



# “I Can” Mascoma High School Life Science Curriculum

## I Have Good SCIENTIFIC SKILLS

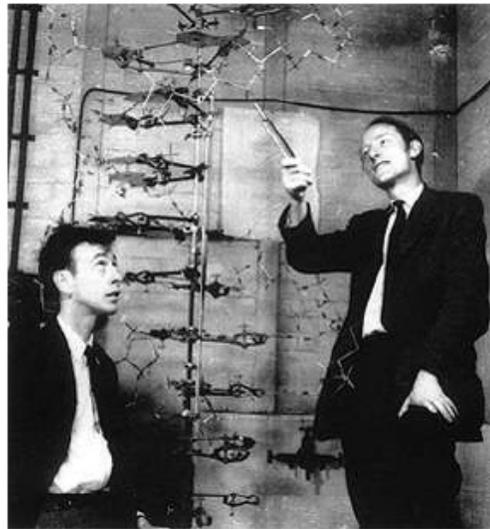
- I can observe and ask questions about scientific topics.
- I can build and revise a simple model to represent events and design solutions.
- I can develop a model to describe or represent scientific phenomena.
- I can plan and carry out a scientific investigation to answer a question or solve a problem.
- I can produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials is considered.
- I can make observations and measurements to produce data to serve as the basis for evidence for the explanation of a phenomenon.
- I can measure and graph quantities such as weight and length to address scientific and engineering questions and problems.
- I can explain the results of a scientific investigation.

# I know Molecules to Organisms: Structures and Processes

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In 1953, DNA (deoxyribonucleic acid) was discovered as a double helix structure by Watson and Crick using data collected by Rosalind Franklin.



□ I can construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life throughout systems of specialized cells. (Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis).

□ I can develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. (Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. Example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system. Assessment does not include interactions and functions at the molecular or chemical reaction level.).

I can plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. (Examples of investigations could include heart rate response to exercise, stomata response to moisture and temperature, and root development in response to water levels. Assessment does not include the cellular processes involved in the feedback mechanism.).

I can use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms (Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.)

I can use a model to illustrate how photosynthesis transforms light energy into stored chemical energy (Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Assessment does not include specific biochemical steps).

I can conduct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules (Emphasis is on using evidence from models and simulations to support explanations. Assessment does not include the details of the specific chemical reactions or identification of macromolecules.).

I can use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy (Emphasis is on the conceptual understanding of the inputs and outputs of the process of cellular respiration. Assessment does not include identification of the steps or specific process involved in cellular respiration).

A little primer for my teacher: **Every student is responsible for the blue standards. Only juniors and seniors are responsible for the black standards.**

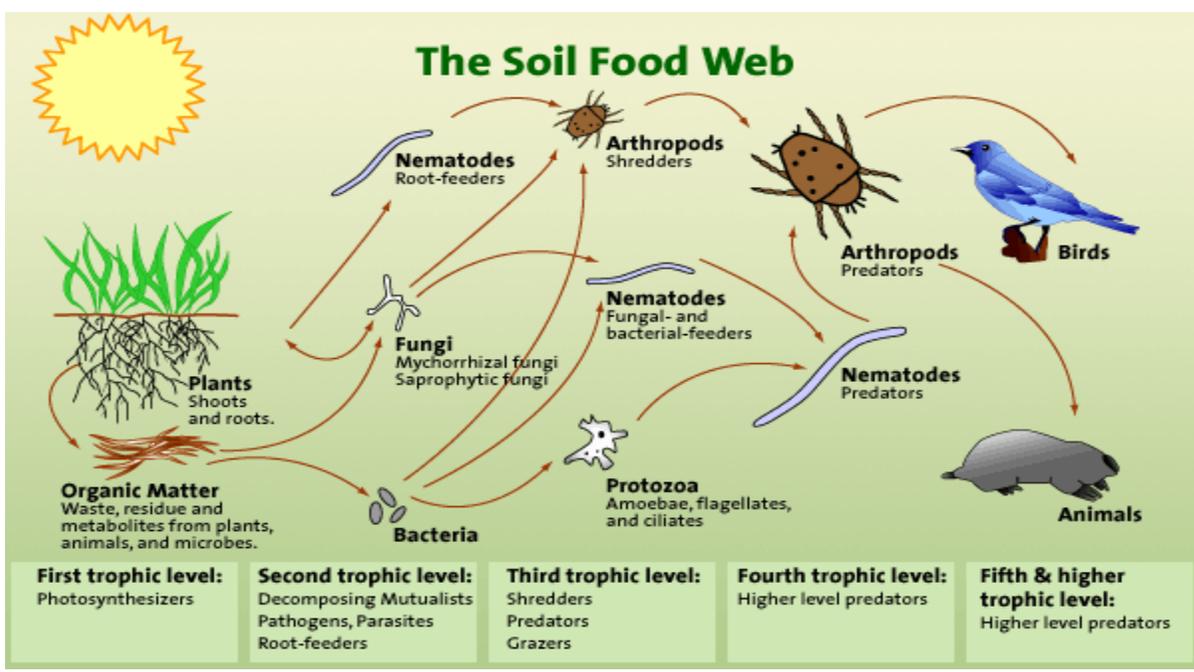
Mascoma Standards	<a href="#">RST.11.1</a> - Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	<a href="#">WHST.9.2</a> - Write informative/explanatory texts including the narration of scientific procedures, experiments, or technical processes.
	<a href="#">WHST.9.5</a> - Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose or audience.	<a href="#">WHST.9.7</a> - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

