



# Psyche Additive Manufacturing

Team 501 - DR 5



FAMU-FSU  
College of Engineering

# Team Introductions



Asael Caballero  
Reyes  
*Thermal Engineer*



Jack DiBenedetto  
*Systems  
Engineer*



Rafe Erisman  
*Mechatronics  
Engineer*



Derek Jacobson  
*CAD  
Engineer*



Joshua Pruitt  
*Material and Design  
Engineer*



Canaan St Lewis  
*Astronautical  
Engineer*

# Sponsor and Advisor



Dr. Cassie Bowman  
Sponsor



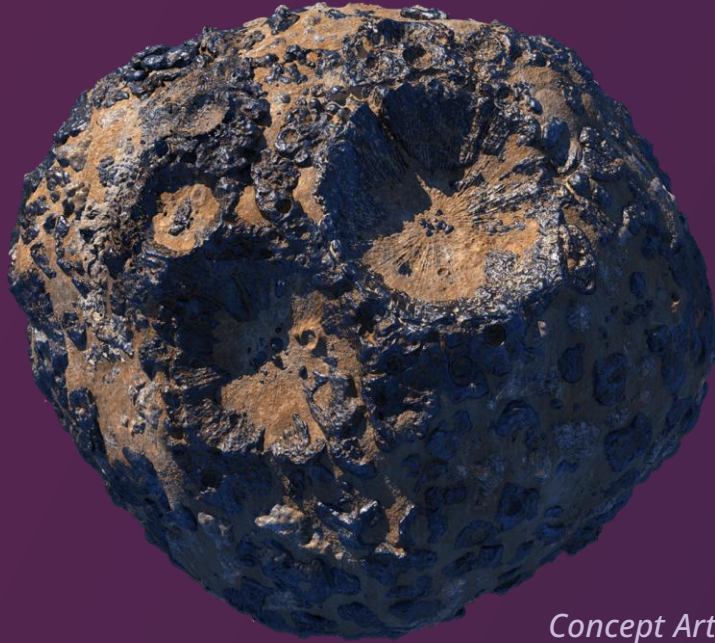
Dr. Dorr Campbell  
Advisor

# Objective

The objective of this project is to design a device for additive manufacturing that prevents metal powder from suspending in microgravity on the Psyche asteroid.



# Psyche Mission



*Concept Art*

- Psyche is an M-type asteroid hypothesized to be a remnant from a planetesimal.
- In 2023, NASA sent a spacecraft to observe Psyche's surface set to arrive in 2029.
- Believed to be composed of 30-60% metal.
  - Particularly iron and nickel

