**Evolution**

**Essential Standard:**

**Bio.3.4 Explain the theory of evolution by natural selection as a mechanism for how species change over time**

**Clarifying Objectives: Unpacking – What does this standard mean a child will know, understand, and be able to do?**

* **Bio.3.4.1 Explain how fossil, biochemical, and anatomical evidence support the theory of evolution.**
* **Bio.3.4.2 Explain how natural selection influences the changes in species over time.**
* **Bio.3.4.3 Explain how various disease agents (bacteria, viruses, chemicals) can influence natural selection.**

**Bio.3.4.1**

**• Summarize the hypothesized early atmosphere and experiments that suggest how the first “cells” may have evolved and how early conditions affected the type of organism that developed (first anaerobic and prokaryotic, then photosynthetic, then eukaryotic, then multicellular).**

**• Summarize how fossil evidence informs our understanding of the evolution of species and what can be inferred from this evidence.**

**• Generalize what biochemical (molecular) similarities tell us about evolution.**

**• Generalize what shared anatomical structures (homologies) tell us about evolution.**

**Bio.3.4.2**

**• Develop a cause and effect model for the process of natural selection:**

**▪ Species have the potential to increase in numbers exponentially.**

**▪ Populations are genetically variable due to mutations and genetic recombination.**

**▪ There is a finite supply of resources required for life.**

**▪ Changing environments select for specific genetic phenotypes.**

**▪ Those organisms with favorable adaptations survive, reproduce and pass on their alleles.**

**▪ The accumulation and change in favored alleles will lead to changes in species over time.**

**• Illustrate the role of geographic isolation in speciation.**

**Bio.3.4.3**

**• Develop a cause and effect model for the role of disease agents in natural selection including evolutionary selection of resistance to antibiotics and pesticides in various species, passive/active immunity, antivirals and vaccines.**

**Key Vocabulary:**

**3rd Tier Words: Abiogenesis, spontaneous generation, primordial soup, heterotroph hypothesis, endosymbiont hypothesis, biogenesis, natural selection, variation, overproduction, competition, survival of the fittest (best adapted), adaptation, gene pool, mutations, selection forces, stabilizing/directional/disruptive selection, speciation, geographic isolation, reproductive isolation, gradualism, punctuated equilibrium, fossil, relative dating, radioactive dating, biochemical evidence, homologous structures, vestigial structures, resistance, passive/active immunity, vaccine, genetic drift, selective advantage, favorable trait, fitness, evolve, use or disuse, acquired traits, variation, allele frequency, genetic equilibrium, founder effect, bottleneck effect, convergent evolution, divergent evolution (adaptive radiation), comparative anatomy, analogous structures, common ancestor, native, embryology, geographic distribution**

**2nd Tier Words: originate, condense, diverse, plentiful, diversity, influence, predict, abundance, change, significant, offspring, survive, range, finch, favorable, accumulate, component, simulate, acquire, finite, apparatus, archaic, modification, decent, rudimentary, resistance, susceptible, viable, migrate, barrier, sterile, abrupt, stable, rapid**

**Common Misconceptions:**

* **Species that have no apparent, obvious, or superficial similarities have no similarities at all.**
* **Individual organisms can deliberately develop new heritable traits because they need them for survival.**
* **Changes to the environment cannot lead to changes in the traits of species living in that environment.**
* **Humans do not share a common ancestor with other living organisms.**
* **Members of different species do not share a common ancestor.**

**Essential Questions:**

**3.4.1**

**How did the first cells come to be?**

**How do we know that evolution (change in organisms) has occurred?**

* **I will describe the formation of the first cells according to the heterotroph hypothesis**
* **I will analyze experimental evidence that proves spontaneous generation could have occurred under early atmospheric conditions**
* **I will explain the formation of eukaryotic cells according to the endosymbiont hypothesis**
* **I will analyze the experiments of Redi and Pasteur that disprove spontaneous generation under current conditions**
* **I will explain examples of fossil evidence as it pertains to evidence for evolution (gradualism or punctuated equilibrium)**
* **I will analyze amino acid sequences of various organisms to identify evolutionary relationships (common ancestry)**
* **I will analyze homologous and vestigial structures to identify evolutionary relationships (common ancestry)**

**3.4.2**

**How did all life on Earth come from a few cells?**

**Why do organisms change over time?**

* **I will explain the process of natural selection including variation, overproduction, competition, and survival of the best adapted**
* **I will apply Darwin’s process of natural selection to the evolution of a favorable trait in a specific organism**
* **I will explain that mutation and sexual reproduction provide the variation necessary for the process of natural selection**
* **I will provide examples of structural, behavioral, and physiological adaptations that evolved due to natural selection**
* **I will explain that organisms with favorable adaptations survive, reproduce, and pass those adaptations to their offspring**
* **I will model the process of natural selection in a population of organisms (online or lab simulation)**
* **I will explain that evolution occurs when the gene pool of a population changes – not at the individual level**
* **I will describe examples of stabilizing, directional, and disruptive selection as a result of environmental conditions**
* **I will explain that geographic isolation may lead to reproductive isolation which may result in speciation**

**3.4.3**

**Does evolution still happen today?**

* **I will describe the evolution of pesticide resistant insects and antibiotic resistant bacteria using Darwin’s theory of natural selection**
* **I will explain the selective advantage of viruses that are able to mutate quickly, making them more difficult to treat/prevent using antivirals or vaccines**
* **I will provide examples of passive vs. active immunity to viral infections**