Experimental Design Matrix

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>FOOD SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cottonseed Oil</td>
<td>Cheerios</td>
</tr>
<tr>
<td>Combitherm</td>
<td>Peanuts</td>
</tr>
<tr>
<td>Technipaq</td>
<td>Cheerios/Technipaq</td>
</tr>
<tr>
<td>Tolas</td>
<td>Peanuts/Tolas</td>
</tr>
<tr>
<td>Oil in Combitherm</td>
<td></td>
</tr>
</tbody>
</table>

Deliverables
- Quantitatively evaluate each packaging material after final processing for oxygen and water vapor transmission through analysis of ingredients susceptible to moisture uptake and lipid oxidation.
- Qualitatively determine changes in food product attributes through sensory evaluation methods after storage in 3 different packaging films.
- Evaluate the potential of each packaging material based on qualitative and quantitative results.

Purpose
- Evaluate new high barrier food packaging films for use on long duration space missions.
- Determine the effects of:
  - High temperatures during heat sealing
  - Stress cracking from folds in the films caused by vacuum packing
  - Relative humidity during storage

Deliverables
- Develop high barrier food packaging film for long-term space missions.
- Determine the effects of high temperatures, stress cracking, and relative humidity on food packaging.

Food Sample Selection
- Dry cereal is prone to reduced quality from absorption of water vapor.
- Cottonseed oil is susceptible to lipid oxidation in the presence of oxygen.
- Peanuts produce a rancidity marker, hexanal, which can be quantified by analysis of the gas in the headspace of the package.

Packaging Material Information

**Combitherm Film**
- Structure: Nylon/EVOH/Nylon/High Ethylene Vinyl Acetate Polyethylene/LDPE
- PROS: Lightweight and transparent. Microwaveable and can be incinerated.
- CONS: Requires an overwrap film due to poor barrier properties. Overwrap causes a major increase in mass for food system.

**Technipaq Film**
- Structure: A quadslaminate film. PET/Polyethylene/Aluminum/Inomer
- PROS: Best barrier properties available in a film.
- CONS: Film cannot be incinerated or microwaved due to aluminum layer. Film is not clear to allow for food identification.

**Tolas Film**
- Structure: A PET film coated with a thin layer of aluminum oxide.
- PROS: Very lightweight with excellent barrier properties. Transparent film. Microwaveable and can be incinerated.
- CONS: Stress cracking caused by wrinkles during vacuum packing may reduce the barrier properties.