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| **4.LCT Life Cycles and Traits** |
| Students who demonstrate understanding can:  **a. Investigate the life cycles of plants and animals to compare similarities and differences among organisms.** [Clarification Statement: Examples of organisms to compare could be flowering plants, butterflies, and frogs.] [Assessment Boundary: Reproduction is addressed as part of the process – birth, growth, development, reproduction, death – and the different ways organisms go through the process.]  **b. Use evidence to compare characteristics inherited from parents, characteristics caused by the environment, and those resulting from both.** [Clarification Statement: Examples of characteristics inherited from parents could be the ability to roll one’s tongue or characteristics of domestic animals; characteristics caused by the environment could be a scar or language; and characteristics resulting from both could be height or some health conditions.] [Assessment Boundary: The mechanisms of inheritance are not to be included.]  **c. Provide evidence that offspring can inherit different information from their parents.** [Clarification Statement: Examples of different information that can be inherited could be different coat colors in dogs of the same litter or one sibling who needs glasses and another who does not.] [Assessment Boundary: The genetic mechanisms of inheritance are not to be included.]  **d. Obtain and communicate information about different versions of the same traits in different kinds of organisms.** [Clarification Statement: Examples of different kinds of animals having different versions of the same trait could include the different lengths, textures, and colors of feathers, hair, or fur of different animals.] [Assessment Boundary: The genetic mechanisms of inheritance are not to be included.]  **e. Use evidence to describe patterns of variation in a trait across individuals of the same kind of organism.** [Clarification Statement: Examples of variation in a trait across individuals of the same kind of organism could be different coloration of wolves or thickness of wool in sheep.] [Assessment Boundary: The genetic mechanisms of inheritance are not to be included.]  **f. Use evidence to explain how some characteristics that vary among individuals of the same kind of organism can provide advantages to survive, find mates, and reproduce.** [Clarification Statement: Examples of advantages could include animals that run faster are better escape predators or birds with brighter colored feathers are more likely to attract mates.]  **g. Obtain information to explain how breeders use variations in traits to produce desired types of domesticated organisms.** [Clarification Statement: Examples could be sheep that are bred for thicker wool coats or disease resistant corn that is used in cultivation.]  **h. Obtain and communicate information that some characteristics of organisms have been used to inspire technology that meets societal needs.** [Clarification Statement: Students could identify technologies that utilize advantageous characteristics of organisms such as: sonar, insulated vests, camouflage fatigues, Velcro.] [Assessment Boundary: Mechanisms of production not included at this grade band. Focus is on utility only.] |

**NEXT GENERATION SCIENCE STANDARDS - HEREDITY**

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| **MS.LS-GDRO Growth, Development, and Reproduction of Organisms** |
| Students who demonstrate understanding can:  **a. Use evidence to support an explanation of how environmental and genetic factors affect the growth of organisms.** [Clarification Statement: The emphasis is on the impact of factors in terms of cause and effect, not the mechanism (e.g., abundant food leads to more significant growth, offspring of large breeds of dogs are larger than the offspring of small dogs).]  **b. Investigate and present evidence that plants continue to grow throughout their life through the production of new plant matter via photosynthesis.** [Assessment Boundary: Reproduction is not treated in any detail here, for more specifics of grade level see DCI LS3.A.]  **c. Use models to construct an explanation of how the genetic contribution from each parent through sexual reproduction results in variation in offspring and how asexual reproduction results in offspring with identical genetic information.** [Assessment Boundary: The emphasis is on the impact of gene transmission in reproduction, not the mechanism of the gene interactions.]  **d. Plan and conduct investigations to gather evidence for the relationship among specialized plant structures, specific animal behaviors, and the successful reproduction of the plant.** [Clarification Statement: Examples of evidence of successful reproduction of plants could include placement of stamen and bees gathering nectar, hard shells on pine nuts and squirrels burying nuts.]  **e. Use empirical evidence to support an argument for how characteristic animal behaviors affect the probability of successful reproduction.** [Clarification Statement: Examples of animal behaviors could include birds building nests to protect young, brown trout spawning in late fall when predators are less active.]  **f. Provide explanations of how changes (mutations) to genes, which are located on chromosomes, affect specific inherited traits resulting in harmful, beneficial, or neutral effects.**  **g. Provide an explanation for the relationship among changes (mutations) to genes, changes to the formation of proteins, and the effect on the structure and function of the organism and thereby traits.**  **h. Communicate explanations of ways technologies enable humans to influence the inheritance of certain traits in plants and animals.** [Clarification Statement: Examples of human influence could be breeds of cattle for various purposes, disease resistant crops, genetically modified organisms.] |

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| **HS.LS-IVT Inheritance and Variation of Traits** |
| Students who demonstrate understanding can:  **a. Ask questions and obtain information about the role of patterns of gene sequences in DNA molecules and subsequent inheritance of traits.**  **b. Use a model to explain how mitotic cell division results in daughter cells with identical patterns of genetic materials essential for growth and repair of multicellular organisms.** [Assessment Boundary: The focus is on conceptual understanding of the process; the details of the individual steps are beyond the intent.]  **c. Construct an explanation for how cell differentiation is the result of activation or inactivation of specific genes as well as small differences in the immediate environment of the cells.** [Assessment Boundary: Limited to the concept that a single cell develops into a variety of differentiated cells and thus, a complex organism.]  **d. Use a model to describe the role of cellular division and differentiation to produce and maintain complex organisms composed of organ systems and tissue subsystems that work together to meet the needs of the entire organism.** [Clarification Statement: The focus is on the conceptual understanding that a single cell can give rise to complex, multicellular organisms consisting of many different cells with identical genetic material.] [Assessment Boundary: Limited to the concept that a single cell develops into a variety of differentiated cells and thus, a complex organism.]  **e. Communicate information about the role of the structure of DNA and the mechanisms in meiosis for transmitting genetic information from parents to offspring.** [Assessment Boundary: The focus is on conceptual understanding of the process; details of the individual steps of the process of meiosis are beyond the intent.]  **f. Communicate information that inheritable genetic variations may result from: (1) genetic combinations in haploid sex cells, (2) errors occurring during replication, (3) crossover between homologous chromosomes during meiosis, and (4) environmental factors.** [Clarification Statement: Information on genetic variation should include evidence of understanding the probability of variations and the rarity of mutations.] [Assessment Boundary: The focus is on conceptual understanding of the sources of genetic variation that are heritable.]  **g. Use probability to explain the variation and distribution of expressed traits in a population.** [Assessment Boundary: Hardy-Weinberg calculations are beyond the intent of this standard.] |