Name: _____ Team Members: _____ Date: _____ L/P

Tech Ed Design Project: Paper Furniture

See next page for MA Standards alignment

Designed by Bethany Gately

Problem:

Maria is a little girl who does not have a lot of money, but wants doll furniture for her American Girl Doll, Olivia. She found Olivia at a secondhand store, clearly used and with messy hair, but she loves her very much. However, Maria does not have the resources to buy the expensive American Girl Doll furniture that fit Olivia. She heard you can make doll furniture out of paper, and she would love a bed for Olivia to sleep on at night. Can you help?! ☺

Goal:

To create a bed that will fit Olivia (the American Girl Doll) using only paper and tape.* Though you want it to be functional, also consider the amount of resources you're using, how it looks, and if it would be comfortable.

**You may use any kind of tape that you wish!*

Constraints:

- Bed must allow doll to sleep at least 5 inches off the ground
- Bed frame must be composed of only 8 x 11 printer paper & tape
- Mattress, pillow & blanket must be handmade by you, using no more than 3 materials
- Each low-cost material must have a building material counterpart, such that this doll bed could be used as a prototype to create the same bed but for a human (ex. paper → wood)

Engineering Design Process Overview:

Step of Design Process	General Meaning	Paper Furniture Challenge
1. Identify Problem/Goal		
2. Background Research		
3. Specify Requirements/ Constraints		
4. Develop Ideas (Brainstorm)		
5. Pick Best Idea		
6. Construct Prototype* **initial model/product*		
7. Test Prototype		
8. Make Adjustments & Redesign		

NOTE: Engineers do not always follow the engineering design process steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to make a modification or change to your design. This way of working is called **iteration (repeating a process or procedure)**, which your group will likely do!

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Tech Ed Design Project: MA Standards Alignment
Ms. Gately's Class 2018-2019

Topics Covered:

-Engineering Design Process
-Universal Systems Model
-Prototyping
-Decision Matrix
-Scaled Drawings
-Tools & Materials
-Design Communication (Brochure → Customer)
-Product Creation (Manufacturing Processes)

Standards Covered:

6.MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution. Include potential impacts on people and the natural environment that may limit possible solutions.*

6.MS-ETS1-5(MA). Create visual representations of solutions to a design problem. Accurately interpret and apply scale and proportion to visual representations.*

Clarification Statements:
• Examples of visual representations can include sketches, scaled drawings, and orthographic projections.
• Examples of scale can include 1⁄4″ = 1′0″ and 1 cm = 1 m.

6.MS-ETS1-6(MA). Communicate a design solution to an intended user, including design features and limitations of the solution.

Clarification Statement:
• Examples of intended users can include students, parents, teachers, manufacturing personnel, engineers, and customers.

6.MS-ETS2-2(MA). Given a design task, select appropriate materials based on specific properties needed in the construction of a solution.*

Clarification Statement:
• Examples of materials can include metals, plastics, wood, and ceramics.

7.MS-ETS1-2. Evaluate competing solutions to a given design problem using a decision matrix to determine how well each meets the criteria and constraints of the problem. Use a model of each solution to evaluate how variations in one or more design features, including size, shape, weight, or cost, may affect the function or effectiveness of the solution.*

7.MS-ETS1-4. Generate and analyze data from iterative testing and modification of a proposed object, tool, or process to optimize the object, tool, or process for its intended purpose.*

7.MS-ETS1-7(MA). Construct a prototype of a solution to a given design problem.*

8.MS-ETS2-5(MA). Present information that illustrates how a product can be created using basic processes in manufacturing systems, including forming, separating, conditioning, assembling, finishing, quality control, and safety. Compare the advantages and disadvantages of human vs. computer control of these processes.

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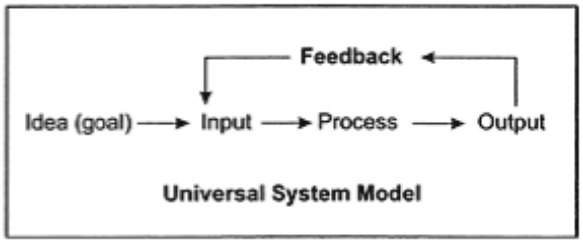
Universal Systems Model

A universal systems model is similar to the engineering design process, but it has fewer steps. This model can be used to solve many problems, though is typically used in technology.



If the **system** is defined as the **paper doll furniture factory**, identify how each part of the universal systems model is represented by this paper furniture project. [You can list ideas.]

Goal: _____
(What are you trying to do?)

Inputs: _____
(What resources/factors/ "ingredients" are in the system?)

Processes: _____
(What are the steps needed to reach the goal?)

Outputs: _____
(What potential results/products could you end up with?)

