



# FOLDABLE

Music Stand

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Purpose, Audience, & Varieties

# Background



# Purpose and Audience

- Holds sheet music, books, tablets
- Main attraction is portability and compactness
- Musicians
  - Singers, strings, brass, percussion, beginners, advanced
  - Versatile

# Music Stand Varieties

- History
  - Ancient China, Europe
- Patents
  - American patents from mid 1800s
  - No overlap with our design improvements
- Materials
  - Metal: steel, aluminum
- Build
  - Solid back or skeleton
  - Foldable
  - Portable



Product Information & Challenges

# Product Analysis



# Nomad™ Stand

- Original price tag: ~\$15
- Materials: Powder Coated Steel, ABS Plastic, Rubber
- Three subassemblies:
  - Main Frame
  - Shafts
  - Tripod





# Challenges

- Many precisely interlocking parts that must move in specific ways
- Powder coating led to inconsistent dimensions from part to part
- Creating a solution that did not undermine the strengths of the product

# Weight Analysis

	Full	Frame	Shaft	Tripod	Extension
Actual (g)	<b>924.6</b>	367.2	266.2	225.2	66
Estimated (g)	<b>777</b>	256	247	180	94
Difference (g)	<b>147.61</b>	111.2	19.21	45.2	28
% Error	<b>16.0%</b>	30.3%	7.2%	20.1%	42.4%

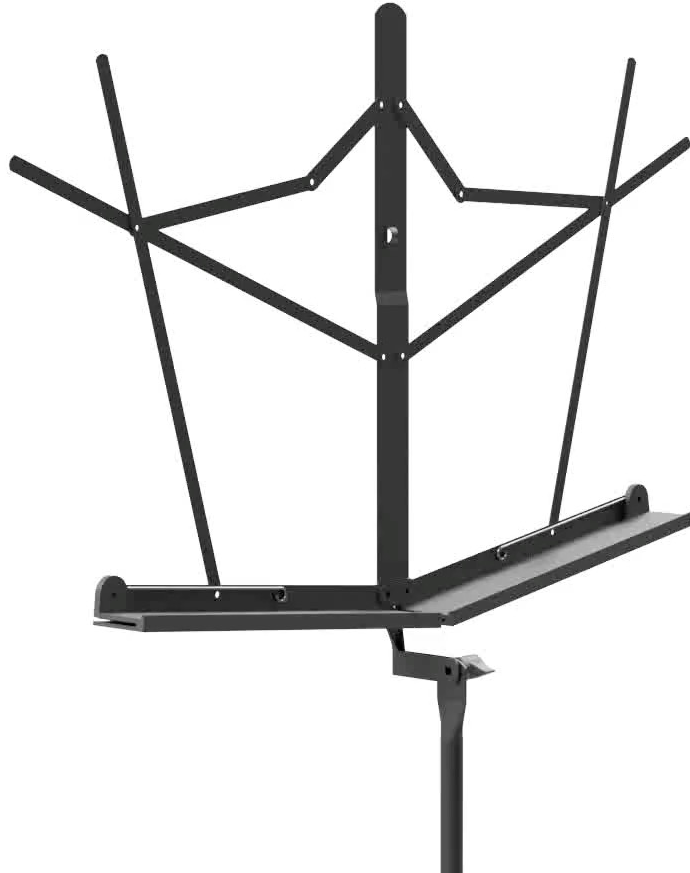
Full assembly weight is off by 16%

- Steel is powder coated
- Some plastic pieces have metal inserts
- Extensions are micro carbon fiber filled nylon versus just generic thermoplastic resin

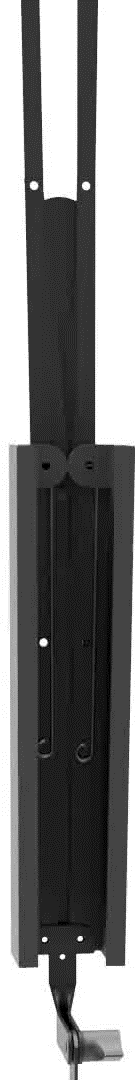
Allowed us to estimate plastic as ABS versus PC/ABS or HDPE



# Folding



# Folding



# Folding





Disassembling

Details of each section

# Sub-Assembly



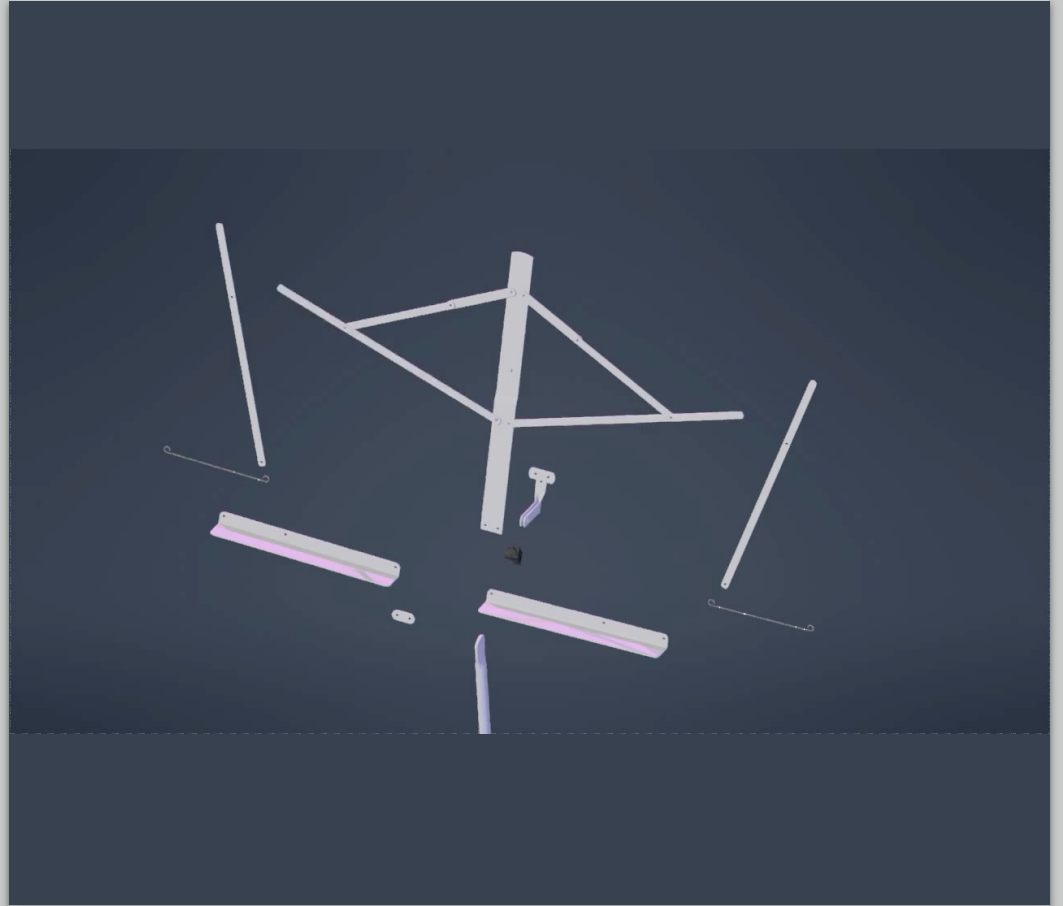
# Frame

- Foldable for compact
- Holding music books, sheets, etc.
- Adjustable angle
- Actual weight: 367.2 g
- Estimated: 256 g



# Frame Components

- Long Linkages x4
- Med. Linkages x2
- Small Linkages x2
- Spine
- Base x2
- Bracket
- Joint
- Clasps x2
- Knob





# Frame Component Purposes

- Linkages
  - Give support for sheets
- Spine
  - Main support for back
- Bracket
  - Connects base to joint
- Joint
  - Connects frame to shaft
- Sheet clasps
  - Clip in sheets to frame
- Knob
  - Allows for angled adjustment



