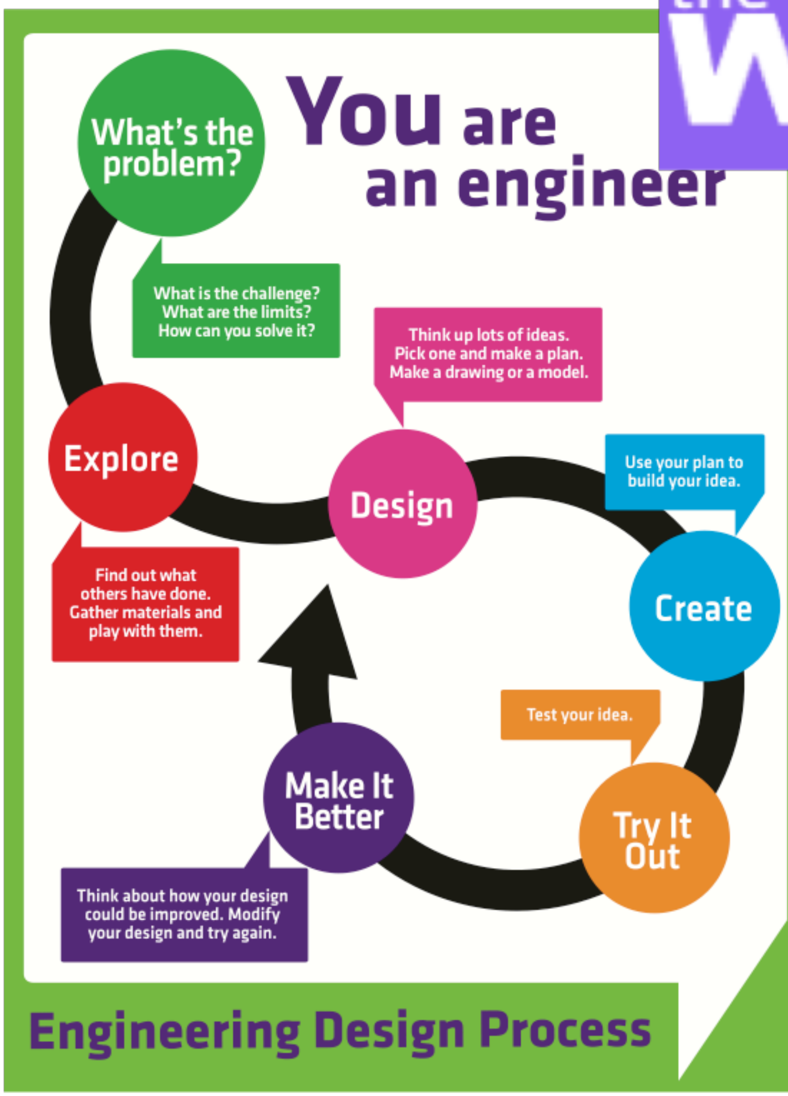
Cardboard Chair Project



Name: ______________________________________

Date: __________________ **Grade:** ____ **Section:** ___

Cardboard Chair Project

DESIGN CHALLENGE

Design and build a cardboard chair that will comfortably support an "average" middle school student.

Criteria

You prototype must...

- Be made entirely out of cardboard and glue.
- Have a seat and a back.
- The seat of the chair must be at least 16" from the floor (measured to the bottom of the seat).
- The top of the back must be no less than 30" from the floor.
- Be portable (able to be carried through doors).
- Be comfortable to sit in

Constraints

Your prototype must stay within these limits...

- No painting or coloring of any kind!
- No metal or other fasteners are permitted. (Such as staples, nails, screws or tacks)

Approved Materia

- Cardboard
- Glue

NOTE: Keep track of and safeguard all materials. **Points will be lost if replacement parts are needed.**

Key Points

- The strength of any material can be increased or decreased by changing its form
- Weak materials can be strengthened through folding, creasing or other modifications
- Load distribution is key in identifying areas of potential weakness

Key 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.
- **Ergonomics**: the practice of designing objects that conform to the dimensions of the human body to maximize comfort.
- **Load:** weight that is carried by an object**.**
- **Strut:** a brace or support.
- **Sway:** to move back and forth.
- **Truss:** a triangular support.

