

LESSON 5: The Starting Point (For Engineers)

Generating project ideas based on a need, selecting a project and formulating a driving question

This unit addresses the dilemma encountered by most students who want to do an engineering project for the science and engineering fair. The lessons in this unit will provide them with a review of the engineering design process and the foundational skills needed in conducting a successful engineering design project. They will be guided on how to generate project ideas, translate them into engineering designs, formulate a driving question and consider how a design is transforming as it adapts to a world in transition.

Learning Tasks: (What You Will Do)

1. Select 3 engineering topics that you are interested in. The topics have to be on or above your grade level. Your teacher will review these topics with you to decide on the best and final topic for you to work on.
2. Formulate a research problem or a driving question based on your topic. The research problem is a statement about an area of concern, a condition to be improved, a difficulty to be eliminated that requires deliberate investigation. A driving question on the other hand provides a framework for the “why” by doing the “how.” It operationalizes (i.e. sets into motion) the challenge, and connects the final product, proposal, and/or idea to solve a problem.

(Note: Do not start your project until your topic or research problem has been approved.)

Tools: (What You Will Need)

- Preliminary Project Approval Form
- Intel-ISEF Approval Form (1B)
- Engineering Project Proposal Form
- Choosing An Engineering Project Decision Making Matrix

Part 1. Generating Project Ideas (Thinking Like An Engineer)

Every engineering project starts with an idea which is provoked by a need or a problem that has been insufficiently solved or not solved at all. Engineering projects involve creative problem-solving and they are not for hypothesis testing. Idea generation in engineering is not a random process governed solely by an individual's personal trait or bias, but a relatively structured process where several ideas from different people meet. There is emphasis on collaboration, creativity and innovation which results in different product designs. Thus, design engineers face the challenge of finding a creative and novel solution to an identified design problem or need. They try to generate as many possible solutions as they can before choosing the one that they feel is the best. The ability to solve design problems productively or to come up with a novel design by means of divergent idea generation is a precondition for finding appropriate solutions.

TIPS:

- Do some background reading. Read as much as you can. Use internet search engines. Browse as much as you can until you find a project that catches your attention.
- You are to create a solution to a presenting need of a particular customer or target group.
- Consider your constraints which could limit your flexibility - like cost, time, and resources. Good designs will meet important design criteria even within the limits fixed by constraints. Since cost is always a design constraint, good designs should be economical.

Part 2. Selecting A Project

Engineering is a broad term that covers a wide range of applications and industries. Combining mathematics, science and technology, engineers produce creative solutions to real world problems. There are many different kinds of engineers and engineering fields. Therefore, choose a project in the area of engineering that interests you. Expertise in a particular field (e.g. mechanical engineering, electrical engineering, chemical engineering, etc.) is required from an engineer. If the engineering is done properly and creatively, the project succeeds, operating costs are minimized, operating efficiency is maximized, and lives can even be saved. One creative idea can

save us lot but the absence of a creative idea can be disastrous for everyone and may even have long-lasting effects..

Part 3. Formulating A Driving Question

The driving question maintains the focus of the project. It captures and communicates its purpose. It guides the project all throughout - from beginning to end. It creates interest and a feeling of challenge. All driving questions should be open-ended, but there are several categories of driving questions and here are some tips on how to formulate them.

- (a) Philosophical or debatable questions by nature require rigorous thought and corresponding products. Example: Should we build a new highway on (the proposed site)?
- (b) Product-specific questions are not just about the product, it should also include the purpose. Examples: How do we create a water-proofing product that would protect our house walls from flood damage?
- (c) Role-oriented questions give authentic real-world role with a problem to solve or project to accomplish. Example: How do I as a structural engineer design a bridge on (the proposed site)?

Activity on Selecting an Engineering Design Project and Formulating a Driving Question

Project Overview:

Studies show that breakfast is the most important meal of the day since it jump-starts our activities but our busy schedules and lifestyles sometimes do not allow us to indulge in sit-down breakfasts where we can sample an assortment of food items and make healthy choices. Oftentimes, the quick fix is a bowl of cereals which contains carbohydrates (sugars and starches) that provide us with energy and loaded with fiber that can help curb our hunger and keep us feeling full and satisfied throughout the day or until our next meal. Most of these cereals contain a lot of sugar and too much of a good thing can be a bad thing. And monitoring sugar consumption can be problematic if one is always on the go. Designing and constructing a cereal box that would provide consumers with a portion that contains the

recommended daily allowance of sugar and fiber can help promote health since people often mistake package size for recommended serving size.

Challenge:

Design a cereal box for an amount of cereals that contain the recommended daily allowance for fiber and sugar. (Note: Choose a particular brand of cereal, take note of the amount that would contain the recommended daily allowance for sugar and fiber and consider packing and handling requirements from point of origin to your table in your design for no one wants to eat crushed cereals!) Use the Decision Matrix Worksheet to help you choose an engineering project.

Driving Question:
