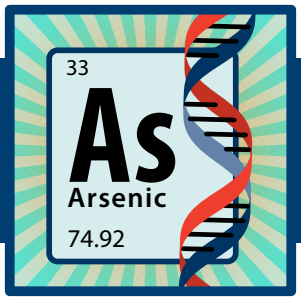
UNIT: DNA
LESSON 1: ARSENIC AND EPIGENETICS: A DNA STORY



TEXAS BIOMEDICAL RESEARCH INSTITUTE
HEALTH STARTS WITH SCIENCE

NEXT GENERATION SCIENCE STANDARDS (NGSS)
TEXAS ESSENTIAL KNOWLEDGE AND SKILLS (TEKS)

Texas Essential Knowledge and Skills (TEKS)

7TH GRADE

Scientific and Engineering Practices

(1) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:

(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;

(B) use scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;

(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;

(D) use appropriate tools such as graduated cylinders, metric rulers, periodic tables, balances, scales, thermometers, temperature probes, laboratory ware, timing devices, pH indicators, hot plates, models, microscopes, slides, life science models, petri dishes, dissecting kits, magnets, spring scales or force sensors, tools that model wave behavior, satellite images, hand lenses, and lab notebooks or journals;

(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;

(F) construct appropriate tables, graphs, maps, and charts using repeated trials and means to organize data;

(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems;

(2) The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:

(A) identify advantages and limitations of models such as their size, properties, and materials;

(B) analyze data by identifying any significant descriptive statistical features, patterns, sources of error, or limitations;

(D) evaluate experimental and engineering designs.

(3) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;

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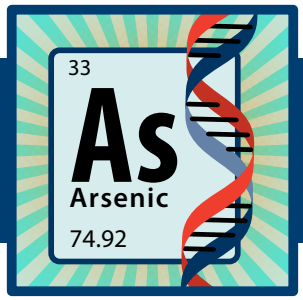

(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.

Recurring Themes and Concepts

(5) The student understands that recurring themes and concepts provide a framework for making connections across disciplines. The student is expected to:

(A) identify and apply patterns to understand and connect scientific phenomena or to design solutions;

(B) identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems;

(C) analyze how differences in scale, proportion, or quantity affect a system's structure or performance;

(D) examine and model the parts of a system and their interdependence in the function of the system;

(G) analyze and explain how factors or conditions impact stability and change in objects, organisms, and systems.

Matter and Energy

(6) The student knows that matter has measurable physical properties that determine how matter is identified, classified, changed, and used. The student is expected to:

(A) compare and contrast elements and compounds in terms of atoms and molecules, chemical symbols, and chemical formulas;

(B) use the periodic table to identify the atoms and the number of each kind within a chemical formula;

(C) distinguish between physical and chemical changes in matter;

Earth and Space Science

(11) The student understands how human activity can impact the hydrosphere. The student is expected to:

(A) analyze the beneficial and harmful influences of human activity on groundwater and surface water in a watershed;

Organisms and Environments

(13) The student knows how systems are organized and function to support the health of an organism and how traits are inherited. The student is expected to:

(A) identify and model the main functions of the systems of the human organism, including the circulatory, respiratory, skeletal, muscular, digestive, urinary, reproductive, integumentary, nervous, immune, and endocrine systems;

(B) describe the hierarchical organization of cells, tissues, organs, and organ systems within plants and animals;

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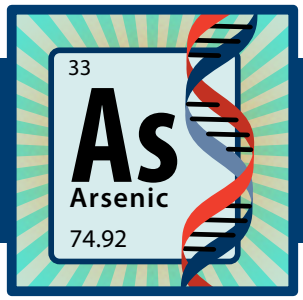

8TH GRADE:

Scientific and Engineering Practices:

(1) The student, for at least 40% of instructional time, asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to:

(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations;

(B) use scientific practices to plan and conduct descriptive, comparative, and experimental investigations and use engineering practices to design solutions to problems;

(C) use appropriate safety equipment and practices during laboratory, classroom, and field investigations as outlined in Texas Education Agency-approved safety standards;

(D) use appropriate tools such as graduated cylinders, metric rulers, periodic tables, balances, scales, thermometers, temperature probes, laboratory ware, timing devices, pH indicators, hot plates, models, microscopes, slides, life science models, petri dishes, dissecting kits, magnets, spring scales or force sensors, tools that model wave behavior, satellite images, hand lenses, and lab notebooks or journals;

(E) collect quantitative data using the International System of Units (SI) and qualitative data as evidence;

(F) construct appropriate tables, graphs, maps, and charts using repeated trials and means to organize data;

(G) develop and use models to represent phenomena, systems, processes, or solutions to engineering problems;

(2) The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to:

(A) identify advantages and limitations of models such as their size, properties, and materials;

(B) analyze data by identifying any significant descriptive statistical features, patterns, sources of error, or limitations;

(D) evaluate experimental and engineering designs.

