Cody Outdoor Classroom

Where Learning Comes Naturally

Overviews of Engineering Lessons

Below are overviews of Cody Outdoor Classroom's engineering lessons. Please note each lesson specifies the grades it is designed for. Some lessons can be tailored to include additional grades; please contact us for more information regarding this.

NGSS, MA, and NH science standards for the lessons are listed in an Appendix below the overviews.

So Many Choices!
Comparing Design Solutions
Grades: 2nd, 3rd
Why do we have crayons, colored pencils, and markers? Plastic, paper, and reusable bags? Couldn't one do the trick? Students answer these questions by testing multiple solutions to the same design problem, such as various coloring tools, and comparing their strengths and weaknesses. While using their own creative ideas, they explore how creativity drives innovation, both in the diversity of design solutions and the audiences they appeal to.

Creation Station
Engineering Design Process
Grades: 4th, 5th
Students learn how engineers use the engineering design process to solve problems. Students work collaboratively using the design steps to create a solution that meets the given criteria and constraints of a stated problem. Students will practice good design testing techniques, such as controls and multiple tests, to generate results that will help them improve their model / prototype. We work with teachers to customize the design problem presented for this lesson (e.g. to enhance a recent science concept or to get students outdoors). The design problem may include: rollercoasters, mini-structures, catapults, water systems, or boats. All are hands-on, collaborative, and designed to enhance critical thinking skills.

Wreck Center
Impacts of Human Population and Environmental Factors on Design Solutions
Grades: 6th, 7th
A town has recently received a grant to build a recreation / community center. Students work collaboratively to create an initial design, considering constraints such as time, cost, physical space, and aesthetics. As further tests are conducted on the property, they receive "speed bumps": zoning / permitting issues, endangered species on the land, or an unforeseen change in population. The teams must modify their solutions to account

for the “speed bumps”. They will learn how engineers regularly face these challenges in the design process and must strategize ways to balance environmental and human factors, while creating a solution that still fulfills the established criteria.

Keep the Chill Out
Testing and Modifying Competing Design Solutions
Grades: 7th and 8th
In the winter, we New Englanders rely on insulating materials to help retain body heat (specifically on our head, hands, and feet). In this experiment, students systematically test, using temperature probes, the insulating properties of various materials used to make mittens and socks. They analyze this data, along with data for material cost, to create an innovative prototype to keep our extremities warm. Although scientific analysis is essential to generating effective design solutions, creativity also influences designs. While using their own creativity, they will explore how it drives innovation, both in the diversity of design solutions and the audiences they appeal to.

See next page for Appendix: Science Standards.

Appendix: Science Standards

So Many Choices!
Comparing Design Solutions

NGSS: K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people might want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
NGSS: K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same design problem to compare the strength and weaknesses of how each object performs.
NGSS: 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

MA: 2.K-2-ETS1-3. Analyze data from tests of two objects designed to solve the same design problem to compare the strength and weaknesses of how each object performs.
MA: 3.3-5-ETS1-2. Generate several possible solutions to a given design problem. Compare each solution based on how well each is likely to meet the criteria and constraints of the design problem.

NH: S:SPS1:2:1.4 Ask questions that lead to exploration and investigation as a result of working with materials and objects.
NH: S:SPS1:4:3.2 Plan and test ideas through guided experiments.
NH: S:SPS1:4:4.3 Identify and suggest possible explanations for patterns.
NH: S:SPS1:4:5.3 Draw a conclusion to answer an initial question, based on the evidence collected.
NH: S:SPS2:4:1.3 Know when comparisons might not be fair because some conditions are not kept the same.

Creation Station
Engineering Design Process

NGSS: 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
NGSS: 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
NGSS: 3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

MA: 4.3-5-EST1-3. Plan and carry out tests of one or more design features (size, shape, material, weight) of a given model or prototype in which variables are controlled and failure points are considered to identify which features need to be improved. Apply the results of tests to redesign a model or prototype.
MA: 4.3-5-ETS1-5(MA). Evaluate relevant design features that must be considered in building a model or prototype of a solution to a given design problem.

NH: S:SPS1:4:2.1 Plan a step-by-step process to solve a practical problem or to carry out a “fair test” of a simple scientific question.
NH: S:SPS2:4:1.3 Know when comparisons might not be fair because some conditions are not kept the same.

