Science and Engineering
Course Syllabus
CTY Day Sites

		WHAT **(skills, goals, knowledge, concepts, readings)**	**HOW** **(activities)**
Day 1 **(Monday)**	**Morning**	I. Introductions II. Rules And Procedures III. Lab Safety IV. Pre-Assessment	I. Teacher presented classroom procedures and students presented the Honor Code II. Discussed lab safety and signed contracts III. Icebreaker – "3 degrees of connection" IV. Brainwarming Logic Exercises V. Students took pre-assessment to determine prior knowledge
	Afternoon	I. Planning and Teamwork in Science and Engineering II. Introduce Class Wiki	I. Activity used to introduce engineering and group work – Build a bridge using only paper and tape. Discussion on successes and difficulties and process used to solve problem II. Introduce and provide instructions on how to use the class wiki for homework assignments and the sharing of ideas
	Homework	Velocity and acceleration Wiki research assignment	Read *Can You Feel the Force* (FtF) pg. 30-31 HW: Research a speed record: "How fast is the fastest _____?" and post result on class Wiki.

		WHAT (skills, goals, knowledge, concepts, readings)	HOW (activities)
Day 2 (Tuesday)	**Morning**	I. Science vs. Engineering II. Displacement, Velocity, and Acceleration discussion III. Understanding motion IV. Relative velocity	I. Students wrote definitions of science and engineering and discussed the differences II. Students brainstormed different areas of science and engineering and discussed specific examples of science and engineering careers. III. Discussed the concepts of displacement, velocity, and acceleration, and how to calculate v & a. Used HW to calculate distance traveled in a given time. IV. Worksheet "What Is Motion?" with velocity and acceleration problems V. Outdoor Motion Lab with tape measure and stopwatches. Students demonstrated the difference between instantaneous and average velocity VI. Discussed relative velocity
	Afternoon	I. Breaking the Sound Barrier II. Analyzing Motion Graphs	I. Lecture, video clips, and discussion on breaking the sound barrier II. Explained distance versus time and velocity versus time graphs; Discussed how they illustrated speed and acceleration. III. Worksheet on analyzing motion graphs.
	Homework	I. Intro to Forces II. Buoyancy and Lift III. Bring empty soda bottles	I. What is a Force? Read FtF pg. 21-23 II. "How do Planes Stay in the Air?" Read FtF pg. 42-45 III. Inform students to bring an empty soda bottle for water bottle rocket
Day 3 (Wednesday)	**Morning**	I. Review Measuring Motion II. Introduction to Forces III. Balanced and Unbalanced Forces IV. Physics of Flight	I. Review motion worksheets II. Students brainstormed and saw how forces are everywhere. Key concept: a Force is a Push or a Pull III. Learned about balanced and unbalanced forces; tug-of-war lab, worksheet IV. Intro to Physics of Flight Concepts, Buoyancy, and Bernoulli's Principle (PPT)

		WHAT (skills, goals, knowledge, concepts, readings)	HOW (activities)
	Afternoon	I. Aeronautical Engineering	I. Students constructed model planes using balsa wood and paper (Whitewings)
	Homework	I.Newton's Laws II."G Forces" III. Bring empty soda bottles	I. Isaac Newton and his 3 Laws of Motion. Read FtF pg. 24-27 II. Read FtF pg. 32-33 III. Remind students to bring empty soda bottle for water bottle rocket
Day 4 (Thursday)	**Morning**	I. Flight Testing II. Human spaceflight	I. Students tested their model planes and tweaked them for optimum flight characteristics II. Viewed video clips and discussed Spaceship One, the first private manned spacecraft. Students considered the requirements for putting a person in space, and differences between a government funded versus private space program.
	Afternoon	I. Newton's Laws of Motion II. Inertia III. Mass vs. Weight IV. Force pairs	I. Introduction to and Demonstrations of Newton's 3 Laws of Motion II. 1st Law of Inertia III. 2nd Law, Force causes Mass to Accelerate. Worksheet IV. The difference between mass and weight. Calculating Weight WS V. 3rd Law, Equal and Opposite Forces. VI. Students came up with their own demonstrations of each of Newton's 3 Laws of Motion
	Homework	I. Bring empty soda bottles II. Gravity and Drag III. Wiki Assignment : Newton's Laws at work	I. Remind students to bring empty soda bottle for water bottle rocket II. "How fast can you fall?" Read FtF pg. 40-41 Air resistance: Read FtF pg. 46-47 III. Post examples of Newton's Laws at work to the class wiki