# Project Overview



Design and demonstrate a proof of concept with intellectual merit

- Digital Twin
- Physical Prototype



Design full Additive manufacturing process utilizing our merit



Integrate our system into hypothetical future missions

# Assumptions

## Print Ready Material

- Surface material will be harvested and refined to necessary specifications

## External Power Source

- Sufficient power will be provided

## Repairability

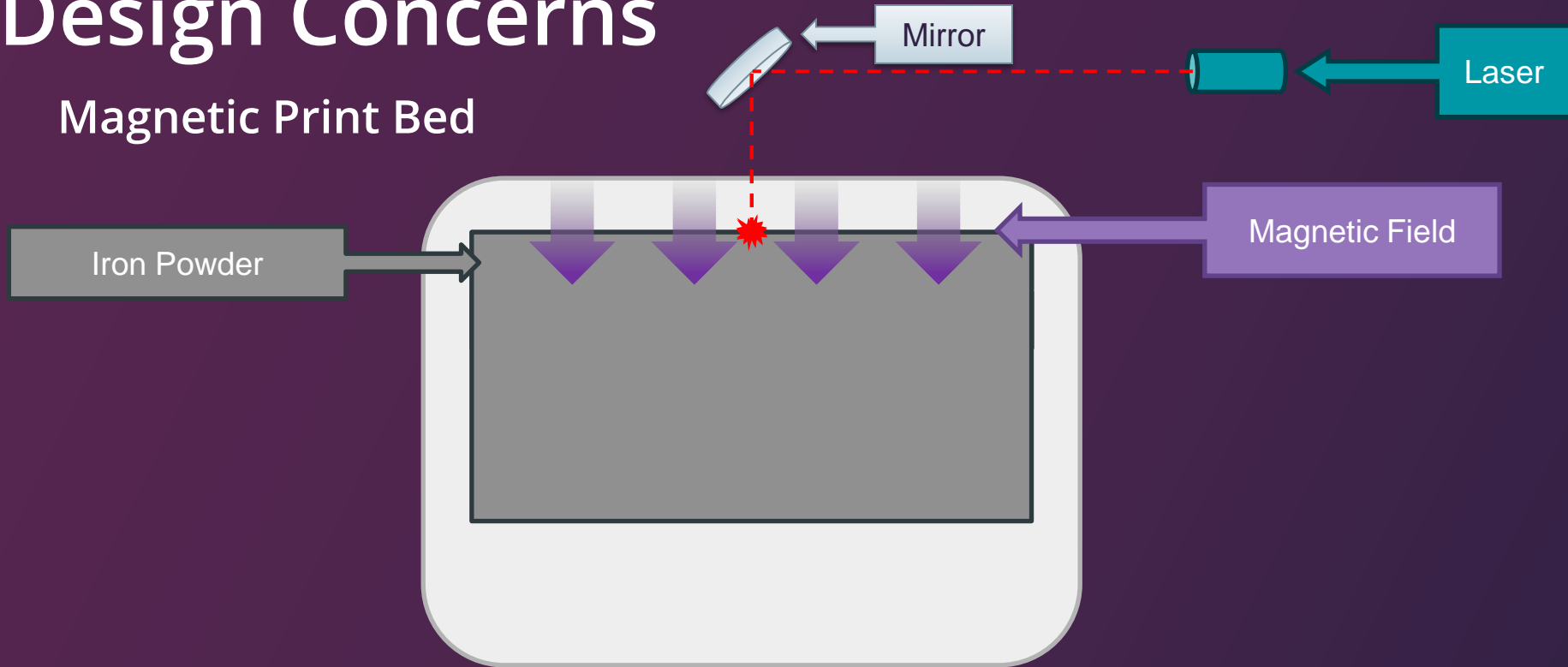
- The system will be maintained by an external system

