measurements, and calculations, on the validity and	The Nature of Science and Biology	The Scientific Method Lab

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Strand	Standards	Concepts	Benchmarks	Unit Name	Course Topic Description
			reliability of data and resultant explanations (conclusions)	Photosynthesis and Cellular Respiration	Enzyme Lab
		7.1.D Scientific inquiry includes evaluation of explanations (hypotheses, laws, theories) in light of scientific principles (understandings)	**7.1.D.a** Analyze whether evidence (data) and scientific principles support proposed explanations (hypotheses, laws, theories)	The Nature of Science and Biology	The Scientific Method Lab
				Photosynthesis and Cellular Respiration	Enzyme Lab
			7.1.D.b Evaluate the reasonableness of an explanation (conclusion)	The Nature of Science and Biology	The Scientific Method Lab
				Photosynthesis and Cellular Respiration	Enzyme Lab
		7.1.E The nature of science relies upon communication of results and justification of explanations	**7.1.E.a** Communicate the procedures and results of investigations and explanations through:		
			7.1.E.a.1 oral presentations	Population Ecology	Biomes Lab
			7.1.E.a.2 drawings and maps	Evolution	Evolution Lab
				History of Life on Earth	History of Life Lab
			7.1.E.a.3 data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities)	The Nature of Science and Biology	The Scientific Method Lab
				Photosynthesis and Cellular Respiration	Enzyme Lab
					Photosynthesis Lab
			7.1.E.a.4 graphs (bar, single, and multiple line)		
			7.1.E.a.5 equations and writings		

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Strand	Standards	Concepts	Benchmarks	Unit Name	Course Topic Description
			7.1.E.b Communicate and defend a scientific argument	Evolution	Descent With Modification: Opposing Theories Notebook
			7.1.E.c Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work)		
8 Impact of Science, Technology and Human Activity	**8.1** The nature of technology can advance, and is advanced by, science as it seeks to apply scientific knowledge in ways that meet human needs	**8.1.A** Designed objects are used to do things better or more easily and to do some things that could not otherwise be done at all	Not assessed at this level		
		8.1.B Advances in technology often result in improved data collection and an increase in scientific information	**8.1.B.a** Recognize the relationships linking technology and science (e.g., how technological problems may create a demand for new science knowledge, how new technologies make it possible for scientists to extend research and advance science)	Cell Structure	Microscopes
				Genetics	Biotechnology and the Genetics Revolution
		8.1.C Technological solutions to problems often have drawbacks as well as benefits	**8.1.C.a** Identify and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks) and benefits of technological solutions to a given problem (e.g., damming a river for flood control, using pesticides to eliminate mosquitoes, genetic engineering of cells, use of satellite communications to gather information)	Genetics	Biotechnology and the Genetics Revolution
				Biological Diversity	Domain Bacteria
	8.2 Historical and cultural perspectives of	**8.2.A** People of different gender and ethnicity have contributed to scientific	**8.2.A.a** Recognize contributions to science are not limited to the work of	Genetics	DNA Lab
					RNA Lab

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	scientific explanations help to improve understanding of the nature of science and how science knowledge and technology evolve over time	discoveries and the invention of technological innovations	one particular group, but are made by a diverse group of scientists representing various ethnic and gender groups	Genetics	DNA Lab
					RNA Lab
				Biological Diversity	Taxonomy and Cladistic Classification
			8.2.A.b Recognize gender and ethnicity of scientists often influence the questions asked and/or the methods used in scientific research and may limit or advance science knowledge and/or technology		
		8.2.B Scientific theories are developed based on the body of knowledge that exists at any particular time and must be rigorously questioned and tested for validity	**8.2.B.a** Identify and describe how explanations (hypotheses, laws, theories) of scientific phenomena have changed over time as a result of new evidence (e.g., model of the solar system, basic structure of matter, structure of an atom, Theory of Plate Tectonics, Big Bang and nebular theory of the Universe, explanation of electric current)		
			8.2.B.b Identify and analyze current theories that are being questioned, and compare them to new theories that have emerged to challenge older ones (e.g., Theory of Evolution, theories of extinction, global warming)	Evolution	Descent With Modification: Opposing Theories Notebook
	8.3 Science and technology affect, and are affected by, society	**8.3.A** People, alone or in groups, are always making discoveries about nature and inventing new ways to solve problems and get work done	Not assessed at this level		
		8.3.B Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and	**8.3.B.a** Analyze the roles of science and society as they interact to determine the direction of scientific and technological progress (e.g.,	Genetics	Biotechnology and the Genetics Revolution

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		technology	prioritization of and funding for new scientific research and technological development is determined on the basis of individual, political and social values and needs; understanding basic concepts and principles of science and technology influences debate about the economics, policies, politics, and ethics of various scientific and technological challenges)	Genetics	Biotechnology and the Genetics Revolution
			8.3.B.b Identify and describe major scientific and technological challenges to society and their ramifications for public policy (e.g., global warming, limitations to fossil fuels, genetic engineering of plants, space and/or medical research)		
			8.3.B.c Analyze and evaluate the social, political, economic, ethical, and environmental factors affecting progress toward meeting major scientific and technological challenges (e.g., limitations placed on stem-cell research or genetic engineering, introduction of alien species, deforestation, bioterrorism, nuclear energy, genetic counseling, computer technology)	Genetics	Biotechnology and the Genetics Revolution
		8.3.C Scientific ethics require that scientists must not knowingly subject people or the community to health or property risks without their knowledge and consent	**8.3.C.a** Identify and evaluate the need for informed consent in experimentation		
			8.3.C.b Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment)	Genetics	Biotechnology and the Genetics Revolution
			8.3.C.c Identify and evaluate the role		

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Strand	Standards	Concepts	Benchmarks	Unit Name	Course Topic Description
			of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution)		
		8.3.D Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible	**8.3.D.a** Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an "eye witness", a scientist speaking within or outside his/her area of expertise)		
			8.3.D.b Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society		