	<p><a href="#">WHST.11.8</a>- Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, while avoiding plagiarism and overreliance on any one source and following a standard format for citations.</p>	<p><a href="#">WHST.9.9</a>- Draw evidence from informational texts to support analysis, reflection, and research.</p>
	<p><a href="#">SL-11.5</a>- Make strategic use of digital media (textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence to add interest.</p>	<p><a href="#">MP-9.4</a>- Model with mathematics</p>
	<p><a href="#">HSF-IF.C-9.7</a>- Graph function expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.</p>	<p><a href="#">HSF.BF.A-9.1</a>- Write a function that describes a relationship between two quantities.</p>
Vocabulary	<p>DNA, specialized cells, protein structures, protein functions, multicellular organism, nutrient uptake, neural stimuli, feedback mechanism, homeostasis, mitosis, cell differentiation, complex organism, photosynthesis, combined elements, amino acids, carbon based molecules, cellular respiration, compounds, bonds, net transfer of energy, genes, mediate behaviors, positive/negative feedback, variants, chromosomes, daughter cells, hydrocarbon backbone, recombine, chemical reactions</p>	
Disciplinary Core Ideas	<p><u>Structure and Function</u></p> <ul style="list-style-type: none"> <li>• Systems of specialized cells within organisms help them perform the essential functions of life.</li> <li>• All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.</li> <li>• Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.</li> <li>• Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (through negative feedback) what is going on inside the living system.</li> </ul> <p><u>Growth and Development of Organisms</u></p> <ul style="list-style-type: none"> <li>• In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of</li> </ul>	

	<p>each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism.</p> <p><u>Organization for Matter and Energy Flow in Organisms</u></p> <ul style="list-style-type: none"> <li>• The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen.</li> <li>• The sugar molecules thus formed contain carbon, hydrogen, and oxygen; their hydrocarbon backbones are used to make amino acids and other carbon based molecules that can be assembled into larger molecules (such as proteins or DNA), used to form new cells.</li> <li>• As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.</li> <li>• As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment.</li> </ul>
<p>Cross-cutting Concepts</p>	<p><u>Systems and System Models</u></p> <ul style="list-style-type: none"> <li>• Modules (physical, mathematical, and computer models) can be used to simulate systems and interactions- including energy, matter, and information flows- within and between systems at different scales.</li> </ul> <p><u>Energy and Matter</u></p> <ul style="list-style-type: none"> <li>• Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within a system.</li> <li>• Energy cannot be created or destroyed, it only moves between one place and another, between objects and/or fields, or between systems.</li> </ul> <p><u>Structure and Function</u></p> <ul style="list-style-type: none"> <li>• Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem.</li> </ul> <p><u>Stability and Change</u></p> <ul style="list-style-type: none"> <li>• Feedback (negative or positive) can stabilize or destabilize a system.</li> </ul>

<p>Science and Engineering Practice</p>	<ul style="list-style-type: none"> <li>• Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.</li> <li>• Use a model based on evidence to illustrate the relationships between systems or between components of a system.</li> <li>• Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, amount, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time) and refine the design accordingly.</li> <li>• Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, and peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past, and will continue to do so in the future</li> <li>• Construct and revise an argument based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, and peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past, and will continue to do so in the future</li> <li>• Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest, ethical reporting of findings.</li> </ul>
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## I Know About Ecosystems: Interactions, Energy and Dynamics



□ I can use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales. (Emphasis is on quantitative analysis and comparison of relationships among interdependent factors, including boundaries, resources, climate and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets. Assessment does not include deriving mathematical equations to make comparisons.).

