Element E – Score 2
Crutch Beverage Holder

This entry would be likely to receive a score of 2 based on the EDPPSR. A group of engineering educators who scored this portfolio assigned scores to the Element E entry that ranged from 1 to 3, but the majority assigned a 2. In doing so, some cited the discussion of the importance of center of gravity to the design or the discussion of weight as minimal substantiation of the proposed solution (although one rater noted that there was confusion about weight and mass). There was mixed reaction to the inclusion of the Gantt chart as evidence, some raters "buying into" this but others noting that it did not contribute to substantiation of the proposed solution. The absence of other evidence that the proposed solution is substantiated with STEM principles and/or practices applicable to design requirements and/or functional claims keeps this from a higher score, as does the fact that the entry also lacks evidence of review by at least one expert (a qualified consultant or a project mentor). The absence of that evidence, which is one characteristic of a score point 1 entry, does not require that this entry receive that score, since overall, the best fit with the descriptors supports a 2.

This entry describes what the designers did but does not provide any actual evidence or documentation of what they did. For Element E, stronger entries provide a clear window into the application of STEM principles and practices. As is often the case, more showing, documented with calculations reviewed and confirmed or corrected by outside expert(s) would lead to a higher score.

Engineering Design Process Portfolio Scoring Rubric
Component and Element Titles

Component I: Presenting and Justifying a Problem and Solution Requirements
- Element A: Presentation and justification of the problem
- Element B. Documentation and analysis of prior solution attempts
- Element C. Presentation and justification of solution design requirements

Component II: Generating and Defending an Original Solution
- Element D: Design concept generation, analysis, and selection
- **Element E: Application of STEM principles and practices**
- Element F: Consideration of design viability

Component III: Constructing and Testing a Prototype
- *Element G: Construction of a testable prototype*
- Element H: Prototype testing and data collection plan
- Element I: Testing, data collection and analysis

Component IV: Evaluation, Reflection, and Recommendations
- Element J: Documentation of external evaluation
- *Element K: Reflection on the design project*
- Element L: Presentation of designer's recommendations

Component V: Documenting and Presenting the Project
- Element M: Presentation of the project portfolio
- Element N: Writing like an Engineer

Please Note: Elements M and N require no submission from the portfolio author(s) and are intended to be scored based on the portfolio work as a whole from what has been submitted from Elements A through L

Element E: Application of STEM principles and practices

5 The proposed solution is well-substantiated with STEM principles and practices applicable to all or nearly all design requirements and functional claims; there is substantial evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by two or more experts (qualified consultants and/or project mentors) and that those reviews provide confirmation (verification) or detail necessary to inform a corrective response.

4 The proposed solution is generally substantiated with STEM principles and practices applicable to some design requirements and functional claims; there is some evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by at least two experts (qualified consultants and/or project mentors) and that those reviews provide confirmation (verification) or some detail necessary to inform a corrective response.

3 The proposed solution is partially substantiated with STEM principles and practices applicable to at least a few design requirements and functional claims; there is some evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by at least one expert (qualified consultant or project mentor) but this review may not provide clear confirmation (verification) or at least some detail to inform a corrective response.

2 The proposed solution is minimally substantiated with STEM principles and practices applicable to at least a few design requirements and functional claims; there is minimal evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by at least one expert (qualified consultant or project mentor) but there is no evidence of confirmation (verification) or any detail to inform a corrective response.

1 The proposed solution is minimally substantiated with STEM principles or practices applicable to at least a few design requirements and functional claims; however, there is no evidence that the application of those principles and practices by the student or a suitable alternate has been reviewed by an expert (qualified consultant or project mentor).

0 The proposed solution is not substantiated with STEM principles or practices applicable to any design requirements and/or functional claims.

The solution to our problem will address many STEM (science, technology, engineering and mathematic) concepts.
The Engineering concept of product / project management was utilized at the start of this project. Using the free software download at ganttproject.biz, we created a project schedule that enabled us to track our progress so we will complete this project on time. Our Gantt chart can be viewed at: **Gannt Chart PDF.pdf**
Center of gravity is an important concept of our design. Our Crutch Beverage Holder relies on balance and precision. Therefore, understanding how the center of gravity works is important. Our cup holder, not including the frame, is a symmetrical object. The center of gravity or centroid is in the center of the inside of the cup holder, and closer to the top. Because of this, we made the pivot pins above the center of gravity. This allows the cup holder to stay upright with the bottom of the cup holder maintaining its position. When we fill a cup full of liquid and place it in the cup holder, the centroid moves closer to the top. In order to prevent our cup holder from tipping, we must add a weight to the bottom. This will offset the weight of the liquid and move the center of gravity. The lower the centroid in our cup holder, the more likely it will maintain its balance.
Reducing the weight of our product was a necessity. We decided to make the cup holder as thin as possible in order to reduce the weight and material needed. This is turn would reduce the cost and time it would take to manufacture our product. We also chose plastic as our material. This would affect the density which would also affect the weight. The mass of our product will be equal to the density multiplied by volume. The volume of our prototype would remain constant, but our density would be determined by the material. We also wanted to the change the weight of the product because consumers had told us when there was a 2-3 pound difference between one crutch and another, it would cause an unbalance. They would have a harder time moving from one point to another.
We also used Autodesk Inventor, in which we applied many math and geometry concepts in our design. We used engineering notebooks on a daily basis and recorded the entire design process. There were also many safety requirements we had to follow while using the rapid prototype machine and the hand tools we used to create our prototype.

Name	Begin date	End date
Form teams	6/18/12	6/18/12
Identify Probrem	6/18/12	6/18/12
Justify Problem	6/19/12	6/19/12
Research Existing Solutions	6/18/12	6/19/12
Write Problem Statement	6/19/12	6/19/12
Brainstorming	6/20/12	6/20/12
Determine a Solution	6/20/12	6/20/12
Design a Solution	6/21/12	6/21/12
Build a Prototype	6/22/12	6/25/12
Test Prototype	6/26/12	6/26/12
Redesign	6/26/12	6/26/12
Retests	6/26/12	6/26/12
Prepare Presentation	6/27/12	6/27/12
Practice Presentaion	6/27/12	6/28/12
Present findings	6/28/12	6/28/12
Update Portfolio Daily	6/19/12	6/28/12