**Engineering Design – Grades 3-5**

***Engineering Phase C: Optimizing the Design Solution***

**Group Discussion**

Now that you have run several tests to collect evidence under different conditions, created a sketch of your solution, and shared your designed solution with your peers; it is time to "**optimize**" your design.

The term "optimize" is often used in engineering to describe a process of refining your design (making small improvements) based upon test data, and reflecting on how your design meets the criteria and conforms to the constraints (limitations).

**Thinking about Optimization:**

In Phase A you discussed criteria and constraints. Write the criteria (what is success) and the constraints (limitations) that were discussed in Phase A in the section below.

Criteria:

Criterion:

Criterion:

Criterion:

Criterion:

Constraints:

**Evaluating Design Solutions:**

Making "trade-offs" is an important part of the optimization process. "Trade-offs" are decisions that are made to focus on or value certain design criteria while devaluing other criteria.

In other words, it is like using a weaker material (lowering quality in the criterion of durability) to reduce the cost of the solution (improving the criterion of cost). In this example, the criterion of durability is “traded off” for the more valuable criterion of cost. It is very important to know that trade-offs are based upon the end-user of the product or system. So, using the example, if safety was a criterion that was valued then durability would also be valuable and the trade-off for cost would not be a good decision.

1. With the specific goals (criteria) and material limitations (constraints) in mind, use (or modify) the table below to describe how well your designed solution meets each criterion and accounts for the constraints.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Criteria:** | **Value of the Criterion to the end-user**  0 = not important  1 = slightly important  2 = important  3 = very important | **Evaluating my design solution(s)**  Use the rubric below to evaluate how well your design solution(s) meets each criterion. | | | |
|  |  | 0 = not met | 1 = slightly met | 2 = met | 3 = exceeds |
| *1.* |  |  |  |  |  |
| *2.* |  |  |  |  |  |
| *3.* |  |  |  |  |  |
| *4.* |  |  |  |  |  |
| *5.* |  |  |  |  |  |

**Group Discussion:**

Now that you have evaluated your design solution against each criterion, share your evaluation with other groups. As you share, pay close attention to different values for each criterion and how well other design solutions meet needs of the end-user.

The goal for the group discussion is to come to consensus about which criteria are most valuable to the end-user and recognize that there are many possible design solutions that can work. However, some solutions are better due to specific criterion values (which can change based upon changing conditions).

**Optional Extension: Retest and Optimization**

Based upon the results from the evaluation rubric, make small changes to your design solution and retest. This should be done in a cycle of:

1. Determine one change/modification
2. Make the change/modification
3. Run several trials to test the effect of the change/modification
4. Record data from the test and use this data to make further changes/modification
5. Repeat