

LESSON OVERVIEW FOR PARENTS



Design and Build a Working Cardboard Chair

These days it seems that there are a lot of cardboard boxes piling up. Lets make use of these while learning about some engineering concepts. Use those concepts to design and construct a usable chair.

Lesson objectives

- Explain a functional chair design using the Engineering design process.
- Explain the concept of structural engineering.
- Design a comfortable chair for a specific user demonstrating construction methods.
- Identify successful support structures using physics and engineering skills

Outcomes

- Students will use the Engineering Process to design a functional cardboard chair.
- Students will demonstrate an understanding of structural components used to construct a functional cardboard chair by constructing a chair.
- Students will test and asses the functionality of the cardboard chair.
- Student will follow the Engineering Design Process to make changes and improvements to the cardboard chair.

Resources

• The Cardboard Chair Challenge

https://youtu.be/FuAqA GhVQ0

https://www.youtube.com/watch?v=hbiwVOUGEQc

We would love to see your child's creativity so please tag us at James E. Richmond Science Center on Facebook and Twitter. Thanks for visiting! See you soon!

ENGINEERING CHALLENGE DIRECTIONS

Design and Build a Working Cardboard Chair



PURPOSE

Engineering challenges are a fun and educational activity to solve a stated task. There is not a single solution or one correct answer for each specific challenge. Rather you are encouraged to try alternative solutions and use the Engineering Design process to meet each mini-lab or challenge for the optimal result.

ENGINEERING DESIGN PROCESS

The **engineering design process** is a series of **steps** that engineers follow to come up with one possible solution to a problem. Often the solution involves **designing** a solution that accomplishes a certain task and/or meets certain criteria. However, one very important aspect of the design process, is the feedback loop. This is used to look at outcomes and then make adjustments to develop a solution that is more successful at meeting the task.



Design and Build a Working Cardboard Chair

Parameters / Constraints

- Be made entirely out of cardboard and use no glue or tape.
- Maintain the original color of the boxes (no painting or coloring)
- Chair must have a seat and a backrest (aka- no benches or stools)
- Chair must be at least 17" off the ground
- Be portable (able to be carried through doors).
- Be comfortable to sit in
- Chair must successfully hold your weight

Design Considerations

- The strength of any material can be increased or decreased by changing its form
- Weak materials can be strengthened through folding, creasing, layering or other modifications
- Load distribution is key in identifying areas of potential weakness
- Cardboard has a grain that runs parallel to the corrugation inside (determine which direction gives the cardboard the greatest strength).
- The type of joints used to connect the pieces will increase the overall strength of your chair

Terms

- Beam: a supporting member that transfers weight from one location to another.
- Center of gravity: the single point in an abject that gravity pulls on.
- Compression: a force that presses or pushes towards an object's center.
- Load: weight that is carried by an object.
- Strut: a brace or support.
- Truss: a triangular support.

Useful Resources:

Videos

https://youtu.be/FuAqA_GhVQ0



TYPES OF CORRUGATED CARDBOARD



Construction Techniques

Here are some examples of cardboard construction techniques. You may use any of these or develop some of your own.

Stacking: Cut multiple layers of card-board and stack them together (Figure ,1) to achieve thickness and stability





Folding: Fold cardboard into the desired shape. Triangular shapes (Figure 2), with the base at the bottom, are the strongest.



Notch: Cut a slot on one side of the cardboard, and a tab on the other. Fold the piece and insert the tab into the slot to hold it in place (Figure 4).

Flange: Cut tabs into the end of a tube, and spread them out flat to give the tube more stability (Figure 5).











Figure 4



Figure 5

Construction Examples



Folded into a triangle truss to create a beam



Triangle truss connected through a triangle cut out to hold its shape



Triangle trusses used as beams to distribute the weight to the side panels





Slot/Insert construction method used to create the vertical support for the seat of the chair

Time to Build!

Challenge:

Design and construct a chair built entirely of cardboard that will hold you, using no glue or adhesives of any kind.

Follow the Engineering Design Process on page 1

Pre-Design Questions to Consider:

- When you are planning, think about which shapes provide the greatest structural strength.
- Think about how you will connect the separate pieces of cardboard without the use of adhesives or tape.
- Is all cardboard the same?
- If your first design doesn't work, evaluate what went wrong and try again.

Design Notes:

Quick Sketch

Sketches of Your Design:



Now Build The Chair:





My prototype's performance was:

Exceptional: it worked every time it was tested and needed no repair or modificationVery good: it worked most of the time it was tested and only needed minor repair or modificationGood: it worked some of the time it was tested but needed repair or modificationNot good: it didn't really work and needed a full re-design

If your first design doesn't work, evaluate what went wrong and try again.

Things that I redesigned (changed)

What were the purposes of the changes?

Things I'd do differently next time

Why would you do these things differently?

Would a different material work better?

Is all cardboard the same? If not what difference did you discover.

Now that you have identified things to change- Consider a redesign



Share Your Final Design With Us!

Post a picture of your chair by tagging us at James E. Richmond Science Center on Facebook and Twitter.

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