Chair Competition

Chairs will be evaluated by having other students sit in them and vote to determine which design is the most comfortable and "cool."

IDENTIFY THE PROBLEM

In your own words... state what you've been asked to do.

I have been asked to ____ that will

____

Look at the rubric for this project on the last page and then answer the next two questions.

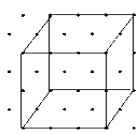
1. What do you think will be the most challenging part? _____________________________________

2. What's ONE strategy you can try to overcome it? ____

____

DEVELOP POSSIBLE SOLUTIONS

In the boxes below, draw six (6) **different isometric versions** (see example) of what your design might look like. It's very important to label the drawing to help me understand your thinking.

Prototype #1	Prototype #2
	
Prototype #3	**Prototype #4**
Prototype #5	**Prototype #6**

CHOOSE A SOLUTION

Identify which prototype you've chosen to make and explain why. ***If you really can't tell me why this prototype is insanely great, you shouldn't be building it.***

A paragraph has a beginning a middle and an end.
*The **beginning,** or the topic sentence, states what the paragraph is about.*

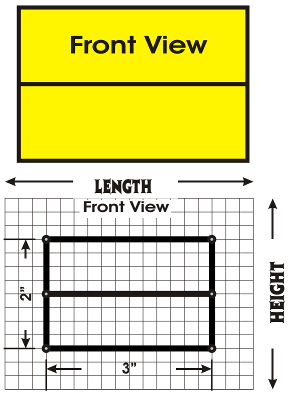
*The **middle** develops the idea in detail by giving specific support & details for it (usually 3 - 5).*

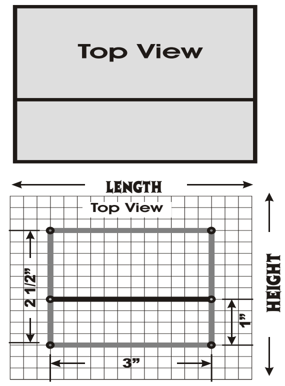
*The **end** (conclusion) restates the main idea in the topic sentence.*

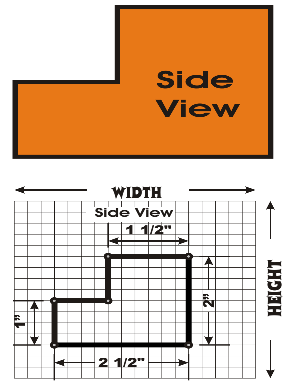
CHOOSE A SOLUTION

You need to create clear, specific and labeled drawings (using rulers and other drawing instruments) from three different views (front, top and side). Label the dimensions like the examples below.

You will not be able to build until the drawings are completed.







Orthographic Production Drawings

Front View

Top View

Materials Needed

(Ex. 1 piece of cardboard 2'x3')

Tools Needed

Side View

BUILD A PROTOTYPE

There are many ways to build your prototype. This building guide gives you some hints and suggestions to consider while building yours. Trying to copy exactly the parts shown here probably isn't a good idea. You have to make the parts fit for your design.

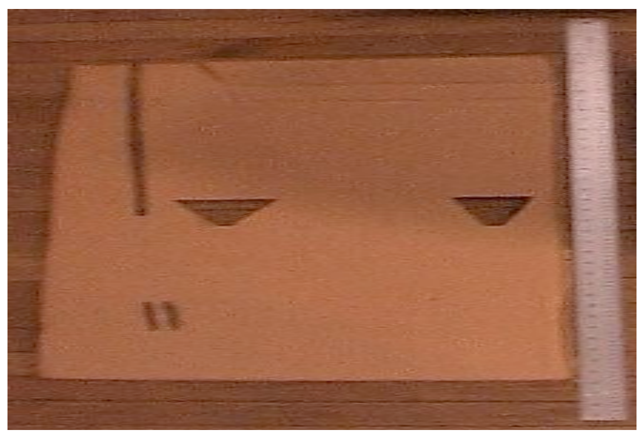
However irritating it may be, I **strongly recommend** that you read through all of these instructions and make sure you understand them before starting on your own construction.

