Accordian Bookcase

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PROJECT MISSION

Design a Multipurpose and Spacious Bookcase that uses sustainable materials.

PROJECT GOALS

- Accommodate as many books as possible without compromising the safety and strength of the bookshelf.
- Design the bookcase so that it is modular and can be moved around the room to accommodate a space with an open floor plan.
- Use sustainable and environmentally friendly materials in the production of the bookcase.
- Expand the functionality of the bookcase so that it is multipurpose.

PROJECT CHALLENGES

- Difficulty in designing the hinges in SolidWorks.
- Deciding how to assemble the bookcase via notches, nails, dovetails, etc.
- Figuring how to lower the center of gravity to provide better stability.
- Figuring out the measurements to minimize any weakness in the design.
- Determine the proper orientation (face out/face in) of the units to maximize the usefulness.
- Finding sustainable material in SolidWorks.
- Original design called for bamboo.
- Determining proper orientations in SolidWorks for mating of indidvidual bookcases with hinges.

PROJECT PLAN

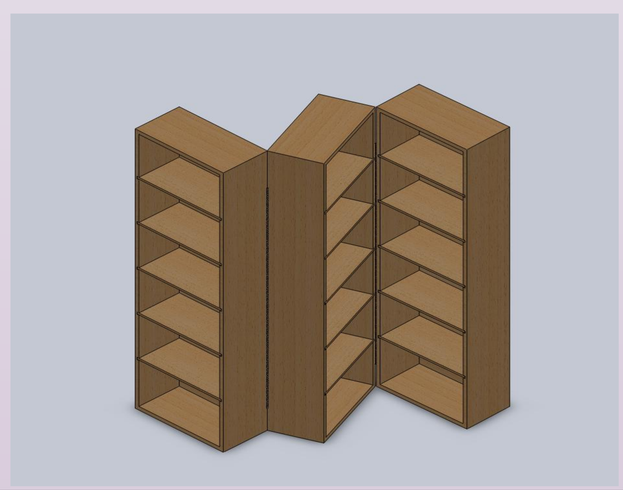
- Two students were assigned to complete the assembly of the project. This involved:
  - o Creating uniformly spaced notches in the bookcase
  - o Mating the shelves to the bookcase to line up with the notches
  - o Duplicating the unit bookcase to create three bookcases
  - o Moving the three unit bookcases so that they are placed in a Z formation to attach the piano hinges
  - o Mating the piano hinges in the correct position so that the three unit bookcases can fold up to take a smaller footprint in the room
- Two students were assigned to work on the poster and power point presentation. One student worked on the open template while the other student sent responses through email. In addition to completing these deliverables, they needed to decide on the overall Project Mission and Classroom Application.
- Team members were switched to optimize experience and expertise.

POSSIBLE SOLUTIONS

- A single bookcase with a broader base that tapers to less depth at the top.
- Modular cubes that can be stacked in various formations to fit different geometries.
- Modular units that can be folded and expanded like an accordion to have a minimal footprint for storage.
- A bookcase that can act as a room divider.
- A two-sided bookcase with deeper shelves at the base and tapers at the top.

FINAL SOLUTION

- A bookcase that is composed of three units linked by piano hinges.
- The bookcase is linked to form a Z-formation.
- Each unit of the bookcase is identical in design and dimension.
- The units are uniform from top to bottom.
- When fully expanded, all three units face the same direction.
- When collapsed, the two exterior units face outward and the interior unit is sandwiched between.
- The material choice is bamboo because it can grow up to 24 inches per day.



LESSONS LEARNED

- Learned how to use the shell feature to create a box from a simple extruded rectangle.
- Learned how to sketch on a side of the part instead of sketching on a plane.
- Learned how to use the extruded cut tool to create notches in the part.
- Learned how to use the pattern feature to duplicate a task that could be very time consuming in SolidWorks.
- Learned how to create a piano hinge in SolidWorks.
- Learned how to create an extruded right triangle using the polygon tool and revising the sides and angles.
- It was very helpful to have one person on the team who was a SolidWorks expert but more than one person on the team would have taken away from the learning experience for the other team members. Each team member took turns in the design process on SolidWorks.
- The decision to use nails, dowels, pegs, notches, or slots in the assembly of a project is a complicated decision with ramifications to consider. As a consumer, we take assembly for granted, for example, using nails in a bookcase could potentially be very time consuming.
- Although more sustainable building materials exist, such as bamboo, they do not exist in SolidWorks.

CLASSROOM APPLICATION

- Utilize the SolidWorks website resources so that students who are having difficulty designing more complicated parts such as wheels or hinges, can download these pieces.
- Depending on the skill level of the students, allow them to use nails or glue without potential ramifications.
- Provide cardboard for the students to experiment with their design.
- You could challenge the students to attempt their design with no nails for differentiated instructions.
- Provide exemplary examples of the deliverables that are similar but not identical to the constraints of the project so not to reveal a potential solution yet provide students an idea of what is expected as a final product.