□ I can use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. (Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data. Assessment is limited to provided data.).

□ I can construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions (Emphasis is on conceptual understanding of the role of aerobic and anaerobic respiration in different environments. Assessment Boundary- does not include the specific chemical processes of either aerobic or anaerobic respiration.).

□ I can use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem (Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen, and nitrogen being conserved as they move through an ecosystem. Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.).

□ I can develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere (Examples of models could include simulations and mathematical models. Assessment does not include the specific chemical steps of photosynthesis and respiration).

□ I can evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem (Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.).

□ I can design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity (Examples of human activity can include: urbanization, building dams, and dissemination of invasive species.).

□ I can evaluate the evidence for the role of group behavior on individual and species' chances to survive and reproduce (Emphasis is on: distinguishing between group and individual behavior, identifying evidence supporting the outcomes of group behavior, and developing logical and reasonable arguments based on evidence. Examples of group behavior could include: flocking, schooling, herding, and cooperative behaviors such as hunting, migrating, and swarming.).

A little primer for my teacher: **Every student is responsible for the blue standards. Only juniors and seniors are responsible for the black standards.**

Mascoma Standards	<a href="#">RI.9.1</a> - Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.	<a href="#">RIST.11.1</a> - Cite textual evidence to support analysis of science and technical texts, attending to the important distinctions the author makes and to any gaps or inconsistencies in the account.
	<a href="#">RIST.11.7</a> - Integrate and evaluate multiple sources of information presented in diverse formats and media (quantitative data, video, multimedia, etc.) in order to address a question or solve a problem.	<a href="#">RIST.11.8</a> - Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
	<a href="#">WHST.9.2</a> - Write informative/explanatory texts including the narration of scientific procedures, experiments, or technical processes.	<a href="#">WHST.9.5</a> - Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose or audience.
	<a href="#">WHST.9.7</a> - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.	<a href="#">MP-9.2</a> - Reason abstractly and quantitatively.
	<a href="#">MP-9.4</a> - Model with mathematics.	<a href="#">HSN-Q.A-1</a> - Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
	<a href="#">HSN-Q.A-2</a> - Define appropriate quantities for the purpose of descriptive modeling.	<a href="#">HSN-Q.A-3</a> - Chose a level of accuracy appropriate to limitations on measurement when reporting quantities.

