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Georgia-Pacific Award

Dual-Degree Engineering with a Mathematics Minor

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Investigating Modularity in 3D-Printed Product Design

This research examines how increasing modularity affects the material use, production time, cost, and customization of 3D-printed products. Three desk organizer designs with different levels of modularity will be designed, printed, and compared to identify the benefits and tradeoffs of modular product design.

Can modular 3D-printed design use less material?

Test subject: a desk organizer



One piece | **Two pieces** | **Four pieces**

Does more modularity help, or hurt?

Research Plan

1. **Choose a simple product**
2. **Design modules in Tinkercad**
3. **Print prototype versions**
4. **Measure material, time, cost**
5. **Compare and conclude**

What changes

1 → 2 → 4

pieces

Design Comparison

Measure	One-piece	2-piece	4-piece
Pieces	1	2	4
Material (g)	**TBD**	**TBD**	**TBD**
Print time	**TBD**	**TBD**	**TBD**
Cost ($)	**TBD**	**TBD**	**TBD**
Configurations	1	**TBD**	**TBD**
Replaceable parts	0	1	4
Assembly time	N/A	**TBD**	**TBD**

Filament Cost and Weight

Material	Cost per kg	Density (g/cm³)
PLA	**$20**	**1.24**
ABS	$22	1.04
PETG	$22	1.27
TPU	$30	1.21
Carbon fiber	$50	1.29
PVA	$100	1.23

Prices approximate · higher density = heavier part

Why PLA?

1. **Low cost**
   About $20 per kg
2. **Easy to print**
   Works on a basic printer
3. **Low warping**
   Modules stay flat
4. **Plant-based**
   Renewable plant source

Trade-off: less heat resistant than ABS

Cost to Produce



One piece

Make it: $___

Fix a part: $___

Two pieces

Make it: $___

Fix a part: $___

Four pieces

Make it: $___

Fix a part: $___

Cost = Material + Print Time

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