Mechanical Modular Furniture Design

Design and build a modular, affordable, collapsible piece of furniture, using PVC piping as the "frame" for ___(student defined customer/ audience/)____

Tackling this project, you will use the **5-Step Design Process** which is as follows:

1. Identification of problem, need or "customer".
2. Concepts and Ideas.
3. Comprise Solutions
4. Models and/ or Prototypes.
5. Production and or working drawings

Classroom Project Introduction: Introduction to the project idea, discuss what affordable, collapsible, means. What PVC piping is for. Examples of the idea of modular construction.

Students can work in teams or individually.

Day 1

1. **Identify your problem**: Students to decide what type of customer/ audience they would like to design and build a piece of furniture for. In this step you will need to ask and answer a number of questions. For example, you may ask; who is your customer? What are they asking for? What does the customer want you to do? What are you trying to do? Are there any codes or standards you will need to address? What is the market potential? What type of price bracket are you aiming for? Etc. At this point however, there is no **solution.**

    a. Students to think/ discuss with team members their experience with the defined customer they have.
    b. Reflect on personal experiences
    c. Start to identify the problem they will be designing for.

(Grading Milestone Check- Participation of ID of Problem)

Day 2 and 3

2. **Concepts and Ideas:** In this step students will do things such research ideas, look at what others have done in the past, look at similarities between what you want to do and another object/ design. **Many, many, many** ideas are collected, ***reasonable and otherwise***, for possible solutions to the problem and **many,many,many** sketches are produced. No attempt to evaluate the ideas at this stage, and all notes, research and sketches are dated and signed and saved for later use and record and proof.
    a. What are some possible ideas for the furniture?
    b. Create problem statements such as "How might we…?"
    c. Start sketching ideas
    d. Research precedent studies

e. List as many ideas as you can
f. Defer judgement. You never know where a good idea is going to come from. The key is make everyone feel like they can say the idea on their mind and allow others to build on it.
g. Encourage wild ideas. Wild ideas can often give rise to creative leaps. In thinking about ideas that are wacky or out there we tend to think about what we really want without the constraints of technology or materials.
h. Build on the ideas of others. Being positive and building on the ideas of others take some skill. In conversation, we try to use "and" instead of "but."
i. Stay focused on the topic. Try to keep the discussion on target, otherwise you can diverge beyond the scope of what you're trying to design for.
j. One conversation at a time. Your team is far more likely to build on an idea and make a creative leap if everyone is paying full attention to whoever is sharing a new idea.
k. Be visual. In live brainstorms we write down on Post-its and then put them on a wall. Nothing gets an idea across faster than drawing it. Doesn't matter if you're not Rembrandt!
l. Go for quantity. Aim for as many new ideas as possible. In a good session, up to 100 ideas are generated in 60 minutes. Crank the ideas out quickly and build on the best ones.

(Grading Milestone Check-Production of Sketches and Research

Day 4,5,6

3. **Comprise Solutions**
   All ideas need to have careful consideration and combined into one or more promising compromise solutions. Look at the pros and cons and readdress the questions you came up with in Step 1. Refine your sketches and develop them further to study more detailed items. Get feedback.

(Grading Milestone Check- Individual and Partner Compromised Solution Sketch)

Day 7,8: Materials Planning, 9-13 Build. (Days may not be in a row inorder for teacher to buy material)

4. **Models and/ or Prototypes**
   A scale model is constructed to study, analyze, and refine a design. It is also a way of physically showing your client the idea. A full sized working model is called a "prototype". The best models are the ones made of the actual materials planned on being manufactured with, but sometimes alternative materials are acceptable. In addition to physical models, 3D computer models can also be built. Often at times when a designer reaches this step they realize something that was unknown before and have to go back to Step 2. This is not considered a failure, just part of the design process.
   a. Put together a "shopping list" of PVC material and other's needed.

(Grading Milestone Check- Parts list and model)

Day 14-18

5. **Production and or Working Drawings:**
   Draft drawings that fully describe the object you have designed so it can be manufactured and produced.

(Grading Milestone Check-Progress checks and Final Working Drawings)

Products	Individual	1. Participation in ID of problem discussion 2. Concept and idea sketches 3. Proof of research and precedent studies 4. Compromised solution sketches 5. Participation in compiling parts list. 6. Participation in model building 7. Agreed assigned working drawing portion. 8. Individual participation in product presentation. 9. On-line portfolio recording of the 5-steps, through writing, scans of sketches, working drawings and pictures of model.
	Team	1. Agreed upon selected comprised solution sketch from individual student. 2. PVC Parts list 3. Model or prototype 4. Working drawings 5. Group product presentation

Products Presentation: (include how the products will be made public and who students will engage with during/at end of project)

Resources Needed: PVC Piping, PVC cutting tools, work room to build, audience to present to, computer to research, CAD and create needed presentation. Presentation space.

Standards:

III A1- Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).
III A2- Use the skills required in project management to track and assess the progress of a plan, process, or project as assigned.
III A4- Employ critical thinking and interpersonal skills to resolve conflicts with staff and/or customers.
III A6- Conduct technical research to gather information necessary for decision-making.
IV-B5- Access and navigate Internet (e.g., use a web browser).
IV-B6- Search for information and resources.
IV-B12- Deliver presentations with supporting materials.

IV-B20- Facilitate group work through management of shared files and online information.
IV-B22 - Manage computer operations.
IV-B23 - Manage file storage.
IV-D2 - Use modeling, simulation, or visual reproduction to effectively analyze, create, and/or communicate to others regarding plans, projects, problems, issues or processes.

VII-A-1 Employ leadership skills to accomplish organizational goals and objectives.
VII-A-2 Employ organizational and staff development skills to foster positive working relationships and accomplish organizational goals.
VII-A-3 Employ teamwork skills to achieve collective goals and use team members' talents effectively.
VII-A-4 Establish and maintain effective working relationships with all levels of personnel and other departments in order to accomplish objectives and tasks.
VII-A-5 Conduct and participate in meetings to accomplish work tasks.
VII-A-6 Employ mentoring skills to inspire and teach others.

X-B-4 Use project-management skills to improve workflow and minimize costs.
X-C2- Describe the elements of good engineering practice (e.g. understanding customer needs, planning requirements analysis, using appropriate engineering tools, prototyping, test, evaluation, and verification).
X-C7- Safely operate a variety of tools, machines, and equipment (e.g. milling machines, rapid prototyping machines, drill press, band saw, CNC machines, and hand tools).

X-H1- Demonstrate knowledge of assembly and exploded assembly drawings
X-I4- Identify common part features (fillets, rounds, draft angles, chamfers)
X-K2- Draw true view, true length lines, and true angles
X-L1- Locate and describe features
X-L8- Identify measurements