		WHAT (skills, goals, knowledge, concepts, readings)	HOW (activities)
Day 5 (Friday)	**Morning**	I. The Force of Gravity II. Falling objects, Freefall III. Weightlessness vs. "Zero-g" IV. Air resistance and Drag	I. Students presented their Newton's Laws at work examples II. Introduction to the force of gravity and weight III. Students observe demonstrations that show that all objects fall at the same rate in the absence of air resistance. Dropping paper vs. book IV. Penny and feather demonstration V. Understanding weightlessness: Why do astronauts in space "float"? VI. Demonstrating Freefall: Dropping a spring scale VII. Experiencing freefall: Superman, the Ride VIII. Discussion on reducing air resistance in vehicles
	Afternoon	Application of Newton's Laws: Rockets!	I. Engineering project: Introduce Water Bottle Rockets II. Discussed what makes a rocket stable in flight. Applied Newton's Laws to rockets III. Students began constructing their water bottle rockets
	Homework	I. Wiki assignment: Spacecraft II. Bridge Building Simulators	I. Students researched the history of human spaceflight and posted about interesting spacecraft on the class wiki II. Explore how to make strong bridges using two bridge building games: Bridgecraft (http://www.physicsgames.net/game/BridgeCraft.html) or Cargo Bridge (http://www.physicsgames.net/game/Cargo_Bridge.html)
Day #6 (Monday)	**Morning**	I. Engineering project: Water Bottle Rockets II. Testing Water Bottle Rockets	I. Students finished building their water bottle rockets II. Students launch and test their Water Bottle Rockets
	Afternoon	I. Bridge Building Simulators	I. Computer lab: Students used "Cargo Bridge" to learn about using triangles to create strong and sturdy bridge designs

		WHAT (skills, goals, knowledge, concepts, readings)	HOW (activities)
	Homework	I. Skyscraper design computer activity	I. Students learned about building tall structures on the PBS Building Big website (www.pbs.org/wgbh/buildingbig/skyscraper/index.html)
Day #7 (Tuesday)	**Morning**	I. Static (balanced) Forces II. Forces on Structures III. Engineering project: building towers	I. Discussed how static forces applied to engineering buildings and bridges II. Used online lab from PBS "Building Big" website to discuss forces on structures (http://www.pbs.org/wgbh/buildingbig/lab/index.html) III. Introduced balsa wood engineering project. Watched instruction video on designing and building balsa wood structures IV. Students designed towers on grid paper using different truss schemes V. Students began building balsa wood towers that stand at least 20 cm high
	Afternoon	I. Engineering project: building towers	I. Students continued building balsa wood towers
	Homework	I. Bridge design computer activity	I. Students learned about building bridges on the PBS Building Big website (www.pbs.org/wgbh/buildingbig/bridge/index.html)
Day #8 (Wednesday)	**Morning**	I. Engineering project: building towers II. Testing structures III. Engineering bridges	I. Students completed building balsa wood towers II. Tested tower strength III. Students applied what they learned from towers to design and build a balsa wood bridge that spans at least 20cm.
	Afternoon	I. Engineering bridges	I. Students continued building bridges

		WHAT (skills, goals, knowledge, concepts, readings)	HOW (activities)
	Homework	I. Wiki research assignment: Superstructures	I. Students researched superstructures of the world: tallest building, longest bridge, biggest dam, etc. and posted research on class Wiki II. Read "Can you walk on custard?" FtF pg. 70-71
Day #9 (Thursday	**Morning**	I. Engineering bridges	I. Students completed balsa bridges and tested the load limit for their bridges
	Afternoon	I. Engineering example: Designing the Lunar Lander II. Kinetic and Potential Energy III. Conservation of Energy IV. Roller Coaster Analysis V. Projectile motion	I. Students watched *From the Earth to the Moon: Spider*, and learned about the process of design and working with engineering constraints and budgets. II. Students learned about Kinetic and Potential Energy III. Conservation of Energy Practice Worksheet IV. Application of Conservation of Energy: Roller Coasters V. Conservation of Energy Lab - Projectile Motion. Using a projectile ramp and metersticks, students determined experimentally the relationship between how high a ball starts on the ramp with how far away horizontally it hits the ground
	Homework	I. Energy Conservation II. Energy and Collisions	I. Energy: Read FtF pg 34-35 II. Read "Why do balls bounce?" FtF pg. 48-49
Day #10 (Friday)	**Morning**	I. Applications of stored energy: Rubber band plane	I. Students constructed a balsa wood plane that utilized the energy stored in a rubber band to power a propeller. II. Students finished building their rubber band planes and tested them.