NH: S:SPS2:4:2.1 Demonstrate that if something consists of many parts, the parts usually influence one another.
NH: S:SPS2:4:2.2 Provide examples that demonstrate that something may not work well (or at all) if a part of it is missing, broken, worn out, mismatched, or misconnected.
NH: S:SPS4:4:4.1 Ask questions and plan investigations to find answers.
NH: S:SPS4:4:6.2 Engage in group decision making activities.
NH: S:SPS1:6:2.3 Incorporate components of good experimental design, such as controls and multiple trials, into investigations.
NH: S:SPS1:6:3.1 Carry out simple student or teacher-developed procedures or experiments.
NH: S:SPS2:6:1.3 Explain that sometimes similar investigations get different results because of unexpected differences in the things being investigated, the methods used, or the circumstances in which the investigation is carried out, and sometimes just because of uncertainties of observations.
NH: S:SPS2:6:2.3 Estimate or predict the effect that making a change in one part of the system will have on other parts, and on the system as a whole.
NH: S:SPS3:6:1.2 Work collectively within a group toward a common goal.
NH: S:SPS3:6:3.2 Identify and describe the procedure for designing a product, including identifying a need, researching, brainstorming, selecting, developing a prototype, testing and evaluating.

Wreck Center
Impact of Human Population and Environmental Factors on Design Solutions

NGSS: MS-EST1-1. Define the criteria and constraints of a 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.

MA: 6.MS-EST1-1. Define the criteria and constraints of a problem with sufficient precision to ensure a successful solution. Include potential impacts on people and the natural environment that may limit possible solutions.
MA: 6.MS-ETS1-6(MA). Communicate a design solution to an intended user, including design features and limitations of the solution.
MA: 7.MS-EST1-7(MA). Construct a prototype of a solution to a given design problem.

NH: S:SPS2:6:2.1 Recognize that thinking about things as systems means looking for how every part relates to others.
NH: S:SPS2:6:2.3 Estimate or predict the effect that making a change in one part of the system will have on other parts, and on the system as a whole.
NH: S:SPS3:6:1.2 Work collectively within a group toward a common goal.
NH: S:SPS3:6:2.3 Explore evidence that human-caused changes have consequences for the immediate environment as well as for other places and future times.
NH: S:SPS3:6:3.2 Identify and describe the procedure for designing a product, including identifying a need, researching, brainstorming, selecting, developing a prototype, testing and evaluating.
NH: S:SPS2:8:1.5 Recognize that some matters cannot be examined usefully in a scientific way, such as those matters that by their nature cannot be tested objectively and those that are essentially matters of morality.

NH: S:SPS3:8:2.4 Synthesize observations and findings into coherent explanations about natural resources and the environment.
NH: S:SPS3:8:3.1 Design a product or solution to a problem.
NH: S:SPS4:8:9.2 Participate in simulation or role-playing activities in which students grapple with the ethics of complex issues.

Keep the Chill Out
Testing and Modifying Competing Design Solutions

NGSS: MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

NGSS: 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.

MA: 7.MS-ETS1-2. Evaluate competing solutions to a given design problem using a decision matrix to determine how well each meets the criteria and constraints of the problem. Use a model of each solution to evaluate how variations in one or more design features, including size, shape, weight, or cost may affect the function or effectiveness of the solution.
MA: 7.MS-ETS107(MA). Construct a prototype of a solution to a given design problem.

NH: S:SPS1:8:1.1 Use appropriate tools to accurately collect and record both qualitative and quantitative data gathered through observations (e.g., temperature probes, electronic balances, spring scales, microscopes, stop watches).
NH: S:SPS1:8:2.3 Identify flaws or omissions in the design of simple experiments.
NH: S:SPS2:8:1.2 Realize that when similar investigations give different results, the scientific challenge is to judge whether the differences are trivial or significant, and this often requires more investigations.
NH: S:SPS2:8:2.5 Describe how objects and substances can store energy (e.g., a battery, food, gasoline).
NH: S:SPS3:8:3.1 Design a product or solution to a problem.
NH: S:SPS3:8:3.3 Evaluate student-designed products according to established criteria and recommend improvements or modifications.
NH: S:SPS4:8:6.1 Work in diverse pairs/teams to answer questions, solve problems and make decisions.