Applied Technology & Engineering…

We know how to make it wow!

Cardboard Chair Project

Name: _____

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

Cardboard Chair Project

PROJECT SPECIFICATIONS

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 at least 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 "new" cardboard
- No metal or other fasteners are permitted. (Such as staples, nails, screws or tacks)

Approved Materials

- 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.
- A chair that that is wider at its top than at its base is more difficult to keep from falling.

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.

Technique Tips

Making a Sturdy Chair

Keeping in mind that your chair will fail at its weakest link, you should make slots that will not allow any motion of the members (parts) as they sit in the joints. (Joints are where members are joined together.) You should try to cut all slots carefully so they a e straight, parallel and the exact width of the material that will fit into them. **Many chairs fail from unwanted swaying.**

Not everyone will sit on your chair where you planned. For example, they may sit on the front edge rather than towards the back of the seat. This would put a greater load on the front columns, requiring them to carry a load that would have been distributed among several columns or other load bearing members. Therefore **it is useful to plan your chair for the person who may not follow your instructions about where to sit.**

LEARNING TARGET:

RESEARCH

I CAN use and follow the engineering design and build a cardboard chair that will comfortably support a middle school student.

Use the posted web links for this project to find the info for the questions.

1. *IN YOUR OWN WORDS...* What is corrugated cardboard?

_____

_____

_____

_____

2. *IN YOUR OWN WORDS...* How is corrugated cardboard made?

_____

_____

_____

_____

3. *IN YOUR OWN WORDS...* What is the primary raw material used to make cardboard?

_____

_____

_____

_____

4. *IN YOUR OWN WORDS...* How many cubic yards of landfill space can be saved by recycling 1 ton of cardboard?

_____

_____

_____

_____

4. *IN YOUR OWN WORDS...* How many trees can be saved each year if each household used 1 roll of recycled paper towels?

_____

_____

_____

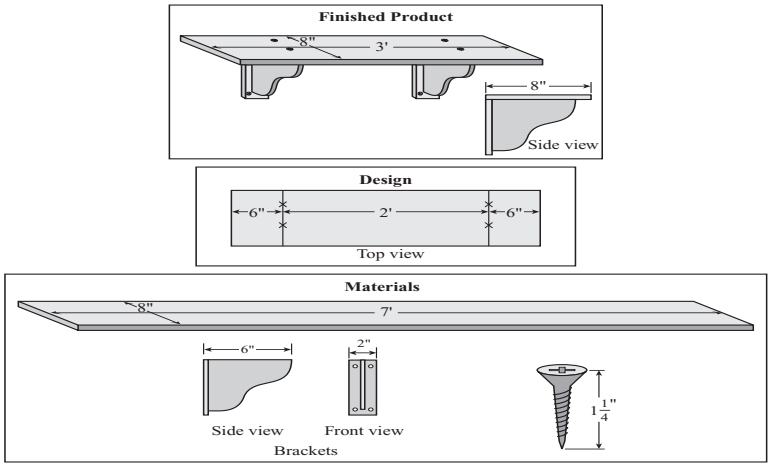
_____

LEARNING TARGET:

RESEARCH

I CAN use and follow the engineering design and build a cardboard chair that will comfortably support a middle school student.

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.

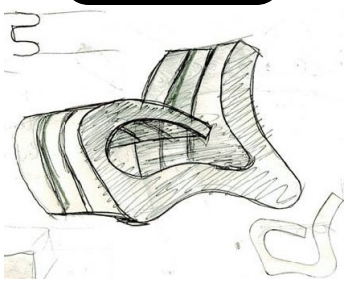
LEARNING TARGET:

CHOOSE THE BEST SOLUTION

I CAN use and follow the engineering design and build a cardboard chair that will comfortably support a middle school student.

In the spaces below, draw **DIFFERENT** versions of possible prototypes that could hit the target and meet this project's criteria (follow the two examples). List the advantages and disadvantages of each one to help you decide which one to build first.

