Next Generation Science Standards Alignment for the Biomimicry Youth Design Challenge | Middle School

The foundational biomimicry, climate change, and the design challenge alignments are shown in the table below. Alignment strength will depend on lesson choice, depth of instruction, and problem choice. Additional specific physical, earth, and life science standards can be targeted by choosing a particular type of problem for the design challenge.

Biomimicry

NGSS Disciplinary Core Idea	Science & Engineering Practices	Crosscutting Concepts
MS-LS1.A: Structure and Function • Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. • In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. **MS-LS4.C: Adaptation** • Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes.	Developing and Using Models Engaging in Argument from Evidence Constructing Explanations and Designing Solutions	Structure & Function Systems & System Models Patterns

Solving a problem that affects climate change

The Biomimicry Youth Design Challenge asks students to develop innovations that address climate change. Additional standards can be demonstrated by having students focus on a particular type of climate-related problem (e.g,. water, energy) or create a solution with particular features.

NGSS Disciplinary Core Idea	Science & Engineering Practices	Crosscutting Concepts
MS-ESS3.C: Human Impacts on Earth Systems • Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. • Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. **MS-ESS3.D: Global Climate Change** • Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.	Constructing Explanations and Designing Solutions Engaging in Argument from Evidence Asking Questions and Defining Problems	Cause and Effect Stability & Change

Additional physical, earth, and life science alignments can be made by selecting a specific NGSS-aligned UN Sustainable Development Goal as the focus of the problem investigation and students solution. Student design teams would then identify a problem that addresses this SDG and demonstrate their understanding of the relevant concepts and practices when they design a biomimicry solution. Refer to the YDC resource: *UN Sustainable Development Goals Aligned to NGSS.*

Engineering Design Process

NGSS Disciplinary Core Idea	Performance Expectations	Science & Engineering Practices	Crosscutting Concepts
MS-ETS1.A: Defining and Delimiting Engineering Problems • The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1) **MS-ETS1.B: Developing Possible Solutions** • A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4) • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3) • Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3) • Models of all kinds are important for testing solutions. (MS-ETS1-4) **MS-ETS1.C: Optimizing the Design Solution** • Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3) • The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)	**MS-ETS1-1.** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. **MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. **MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. **MS-ETS1-4.** Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.	Asking Questions and Defining Problems Developing and Using Models Analyzing and Interpreting Data Constructing Explanations and Designing Solutions Engaging in Argument from Evidence Obtaining, Evaluating and Communicating Information	Influence of Engineering, Technology, and Science on Society and the Natural World Systems and System Modeling Structure & Function