Fall 2010: E 10
Professor Lisa Pruitt
Mechanical Engineering Module

Leadership for Broadening Engineering Ingenuity

This module provides the framework for development of the core competencies necessary for leadership in the context of broadening engineering excellence and design ingenuity. The module presents the processes in engineering design, mechanisms for developing personal and team leadership styles; addresses differences in learning and personality styles; provides pathways for implementing mission statements and plans of action; and offers opportunities for strategic thinking, problem solving and brainstorming; and utilizes teamwork in diverse settings for societal and k-12 service learning. The technical foundation of this module is centered upon the process of engineering design and implementation of ingenuity projects in collaboration with the Lawrence Hall of Science (LHS) and our engineering student group called Berkeley Engineers and Mentors (BEAM). The project at LHS is entitled "*Ingenuity in Action*" and offers opportunity for implementation of projects that teach the engineering design process. Pedagogy skills include principles of education/teaching styles and levels of learning. Leadership skills developed include awareness of body language; methods for optimized communication; ethical considerations; time management; team-building, personal assessments, mentoring; and conflict resolution. The module will involve K-12 outreach teaching activities involving fundamental principles of design methodology for engineering technology.

Module Lecture Topics

Design Process: Fundamentals of engineering design and the problem solving cycle. The NASA design cycle.

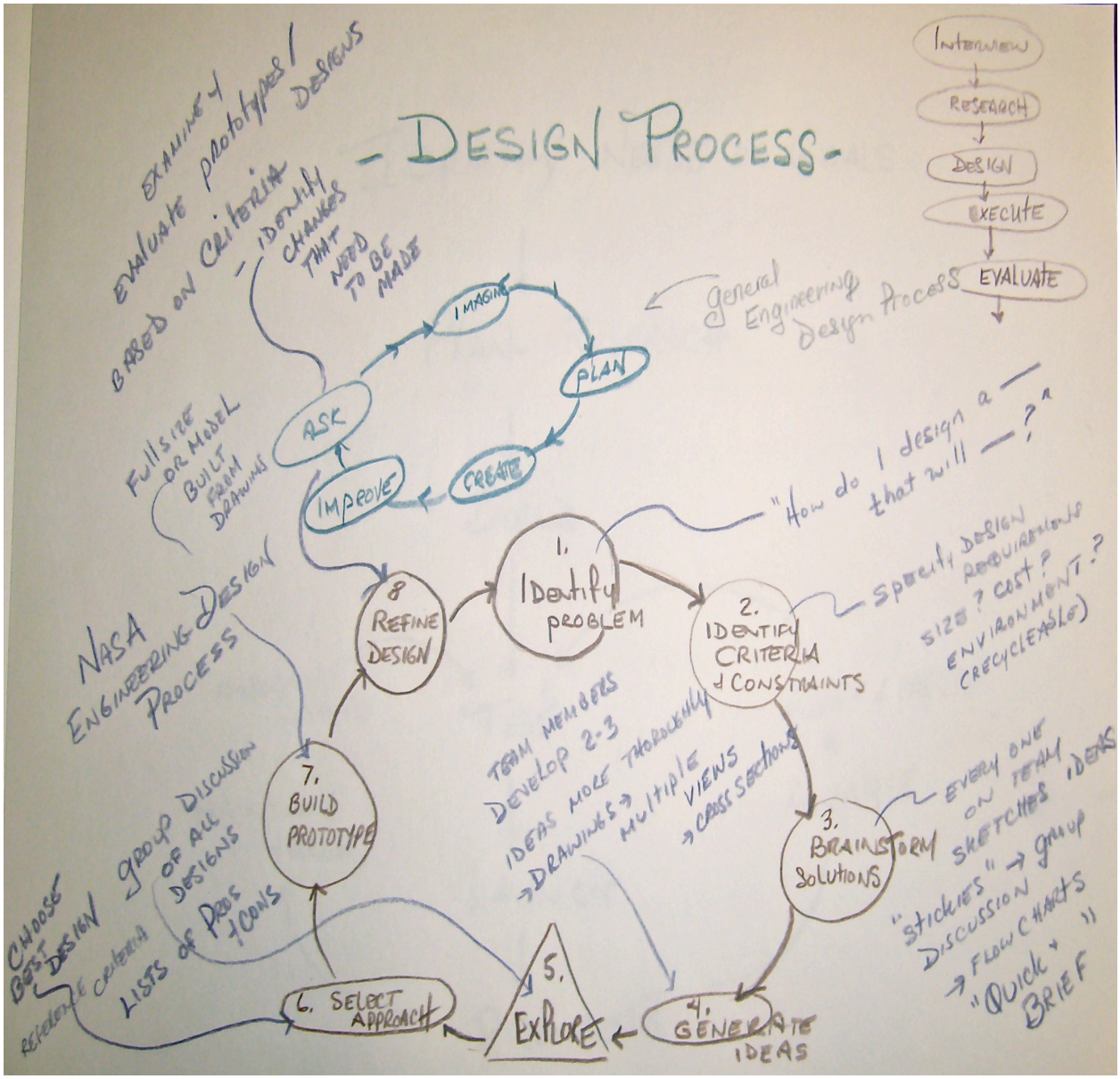
Development of Self: Foundation for conversation. Assessment of strengths and weaknesses. Building congruency, trust and ethical standards. Life balance as a practice. Awareness of body language and voice. Strategic thinking. Problem solving. Creativity and innovation.