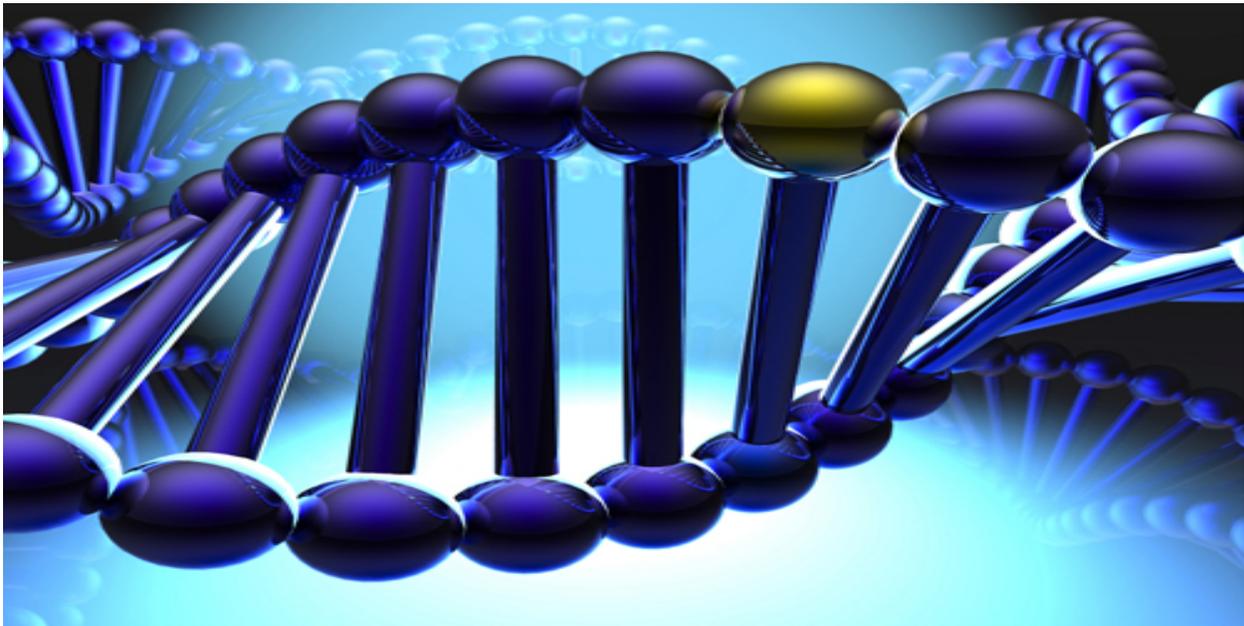
	<a href="#">HSS.ID.A-9.1- Represent data with plots on a real number line.</a>	<a href="#">HSS.IC.A-9.1- Understand statistics as a process for making inferences about population parameters based on a random sample for that population.</a>
	<a href="#">HSS.IS.B-9.6- Evaluate reports based on data.</a>	
Vocabulary	Carrying capacity, biodiversity, population, aerobic, anaerobic, biomass, transfer, trophic levels, photosynthesis, cellular respiration, carbon cycling, biosphere, atmosphere, hydrosphere, geosphere, stable conditions, impact of human activity, urbanization, dissemination of invasive species, group behaviors, cooperative behaviors, abundance, anthropogenic changes, landscape value, resource competition	
Disciplinary Core Ideas	<p><u>Interdependent Relationships in Ecosystems</u></p> <ul style="list-style-type: none"> <li>Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.</li> </ul> <p><u>Cycle of Matter and Energy Transfer in Ecosystems</u></p> <ul style="list-style-type: none"> <li>Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.</li> <li>Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.</li> <li>Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes.</li> </ul> <p><u>Ecosystem Dynamics, Functioning, and Resilience</u></p> <ul style="list-style-type: none"> <li>A complex set of interaction within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (the ecosystem is resilient) as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.</li> <li>Moreover, anthropogenic changes (induced by human activity) in the environment –including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change- can disrupt an ecosystem and threaten the survival of some species.</li> </ul>	

	<p><u>Social Interactions and Group Behavior</u></p> <ul style="list-style-type: none"> <li>Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.</li> </ul> <p><u>Biodiversity and Humans</u></p> <ul style="list-style-type: none"> <li>Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).</li> <li>Humans depend on the living world for resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes or recreational or inspirational value.</li> </ul> <p><u>Energy in Chemical Processes</u></p> <ul style="list-style-type: none"> <li>The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.</li> </ul> <p><u>Developing Possible Solutions</u></p> <ul style="list-style-type: none"> <li>When evaluating solutions it is important to take into account a range of constraints including, cost, safety, reliability, and aesthetics and to consider social, cultural, and environmental impacts.</li> </ul>
Cross-cutting Concepts	<p><u>Cause and Effect</u></p> <ul style="list-style-type: none"> <li>Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</li> </ul> <p><u>Scale, Proportion, and Quantity</u></p> <ul style="list-style-type: none"> <li>The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs.</li> <li>Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.</li> </ul> <p><u>Systems and System Models</u></p> <ul style="list-style-type: none"> <li>Models (physical, mathematical, or compute models) can be used to simulate systems and interactions-including energy, matter, and information flows-within and between systems at different scales.</li> </ul> <p><u>Energy and Matter</u></p> <ul style="list-style-type: none"> <li>Energy cannot be created or destroyed- it only moves between one place and another place, between objects and/or fields, or between systems.</li> <li>Energy drives the cycling of matter within and between systems.</li> </ul> <p><u>Stability and Change</u></p> <ul style="list-style-type: none"> <li>Much of science deals with constructing explanations of how things change and how they remain stable.</li> </ul>
Science and Engineering Practice	<ul style="list-style-type: none"> <li>Develop a model based on evidence to illustrate the relationships between systems or components of a system.</li> <li>Use mathematical and/or computational representations of phenomena or design solutions to support explanations.</li> <li>Use mathematical representations of phenomena of design solutions to support and revised explanations.</li> <li>Use mathematical representations of phenomena of design solutions to support claims.</li> <li>Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations,</li> </ul>

models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.

- Design, evaluate, and refine a solution to a complex, real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
- Evaluate the claims, evidence, and reasoning behind currently accepted explanations to determine the merits of arguments.
- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence.
- Scientific argumentation is a mode of logical discourse used to clarify the strength of relationships between ideas and evidence that may result in revision of an explanation.