(3) The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to:

(A) develop explanations and propose solutions supported by data and models and consistent with scientific ideas, principles, and theories;

(B) communicate explanations and solutions individually and collaboratively in a variety of settings and formats; and

(C) engage respectfully in scientific argumentation using applied scientific explanations and empirical evidence.

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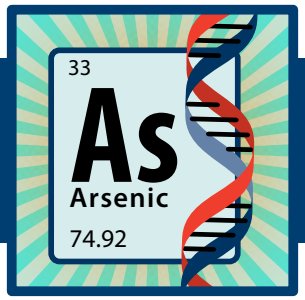

Recurring Themes and Concepts

(5) The student understands that recurring themes and concepts provide a framework for making connections across disciplines. The student is expected to:

(A) identify and apply patterns to understand and connect scientific phenomena or to design solutions;

(B) identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems;

(D) examine and model the parts of a system and their interdependence in the function of the system;

(G) analyze and explain how factors or conditions impact stability and change in objects, organisms, and systems.

Matter and Energy

(6) The student understands that matter can be classified according to its properties and matter is conserved in chemical changes that occur within closed systems. The student is expected to:

(A) explain by modeling how matter is classified as elements, compounds, homogeneous mixtures, or heterogeneous mixtures

(B) use the periodic table to identify the atoms involved in chemical reactions;

(D) compare and contrast the properties of acids and bases, including pH relative to water;

Organisms and Environments

(13) The student knows how cell functions support the health of an organism and how adaptation and variation relate to survival. The student is expected to:

(B) describe the function of genes within chromosomes in determining inherited traits of offspring; and

(C) describe how variations of traits within a population lead to structural, behavioral, and physiological adaptations that influence the likelihood of survival and reproductive success of a species over generations.

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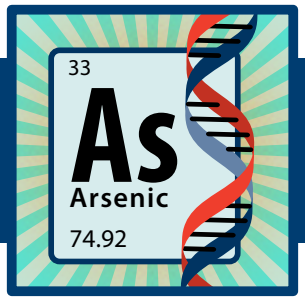

NEXT GENERATION SCIENCE STANDARDS (NGSS)

Middle School

Physical Science	
PS1-2: Matter and Its Interactions	
Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	**1. Organizing data: A)** Students organize given data about the characteristic physical and chemical properties of pure substances before and after they interact; **B)** Students organize the given data in a way that facilitates analysis and interpretation.
	2. Identifying relationships: A) Students analyze the data to identify patterns including the changes in physical and chemical properties of each substance before and after the interaction.
	3. Interpreting data: A) Students use the analyzed data to determine whether a chemical reaction has occurred; **B)** Students support their interpretation of the data by describing that the change in properties of substances is related to the rearrangement of atoms in the reactants and products in a chemical reaction
LS1 – 3: From Molecules to Organisms	
Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.	**1. Supported claims: A)** Students make a claim to be supported, related to a given explanation or model of a phenomenon. In the claim, students include the idea that the body is a system of interacting subsystems composed of groups of cells.
	2. Identifying scientific evidence: A) Students identify and describe the given evidence that supports the claim (e.g., evidence from data and scientific literature).
	3. Evaluating and critiquing the evidence: A) Students evaluate the evidence and identify the strengths and weaknesses of the evidence, including: Types of sources (June 2015 Page 1 of 2), Sufficiency (validity and reliability), and any alternative interpretations of the evidence and why the evidence supports the student's claim, as opposed to any other claims.
	4. Reasoning and synthesis: A) Students use reasoning to connect the appropriate evidence to the claim, describing the chain of reasoning in their argumentation. **B)** Students use oral or written arguments to support or refute an explanation or model

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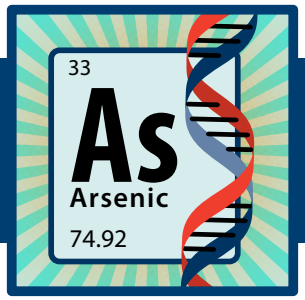

LS1 – 5: From Molecules to Organisms	
Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.	**1. Articulating the explanation of phenomena: A)** Students articulate a statement that relates the given phenomenon to a scientific idea, including the idea that both environmental and genetic factors influence the growth of organisms. **B)** Students use evidence and reasoning to construct a scientific explanation for the given phenomenon.
	2. Evidence: A) Students identify and describe evidence necessary for constructing the explanation, including: Environmental factors and that they can influence growth, Genetic factors and that they can influence growth, Changes in the growth of organisms as specific environmental and genetic factors change. **B)** Students use multiple valid and reliable sources of evidence to construct the explanation.
	3. Reasoning: A) Students use reasoning, along with 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, to connect the evidence and support an explanation for a phenomenon involving genetic and environmental influences on organism growth. Students describe* their chain of reasoning that includes: Organism growth is influenced by multiple environmental and genetic factors.
LS2-1: Ecosystems: Interactions, Energy, and Dynamics	
Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of or	**1. Organizing data: A)** Students organize the given data (e.g., using tables, graphs, and charts) to allow for analysis and interpretation of relationships between resource availability and organisms in an ecosystem, including: Populations of organisms as a function of resource availability and Growth of individual organisms as a function of resource availability.
	2. Identifying relationships: A) Students analyze the organized data to determine the relationships between the size of a population, the growth and survival of individual organisms, and resource availability. **B)** Students determine whether the relationships provide evidence of a causal link between these factors.
	3. Interpreting data: A) Students analyze and interpret the organized data to make predictions based on evidence of causal relationships between resource availability, organisms, and organism populations. Students make relevant predictions, including: Changes in the amount and availability of a given resource may result in changes in the population of an organism, Changes in the amount or availability of a resource may result in changes in the growth of individual organisms, Resource availability drives competition among organisms, both within a population as well as between populations, and Resource availability may have effects on a population's rate of reproduction.

