



## 1.5 Concept Generation

Concept generation is a vital part of any design process. Concept generation provides the design team with a breadth of ideas to select a final design from later. Our design team generated 100 ideas for our design problems. This list can be found in Appendix D.

### 1.5.1 Concept Generation Tools

Multiple methods were used in brainstorming our concepts. These include the use of a morphological chart, as seen in Appendix D, biomimicry, and brainstorming. The first 48 ideas in the list came from the morphological chart. Concepts 75-80 on the list were conceptualized through biomimicry, for example, a cockroach shape could be used to mimic an elliptical shape of the tank. The remaining concepts came from brainstorming, research, and speaking with our technical advisor and sponsor.

### 1.5.2 Medium Fidelity Concept

Five concepts from the concept generation list were selected as medium fidelity concepts. These concepts are shown below in Table 4. A medium fidelity concept is a concept that embodies many of the characteristics that the project should fulfill but is likely not the direction that the design team will pursue. Even though they may not be found in the final design, they are still helpful to show what factors are desirable in the project.

Concept number	Description
62	Film that would specifically block and reflect radiation that would be emitted from the sun.
2	The double shell with a vacuum in between the layers would help alleviate heat transfer from conduction and convection.
97	Supports in between the two layers could be made from a ceramic that would not have a high level of heat transfer.
4	A pill shape allows for a good surface area to volume ratio, powdered insulation will help keep the cryogenic fluids at the proper temperature.
82	Foam insulation between the two shells can help keep the cryogen cold.

Table 4: Medium Fidelity Concepts

### 1.5.3 High Fidelity Concepts

Three high fidelity concepts were chosen from the list of generated concepts. These are concepts that meet the needs of the project to a high extent. These will be utilized later in the design process during concept selection to arrive at concepts that best fit the project.

Concept Number	Description
23	Utilizing multi-layered insulation in the fuel storage will be effective at keeping temperatures at cryogenic levels.
99	Securing the tank with clips allows for the tank to be removed from the ship and reused for another mission.



95	Many thin supports between the two tank layers would allow for structural integrity and small, localized sources of heat transfer.
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Table 5: High Fidelity Concepts

### 1.5.4 Eliminating Concepts

In order to find medium and high fidelity concepts, some ideas were eliminated. The first set of idea eliminations included eliminating the thin-walled ideas from the morphological chart. The team found that a thicker wall on the tank would perform better in reducing heat leak into the system. While looking at the morphological chart ideas, the team also found the pill-shaped container would perform better in maximizing the volume of storage while reducing surface area contact of the fluid to the tank compared to the cylindrical shape.

The second set of eliminations led the team to eliminate the triple-shelled idea. The third shell would cost more, weigh more, and wouldn't be necessary since the double-shell will eliminate the conduction and convection that the third shell would target.

## 1.6 Concept Selection

The concept selection process is the part of the design process where the generated concepts are weighed against each other to determine a final design. This design will move forward as the team's main concept for a prototype. This process is completed on Microsoft Excel where values can be quickly calculated and tables can be created. The process and calculated values are explained in the following sections.