EXAMPLE #1



-It looks really cool and futuristic
-Easy to move

-The curves are hard to cut
-The seat may fail

EXAMPLE #2

-It's very sturdy
-Big arm rests

-Attaching sections will be tricky
-This will need a lot of heavy cardboard

Prototype #1

Prototype #2

Prototype #3

Prototype #4

Prototype #5

Prototype #6

CHOOSE THE BEST SOLUTION

After analyzing the advantages and disadvantages of possible solutions, I have chosen **Prototype # _____** as the best possible solution for the following reasons:

1. _____

2. _____

3. _____

LEARNING TARGET:

CHOOSE THE BEST SOLUTION

I CAN use and follow the engineering design and build a cardboard chair that will comfortably support a middle school student.

>>These drawings CANNOT BE CHANGED once construction has begun!

FRONT VIEW

BACK VIEW

LEFT SIDE VIEW

RIGHT SIDE VIEW

TOP VIEW

BOTTOM VIEW

LEARNING TARGET:

BUILD A PROTOTYPE

I CAN use and follow the engineering design and build a cardboard chair that will comfortably support a middle school student.

Properties of Materials

Every material has a specific property that makes it a good choice for some tasks and a not-so-good choice for other tasks.

Absorbency: soaks up water or liquids *Ex. sponges, cloth , wood*	**Magnetic:** attracted to certain metals *Ex. iron, nickel, steel*
Elasticity:returns to it original shape when it's stretched *Ex. rubber*	**Strength**: can be squeezed or twisted without breaking *Ex. iron, steel, wood*
Conductivity: allows electricity or heat to flow through it *Ex. aluminum, brass, copper, steel, silver, gold, iron, concrete*	**Hardness:** resists scratching and breaking *Ex. iron, steel, wood, concrete*
Flexibility: bends without breaking. *Ex. rubber, cloth, plastic, clay, certain metals*	**Transparency:**something you can see through *Ex. glass, plastic*

WOULD YOU MAKE	NO! What PROPERTY is needed?	What's a good MATERIAL to use?
1. A METAL window?	transparency	glass
2. A STRING chair?		
3. A PLASTIC skateboard?		
4. A PAPER bucket?		
5. A MAGNETIC t-shirt?		
6. A GLASS house?		

LEARNING TARGET:

BUILD A PROTOTYPE

I CAN use and follow the engineering design and build a cardboard chair that will comfortably support a middle school student.

All materials have properties that make them appropriate for certain jobs. Follow the example and check off the properties that make each item useful and effective.

	absorbent	elastic	electrical conductor	flexible	magnetic	hard	transparent	strong
1. rubber glove		✓		✓				✓
2. broom								
3. flip-flops								
4. skateboard								
5. towel								
6. toothbrush								
7. dog collar								
8. doorbell								

LEARNING TARGET:

BUILD A PROTOTYPE

I CAN use and follow the engineering design and build a cardboard chair that will comfortably support a middle school student.

Tools are handheld devices that help accomplish a task like cutting or shaping something. Complete the chart below by checking off the hand tools that would be most useful in each numbered situation.

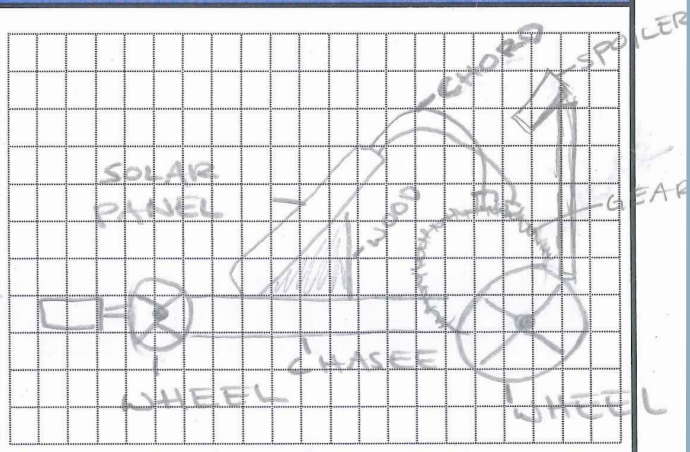
	hammer	screwdriver	coping saw	pliers	hack saw	wood saw	drill	tape measure
1. build a bookshelf	✓			✓			✓	✓
2. fix a toaster								
3. install a door knob								
4. hang a picture								
5. put up a tent								
6. install a ceiling fan								
7. make a birdhouse								
8. fix a bike chain								