## Product Delivery

- An external mechanism will be responsible for removing finished prints

# Design Concerns

## Magnetic Print Bed



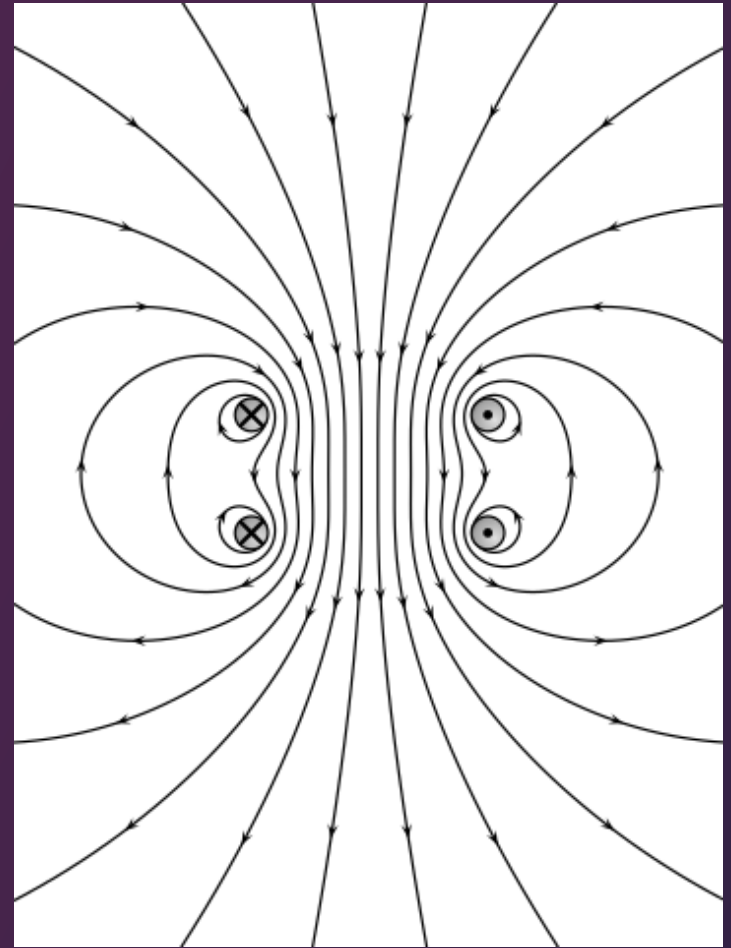
# Magnet Selection/Sizing

## Magnetic Bed

- Reduced Field Strength with Distance
- Size Limitations Limit Magnet Strength
- Clumping

## Helmholtz Coil

- Uniform Magnetic Field over a Larger Volume
- Scalable for Different Sizes/Strengths
- Allows for Environment Adaptability



# Magnet Selection/Sizing

$$B = \left(\frac{4}{5}\right)^{3/2} \frac{\mu_0 n I}{R}$$

$B$  : Magnetic Force at midpoint between the coils       $B$  : 0.02 T

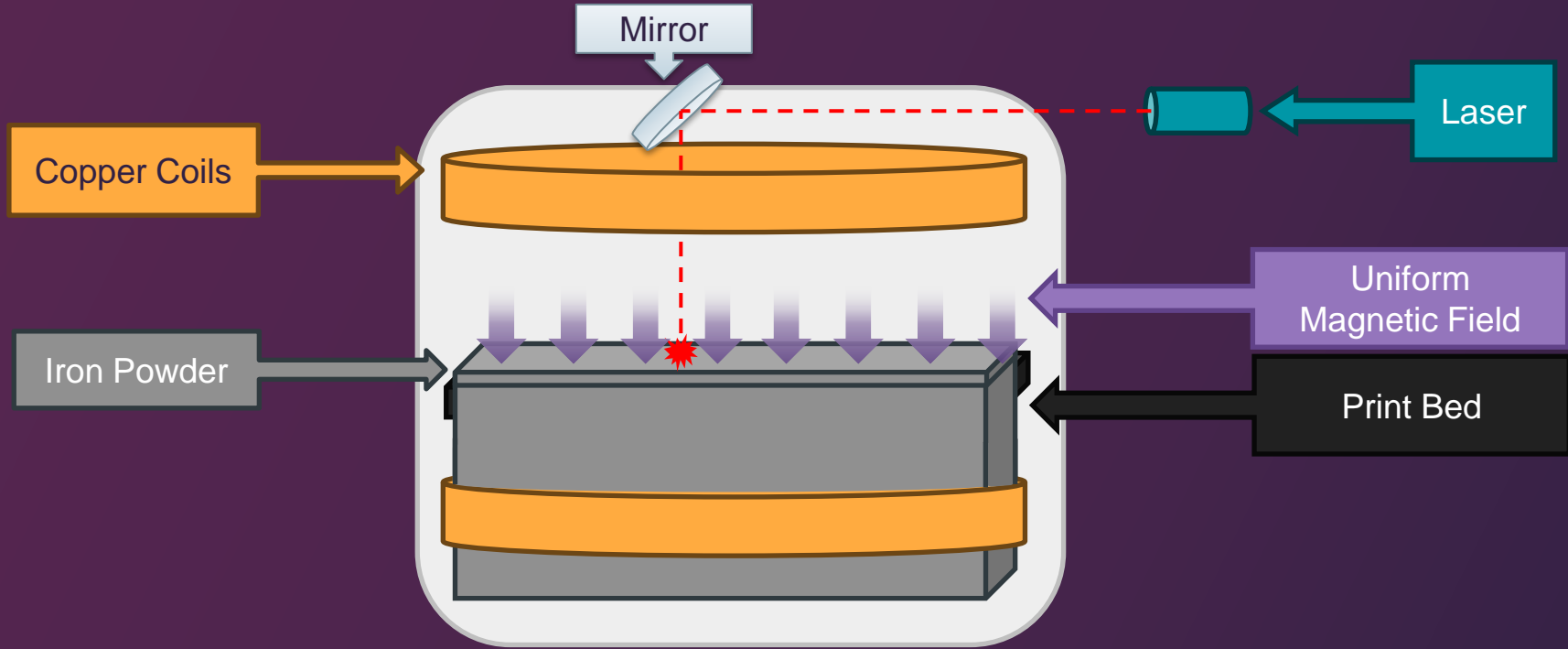
$\mu_0$  : Permeability of free space       $\mu_0$  : Constant

