

1 Alternative Solutions

This section provides eight proposed alternative solutions developed by the team. The alternative solutions are described and illustrated in detail to provide a clear demonstration of the team's brainstorming results. Each heading describes solutions to different parts of the upcycled corn hole boards using various materials and/or methods of application. Sketches for each section are done on *DrawBoard PDF* for visual clarity.

1.1 Upcycled Wheels – Metal Cans

One alternative solution for transportation of the corn hole boards, is metal cans. Metal cans could be filled with cement or another building material (such as: plastic, ceramic, concrete). There would be a hollow center; that way an axel could be attached to use the can as a wheel. Depending on what substance is used to fill the cans, the corn hole boards could end up being heavy. Heavier than if skateboard wheels were used. Upcycled metal cans would tie into an educational theme of reuse; they would also be a unique artistic touch. Metal can wheels would also allow the board to be transported by rolling, unlike a board without wheels. However, the wheels could make it harder to lift the board off the ground; due to the weight. Metal can wheels would also require time to build, as opposed to skateboard wheels which are ready-made. If a wheel needs replacement, it could be potentially harder to replace a metal can wheel, as they aren't "for sale".

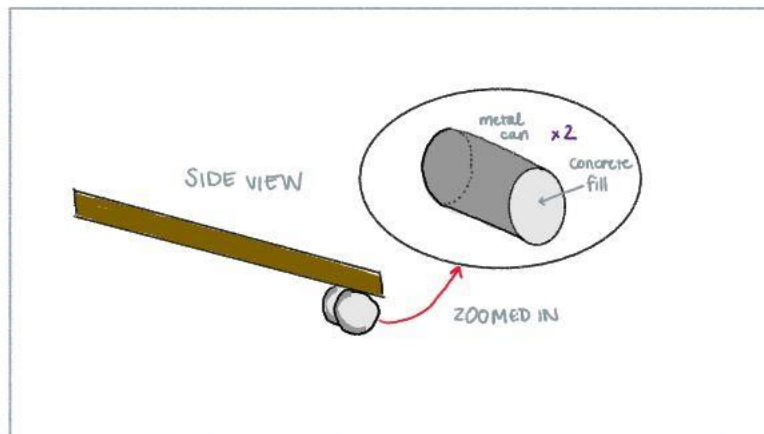


Figure 1 Metal Wheels

1.2 Skateboard Wheels

Another alternative solution for mobility of the boards are simple skateboard wheels. With skateboard wheels, the boards will be easier to move around and won't be as heavy as tin can wheels filled with cement. Skateboard wheels would need an axel like the tin

can wheels, but wheel bearings would help the wheels move better and faster when working against friction. Another benefit for using skateboard wheels is that they would be easier to replace. Skateboard wheels can be bought in bulk for a cheap price. Because of that, wheels can be stored and if anything were to damage the ones on the board, there will be spare ones to switch onto the cornhole boards

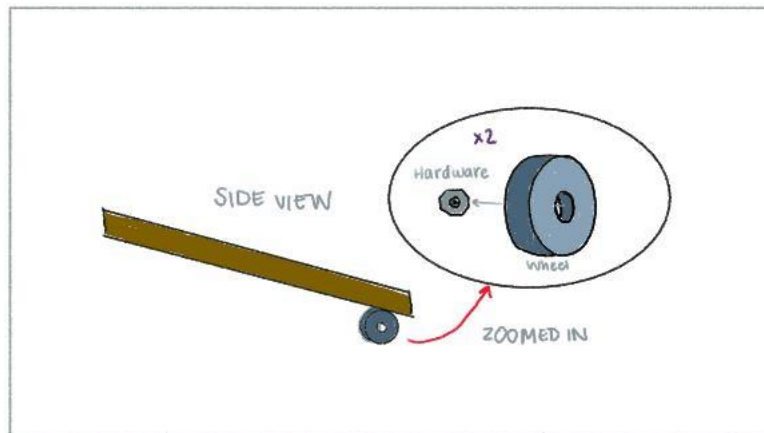


Figure 2 Skateboard Wheels

1.3 Rubber Tire Surrounded Edges

An alternative solution applying to the edges of the board would be to fix cut tires to the outside perimeter of the boards. With the tires on the edges, the edges won't be sharp, they will last longer, and the outer wood will be protected from water and chipping in some cases. To apply to tires to the sides, we will need to acquire 8-12 old car tires, cut them to the right width, and fix them to the boards.

To cut the tires we will need to use a strong utility knife. Examples online show how easy it is to cut a tire. One could also use strong bush clippers that have leverage to cut the tires. To fix them to the sides, a staple gun, long screws, or anything industrial and strong enough to hold the tires to the boards will work.

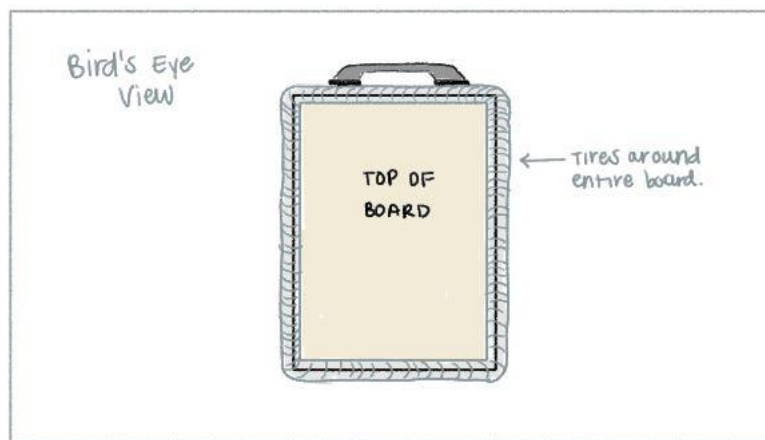


Figure 3 Tire Board

1.4 Sanded Edges

An alternative solution for the edges would be to sand the edges of the boards instead of putting tire rims surrounding the borders. Including the tires that surround each board will make each one more durable and take off any sharp corners that they could have. However, if the group is unable to acquire the right width of tire, or for some reason using the tire borders doesn't work out, sanding the border will be the alternative solution.

Sanding is a strategy that carpenters, artists, and many others use to smooth an object to make it less abrasive. When sanding, it is important to use the right grit and type. There are four different types of sandpaper including ceramic, aluminum oxide, garnet, and silicon carbide. There is also a range of grits that exist going from 40 to 220, the lower the grit number the rougher the paper is.

For the sanding of the side of cornhole boards made of plywood, one would want to use a medium grit, and any type of paper. It is really based off how smooth you want the surface to be. The edges of the cornhole boards don't need to be smooth but can't be sharp; therefore, we could use a low grit paper.

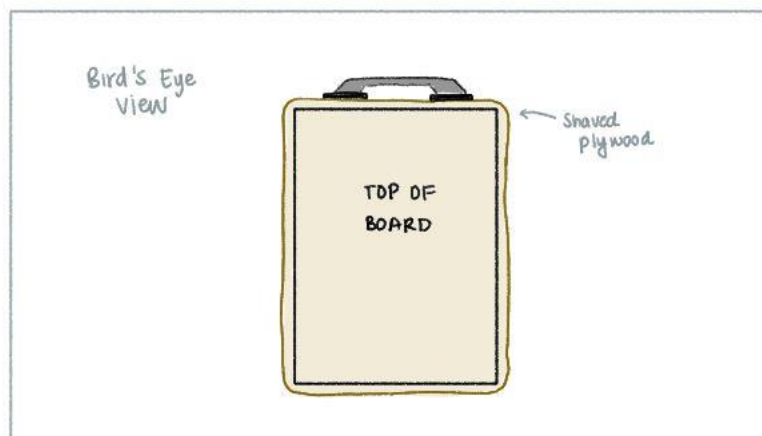


Figure 4 Sanded Board

1.5 Hardware Attachments (Nuts, Bolts, Screws, Rivets)

Metal hardware is a potential solution for joining surfaces together.

