



Intro to Engineering 3-4 Syllabus

Course Goals

1 Learn Physical Principles

Students develop an understanding of geometry, forces, center of gravity, and the laws of physics.

2 Physical Properties and Relationships

Students learn the basic laws of physics and their applications, with a focus on the relationships between energy, force, motion, and physical objects. They conduct hands-on activities and experiments to broaden their understanding of these concepts, and their practical application.

3 Simple Machine Mechanisms

Students learn about six simple machines, and the ways a mechanism can be used effectively. They construct various forms of levers, wheel and axles, pulleys, ramps, wedges, and screws.

Course Topics

1 Force Diagrams

Students generate diagrams of their structures and balance weight, support, and load forces.

2 Center of Gravity

Students learn about centers of gravity in structures, and how to use it to their advantage when creating their own structures.

3 Building Competitions

Students use construction sets, competing with one another to create the tallest towers, strongest bridges, longest cantilevers, and more.

4 Engineering Design Process

Students learn how the engineering design process helps to clearly define a problem and systematically create or develop a solution.

5 Lever Mechanism

Students learn how a lever amplifies an input force to provide a greater output force, which is said to provide leverage.

6 Wheel and Axle Mechanism

Students learn how, as the wheel and axle rotate together, force can be transferred from one to the other.

7 Pulley Mechanism

Students learn the variety of ways that a pulley can lift loads, apply forces, and transmit power.

8 Ramp Mechanism

Students learn how ramps are used to move heavy loads over vertical obstacles.

9 Wedge Mechanism

Students learn how a wedge converts a force applied to its blunt end into forces perpendicular to its inclined surface.

10 Screw Mechanism

Students learn how a screw can amplify force or transfer a rotational force into an axial force.

Course Schedule

Day 1

Icebreakers and Introduction

Students get to know each other and their instructor, and they briefly review classroom rules.

Engineering Design Process

Students learn the engineering design process and use it to plan the construction of a paper tower. They will attempt to create the tallest tower possible using the engineering design process to refine their brainstorming and prototypes.

K'Nex Tower

Students build the tallest tower possible using K'Nex sets.

Day 2

Forces

Students study forces due to weight, supports, and loads, along with how they affect structures.

Center of Gravity

Students learn about the center of gravity and how it applies to structure stability.

K'Nex Tower Day 2

Students build the tallest tower possible using K'Nex sets.

Day 3

Types of Bridges

Students investigate and replicate different types of bridges.

Bridge Building Competition

Students use their knowledge of the different types of bridges to compete with one another to create the strongest bridge.

Day 4

Cantilever Construction

Students compete to build the longest cantilever structure.

City Planning

Students work together to plan out an entire cityscape: downtown, suburbs, highways, railroads and power stations.

Simple Machines Review

Students review the mechanisms they have learned and identify as many real world examples as possible of each. They examine how important the simple machines are in our day to day life and explore how things would be without them.

Wedge Plates

Students examine how a wedge can transfer force over a smaller area to efficiently cut through styrofoam plates.

Day 5

K'Nex Lever Challenge

Students learn about the lever mechanism by creating one out of K'Nex and, with a simple fulcrum, lift the heaviest number of books possible.

Lever Catapult

Students further their understanding of the lever by creating simple catapults and competing to see which catapults throw ping pong balls the farthest.

Day 6

Wheel and Axle Band Stretch

Students examine the amount of energy required to pull heavy loads by constructing a K'Nex car to carry heavy books.

Introduction to the Rube Goldberg Machine

Students watch videos of Rube Goldberg Machines in order to get inspired, and then they brainstorm ideas for their Rube Goldberg Machines that will be built at the end of the second week.

Wheel and Axle String Top

Students create simple wheel and axle tops to demonstrate how the mechanism is able to transfer energy. They compete to see which tops can spin the longest.

Day 7

Ramp and Weights Band Stretch

Students learn how a ramp can simplify the force required to move an object up a vertical plane.

Ramp and Car

Students learn about energy transfer down a ramp by trying to make their K'Nex vehicles roll as far as possible using different ramp angles.

Pulley Rubber Band Stretch

Students create a series of pulleys to demonstrate how the pulley mechanism can simplify work required to move an object.

Pulley Pictionary

Students construct a simple pulley mechanism to deliver messages between partners and their teacher in a game of silent pictionary.

Day 8

Archimedes Screw

Students construct an Archimedes Screw to transfer water from a lower point to a higher point using the screw mechanism. They compete to see which groups can transfer liquid the fastest.

Rube Goldberg Machine

Students combine several mechanisms together to form a chain reaction that completes a simple task. These deliberately over-engineered machines are called Rube Goldberg Machines; the more complicated, the better!

Day 9

Rube Goldberg Machine

Students combine several mechanisms together to form a chain reaction that completes a simple task. These deliberately over-engineered machines are called Rube Goldberg Machines; the more complicated, the better.

Day 10

Rube Goldberg Machine

Students combine several mechanisms together to form a chain reaction that completes a simple task. These deliberately over-engineered machines are called Rube Goldberg Machines; the more complicated, the better!

Kit Cleanup

Students recount their kits to prepare them for the next session.

Final Day Activities

Students finish up the course by watching a documentary about construction.

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Updated on 3/20/2019