Feedback: _____
(Did your product meet your goal? What else could be done to enhance your product?)

Follow-Up Questions:

1. After the first round of **feedback** is complete, is the product done? Why or why not?

   _____

   _____

2. What is the **term** used to describe repeating a process or procedure? _____
3. Are the **inputs** always something you can control? Why or why not? Use examples.

   _____

   _____

   _____

4. Are the **outputs** always going to be what you expect? Why/why not? Use examples.

   _____

   _____

   _____

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Engineering Design Process for Paper Furniture

Step 1: Identify Problem/Goal

- What is the problem? _____

- What is the goal? _____

Step 2: Background Research

Directions:

- Use Google to research paper furniture, paper doll furniture, American Girl dolls, etc.
- Write down any and all relevant **ideas, notes, designs, constraints,** that you find.
  Questions to answer… How big are AGD, and how big should the bed be to fit the doll? How big are real AGD beds? How much do they normally cost? How can you make paper strong enough to hold a doll 5 inches off the ground? What techniques are there? How can you make a doll mattress/pillow/blanket?
- Your notes should **fill the page**! These can include pictures/design ideas.
- Next to each note, write the **root name** of the website.
  *Example: **Root name** of https://molodesign.com/collections/furniture/ = molodesign.com*

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Step 3: Specify Requirements/ Constraints

Directions: Re-read the first page and fill in the proper constraints below:

- Bed must allow an American Girl Doll to sleep at least _____ **inches** off the ground
- Bed frame must be composed of only 8 x 11 printer _____ & _____
- Mattress, pillow & blanket must be _____, using no more than _____ **materials**
- Each low-cost material must have a _____ material counterpart, such that this doll bed could be used as a prototype to create the same bed but for a _____

Step 4: Develop Ideas/Brainstorm

Materials:

- What **type(s) of tape** are you planning to use? _____
- **Who** is responsible for bringing the tape? _____
- What **3 materials** will you use to make the mattress, pillow, & blanket?

  _____, _____, _____
- **Who** is responsible for bringing each material?

  _____ is bringing _____

  _____ is bringing _____

  _____ is bringing _____

Designs:

- Draw possible **bed/mattress/pillow/blanket** designs & write notes with descriptions (height, width, materials, etc.)

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Step 5: Pick Best Idea

Directions: Draw your chosen design in the box, adding any notes/specifications as needed. You should use a ruler to create nice lines, and make a scale to represent the actual size. (Ex. 1 cm in drawing = 1 inch in real life)

After researching & brainstorming, I have decided to create the initial prototype based on the following design:

Step 6: Build Prototype!

Directions: Use the resources provided (printer paper), plus the resources you brought (tape & 3 materials of your choice) to build a prototype! Make sure all constraints are met.

Resource use: How many pieces of paper does your prototype require? _____

Step 7: Test Prototype!

Directions: **Use the American Girl Doll provided** to help test the durability (strength) and functionality (how well it works) of your prototype! Make sure that all constraints are met.

Step 8: Make Adjustments & Redesign

1) What are some observations you made after you tested your bed with the American Girl Doll? *(write at least 3)*

2) What do you need to change to increase durability and functionality of your bed?

3) **Make the adjustments to your prototype & test again!!**

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Decision Matrix

A **Decision Matrix** is a chart used to rate different prototypes/products by scoring them based on defined criteria. After all prototypes have been scored, the option with the highest score "wins". This helps engineers and manufacturers decide which product to create/use.

Simple Decision Matrix			
	OPTIONS		
Criteria	Car A	Car B	Car C
Cost	5	3	3
Practicality	2	4	3
Performance	4	2	5
Reliability	1	2	4
Fuel Economy	2	3	3
TOTAL	14	14	18

1. Based on this Decision Matrix, which car is the best choice? _____

2. Why? _____

Evaluating Prototypes:

Directions: With sticky notes, label each of your group member's prototypes #1-4. Then score them based on the decision matrix below. Use the decision matrix to decide which prototype your group should use moving forward. Then as a group, identify areas of weakness of the winning prototype (because it's still not perfect yet) and make adjustments to improve design.

Paper Furniture Decision Matrix				
Criteria *(Max score = 5)*	Options			
	Prototype #1	**Prototype #2**	**Prototype #3**	**Prototype #4**
	By: _____	By: _____	By: _____	By: _____
Meets Constraints				
Functionality				
Durability				
Comfort				
Visual Appeal				
Resource Use*				
Mass Production**				
Total:				

*A score of 5 would denote a product that does not use an abundance of resources

**A score of 5 would denote an easily mass produced product, meaning there are not lots of little details or customized pieces

Based on this decision matrix, which prototype is the best one to use? _____

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EXTRA SPACE FOR NOTES/DESIGNS: