**Subject area/course**: Mathematics/Calculus

**Grade level/band**: 11-12

**Task source**: Summit Public Schools

**Optimization Project**

**STUDENT INSTRUCTIONS**

1. **Task context**:

In the fields of product design, engineering, economics, and others, people are always trying to find the best answer, the best product, and the most profit. Previously, we described maxima and minima of functions and some simple word problems. It is now time to use this process to design your own products.

1. **Final product**:

You are going to choose a product or design to optimize. You will be defining variables, creating equations, calculating derivatives, graphing solutions, and justifying your solutions.

1. In groups, using intuition and reasoning, determine the optimal waffle cone that can fit the most ice cream. During this time, you will carefully design a clear and orderly action plan to optimize waffle cone design with your group members.
2. In partners, develop the optimal cereal box using given constraints.
3. Review and give feedback on another pair's cereal box. These mini projects will help you identify the process to apply to a project of your choosing.
4. Individually, choose a product or design to optimize and write a proposal that details the problem and relevant components. Clearly explain the specific problem that you will analyze. Focus on precisely defining the terms, equations, axis labels, and symbols that you use in your report. Create a visual diagram that identifies the significant variables in your problem and include mathematical equations that relate the components of this system to the overall problem. Graph and explain the relationship between variables in this system. You will be presenting this proposal to your Peer Feedback Group. Proposals must have unanimous support to be accepted; revisions can be suggested before proposal is accepted.
5. Develop a clear, detailed action plan to calculate an optimal solution for your overall problem. Each step in the action plan should include a rationale that connects the specific steps to the larger patterns and concepts. Follow these steps to calculate an optimized value. This step will have a peer check before calculations are complete to assess the validity of the process, as well as after the calculations are complete to verify that the same conclusion is reached by independent work.
6. Use the relationship between a function and its derivative to fully explain your calculated value. Explain specific details and examples that support your reasoning, including a graph of both the optimization function and its derivative, to develop your explanation and connect your interpretation to the patterns between variables as identified in your proposal. Include analysis of error and limitation in your justification.
7. Present your solution alongside a physical model based on your optimized values for each component of the problem. This presentation will allow you to received feedback/critique before reflecting on this process.

**Additional Information**

1. **Knowledge and skills you will need to demonstrate on this task:**

* Integrate and synthesize multiple sources of information.
* Use oral and written communication skills to learn, evaluate, and express ideas for a range of tasks, purposes, and audiences.
* Use quantitative reasoning to solve problems arising in everyday life, society, and the workplace.

1. **Materials needed:**

Documents:

* Item A. Optimization Waffle Cone
* Item B. Optimization Cereal Boxes
* Item C. Proposal Outline
* Item D. Action Plan Guidelines
* Item E. Analysis Guidelines
* Item F. Final Product and Presentation Guidelines
* Item G. Bloom’s Project Reflection

1. **Time requirements:**

This task will take approximately 2-3 weeks to complete. Your teacher will provide additional details regarding deadlines and due dates.

1. **Scoring:**

Your work will be scored using the Summit Public Schools Optimization Project rubric. You should make sure you are familiar with the language that describes the expectations for proficient performance.