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.

Bridge the Gap
Exploring Engineering
Grades: K, 1st
How do engineers generate a successful design? They brainstorm and share ideas with other engineers and research the problem. Students have hands-on exploration time to explore how arch bridges and beam bridges are used to span a gap. They apply this learning to their pre-existing schema of bridges to solve an instructor-presented problem. Students evaluate the success of their design, and share which constraints had the greatest influence on their solution. Students will gain an understanding of the collaborative design process and skills engineers utilize to create successful solutions.

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.

Material Mix-Up
Examining Constraints and Comparing Solutions
Grades: 4th, 5th
Students learn how engineers use the engineering design process to solve problems. Students will design multiple solutions to the same problem and generate and evaluate data to compare the solutions. They will understand challenges engineers face, such as working with unfamiliar materials and meeting budget constraints. While using their own creative ideas, they will also explore how creativity drives innovation, both in the diversity of design solutions and the audiences they appeal to.

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Creation Station
Engineering Design Process
Grades: 4th, 5th, 6th, 7th, 8th
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, 8th
A town has recently received a grant to modernize its outdated recreation / community center. Student groups are each assigned a particular aspect to update, such as the buildings, activities, transportation / parking, and energy sources. Each group will evaluate three proposed design solutions for one aspect of the center and choose the one that best meets the needs of the people and minimizes the community center's environmental impact. Each group will explain and defend the solution they chose and the whole class will evaluate how effectively the final product met the design criteria. 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.

See next page for Appendix: Science Standards.

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Appendix: Science Standards

Bridge the Gap
Exploring Engineering

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: 1.K-2-ETS1-1. Ask questions, make observations, and gather information about a situation people want to change that can be solved by developing or improving an object or tool.
MA: 1.K-2-ETS1-2. Generate multiple solutions to a design problem and make a drawing (plan) to represent one or more of the solutions.

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.

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.

Material Mix-Up
Examining Constraints and Comparing Solutions

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.

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.
NGSS: 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.

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.
MA: 6.MS-ETS1-6. Communicate a design solution to an intended user, including design feature and limitations of the solution.

MA: 7.MS-ETS1-4. Generate and analyze data from iterative testing and modification of a proposed object, tool, or process to optimize the object, tool, or process for its intended purpose.
MA: 7.MS-ETS1-7. Construct a 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.
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NH: S:SPS1:6:3.1 Carry out simple student or teacher-developed procedures or experiments.
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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.