1. First get some sturdy cardboard. The point of the chair is to be environmentally friendly though, so find some used cardboard somewhere instead of buying your materials.

2. Cut out the back as a rectangle with the fold down the middle.

3. Cut a very shallow V from the bottom of the back to cause it to tilt backwards. About 1.5" at the fold.

4. Cut the sides. They are simple rectangles and will be mirror images of each other.



5. Choose how high you want the seat to be.

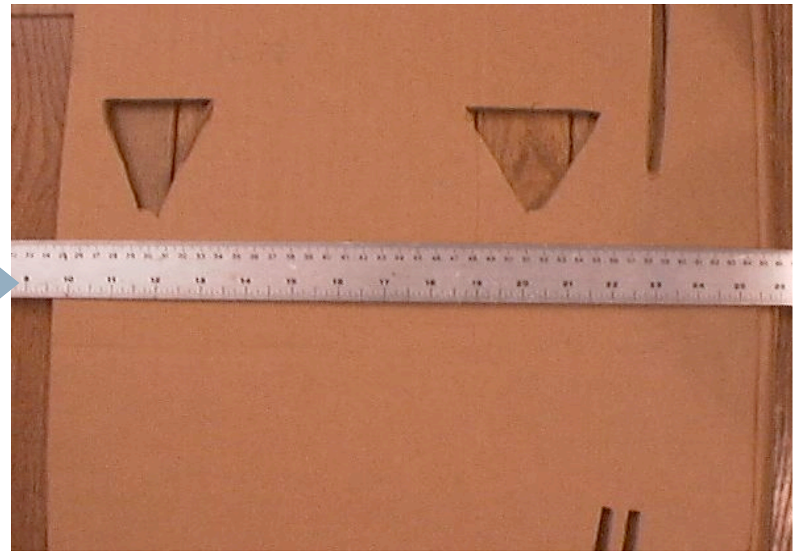
6. Cut slots in the bottom of the back parallel to the long edges to for the sides. **The slots should be less than the height of the seat chosen.**

7. Cut matching slots in the sides. These slots have to be **at an angle** to match the tilt of the back, and long enough to reach down to the top of the slots in the back.

8.Cut the support beams and seat.

9. Fold the beams twice along their length to give a triangular cross section.

10. Cut holes to receive the beams. The holes should be triangular with the top of the triangle parallel to the bottom of the side. **The fit should be snug.** The holes on opposite sides should be the same, but front and back holes might be different if your beams' cross-sections are not equilateral (As seen in this case.)



11. Cut a slot in the back at the appropriate height to receive the seat. Note that as the back slants and is bent, the slot is not straight (the halves should be parallel to the `V' at the bottom, and should be symmetric. The slot will have to be **wider than the seat thickness** because of the distance of the seat from the ground.

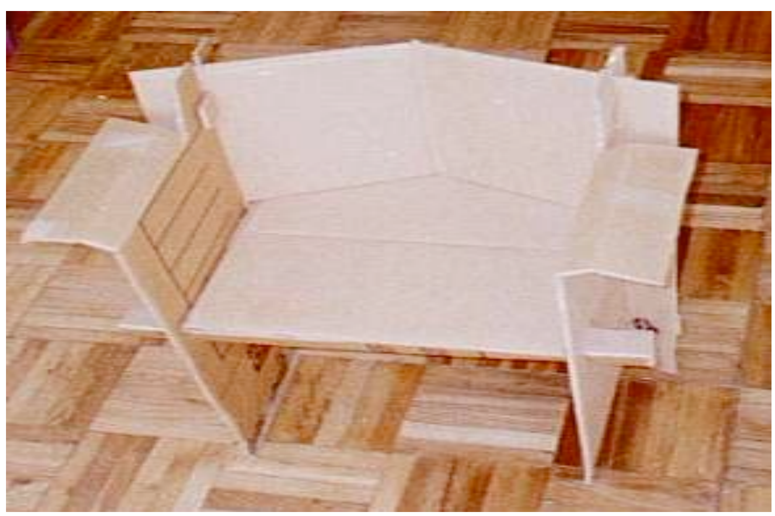
12. Slot the back into each of the sides.

