Apogee Program
Session 1 & 2
Course Title: Designing Machines That Work: Engineering & Physics

Course Description
How do machines work? How do you build the strongest bridge with the lightest building material? In this active classroom environment, students learn about the fundamentals of physics as they investigate engineering concepts such as the conservation of energy and Newton's Laws of Motion. The course involves several projects, which involve designing, building, and testing trebuchets, balsa wood bridges, and our biggest project – basswood CO_2 dragster cars. In this hands-on environment, students will learn about velocity, acceleration, force, gravity, simple machines, friction, and aerodynamics. To complement the lab work, field trips and presentations serve as catalysts for new ideas and applications of course concepts in the real world.

Essential Questions
- What are the benefits and limitations of an engineering approach to solving problems?
- How does a physicist view the world differently than an average person?

Outcomes
Upon successful completion of this course, students will:
a. learn the basic principles of physics.
b. learn and apply the basic principles of engineering.
c. develop personal skills to help them tackle the challenge of a large project.
d. develop an awareness of their strengths and areas for improvement through studying for quizzes, learning from texts, and completing projects
e. develop social skill necessary to work effectively with groups.

Instructional Strategies
Over the six years of teaching this course, I have developed numerous ways of approaches to working with the talented and gifted students First, hands-on projects allow the students to design and construct at their own cognitive and skill level. During project time, students spend most of their time working individually or in small groups allowing the teacher and TA to give personalized instruction appropriate to their skill level. We also have flexible grouping where different groups receive different instruction and complete different portions of the next day's quiz depending on the group they were in the previous day. I also have adapted tiered assignments that provide opportunities for students to tackle more difficult topics and physics problems.

Resources and Materials
- Books

- Paul Hewitt. Conceptual Physics for High School. 2006. **ISBN-13:** 978-0131663015

- **Materials**

A teacher developed packet with most homework assignments, laboratory experiments, readings, and other course material.

Student Assessment

- **Documentation of Learning**
  We use daily quizzes, journal entries, self-reflections, laboratory activities, balsa wood bridge project, CO2 basswood dragsters, and a final exam as methods of assessing the students' progress in the course.

Schedule

Date	Topic(s)	In-class Activities	Assignments/Assessments
June 27, 2011	Introductions, Physics and Scientific Method, Engineering	Scientific Method group activity, What is Physics activity, index card tower	Scientific Method Reading, Engineering Reading, Bridge Reading, Student Response
June 28, 2011	Relative Motion, Speed, Velocity, Bridges	Speed Lab, ESPN Sportsfigures video, Balsa Bridge project	Motion Reading, Bridge Building Tips, Velocity Homework Problems, Student Response
June 29, 2011	Acceleration, Free Fall, Bridges	Acceleration Notes, Reaction Time Lab, Balsa Bridge project	Acceleration Reading, Acceleration Problems, Projectile Motions (challenge), Student Response
June 30, 2011	Acceleration, Free Fall, Hang Time, Bridges	Hang Time Lab, Balsa Bridge project	Free Fall Reading, Free Fall Homework Problems, Rough Designs for CO_2 Cars, Kinematics Equations (challenge), Student Response
July 1, 2011	Newton's Laws of Motions, Friction, Weight, Mass	Newton's Law Demos, Weight vs. Mass Notes, Test Bridges	Newton's Law Homework Questions & Problems, Bridge Building Reflection
July 4, 2011	Newton's Laws of Motion, Friction, Aerodynamics	Shoe Lab, CO_2 Dragster project	Friction Reading & Net Force Problems, Student Response
July 5, 2011	Work, Power, Energy	Work & Power Lab, CO_2 Dragster project	Work & Power Reading & Problems,
July 6, 2011	Work, Power, Energy, Simple Machines, Mechanical Advantage	Inclined Plane Lab, CO_2 Dragster project	Simple Machine Reading, Simple Machines Problems, and Student Response
July 7, 2011	Work, Power, Energy, Simple Machines, Mechanical Advantage	Simple Machine Lab, CO_2 Dragster project	Pulley & Lever Problems, Simple Machine Reading Questions, Student Response
July 8, 2011	Energy, Simple Machines, Mechanical Advantage	Energy Lab, CO_2 Dragster project	Energy Reading, Energy Questions, Conceptual Development Questions, Energy Problems, Student Response
July 11, 2011	Pressure, Density, Buoyancy	Clay Boat Lab, CO_2 Dragster project	Pressure & Buoyancy Reading, Pressure & Buoyancy Problems

Date	Topic(s)	In-class Activities	Assignments/Assessments
July 12, 2011	Simple Machines, Energy, Work, Power, Buoyancy, Density, Pressure	Field Trip	Field Trip Reflection, Independent Report on Physic Topic of Student's choice
July 13, 2011	Velocity, Acceleration, Newton's Laws of Motion, Aerodynamics	Race Day	Car Journal, Independent Report on Physic Topic of Student's choice, Study for Final exam
July 14, 2011	Simple Machines, Modern Physics	Trebuchet projects	
July 15, 2011	Simple Machines, Energy, Work, Power, Buoyancy, Density, Pressure	Expo Day Displays	

CTD Statement on Third-Party Web Sites

Instructors are required to thoroughly review any third-party web sites they intend to use in their courses for inappropriate content. However, because web content continuously changes, CTD disclaims any responsibility for any of the content contained on third-party web sites used in course materials. If you become aware of anything that may be inappropriate, please notify CTD staff immediately.