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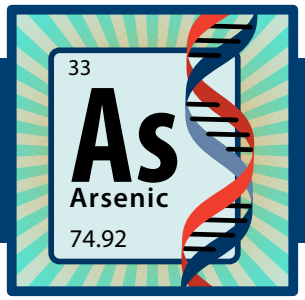

MS-LS2-2: Ecosystems: Interactions, Energy, and Dynamics	
Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.	**1. Articulating the explanation of phenomena: A)** Students articulate a statement that relates the given phenomenon to a scientific idea, including that similar patterns of interactions occur between organisms and their environment, regardless of the ecosystem or the species involved. **B)** Students use evidence and reasoning to construct an explanation for the given phenomenon. 3 Reasoning a Students identify and describe* quantitative or qualitative patterns of interactions among organisms that can be used to identify causal relationships within ecosystems, related to the given phenomenon. June 2015 Page 1 of 2 **b** Students describe* that regardless of the ecosystem or species involved, the patterns of interactions (competitive, mutually beneficial, predator/prey) are similar. **c** Students use reasoning to connect the evidence and support an explanation. In their reasoning, students use patterns in the evidence to predict common interactions among organisms in ecosystems as they relate to the phenomenon, (e.g., given specific organisms in a given environment with specified resource availability, which organisms in the system will exhibit competitive interactions). Students predict the following types of interactions: **i.** Predatory interactions. **ii.** Competitive interactions. **iii.** Mutually beneficial interactions.
	2. Evidence: A) Students identify and describe the evidence necessary for constructing the explanation, including evidence that: **1)** Competitive relationships occur when organisms within an ecosystem compete for shared resources, **2)** Predatory interactions occur between organisms within an ecosystem, **3)** Mutually beneficial interactions occur between organisms within an ecosystem. **4)** Organisms involved in these mutually beneficial interactions can become so dependent upon one another that they cannot survive alone. **5)** Resource availability, or lack thereof, can affect interactions between organisms. **6)** Competitive, predatory, and mutually beneficial interactions occur across multiple, different, ecosystems. **B)** Students use multiple valid and reliable sources for the evidence.

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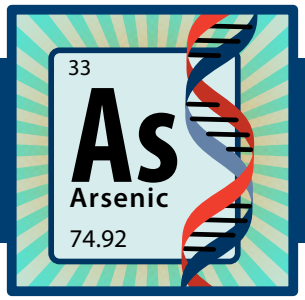

MS – LS3- 2: Heredity: Inheritance and Variation of Traits	
Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.	**1. Components of the model: A)** Students develop a model for a given phenomenon involving the differences in genetic variation that arise from sexual and asexual reproduction. In the model, students identify and describe the relevant components, including: **1)** Chromosome pairs, including genetic variants, in parents and offspring.
	2. Relationships: A) In their model, students describe the relationships between components, including: **i.** During reproduction (both sexual and asexual), parents transfer genetic information in the form of genes to their offspring. **ii.** Under normal conditions, offspring have the same number of chromosomes, and therefore genes, as their parents. **iv.** During sexual reproduction, two parents (two sets of chromosomes) contribute genetic material to the offspring. June 2015 Page 1 of 2 more genetic variation occurs in organisms that reproduce sexually compared to organisms that reproduce asexually.
	3 Connections: A) Students use the model to describe* a causal account for why sexual and asexual reproduction result in different amounts of genetic variation in offspring relative to their parents, including that: In sexual reproduction: **1.** Offspring have two sources of genetic information (i.e., two sets of chromosomes) that contribute to each final pair of chromosomes in the offspring. **2.** Because both parents are likely to contribute different genetic information, offspring chromosomes reflect a combination of genetic material from two sources and therefore contain new combinations of genes (genetic variation) that make offspring chromosomes distinct from those of either parent. **B)** Students use cause-and-effect relationships found in the model between the type of reproduction and the resulting genetic variation to predict that more genetic variation occurs in organisms that reproduce sexually compared to organisms that reproduce asexually.

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