Nuts and bolts join surfaces together by screwing together and compressing the two surfaces. Friction between the threads of the fasteners is what creates compression. In situations where parts are moving frequently, nuts and bolts can loosen. However, they are easy to tighten. Nuts and bolts would also make the cornhole boards easy to repair. This is because they are very replaceable, and do not require complicated repair, or curing time (as adhesives often do). There are solutions to improve the longevity of the

bond, and too decrease the frequency of maintenance. Using self-locking nuts would be one way of decreasing maintenance. Self-locking nuts reduce loosening by incorporating elastic ring of material for the bolt or screw to lock into. Jam nuts, lock washers, and thread locking fluid are other methods of increasing the longevity of the joint.

Rivets are fasteners that permanently join metal surfaces together. Rivets can be placed in punched holes in the metal surfaces being joined. Blind “pop” riveting is a fairly simple and quick way of joining metal surfaces. Blind/pop rivets are installed using a rivet gun. Rivets would likely last longer than nuts and bolts. However, (as with adhesives), rivets are more complicated to install, repair, or replace than nuts and bolts.



Figure 6 Hardware to join metals.

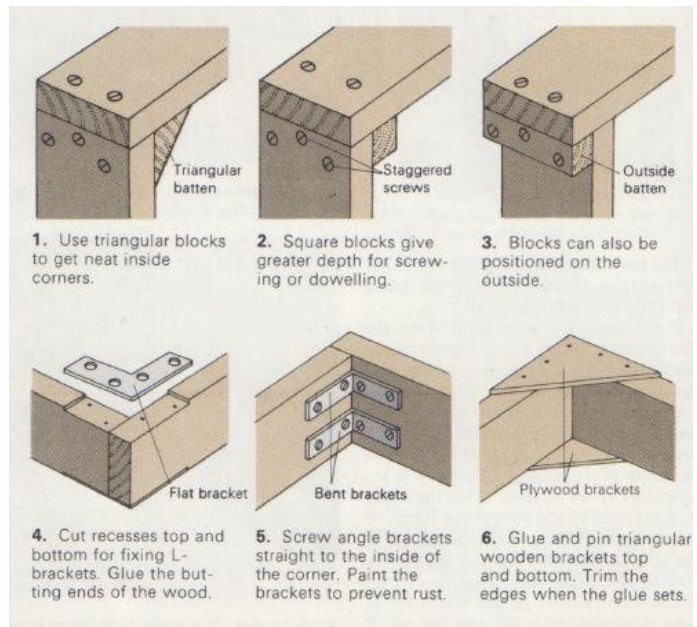


Figure 5 Hardware to join wood.

1.6 Glue/Adhesives

The seventh alternative solution is to use glue and/or other adhesives to bond the surfaces together, instead of nuts, bolts, and screws holding the surfaces together. Using a glue type adhesive would remove any potentially sharp parts sticking out (ex. A bolt sticking out the back end). However, adhesives would potentially have a shorter lifespan and/or be less weather resistant than metal hardware. If the group can't find the right hardware or is not succeeding at placing the hardware in a way that will be non-hazardous, a glue or other adhesive would be an alternative solution.

There are many types of adhesives that could be considered in making a corn hole board. Cyanoacrylate (super glue) or epoxy could be used to create a bond between surfaces of the corn hole boards. Epoxy surfboard resin is a fairly inexpensive, and can

withstand a great deal of force. Surfboard resin is also waterproof, and can cure underwater. A downside of using surfboard resin would be when a board breaks, that the teacher or maintenance would be unlikely to repair it if the repair required resin. Super glue is a commonly available adhesive that most people know how to apply. Super glue can form weak bonds between smooth surfaces. Super glue has a low shearing strength. Therefore, using an epoxy would most likely be the best alternative to hardware.



Figure 7 Joining wood with glue

1.7 Board Cart for Transportation

One last alternative for mobility of the boards is a cart. Having a cart is a simple way to move the boards around, but that means the boards must be light enough to be lifted onto the cart. The cart would have a flat surface (board made from wood or metal) that is a little bit bigger than the cornhole boards. There will be four wheels underneath it that support the board off the ground and enable it to move freely. In the back of the board, will be railings that will be used as handlebars (made from PVC pipe) which helps steer the boards in any direction.



Figure 8 Corn Hole Board Cart