LEARNING TARGET:

BUILD A PROTOTYPE

I CAN use and follow the engineering design and build a cardboard chair that will comfortably support a middle school student.

Keep track of your progress by completing an Engineering Log after every building class. Follow the example below as you go from raw materials to finished prototype.

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 attaching 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 fi-	
❑ **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; tools that you used; materials that you used, parts you worked on, design changes and problems.	Make a labeled drawing (or paste a picture taken w/your phone) of your prototype or the parts you worked on.
LOG #1 Date: _____	
❑ **YES** I used complete sentences to describe my progress ❑ **YES** My description is neatly written and legible ❑ **YES** I described how I used specific tools and materials	❑ **YES** My drawing is large enough and centered in the space ❑ **YES** My line quality is sharp and precise (no smudges) ❑ **YES** Labels and measurements are **OUTSIDE** the drawing

Describe what you did today; tools that you used; materials that you used, parts you worked on, design changes and problems.	Make a labeled drawing (or paste a picture taken w/your phone) of your prototype or the parts you worked on.
LOG #2 Date: _____	
☐ **YES** I used complete sentences to describe my progress ☐ **YES** My description is neatly written and legible ☐ **YES** I described how I used specific tools and materials	☐ **YES** My drawing is large enough and centered in the space ☐ **YES** My line quality is sharp and precise (no smudges) ☐ **YES** Labels and measurements are **OUTSIDE** the drawing

Describe what you did today; tools that you used; materials that you used, parts you worked on, design changes and problems.	Make a labeled drawing (or paste a picture taken w/your phone) of your prototype or the parts you worked on.
LOG #3 Date: _____	
☐ **YES** I used complete sentences to describe my progress ☐ **YES** My description is neatly written and legible ☐ **YES** I described how I used specific tools and materials	☐ **YES** My drawing is large enough and centered in the space ☐ **YES** My line quality is sharp and precise (no smudges) ☐ **YES** Labels and measurements are **OUTSIDE** the drawing

Describe what you did today; tools that you used; materials that you used, parts you worked on, design changes and problems.	Make a labeled drawing (or paste a picture taken w/your phone) of your prototype or the parts you worked on.
LOG #4 Date: _____	
☐ **YES** I used complete sentences to describe my progress ☐ **YES** My description is neatly written and legible ☐ **YES** I described how I used specific tools and materials	☐ **YES** My drawing is large enough and centered in the space ☐ **YES** My line quality is sharp and precise (no smudges) ☐ **YES** Labels and measurements are **OUTSIDE** the drawing

Describe what you did today; tools that you used; materials that you used, parts you worked on, design changes and problems.	Make a labeled drawing (or paste a picture taken w/your phone) of your prototype or the parts you worked on.
LOG #5 Date: _____	
☐ **YES** I used complete sentences to describe my progress ☐ **YES** My description is neatly written and legible ☐ **YES** I described how I used specific tools and materials	☐ **YES** My drawing is large enough and centered in the space ☐ **YES** My line quality is sharp and precise (no smudges) ☐ **YES** Labels and measurements are **OUTSIDE** the drawing

LEARNING TARGET:

TEST THE PROTOTYPE

I CAN use and follow the engineering design and build a cardboard chair that will comfortably support a middle school student.