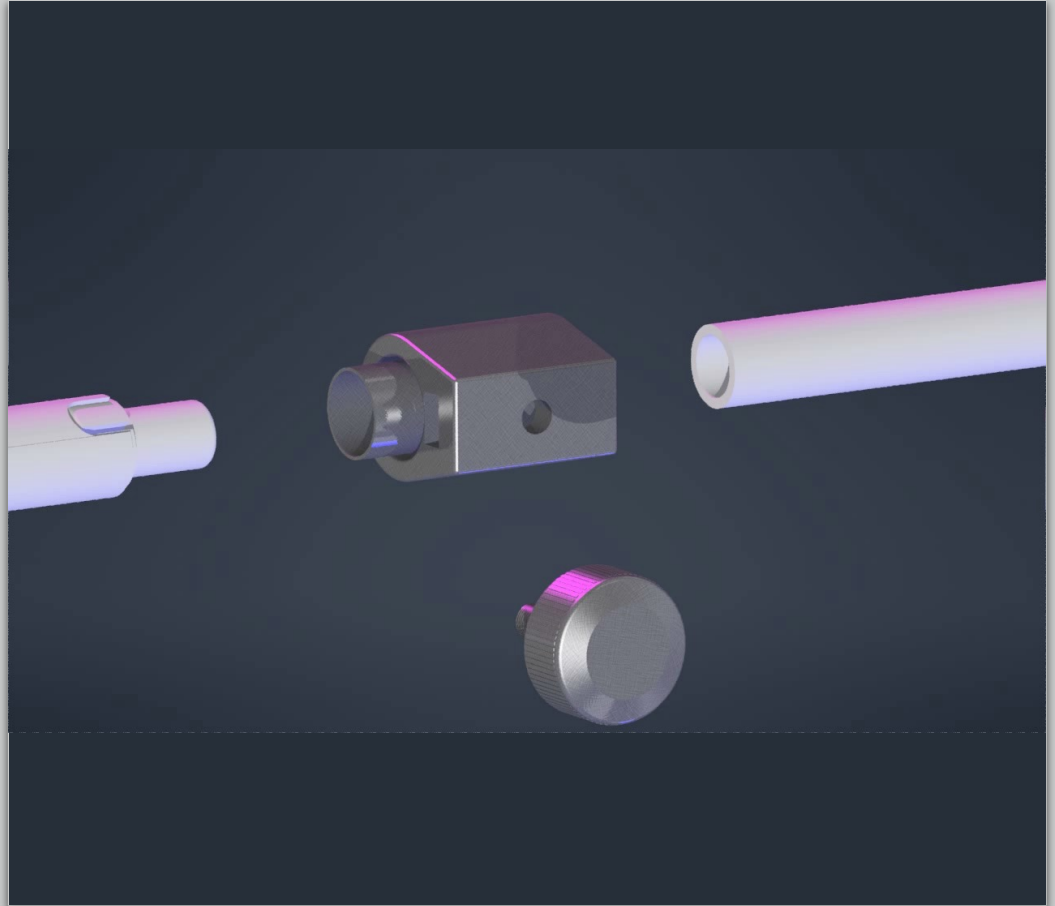


# Shaft

- Connection between tripod & frame
- Adjusts height
  
- Actual Weight: 266.21 g
- Estimated Weight: 237 g

# Shaft Components

- Upper shaft
- Lower Shaft
- Knob
- Shaft connector
- Shaft insert





# Shaft Component Purposes

- Shafts
  - Main supports
- Knob
  - Allows for height adjustment
  - Connected to shaft connector
- Shaft connector
  - Connects shafts together
- Shaft insert
  - Small part inside lower shaft that inserts into shaft connector