13. Push the beams through the holes. Pushing them outwards from the inside, both through one side first should be easiest.

14. Slide the seat through the slot in the back from in front. The seat should be supported by the bottom of the slot and the tops of the beams.

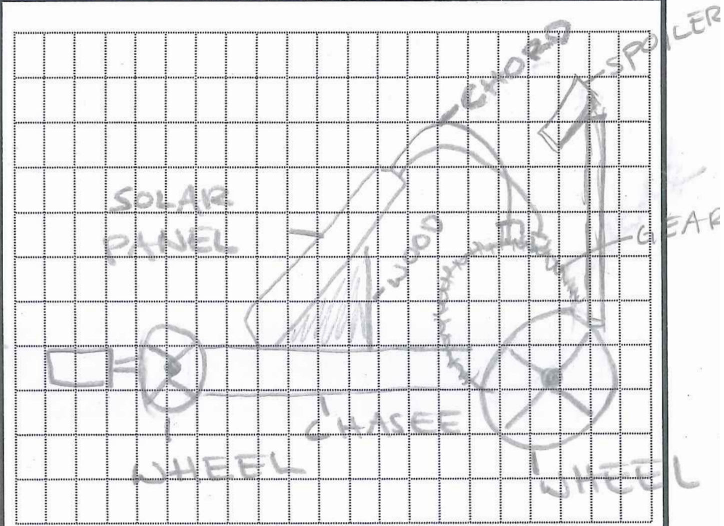
15. Cut arms in the sides according to your taste, comfort, artistic flair.

16. For extra strength, this model of chair has additional supports made of U-**folded rectangles of cardboard. These help to stop the back and sides moving**. For each of these, (there are four- one at the top and bottom of each of the side/back joints). Cut short parallel slots in the back (side) so that one falls on either side of the side (back). Push the U-shaped piece through both slots when the chair is assembled, to strengthen the joint as shown below.



This design was listed in "Critics' Choice" of the
[Education Guardian 24th January 2006:](#)
Art and Design - Take a Seat

EXAMPLE

On the lines below, describe what you did. Mention any difficulties you had or any design changes you made.	Make a labeled sketch that shows what you did.
LOG #5: Date: 5/3/12 Today I finished atta-ching the motor. I had a hard time w/ the gears because the the gear with the gray motor is to big so I changed it to a little smaller instead. I also used a velcro instead of gluing the motor on the car. Today my car is pe-	
❑ **YES** I described the drawing in a clear and understandable way ❑ **YES** I used key terms and information to accurately describe my progress and drawing. I have enough information. ❑ **YES** My description is neatly written and legible.	❑ **YES** My drawing is large enough to show all the details. ❑ **YES** My line quality is sharp and precise (no smudges) ❑ **YES** My labels are outside the drawing and accurate ❑ **YES** My drawing uses shading for highlights

Describe what you did today. Mention any problems you had, design changes or questions.	Make a labeled sketch that shows what you did.
LOG #1 Date: ___________________ _______________________________________ _______________________________________ _______________________________________ _______________________________________ _______________________________________ _______________________________________ _______________________________________ _______________________________________ _______________________________________ _______________________________________ _______________________________________	
YES I used complete sentences to describe my progress **YES** My description is neatly written and legible **YES** I used key terms when possible	**YES** My drawing is large enough and centered in the space **YES** My line quality is sharp and precise (no smudges) **YES** Labels and dimensions are OUTSIDE the drawing

