

## Skills for Good Engineering Design Activities

### Skills that are emphasized in engineering:

The ABET Engineering Accreditation Commission's "Criteria for Accrediting Engineering Programs" (2007-2008 Cycle) lists eleven criteria for student attainment in engineering programs. Two of these criteria that are particularly relevant to our work are:

- (1) "an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability," and
- (2) "an ability to identify, formulate, and solve engineering problems."

Most of the other criteria on the list (e.g. an ability to design and conduct experiments...) are addressed well by the CfAO PDP inquiry science activity designs. But the skills emphasized by the two criteria stated above need special consideration in order to prepare people for engineering work. These skills are identified below.

#### 1) **Defining the Problem**

- a. Communicating with whoever has the problem
- b. Identifying constraints
- c. Defining requirements and criteria for a successful solution
- d. Clarifying the problem definition

#### 2) **Proposing Solutions to the Problem**

- a. Brainstorming a diverse set of solutions and building on others' brainstormed ideas
- b. Imagining a chain of intermediate steps and their consequences
- c. Thinking laterally: using ideas raised from another problem in a new scenario

#### 3) **Evaluating and Selecting Solutions to the Problem**

- a. Analyzing and prioritizing criteria: discriminating that which is important from something not important
- b. Making "back of the envelope calculation": intuition, quick estimation, analysis
- c. Understanding trade-offs within a solution, between solutions, and how a solution interacts with society, the environment, the economy, etc.
- d. Selecting among different possible solutions to choose those most appropriate for solving the problem (use of Pugh Chart): may involve critiquing team's solutions

#### 4) **Systems thinking**

- a. Understanding how what you are working on fits in a system: may involve communicating with other teams or team members
- b. Understanding that things consist of parts
- c. Understanding the need for control mechanisms

#### 5) **Communication and teamwork (in addition to above)**

- a. Defining standards and conventions
- b. Documenting design so that other engineers can understand your work (and possibly participate in your design)
- c. Documenting use of a product or solution (e.g., writing a manual, designing an interface)