# Tripod

- Adjusts height of stand
- Provides support for the stand

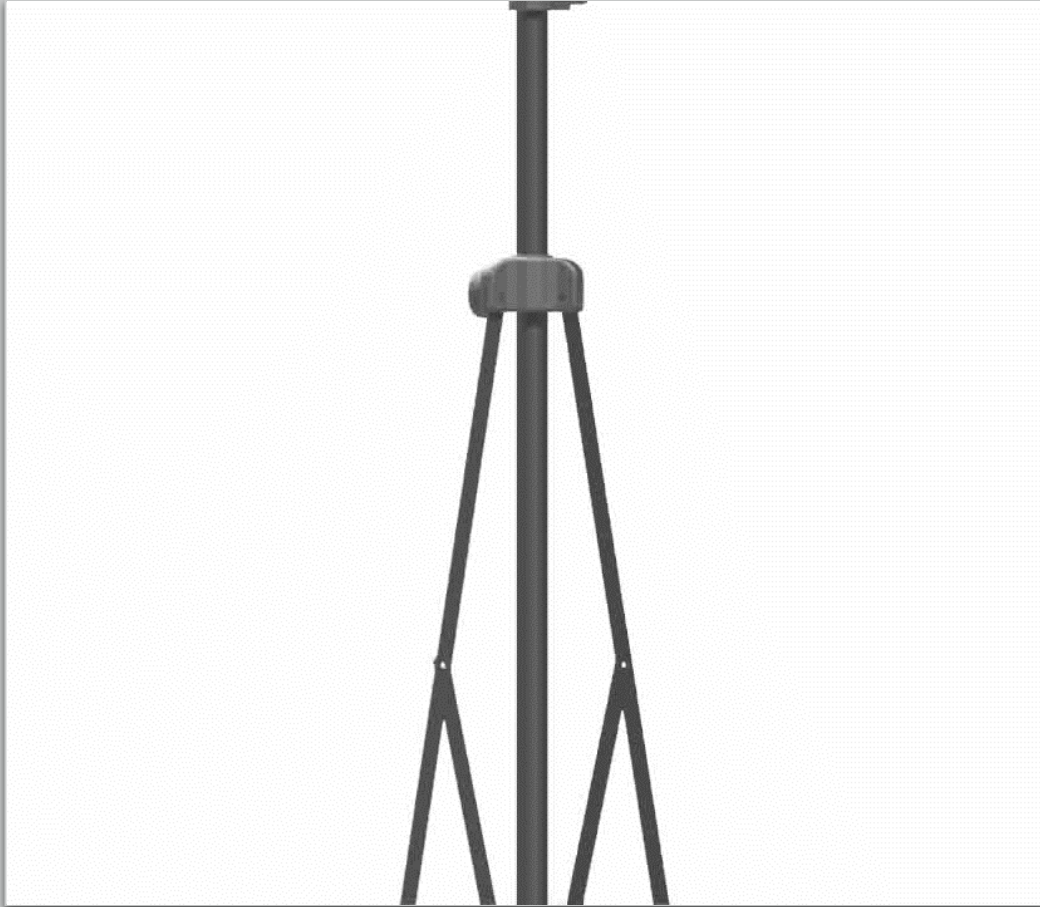
Actual weight: 266.21 g

Estimated weight: 247 g

# Tripod Components

- Adjustable knob
- Linkage knob
- 3 smaller linkages
- 3 rubber feet
- 3 long linkages
- Tripod runner





## Tripod Component Purposes

- Linkage knob holds small linkages in place
- Tripod Runner moves long linkages up and down, expanding the base
- Knob secures Runner
- Feet provide friction

# Strengths

- Transportable
  - Compact
  - Subassemblies fold up and nest
- Sturdy
  - Made of sheet metal; riveted
- Lightweight
- Inexpensive
  - \$15-20
- Adjustable
  - Height and base width can vary according to need

# Weaknesses

- **Primary purpose is to hold music, but does not work well**
- 1. Flat base on our initial stand, slightly different brand only has a small bump
  - Music slides off the front
- 2. Not wide enough to hold more than 2 sheets of music
  - Requires page flipping, which then falls off of the front due to problem 1



Resolving problems and issues

# Our Solution



# Solution Requirements

## Address two main weaknesses:

1. Music can slide off the stand
2. Base is not wide enough to hold >2 pages

### Maintain strengths

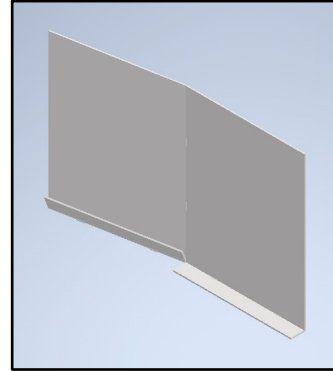
- Low cost
- Compact
- Sturdy
- Lightweight

