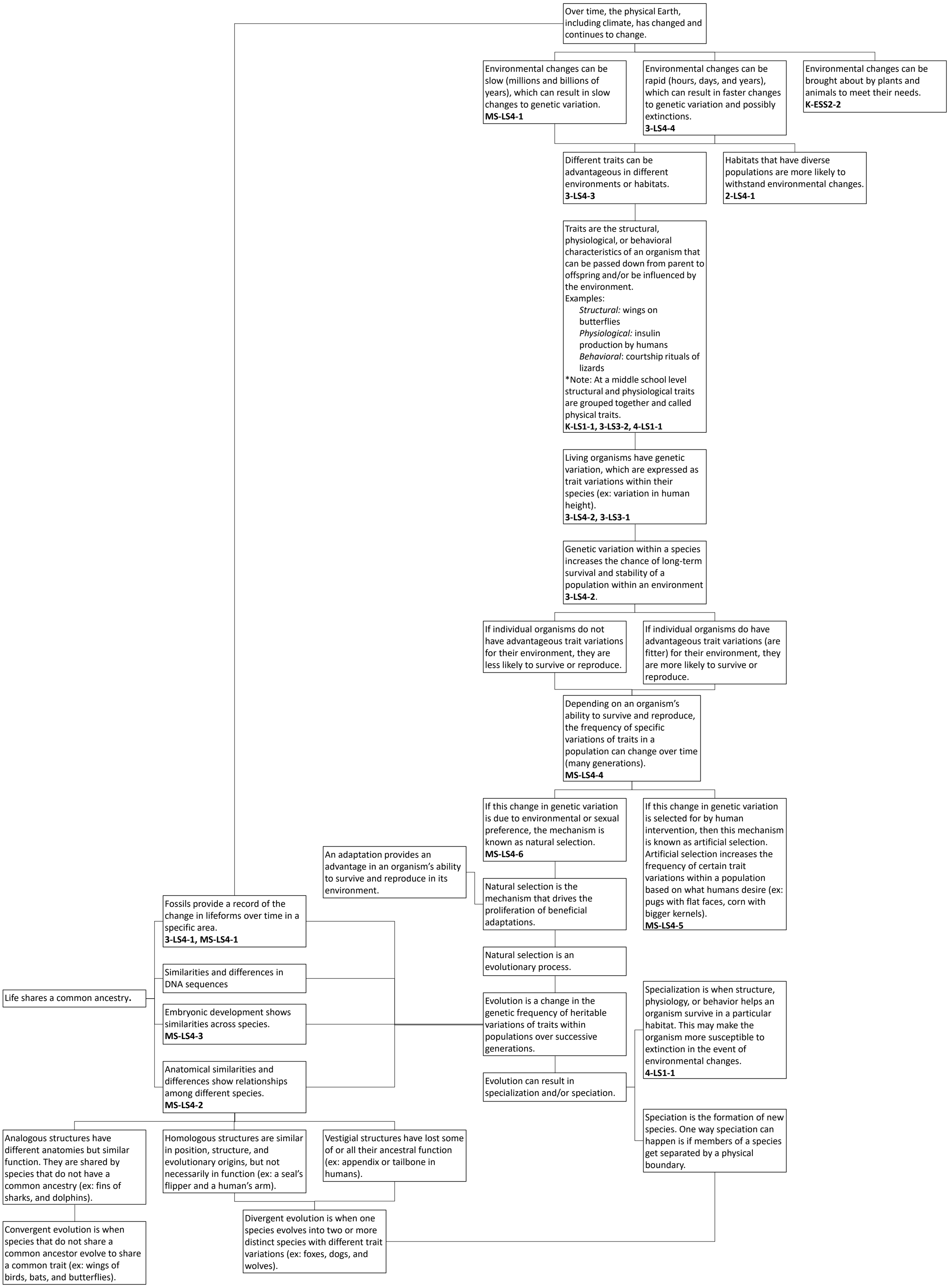
Evolution


Over time, the physical Earth, including climate, has changed and continues to change.
Environmental changes can be slow (millions and billions of years), which can result in slow changes to genetic variation. **MS-LS4-1**
Environmental changes can be rapid (hours, days, and years), which can result in faster changes to genetic variation and possibly extinctions. **3-LS4-4**
Environmental changes can be brought about by plants and animals to meet their needs. **K-ESS2-2**
Different traits can be advantageous in different environments or habitats. **3-LS4-3**
Habitats that have diverse populations are more likely to withstand environmental changes. **2-LS4-1**
Traits are the structural, physiological, or behavioral characteristics of an organism that can be passed down from parent to offspring and/or be influenced by the environment.
Examples:
Structural: wings on butterflies
Physiological: insulin production by humans
Behavioral: courtship rituals of lizards
*Note: At a middle school level structural and physiological traits are grouped together and called physical traits.
K-LS1-1, 3-LS3-2, 4-LS1-1
Living organisms have genetic variation, which are expressed as trait variations within their species (ex: variation in human height). **3-LS4-2, 3-LS3-1**
Genetic variation within a species increases the chance of long-term survival and stability of a population within an environment **3-LS4-2**.
If individual organisms do not have advantageous trait variations for their environment, they are less likely to survive or reproduce.
If individual organisms do have advantageous trait variations (are fitter) for their environment, they are more likely to survive or reproduce.
Depending on an organism's ability to survive and reproduce, the frequency of specific variations of traits in a population can change over time (many generations). **MS-LS4-4**
If this change in genetic variation is due to environmental or sexual preference, the mechanism is known as natural selection. **MS-LS4-6**
If this change in genetic variation is selected for by human intervention, then this mechanism is known as artificial selection. Artificial selection increases the frequency of certain trait variations within a population based on what humans desire (ex: pugs with flat faces, corn with bigger kernels). **MS-LS4-5**
An adaptation provides an advantage in an organism's ability to survive and reproduce in its environment.
Natural selection is the mechanism that drives the proliferation of beneficial adaptations.
Natural selection is an evolutionary process.
Evolution is a change in the genetic frequency of heritable variations of traits within populations over successive generations.
Evolution can result in specialization and/or speciation.
Specialization is when structure, physiology, or behavior helps an organism survive in a particular habitat. This may make the organism more susceptible to extinction in the event of environmental changes. **4-LS1-1**
Speciation is the formation of new species. One way speciation can happen is if members of a species get separated by a physical boundary.
Fossils provide a record of the change in lifeforms over time in a specific area. **3-LS4-1, MS-LS4-1**
Similarities and differences in DNA sequences
Life shares a common ancestry.
Embryonic development shows similarities across species. **MS-LS4-3**
Anatomical similarities and differences show relationships among different species. **MS-LS4-2**
Analogous structures have different anatomies but similar function. They are shared by species that do not have a common ancestry (ex: fins of sharks, and dolphins).
Homologous structures are similar in position, structure, and evolutionary origins, but not necessarily in function (ex: a seal's flipper and a human's arm).
Vestigial structures have lost some of or all their ancestral function (ex: appendix or tailbone in humans).
Convergent evolution is when species that do not share a common ancestor evolve to share a common trait (ex: wings of birds, bats, and butterflies).
Divergent evolution is when one species evolves into two or more distinct species with different trait variations (ex: foxes, dogs, and wolves).