
 <p>Center for Talent DEVELOPMENT®</p>	 <p>NORTHWESTERN UNIVERSITY</p>	<p>SUMMER PROGRAM 2009</p> <p>School of Education and Social Policy 617 Dartmouth Place • Evanston, IL 60201 • 847.467.18257 Summer Office: June 15 – August 12, 2009 • 847.467.4674</p>
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Apogee Program

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. They test these theories — and their own ingenuity — by generating creative alternatives to practical problems faced in scientific and technological fields today. The projects will involve designing, building, and testing catapults, balsa wood bridges, and our biggest project — basswood CO₂ 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.

Outcomes

Upon successful completion of this course, students will:

- learn the basic principles of physics.
- learn and apply the basic principles of engineering.
- develop personal skills to help them tackle the challenge of a large project.
- develop an awareness of their strengths and areas for improvement through studying for quizzes, learning from texts, and completing projects
- develop social skill necessary to work effectively with groups.

Resources and Materials

- Gonick, Larry. *The Cartoon Guide to Physics*. 1990. ISBN-13: 978-0062731005
- Prentice Hall. *Science Explorer: Motion, Forces, and Energy*. 2005. ISBN-13: 978-0132011570
- A packet containing relevant sections from the books listed below will be provided. This packet will include examples of many of the topics we cover in class. Most homework assignments, except those involving experimental write-ups, will be included in the packet.

Student Evaluation

Students will be evaluated on their performance on daily quizzes, the final exam, participation in laboratory activities, effectiveness in building projects and competitions, development of social skills, and their contribution to the class in general

Summer Sample

Course Schedule

Week 1

	Monday	Tuesday	Wednesday	Thursday	Friday
AM	Introduction Name Game Get to Know Grid Make Class Rules Explain expectations What is physics? Science Method Act What is Engineering? Math Pretest	Quiz on Sci Method Describing Motion Relative motion Brainstorm Words Define Words Speed Lab Tracking Speed Split Time Lab	Quiz on Speed Ramp Lab Acceleration Notes Free Fall/ Acceleration Distance of Acc Body Acceleration Problems	Quiz on Acceleration practical gliders wood together Hang Time Lab Algebra Review Jump Around Lab people who fell	Quiz on Acceleration Newton's 1st Law Demos Newton's 1st Law Share stories in groups Explain more examples Newton's 2nd Law Lab 2nd Law Problems Weight vs. Mass Net Force Newton's 3rd Law
PM	Engineering, designing, construction, testing, revise design Social Skills in Groups Index Card Towers Debrief group process Assign building groups Describe Bridge project Discuss Design	Introduce Bridge Proj Watch Build'em/Bust Structure Video Explain rules of contest Show tools, give materials, start sketching Go over social skills work ethic Finish Design	Building Bridges	Finish Building Bridges	Bridge Testing Intro Car Project
HW	Scientific Method reading/Read p202-207 in Science Explorer Bridge Reading Tower Journal	Motion Reading p16-25 Velocity/ Split Times Problems Journal Entry Finish Design Structure Reading	Acceleration Reading p34- 38 Conceptual Physical Science Reading Engineering Reading Acceleration/ Free fall Problems	CO2 Car Introduction Reading Hang Time/ Jump Around Problems Journal Entry	Newton's 1st, 2nd, & 3rd Law Reading p44-49, 52- 61, & 64-66 Newton's Law Problems Journal Entry Make Thumbnail Sketches

Week 2

	Monday	Tuesday	Wednesday	Thursday	Friday
AM	Quiz on Newton's Laws Friction Notes/ μ That μ that you do Shoe Lab Drag/ Air resistance Apply to Car Project Pitsco Video	Friction/ Newton's Law Quiz Work & Power intro Work & Power Lab Recheck Design and trace sideview onto block	Work & Power Quiz Simple Machines Intro Inclined Plane Lab Inclined Plane Lab Review and Inclined Plane Quiz	Pulley Lab Pulley Lab Review Lever Lab Pulley and Lever Quiz Review simple machines Car Game Video	Simple machine Quiz Potential/ Kinetic Energy Conservation of Energy Perpetual Motion Finish Shaping and Sanding
PM	Make Sketches on Graph Paper Check Specs of Sketch	Drill Axle Holes Trace sideview and cut it out Filing and Shape car Sanding car	Cut Top View File and Shape car Sanding Car	Finish Shaping Cars	Finish Sanding Paint Cars
HW	Reflection on CO ₂ Car Project Finish Sketch	Work & Power Reading Simple Machine Reading CO ₂ Journal	Simple Machines Reading 2 Inclined Plane & Pulley hmwk	CO ₂ Journaling Lever & Trebuchet hmwk	Energy Homework CO ₂ Journaling

Week 3

	Monday	Tuesday	Wednesday	Thursday	Friday
AM	Energy Quiz Pressure Notes Pressure and depth Buoyancy/ Density Clay boats Math Under Pressure Submarines Finish Cars	Pressure Quiz CO2 Car Races	Field Trip (be on time for <u>class -we leave at</u> <u>8:30 am</u>)	Final Exam My Feedback Form Watch Nova Video Start Building Trebuchet	Expo Day Show video/ slide show of class in auditorium
PM	Test Cars Prep for Race Assign Roles for Races Create Brackets	CO2 Car Races Field Trip Prep	Field Trip Discuss Field Trip	Build Trebuchet/ Compete Do CTD Form	Parent Conferences
HW	Pressure Reading Pressure Problems	Work on Field Trip Packet	Universal Gravitation Reading Black holes Reading	Study for Final	

Summer Sample