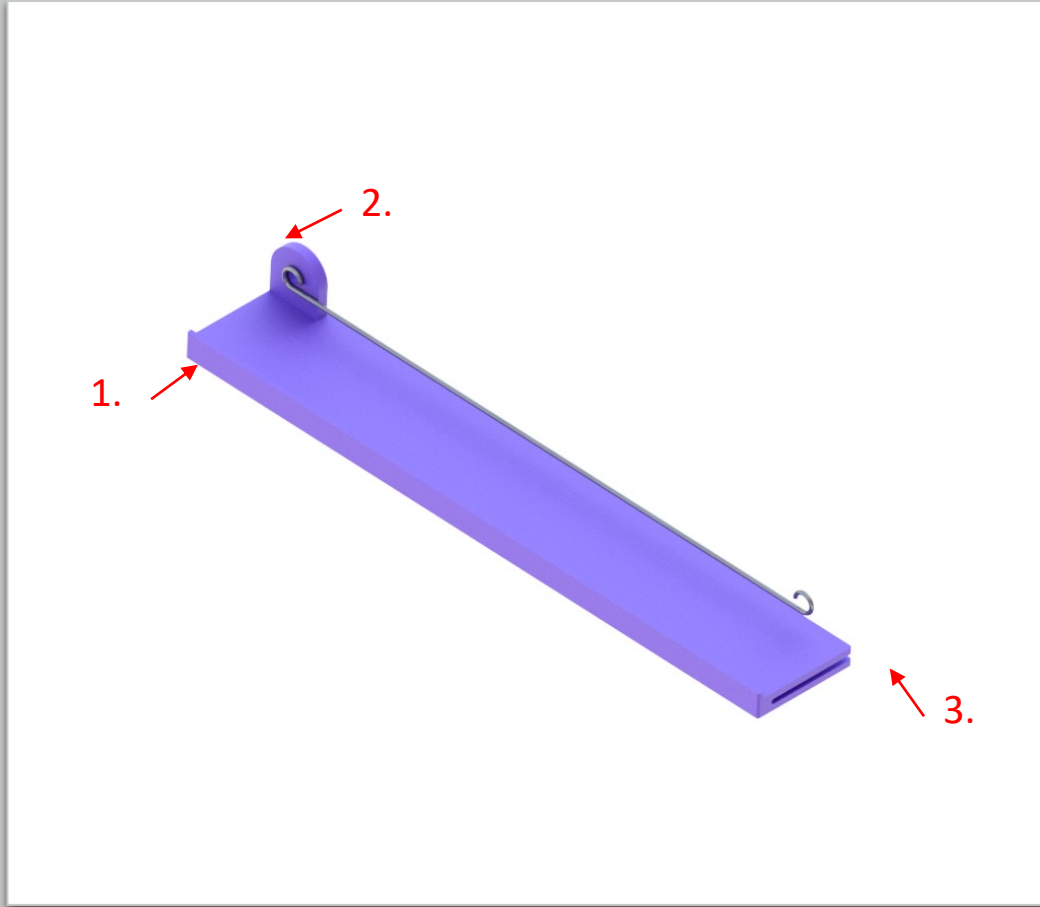
### Ease of Reproduction

- No use of excess support material
- Limit complexity to ensure it meets four requirements

# Solution Options

- Solid back that could double as a music folder
  - Costly
  - Difficult to apply to any music stand
- Shaft attachment to hold water bottle, etc.
  - Difficult to counterbalance
  - Variations already exist
- **Extension with front lip to hold more music**