$n$  : Number of coil turns       $n$  : 444.85 turns

$I$  : Current through the coils       $I$  : 20 Amps

$R$  : Radius of each coil       $R$  : 0.4 meter

# Magnet Assisted Granular Iron Control



# Future Work



# Future Work

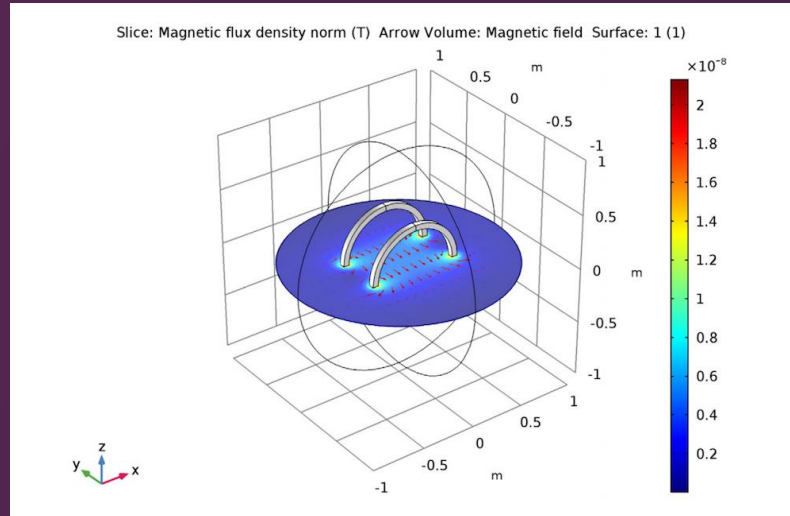
