Center for Talent DEVELOPMENT®
School of Education & Social Policy

NORTHWESTERN UNIVERSITY

Course Syllabus

SUMMER PROGRAM 2011

617 Dartmouth Place · Evanston, IL 60208 · 847/491-8257
Summer Office: June 13 – August 11, 2011 · 847/467-2990

Spectrum Program

Session 1

Course Title: Materials & Engineering Design Honors

Course Description

Engineering bridges the gap between imagination and the laws of nature. Examining the relationship between science and technology, students consider solutions to current product design issues. In this laboratory and project-based course, students engage in inquiry and design, and work through modules such as composites, concrete, biodegradable materials, smart sensors, polymers, food packaging and sports materials to learn scientific concepts and connect them to real-world applications. Each module culminates in a design project that integrates information learned in chemistry, physics, biology, engineering and materials science. The course is good preparation for advanced study in chemistry and physics, as well as engineering.

Essential Questions

- What characteristics and properties of various materials can be applied to the development and design of new materials for the use in chemistry, physics and engineering?
- What global challenges do scientists face in meeting goals of society?

Outcomes

Upon successful completion of this course, students will:

- Know: Students will know the principals and practices associated with materials science and engineering design and experience the processes associated with scientific inquiry and design and the relationship of science and technology.
- Understand: Students will develop an understanding of materials science by applying knowledge from the physical, life, and earth sciences to create materials for specific purposes.
- Apply: Students will have opportunities to identify technological problems, propose designs, choose between alternative solutions, implement and evaluate a solution, redesign the product, and communicate the problem, process and solution. Students will generate questions, design and conduct scientific investigations, formulate models, analyze alternative models, and communicate and defend explanations.
- Analyze, synthesize, or create: Students will have an opportunity to discuss the differences between the purposes and nature of scientific and technological studies and the interrelationship between these fields.

Instructional Strategies

This course is designed for students to be active members of a class as they construct new meaning from class discussions, group activities/lab, and independent work. Students will have opportunities to explore their world through well-designed activities and experiments. Students will also be challenged to work in small groups and solve a problem by designing a new product, testing the design, and presenting to the class their results.

Resources and Materials

- **Books:** Materials World Modules: An inquiry-based Science and Technology Educational Program, Northwestern University.
- **Materials:** calculator, 3-subject notebook, glue stick, flash drive (memory stick)

Student Assessment

- **Pre-Assessment**

The pre-test will be a multiple-choice exam that will focus on the basic science concepts addressed in the course.

- **CTD Grading Scale**

A+	100-97%	A	96-93%	A-	92-90%
B+	89-87%	B	86-83%	B-	82-80%
C+	79-77%	C	76-73%	C-	72-70%
D+	69-67%	D	66-63%	D-	62-60%
F	below 60%				

- **Breakdown of Final Grade**
  10% journal
  40% tests
  50% group projects presentations

- **Post-Assessment**
  The post-test will be the same as the pre-test; a multiple-choice exam that will focus on the basic science concepts addressed in the course.

Schedule

Date(s)	Topic(s)	In-class Activities	Assignments and/or Assessment
June 27	Introduction to course	-group instant challenges - journal set-up	
June 27-28	Sports Materials Module • How can one increase spin of a baseball? • What occurs to the molecules on a ball's surface when it hits a hard object? • What data needs to be collected in order to calculate the coefficient of restitution of a sports ball?	-exploring ball design and materials -investigating the rebound of sports balls -investigating energy absorptions of materials -comparing rolling frictions on different surfaces -researching sports materials	-self-assessment goals: students will set their own goals for the module and write them down in their science logs. Students will refer to them at the start of each activity -portfolio assessment: activity-log sheets, design-log sheets
June 29 -30	Concrete Module • How do you calculate the density of an aggregate mixture? • What occurs when calcium chloride is added to a cement mixture before it is poured?	-hunting for objects made of concrete -comparing different kinds of cements -comparing different concrete foundations -reinforcing concrete	-self-assessment goals: students will set their own goals for the module and write them down in their science logs. Students will refer to them at the start of each activity -portfolio assessment: activity-log sheets, design-log sheets
July 4	Group Design – Day 1	-designing a mini-golf game -designing a fishing pole	- lab report -rubric for group design and presentation
July 5	Group Design – Day 2	-designing a mini-golf game -designing a fishing pole	- lab report -rubric for group design and presentation
July 6	Group Presentations and Module Tests		-written test: multiple choice, short answer, essay.

July 7	Concrete Module • Concrete Lab visit	-concrete block testing	- lab report -design-log sheet
July 7 – 8	Composites Module • How can one reduce the forces that cause cracks in composites? • What properties are considered in developing composite materials?	-testing different kinds of ice -hunting for composite materials -exploring the difference between strength and stiffness -testing a foam composite for strength and stiffness -researching composites	-self-assessment goals: students will set their own goals for the module and write them down in their science logs. Students will refer to them at the start of each activity -portfolio assessment: activity-log sheets, design-log sheets
July 11	Biodegradable Materials Module • Describe the sequence of events as biodegradable materials are broken down in nature • What are the main characteristics and properties of biodegradable materials?	-comparing packaging materials -hunting for biodegradable materials -processing biodegradable materials and comparing their mechanical materials -researching biodegradable materials	-self-assessment goals: students will set their own goals for the module and write them down in their science logs. Students will refer to them at the start of each activity -portfolio assessment: activity-log sheets, design-log sheets
July12	Food Packaging Module • List fundamental functions of food packaging used today • How have manufactures and designers accomplished source reduction?	-investigating food packaging -analyzing food packaging materials -evaluating the impact of food packaging on the environment -comparing the insulating properties of packaging materials	-self-assessment goals: students will set their own goals for the module and write them down in their science logs. Students will refer to them at the start of each activity -portfolio assessment: activity-log sheets, design-log sheets
July 13-14	Group Design	biodegradable product -designing a hot potato package -designing a new food packaging	- lab report -rubric for group design and presentation
July 15	Group Presentations, Module Tests and Parent-Teacher Meetings		-written test: multiple choice, short answer, essay.

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.