Describe what you did today. Mention any problems you had, design changes or questions.	Make a labeled sketch that shows what you did.
LOG #2 Date: ___________________ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____	
YES I used complete sentences to describe my progress **YES** My description is neatly written and legible **YES** I used key terms when possible	**YES** My drawing is large enough and centered in the space **YES** My line quality is sharp and precise (no smudges) **YES** Labels and dimensions are OUTSIDE the drawing

Describe what you did today. Mention any problems you had, design changes or questions.	Make a labeled sketch that shows what you did.
LOG #3 Date: ___________________ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____	
YES I used complete sentences to describe my progress **YES** My description is neatly written and legible **YES** I used key terms when possible	**YES** My drawing is large enough and centered in the space **YES** My line quality is sharp and precise (no smudges) **YES** Labels and dimensions are OUTSIDE the drawing

Describe what you did today. Mention any problems you had, design changes or questions.	Make a labeled sketch that shows what you did.
LOG #4 Date: ___________________ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____	
YES I used complete sentences to describe my progress **YES** My description is neatly written and legible **YES** I used key terms when possible	**YES** My drawing is large enough and centered in the space **YES** My line quality is sharp and precise (no smudges) **YES** Labels and dimensions are OUTSIDE the drawing

Describe what you did today. Mention any problems you had, design changes or questions.	Make a labeled sketch that shows what you did.
LOG #5 Date: ___________________ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____ ____	
YES I used complete sentences to describe my progress **YES** My description is neatly written and legible **YES** I used key terms when possible	**YES** My drawing is large enough and centered in the space **YES** My line quality is sharp and precise (no smudges) **YES** Labels and dimensions are OUTSIDE the drawing

COMPLETE DECISION

My prototype's performance was: (Check one)

___ **Exceptional:** it worked every time it was tested and needed no repairs

Some reasons for this are:

1. ____
2. ____
3. ____

___ **Very good**: it worked most of the time it was tested and didn't need any (or many) repairs

Some reasons for this are:

1. ____
2. ____
3. ____

___ **Good:** it worked some of the time it was tested and needed repairs

Some reasons for this are:

1. ____
2. ____
3. ____

___ **Not good:** it didn't really work

Some reasons for this are:

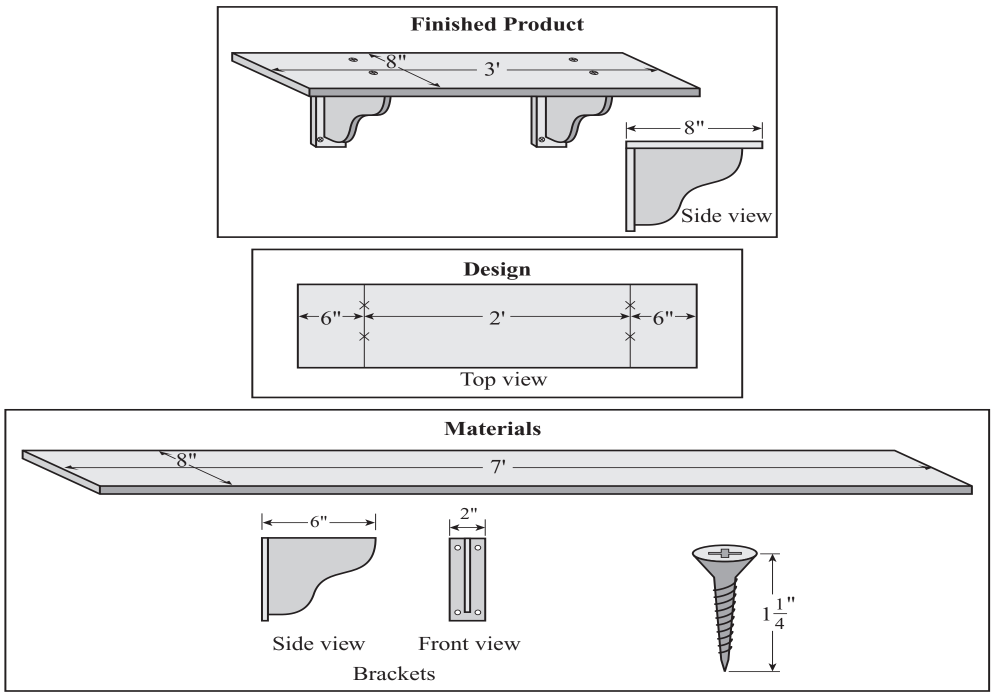
1. ____
2. ____
3. ____

Things that I redesigned (changed)	**What the changes did**
1. ______________________________	1. ______________________________
2. ______________________________	2. ______________________________
3. ______________________________	3. ______________________________

Things I'd do differently next time	**What these might do**
1. ______________________________	1. ______________________________
2. ______________________________	2. ______________________________
3. ______________________________	3. ______________________________

OPEN RESPONSE: MAKING THE SHELF

A design for a wooden shelf is shown below. The materials available for construction include one 1" × 8" × 7 ' board, four wooden shelf brackets with backer boards, and twenty-four 1 1/4” wood screws. Examples of the materials are illustrated beneath the design of the shelf.



Sue wants to make two of these 3-foot-long shelves using these materials.
a) Describe the steps Sue should take to complete this project. Include in your discussion the tools Sue needs to use in each step.
b) Identify and describe ONE safety precaution Sue needs to follow in completing the project.

Cardboard Chair Project

Name: ______________________________

Date: ____________________ **Grade:** _____ **Section:** _____

GOAL #1: **I CAN** **apply** the Engineering Design process to **imagine, plan** and **build** solutions to situations involving bioengineering.				
This is how I'll do it...				
a. *I will make a collection of isometric concept drawings that shows different ways to solve a bioengineering problem. [p.3]*				
0	1	2	3	4
b. *I will have an explanation for my "best idea" with specific reasons and supporting details. [p.4]*				
0	1	2	3	4
c. I will make three-view orthographic drawings of my "best idea" with measurements & labels that others can follow. [p.5]				
0	1	2	3	4
d. *I will complete open response question(s) about technology & engineering [p.13]*				
0	1	2	3	4
e. *I will keep track of my progress and design changes by completing engineering logs during the project.*				
Engineering Log #1 [p.9]				
0	1	2	3	4
Engineering Log #2 [p.10]				
0	1	2	3	4
Engineering Log #3 [p.10]				
0	1	2	3	4
Engineering Log #4 [p.11]				
0	1	2	3	4
Engineering Log #5 [p.11]				
0	1	2	3	4
f. *I will collect and display data about my prototype and use it to evaluate how well it worked. [p.12]*				
0	1	2	3	4
			Final Score	

GOAL#2: **I CAN** **select** and **judge** which tools, materials and methods are the best and safest to use when making a prototype.				
This is how I'll do it...				
a. *I will wear safety goggles and follow all safety procedures in the workshop **without** reminders.*				
0	1	2	3	4
b. *I'll keep track of my materials and not need any replacement parts.*				
0	1	2	3	4
c. *I will clean up my work space and put tools and materials back where they belong.*				
0	1	2	3	4
d. *I will pass the tool-use license test(s) for this project.*				
0	1	2	3	4
			Final Score	

GOAL#3: **I CAN** **explain** and **defend** my reasons for the tools and materials I use when building prototypes.				
This is how I'll do it...				
a. *I will follow my production drawings and building guide to make cardboard furniture fit for an "average" middle school student.*				
0	1	2	3	4
b. *I will build a prototype that looks like a finished product without any loose parts, damaged or rough surfaces, dents, gouges or globs of glue.*				
0	1	2	3	4
c. *I will build, test and demonstrate a prototype that is sturdy, holds together and doesn't need repairs between multiple uses.*				
0	1	2	3	4
			Final Score	