Simulations



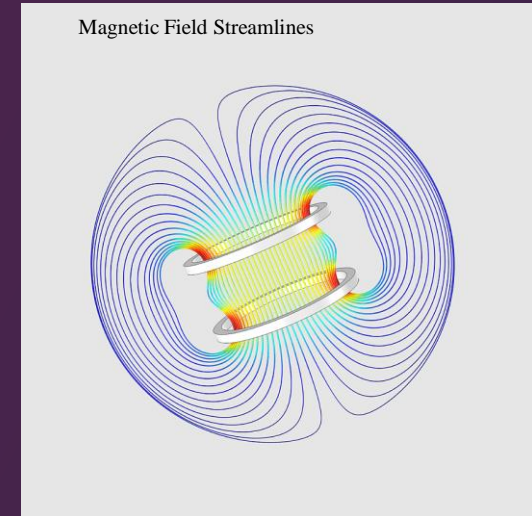
Prototypes



Testing

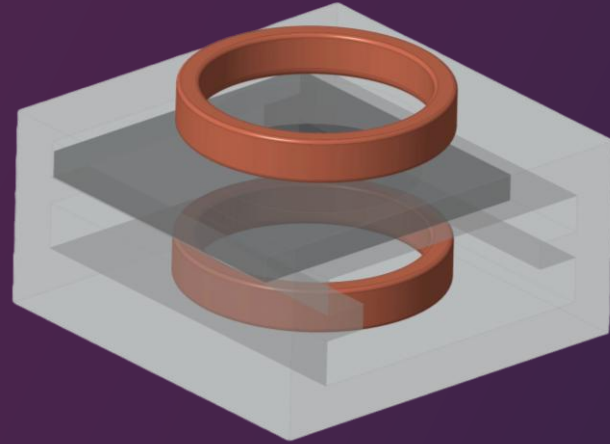


*Bridget Cunningham, COMSOL Blog*

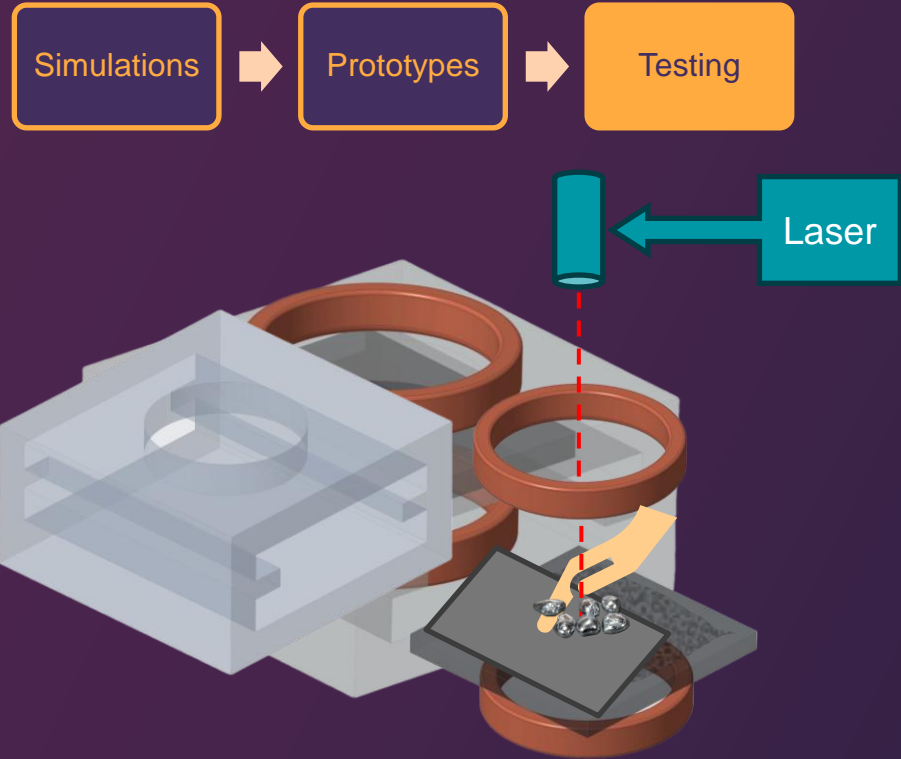
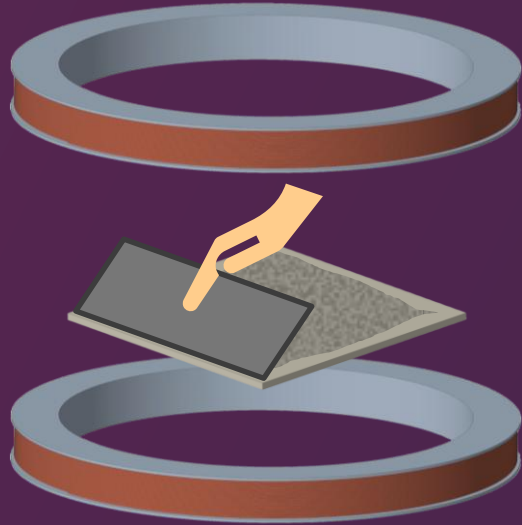