Diversity and Teamwork: Embracing differences in personality (Myer-Briggs) and learning styles (Global vs. Sequential; Intuitive vs. Sensing, Active vs. Reflective; Verbal vs. Visual). Optimization of strengths. Group communication, conflict management, difficult conversations and decision-making. Development of a plan of action (formulation, negotiation, fulfillment, and review). Brainstorming: engagement, exploration, evaluation, and extension.

K-12 outreach: Teaching basic engineering design process and ingenuity in the K-12 domain and the public sector (societal service), and utilizing teaching as form of leadership practice. Introduction to Berkeley Engineers and Mentors (BEAM).

E-10 Lawrence Hall of Science "Ingenuity" project

The Lawrence Hall of Science is interested engaging our visiting public in the engineering design process. The current ***Ingenuity Lab*** and ***Ingenuity in Action*** project activities are primarily tinkering (engineering) activities -- visitors try different solutions to a design challenge—yet are not necessarily thinking about the process they use or how that connects to the realm of professional engineering. The E-10 students in this section will be working together to develop and test a facilitation framework for making the steps of the engineering design process more visible to the LHS visitor audience. As our base, we will start with the NASA encapsulation of the engineering design process (sketched below).



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E-10 Lawrence Hall of Science "Ingenuity" project

Your project will be to design and implement a facilitation strategy for making the engineering design process explicit to LHS visitors. You have two primary options for activities:

1. Adapt an existing activity in the **Ingenuity in Action** exhibit. The museum floor features three activity stations. Revise the facilitation process to add the *NASA encapsulation of the engineering design process* to the activity. Within this exhibit there are three activity stations:

(i) ***Fly High***: Create your own flying machine and test it in a wind tube. This is a highly open-ended design challenge.
(ii) ***Design and Drive***: Combine wheels and treads to optimize your vehicle for climbing on rough surfaces. This project is more constrained due to requirements of gear ratios and terrain, etc.
(iii) **Span the Gap**: Experiment with the basic building of bridges (inspired by the Bay Bridge) to create your own. This design challenge is constrained by a number of factors including safety and efficacy.

This project is completed by implementing your facilitation strategy on the LHS floor with LHS visitors in the **Ingenuity in Action** exhibit.

2. Develop **new challenge* for the **Ingenuity Lab**.

The **Ingenuity Lab** contains legos, motors, gears, programmable microchips, basic circuitry materials, and all kinds of interesting material for tinker. Develop a design challenge for visitors making use of the materials available in that lab space and illustrating the NASA Engineering Design process. This project is completed by facilitating the challenge activity with LHS visitors in the **Ingenuity Lab.**

**new challenge is open-ended and is motivated by available materials and interests of E 10 teams.*

Some "**Ingenuity**" project design parameters:
1) *Your process must allow for the drop-in nature of the museum experience.* Museum teaching can be very different from classrooms. There is not a designated start and stop time. Facilitators must be able to orient new groups as they walk up to the station. More guidance on dealing with challenge will be discussed in class.
2) *Your process needs to allow for visitors to develop their own creative solution to the challenge*. The overall goal of the experience is to allow visitor to do his or her own creative thinking and tinkering. Your facilitation structure should preserve that feeling while still providing structure that illustrates the engineering design process.

3) *Your activity needs to be fun! Museum visitors vote with their feet.* An educational activity is only effective if the visitors are having enough fun that they stick around to finish it!

Getting to LHS: http://www.lawrencehallofscience.org/visit/bus

This link has good directions to LHS, as it links to the Hill line schedule and the AC transit schedule.

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ORGANIZATIONAL DETAILS

5-week module:

15 lectures: 3hrs/week lecture (M W F, 10-11am, 102 Moffitt)

1 hr/week teaching laboratory, 2-3 pm (Tues, 61 Evans (Ryan); Wed, 61 Evans (Farzana); Thurs, 55 Evans (Ryan))

2-hours/week outreach teaching at the Lawrence Hall of Science Ingenuity Lab (scheduled with team and LHS).

Facilitator Contact Information:

Professor Lisa Pruitt: 5134 Etcheverry Hall, lpruitt@me.berkeley.edu, *Office hours:* MF 8-9 am, W 11-12 am

Ryan Shelby (Graduate Student Instructor), ryan_shelby@berkeley.edu, *Office hours*: TBA

Farzana Ansari (Graduate Student Instructor), fansari@berkeley.edu, *Office hours*: TBA

Matt Kury (Mentor): mkury@me.com, Office hours: Tu Th 1-2pm (Bechtel Engineering Center)

Gretchen Walker (Lawrence Hall of Science): gwalker@berkeley.edu

Jennifer Wang (Lawrence Hall of Science): jennifer_wang@berkeley.edu

BEAM (Mentors): http://beam.berkeley.edu/

Grading:

Class participation/assignments: 25%

Module Design **Notebook: 25%

LHS Project: 50% (Project write-up, Oral presentation (include 8 elements of design proves), and team assessment (attached) are due last week of module)

Books:

Suggested: "Engineering Design" Clive Dym and Patrick Littl, 3rd ed, Wiley.

Required: ***Bound design notebook*** (**any type as long as it is bound**). Must be labeled with your name and it must be bound. The lab notebook is your individual course diary—you will keep your personal notes/ideas/discussions/sketches in this book. All entries must be dated. Notebooks are subject to collection at any time and will be submitted at the completion of the module.