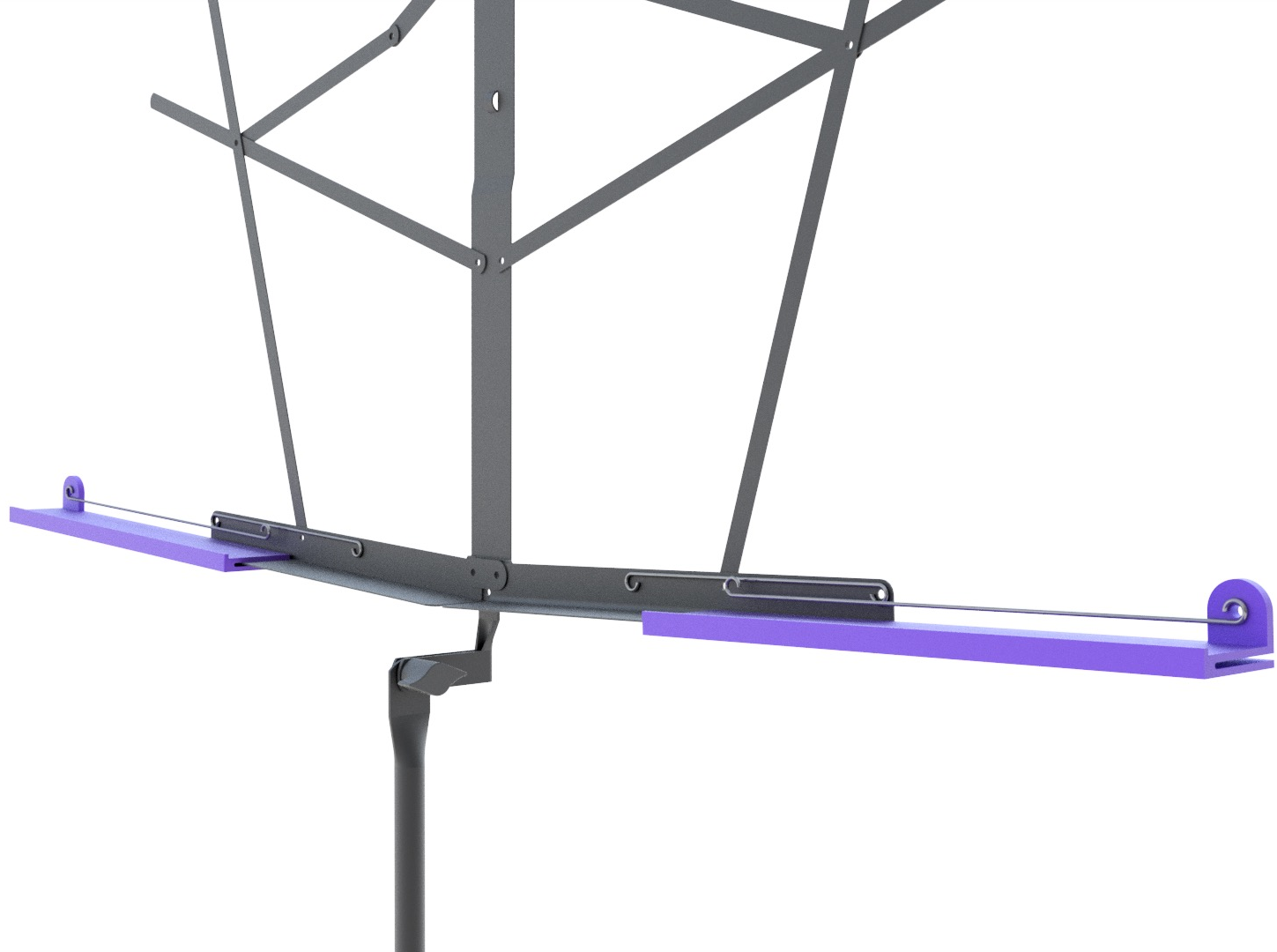




## Base Extension With Lip

- Lip to prevent pages from sliding
- Tab to hold wire back support
- Gap sized for interference fit





# Portability & Manufacturing

- Thin and lightweight
  - Only 66 g
  - <8% of the stand's weight
- Minimal complexity allows for easier manufacturability
- Maintain foldability



# Future Design & Manufacturing

- Universal design
  - Adjustable thickness of addition
    - Snap fits
    - Sliding top piece with different height options
- Maintain product simplicity
  - Keep 3D model design
- Affordability
  - Cost of production
  - Plastic; injection molding
  - Aluminum





# Conclusion

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- Addresses main weaknesses
  - Prevents music from slipping off
  - Holds 4 pages of music versus 2
- Maintains existing strengths
  - Lightweight
  - Durable
  - Inexpensive
  - Versatile
  - Portable



**Questions?**