*Concept Art*

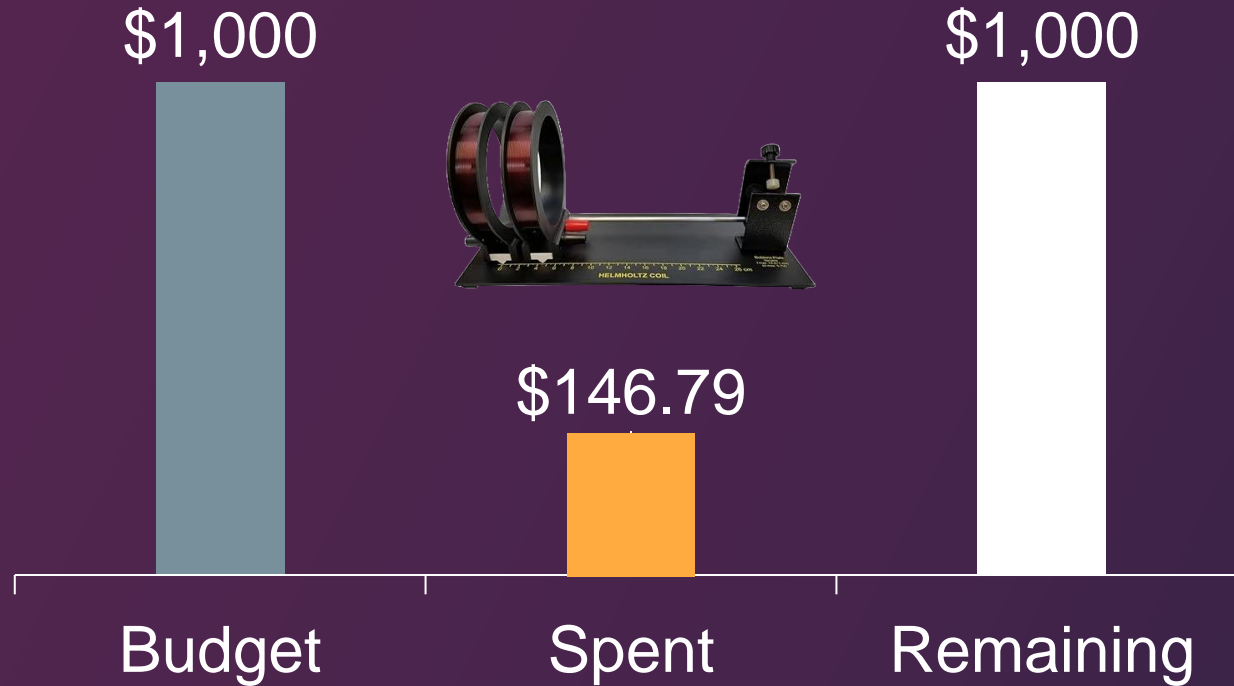
# Future Work



# Future Work



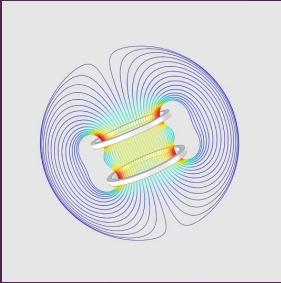
# Bill of Materials



# Recap

The objective of this project is to design a device for additive manufacturing that prevents metal powder from suspending in microgravity on the Psyche asteroid.

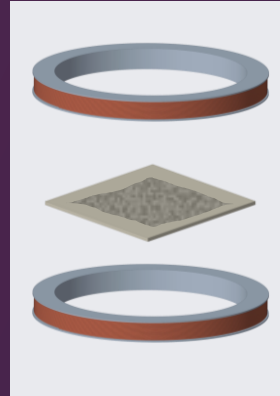
Helmholtz Coil



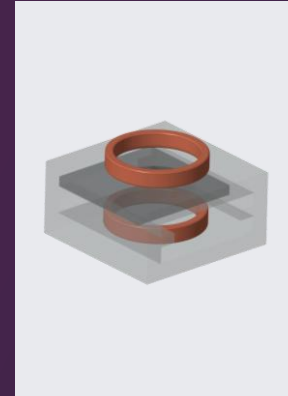
Virtual Twin



Prototype



Validation



# Contact Us



# References

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[https://th.bing.com/th/id/OIP.B\\_eguwvtMZGGE\\_XW89tKwwHaEW?rs=1&pid=ImgDetMain](https://th.bing.com/th/id/OIP.B_eguwvtMZGGE_XW89tKwwHaEW?rs=1&pid=ImgDetMain)

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