		WHAT (skills, goals, knowledge, concepts, readings)	HOW (activities)
	Afternoon	I. Engineering constraints II. JPL Mars Lander design constraints and considerations	I. Discussed engineering constraints using the example of JPL's Mars Rover Mission. II. Viewed video clips from JPL illustrating the process of designing the Mars Lander; *Mars: Dead or Alive* DVD clip. III. Discuss the constraints and tradeoffs for the design of the parachute for the Mars Lander
	Homework	Mars Lander Project	I. Gather materials for Mars Lander vehicle II. Come up with design plan
Day #11 (Monday)	**Morning**	I. Impulse and Momentum II. Engineering Project: Mars Lander III. Mars Lander construction	I. Demonstrations of Impulse and Momentum; egg and sheet. II. Students used knowledge of speed, acceleration, gravity, and Newton's Laws of Motion to design a container to protect an egg dropped from 4 stories up; Goal is to build an effective container within the size constraints, with the lowest mass and cost.
	Afternoon	I. Engineering Project: Mars Lander II. Testing and Evaluating Landers	I. Students finished their Mars Landers. Evaluated the size, weight, and cost of student Landers. II. Tested the Mars Lander vehicles by dropping them from top of building. III. Evaluated Mars Lander vehicles. What design features were effective, and which ones were not?
	Homework	I. Wiki research assignment	Post images and facts about great roller coasters on the class Wiki
Day #12 (Tuesday)	**Morning**	I. Engineering Project: Class Roller Coaster	I. Using the K'Nex Roller Coaster set, the class divided into two teams to construct a marble roller coaster demonstrating the principles of Newton's Laws and Conservation of Energy

		WHAT (skills, goals, knowledge, concepts, readings)	HOW (activities)
	Afternoon	I. Engineering Project: Class Roller Coaster	I. Students completed and tested their roller coasters, using velocity timers to measure and analyze the motion of the coaster at various points on the track
	Homework	I. Atoms and Electric Charge	I. Read FtF pg. 56-59.
Day #13 (Wednesday)	**Morning**	I. Electric Charges and Forces II. Ohm's Law: Current, Voltage and Resistance III. Series and Parallel circuits IV. Applications of charge and electricity V. Engineering project: Simple Circuit construction	I. Introduction to static charge; van de Graaff generator and Tesla Coil demonstrations II. Students learned about basic electric circuits III. Ohm's Law Worksheet IV. Calculating total resistance for series and parallel circuits WS V. Applications of electricity and charge: the Photocopier and TV VI. Electric Pickle Demonstration! VII. Students used the Snaptricity kits to investigate simple circuits (series, parallel, Ohm's Law)
	Afternoon	I. Engineering project: Simple Circuit construction	I. Students used the Snaptricity kits to investigate switches and logic gates
	Homework	I. Electricity II. Magnetism	I. Read FtF 60-61. II. Read FtF 62-63.
Day #14 (Thursday)	**Morning**	I. Magnetism II. Magnetic fields III. Electromagnetism	I. Students explored properties of Magnetism hands-on by comparing permanent magnets and electromagnets. II. Students visualized magnetic fields using a magnetic field line viewer.
	Afternoon	I. Engineering Project: Electric Motors	I. Students learned how electric motors work and constructed their own from parts. II. Discussed how motors work using their completed models
	Homework	I. Wiki assignment: Review of Concepts II. Physics Demo Presentations	I. List all of the projects, demonstrations, and concepts that we learned throughout the course on the class wiki II. Prepare for Physics Demo Presentations

		WHAT **(skills, goals, knowledge, concepts, readings)**	**HOW** **(activities)**
Day #15 **(Friday)**	**Morning**	I. Review and Post-assessment II. Physics Demo Presentations III. Open Q&A session regarding Physics and Engineering	I. Reviewed key concepts and students took post-assessment II. Students prepared presentations of each of the key Physics concepts or demos that we did during the class. III. Open Q&A session regarding Physics and Engineering to answer any questions that students may have about the sciences and engineering careers.
	Afternoon	Class Presentations	Students presented the concepts that they learned by using the demos done in class and their completed projects.