GANADO UNIFIED SCHOOL DISTRICT
(BIOLOGY/GRADE 10TH)

PACING Guide SY 2021 - 2022

Timeline	AZ Science Standards	Crosscutting Concepts and Background Information	Learning Goals and Topics
Quarter 1	L1: Organisms are organized on a cellular basis and have finite life span **Essential HS.L1U1.20**: Ask questions, and/or make predictions based on observations and evidence to demonstrate how cellular organization, structure, and function allow organisms to maintain homeostasis. **Essential HS.L1U1.22:** Construct an explanation for how cellular division (mitosis) is a process by which organisms grow and maintain complex, interconnected systems.	**Crosscutting Concepts** Patterns; Cause & Effect; Scale, Proportion & Quantity; Systems & System Models; Energy & Matter; Structure & Function; Stability & Change **Background Information** Within cells there are many molecules of different kinds which interact in carrying out the functions of the cell. In multicellular organisms **cells communicate** with each other by passing substances to nearby cells to coordinate activity. A **membrane** around each cell plays an important part in **regulating what can enter or leave a cell**. Activity within different types of cells is regulated by enzymes. Systems of specialized cells within organisms help them perform the essential functions of life, which involve chemical reactions that take place between different types of molecules, such as **water, proteins, carbohydrates, lipids, and nucleic acids**. 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. 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**. Outside that range (e.g., at a too high or too low external temperature, with too little food or water available), the organism cannot survive. Feedback mechanisms can encourage (through **positive feedback**) or	1. Scientific Inquiry in Biology 2. The Chemistry of Life 3. Cell Structure & Function

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		discourage (**negative feedback**) what is going on inside the living system. In multicellular organisms, individual cells grow and then divide via a process called **mitosis**, thereby allowing the organism to grow. 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. Given a suitable medium, cells from a variety of organisms can be grown in situ, that is, outside the organism. These **cell cultures** are used by scientists to investigate cell functions and have medical implications such as the **production of vaccines, screening of drugs, and in vitro fertilization.** Plant tissue culture is used widely in the plant sciences, forestry, and in horticulture. Most cells are programmed for a limited number of cell divisions. Diseases, which may be caused by invading microorganisms, environmental conditions or defective cell programming, generally result in **disturbed cell function.** Organisms die if their cells are incapable of further division.	
Quarter 2	L2: Organisms require a supply of energy and materials for which they often depend on, or compete with, other organisms. L4: The unity & diversity of organisms, living and extinct, is the result of evolution.	**Crosscutting Concepts:** Patterns; Cause and Effect; Scale, Proportion and Quantity; System and System Models; Energy and Matter; Structure and Function; Stability and **Change** **Background Information** A complex set of **interaction**s within an **ecosystem** can keep its numbers and types of **organisms** relatively constant over	1. Photosynthesis 2. Cellular Respiration 3. The Biosphere 4. Ecosystems 5. Populations

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	Essential HS.L2U3.18: Obtain, evaluate, and communicate about positive & negative ethical, social, economic, & political implications of human activity on biodiversity of an ecosystem. **HS.L2U1.19**: Develop and use models to show how changes in the transfer of matter and energy within an ecosystem & interactions between species may affect organisms and their environment. **Essential HS.L2U1.21**: Obtain, evaluate, and communicate data showing the relationship of photosynthesis & cellular respiration; flow of energy and cycling of matter.	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 (i.e., 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. 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**. 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. **Biodiversity** is increased by the formation of new species (**speciation**) and decreased by the loss of species (**extinction**). Biological extinction, being irreversible, is a critical factor in reducing the planet's natural	6. Communities & Ecosystems Dynamics 7. Humans and Global Change

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		capital. Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is having positive and negative impacts on biodiversity through **overpopulation**, **overexploitation**, **habitat destruction**, **pollution, introduction of invasive species, and climate change**. These problems have the potential to cause a major wave of biological extinctions—as many species or populations of a given species, unable to survive in changed environments, die out—and the effects may be harmful to humans and other living things. 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. As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. **Matter and energy are conserved** in each change. This is true of all biological systems, from individual cells to ecosystems. Photosynthesis and cellular respiration (including anaerobic	

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		processes) provide most of the energy for life processes. 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, and there is a **limit to the number of organisms that an ecosystem can sustain**. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil and are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved; some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. **Competition** among species is ultimately competition for the matter and energy needed for life.	
Quarter 3	L3: Genetic information is passed down from one generation if organisms to another.	Crosscutting Concepts: Patterns; Cause and Effect; Scale, Proportion and Quantity; System and System Models; Energy and Matter; Structure and Function; Stability and Change	1. Cell Growth & Division 2. Introduction to Genetics 3. DNA

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	Essential HS.L3U1.24: Construct an explanation of how the process of sexual reproduction contributes to genetic variation. **Essential HS.L3U1.25**: Obtain, evaluate, and communicate information about the causes and implications of DNA mutation. **Essential HS.L3U3.26**: Engage in argument from evidence regarding the ethical, social, economic, and/or political implications of a current genetic technology.	**Background Information** In **sexual reproduction**, a specialized type of cell division called **meiosis** occurs and results in the production of sex cells, such as **gametes (sperm and eggs)** or **spores**, which contain only one member from each **chromosome pair** in the parent cell. The information passed from parents to offspring is coded in the **DNA** molecules that form the **chromosomes**. In sexual reproduction, 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. 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 depend on both **genetic and environmental factors.** The overall sequence of genes of an organism is known as its **genome**. More is being learned all the time about genetic	4. RNA & Protein Synthesis

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		information by **mapping the genomes** of different kinds of organisms. When sequences of genes are known genetic material can be **artificially changed** to give organisms certain features. In **gene therapy** special techniques are used to deliver into human cells genes that are beginning to help in curing disease.	
Quarter 4	L4: The unity and diversity of organisms, living and extinct, is the result of evolution. **Essential HS.L4U1.27**: Obtain, evaluate, and communicate evidence that describes how changes in frequency of inherited traits in a population can lead to biological diversity. **Essential HS.L4U1-28**: Gather, evaluate, and communicate multiple lines of empirical evidence to explain the mechanisms of biological evolution.	**Crosscutting Concepts:** Patterns; Cause and Effect; Scale, Proportion and Quantity; System and System Models; Energy and Matter; Structure and Function; Stability and Change **Background Information** **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. The traits that positively affect survival are more likely to be **reproduced** and thus are more common in the population. Natural selection is the result of four factors: (1) the potential for a species to increase in number, (2) the **genetic variation**	1. Darwin's Theory of Evolution 2. Evolution of Population 3. Biodiversity and Classification 4. History of Life

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		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 in order to **survive** and **reproduce**, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. **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 **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 have the trait and to a decrease in the proportion of individuals that do not. Adaptation also means that the distribution of traits in a population can **change** when conditions change. 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 the **extinction**—of some species. Species become extinct because they can no longer survive and reproduce in their **altered environment**. If	

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		members cannot adjust to change that is too fast or too drastic, the opportunity for the species' **evolution** is lost.	