## I Know About Heredity: Inheritance and Variation of Traits



I can ask questions to clarify relationships about the role of DNA and chromosomes in coding instructions for characteristic traits passed from parents to offspring.

(Assessment does not include the phases of meiosis or the biochemical mechanism of specific steps in the process).

I can make and defend a claim based on evidence that inheritable genetic variations may result from: new genetic combinations during meiosis, viable errors occurring during replication, and/or mutations caused by environmental factors. (Emphasis is on using data to support arguments for the way variations occur. Assessment does not

include the phases of meiosis or the biochemical mechanism of specific steps in the process).

□ I can apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population (Emphasis is on the use of mathematics to describe the probability of traits as it relates to genetic and environmental factors in the expression of traits. Assessment does not include Hardy-Weinberg calculations.).

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Mascoma Standards	<u>RIST.11.1</u> - Cite specific textural evidence to support analysis of scientific and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	<u>RIST.11.9</u> - Synthesize information from a range of sources (texts, experiments, simulations, etc.) into a coherent understanding of process, phenomenon, or concept, resolving conflicting information when possible.
	<u>WHST. 9.1</u> - Write arguments focused on discipline specific content.	<u>MP-9.4</u> - Model with mathematics.
Vocabulary	DNA, chromosome, coding, characteristic traits, genetic variations, meiosis, replication, mutation, environmental factor, variation and distribution, expressed trait, genes, regulatory function, structural function, inherited mutation,	
Disciplinary Core Ideas	<u>Structure and Function</u> <ul style="list-style-type: none"> <li>All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins.</li> </ul> <u>Inheritance of Traits</u> <ul style="list-style-type: none"> <li>Each chromosome consists of a single, very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species' characteristics are carried in DNA. All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as-yet known function.</li> </ul> <u>Variations of Traits</u> <ul style="list-style-type: none"> <li>In sexually reproducing organisms, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. Environmental factors can also cause mutations in genes, and viable mutations are inherited.</li> <li>Environmental factors also affect expression of traits and hence affect the probability of occurrences of traits in a population. Thus the variation and distribution of traits observed depends on both genetic and environmental factors.</li> </ul>	
Cross-cutting Concepts	<u>Cause and Effect</u> <ul style="list-style-type: none"> <li>Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</li> </ul> <u>Scale, Proportion, and Quantity</u>	

	<ul style="list-style-type: none"> <li>Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).</li> </ul> <p><u>Science is a Human Endeavor</u></p> <ul style="list-style-type: none"> <li>Technological advances have influenced the progress of science and science has influenced advances in technology.</li> <li>Science and engineering are influenced by society and society is influenced by science and engineering.</li> </ul>
Science and Engineering Practice	<ul style="list-style-type: none"> <li>Ask questions that arise from examining models or a theory to clarify relationships</li> <li>Apply concepts of statistics and probability (including determining function fits to data, slope, intercepts, and correlation coefficients for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.</li> <li>Make and defend a claim based on evidence about the natural world that reflects scientific knowledge, and student-generated evidence.</li> </ul>

## I Know Biological Evolution: Unity and Diversity

### What is Natural Selection?

The **only** explanation for the origin of **adaptations**



*Ceratosoma amoenum* (© Doug Anderson)

I can communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence (Emphasis is on a conceptual understanding of the role each line of evidence has relating to common ancestry and biological evolution. Examples could include: similarities in DNA sequence, similarities in anatomical structures, and order of appearance of structures in embryological development.).

I can construct an explanation based on evidence that the process of evolution primarily results from four factors: the potential for a species to increase in number, the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, competition for limited resources, and the proliferation of those organisms that are better able to survive and reproduce in the environment (Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning. Assessment does not include other mechanisms of evolution, such as, genetic drift, gene flow through migration, and co-evolution).

I can apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. (Emphasis is on analyzing shifts in numerical distribution of traits and using these shifts as evidence to support explanations. Assessment is limited to basic statistical and graphical analysis and does not include frequency calculations.).

I can construct an explanation based on evidence for how natural selection leads to adaptation of populations (Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems, such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms, contribute to a change in gene frequency over time, leading to adaptations of populations).

I can evaluate the evidence supporting claims that changes in environmental conditions may result in: increases in the number of individuals of some species, the emergence of new species over time, and the extinction of other species (emphasis is on determining cause and effect relationships for how changes to the environment such as deforestation, fishing, application of fertilizers, drought, flood, and the rate of change of the environment affect distribution or disappearance of traits in species).