Rank each item from 1 to 5

	Not good				Excellent
Comfort	1	2	3	4	5
Sturdiness	1	2	3	4	5
Portability	1	2	3	4	5
Back support	1	2	3	4	5
Arm support	1	2	3	4	5
Cool design	1	2	3	4	5

Past a digital photo of your chair here

LEARNING TARGET:

MAKE A DECISION

I CAN use and follow the engineering design and build a cardboard chair that will comfortably support a middle school student.

Based on the data I collected, 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 I'd do differently next time	What these things might improve
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____

LEARNING TARGET:

ENGINEERING DESIGN PROCESS

I CAN use and follow the engineering design and build a cardboard chair that will comfortably support a middle school student.

STEP 1: Identify the Need

STEP 2: Research

STEP 3: Develop Possible Solutions

STEP 4: Select the Best Possible Solution

STEP 5: Build a Prototype

STEP 6: Test and Evaluate the Prototype

STEP 7: Communicate the Solution

STEP 8: Redesign

LEARNING TARGET:

PROJECT SCORING SHEET

I CAN use and follow the engineering design and build a cardboard chair that will comfortably support a middle school student.

LOOK-FORS					
To show that I can follow the Engineering Design Process and hit the target...					
a) I will conduct research to to help me plan and build my prototype and use complete sentences to report my findings.. **(Pg.3)**	**0**	**1**	**2**	**3**	**4**
b) I will use complete sentences to answer all parts of a technology/engineering question. **(Pg.4)**	**0**	**1**	**2**	**3**	**4**
c) I will draw different solutions to a design problem listing the likes and dis-likes for each one. I will then choose one drawing as the best solution and explain why. **(Pg.5-6)**	**0**	**1**	**2**	**3**	**4**
d) I will draw what I'm building from different views with sharp, crisp lines and no erasure marks. I'll also include labels and measurements so anyone could understand it and follow it. **(Pg.7)**	**0**	**1**	**2**	**3**	**4**
e) I will identify materials and tools needed for specific tasks when building prototypes. **(Pg. 8-11)**	**0**	**1**	**2**	**3**	**4**
• I will record my progress and follow the checklist to describe how I used specific tools and materials to build my prototype.					
f) **>>**Engineering Log #1 **(Pg.11)**	**0**	**1**	**2**	**3**	**4**
g) >>Engineering Log #2 **(Pg.12)**	**0**	**1**	**2**	**3**	**4**
h) >>Engineering Log #3 **(Pg.12)**	**0**	**1**	**2**	**3**	**4**
i) >>Engineering Log #4 **(Pg.13)**	**0**	**1**	**2**	**3**	**4**
j) >>Engineering Log #5 **(Pg.13)**	**0**	**1**	**2**	**3**	**4**
k) I will collect and display data about my prototype and use it to evaluate how well it worked. **(Pg.15)**	**0**	**1**	**2**	**3**	**4**
l) I will summarize what I did during each step of the Engineering Design Process. **(Pg.16)**	**0**	**1**	**2**	**3**	**4**
• I will build a prototype that ***MATCHES MY ORTHOGRAPHIC DRAWINGS***, (d) meets the criteria, looks like a finished product without any loose parts, damaged or rough surfaces and globs of glue, and holds together without needing repairs between multiple uses.	**0**	**1**	**2**	**3**	**4**

Peer Evaluation

1. Contributed ideas	_____/5	_____/5	_____/5	_____/5
2. Worked hard	_____/5	_____/5	_____/5	_____/5
3. Helped others	_____/5	_____/5	_____/5	_____/5
4. Cooperated	_____/5	_____/5	_____/5	_____/5
5. Helped clean up	_____/5	_____/5	_____/5	_____/5

Scoring Key

Teamwork and the ability to work with others is a crucial 21st Century life skill. You will be evaluated multiple times during this project by your peers. Each member will anonymously score you in the five areas listed on the left from 1 to 5. The scores will be averaged and placed in the blanks after each evaluation.

1-Strongly disagree **2**- Disagree **3**- Neutral **4**-Agree **5**- Strongly agree