Objective/ Background:
To design a barley malting system for Sugar Creek Malting Company for less than $10,000. This design allows for a more uniform high quality roasted product while decreasing the cost from a traditional drum roaster.

Table 1: Stakeholder Requests and Final Deliverables
<table>
<thead>
<tr>
<th>Constraint</th>
<th>Stakeholder Request</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>200 F - 600 F</td>
<td>70 F – 392 F</td>
</tr>
<tr>
<td>Throughput</td>
<td>12 – 15 bushels</td>
<td>Lab scale (0.01 bushels)</td>
</tr>
<tr>
<td>Cost</td>
<td>&lt; $10,000</td>
<td>$10,170</td>
</tr>
<tr>
<td>Equipment</td>
<td>Drum roaster and cooling tray</td>
<td>Conversion oven, fluidized bed for roasting, fluidized bed for cooling</td>
</tr>
</tbody>
</table>

Currently, the only competitor for such a design is a coffee company. If this design were to fail, the Sugar Creek Malting Company could purchase a drum roaster and cooling tray at a higher cost.

Global and Societal Impact:
• Organic Waste/Year: 5,394 kg
• Emissions/Year: 16,624 kg
• Total Waste/Year: 22,018 kg
• Filtered out materials can be composted
• Scrubber on air vented to atmosphere
• Test water for CWA standards before releasing it to streams
• Use heat exchangers to cut down on energy consumption
• Creates jobs for students
• Never been used in the malt industry before

Final Design:

Table 2: Mass Balances and Moisture Content from Roasting
<table>
<thead>
<tr>
<th></th>
<th>Pre-Conversion</th>
<th>Post-Conversion/Pre-Roasting</th>
<th>Post-Roasting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass (g)</td>
<td>400.1</td>
<td>392.9</td>
<td>225.8</td>
</tr>
<tr>
<td>Moisture Content (%)</td>
<td>0.4646</td>
<td>0.4612</td>
<td>0.0567</td>
</tr>
</tbody>
</table>

Economic Analysis:
• Price of roasted malt: $4.25/lb
• Annual insurance: $1,200
• Annual rent: $12,000
• Wages: $50,000
• Estimated sales: 30,000 units/yr
• Production cost: $1.01/lb
• Breakeven point: 2.68 years

Recommendations:
• Scale up of process to batch size of 15 bushels
• Smaller diameter pipes in fluidized bed to prevent the build up of water
• Test with different kinds of barley
• Try to achieve different kinds of malt