I can use create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity (emphasis is on designing solutions for a proposed

problem related to threatened or endangered species, or to genetic variation of organisms for multiple species)

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	<a href="#">WHST.9-2</a> - Write informative/explanatory texts, including the narration of scientific procedures, experiments, or technical processes.	<a href="#">WHST.9-5</a> - Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and/or audience.
	<a href="#">WHST.9-7</a> - Conduct short, as well as more sustained, research projects to answer a question (including a self-generated question), solve a problem; narrow or broaden an inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.	<a href="#">WHST.9-9</a> - Draw evidence from informational texts to support analysis, reflection, and research.
	<a href="#">SL.11.4</a> - Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well-chosen details; use appropriate eye contact, adequate volume, and clear pronunciation	<a href="#">MP-9.2</a> - Reason abstractly and quantitatively.
	<a href="#">MP-9.4</a> - Model with mathematics.	
Vocabulary	Common ancestry, biological evolution, DNA sequence, anatomical structures, heritable genetic variation, mutation, sexual reproduction, proliferation, survival of the fittest, morphology, physiology, compete, adaptation, traits, natural selection, population, biotic, abiotic, ecosystem, gene frequency, emergence of a species, extinction of a species, mitigate adverse impact, biodiversity, embryological evidence, trait distribution, functioning, productivity, sustainable	
Disciplinary Core Ideas	<p><u>Evidence of Common Ancestry and Diversity</u></p> <ul style="list-style-type: none"> <li>Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences from anatomical and embryological evidence.</li> </ul>	

	<p><u>Natural Selection</u></p> <ul style="list-style-type: none"> <li>• Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information- that is, trait variation- that leads to differences in performance among individuals.</li> <li>• The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population.</li> </ul> <p><u>Adaptation</u></p> <ul style="list-style-type: none"> <li>• Evolution is a consequence of the interaction of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment.</li> <li>• Natural selection leads to adaptation that is; to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. That is, the f</li> <li>• Differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that do have that trait, and a decrease in the proportion of individuals that do not.</li> <li>• Adaptation also means that the distribution of traits in a population can change when conditions change.</li> <li>• Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new, distinct species as populations diverge under different conditions, and the decline-and sometimes extinction- of some species.</li> <li>• Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to the change that is too fast or drastic, the opportunity for the species' evolution is lost.</li> </ul> <p><u>Biodiversity and Humans</u></p> <ul style="list-style-type: none"> <li>• Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.</li> </ul> <p><u>Developing Possible Solutions</u></p> <ul style="list-style-type: none"> <li>• When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.</li> <li>• Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.</li> </ul>
Cross-cutting	<u>Cause and Effect</u>

<p>Concepts</p>	<ul style="list-style-type: none"> <li>• Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.</li> </ul> <p><u>Patterns</u></p> <ul style="list-style-type: none"> <li>• Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.</li> </ul> <p><u>Scientific Knowledge Assumes an Order and Consistency in Natural Systems</u></p> <ul style="list-style-type: none"> <li>• Scientific knowledge is based on the assumption that natural laws operate today as they did in the past and they will continue to do so in the future.</li> </ul>
<p>Science and Engineering Practice</p>	<p><u>Analyzing and Interpreting Data</u></p> <ul style="list-style-type: none"> <li>• Apply concepts of statistics and probability (including determining function fits to data, slope, intercept, and correlation coefficients for linear fits) to scientific and engineering questions and problems, using digital tools when feasible.</li> </ul> <p><u>Using Mathematics and Computational Thinking</u></p> <ul style="list-style-type: none"> <li>• Create or revise a simulation of a phenomenon, designed device, process, or system.</li> </ul> <p><u>Constructing Explanations and Designing Solutions</u></p> <ul style="list-style-type: none"> <li>• Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past, and will continue to do so in the future.</li> </ul> <p><u>Engaging in Argument from Evidence</u></p> <ul style="list-style-type: none"> <li>• Evaluate the evidence behind currently accepted explanations or solutions to determine the merits of arguments.</li> </ul> <p><u>Obtaining, Evaluating, and Communicating Information</u></p> <ul style="list-style-type: none"> <li>• Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, and textually) and mathematically.</li> </ul> <p><u>Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena</u></p> <ul style="list-style-type: none"> <li>• A scientific theory is a substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment and the science community validates each theory before it is accepted. If new evidence is discovered that the theory does not accommodate, the theory is generally modified in light of this new evidence.</li> </ul>