

Paper Modeling Techniques

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Use of the paper model in order to determine function, operative logic, proportions, and aesthetic forms of ideas and concepts is not to be overlooked. Paper is readily available and inexpensive as well as very easy to work with. Students' familiarity with this material is already strong, and they have often been exposed to the basic working methods at an early age. Paper, tape, and scissors are common working tools in any classroom or home, so no basic training is required. What is different in this suggested exercise is the definition and awareness of paper and paper types. Paper may be more accurately defined as any fibrous substrate that varies in thickness and surface texture, being made up of mostly paper fibers. This includes corrugated cardboard, mat boards, illustration boards, and foam core board, as well as photocopier bond paper, Bristol board, and museum board.



Paper Types

Paper and paperboard are widely available and inexpensive. This includes photocopier bond paper, which is usually a 40 pound stock, Bristol board cardstock, 80 to 85 pound weight, and colored construction papers. Cover stock, with a thicker paper weight of 80 pounds, is similar to cardstock and effective for basic modeling. This is similar to a thin Bristol board, available in sheets and pads at artist supply stores. Bristol board is a superior performing paperboard due to a harder and smoother finish.

Keep in mind that these high quality materials often come in two or three thicknesses and finishes. Double weight or 4-ply is a doubled sheet, while 2-ply is traditional weight Bristol board. Hot press and cold press refer to manufacturing processes that impart a finished surface to the board. Hot press and cold press refer to manufacturing processes that impart a finished surface to the board. Hot press is smooth with a slightly glossy surface that works well for final finish or applying stickers or adhesive foils and inks. Cold press is best for pencils, markers, and paints, as there is a slight tooth to the surface. Canson brand colored paper is typically 40 to 65 pound weight. There are thinner colored charcoal and pastel drawing papers that are good for surface lamination, but the Canson brand is best due to thickness. These are more expensive than colored "construction" type papers, but are much more durable and better able to withstand bending and shaping. These are usually available by the sheet at art supply stores.

Construction Methods

Harder and thicker boards are very durable for structural models. Complex surfaces can be made using construction similar to that of boat hulls with bulkheads to shape, hold, and attach the outer surfaces. Balsa airplane model technology is another way to think of constructing prototypes, employing bulkheads and structural ties that are

inserted into cut slots. Models may be constructed as disassembly type, or glued at joints with surprisingly strong results. White glues work best with removable masking tape used as clamps. Another type of joint technique to consider is sheet-metal box type construction, most often associated with ductwork.

Paper designs can be constructed with hems and flaps that may be taped together with double-sided tape. Extensions or attachments can be designed into the part and secured with slotted fittings made with a mat knife or hobby knife. Corrugated box construction should also be considered as a basic system of quickly fabricating basic, primitive geometric forms. Showing a corrugated box flat and unfolded will give the students clues to flap design that are very helpful.

An interesting exercise for a basic study is to have students fabricate custom boxes in different sizes from a flat sheet of material based on an existing box. Using this box method will assist them in visualizing internal components of a designed object or machine that contains motors or other components. These elements are often known in early idea phases only in terms of approximate dimensions. These parts can be blocked out in paper and color coded for clarity of layout, visual thinking of construction techniques, and analyzing parts needed.

Suggested Projects

A very enlightening project is the design of a container made from one sheet of board that holds water. While certainly the paper should be of Bristol board-type thickness, a simple polyurethane wipe-on water-based finish will provide waterproofing. This will substitute for the waxed papers and boards used commercially. A fast-dry furniture wax or floor wax will also work. It is strongly recommended that water-based wipe-on or brush-on material be used rather than spray-on finishes because of safety and health concerns related to ventilation and breathing of vapors and chemical solvents. Keep in mind these models will not be food safe due to finishes used.

The project could be described as a bud vase that would hold one to three flowers no longer than 12 inches. While the first impression of the students is that it may be an impossible task, begin with getting them to think of examples of paper containers that hold fluids. The first should be milk carton technology with the manual tear open end. Next, examine a juice box-type container with a puncture seal for a straw. More and more food containers of this type are appearing in grocery stores for a wide variety of foods and products from pasta sauces to laundry detergents.

One of the most interesting configurations is a Chinese food type container with no fasteners (some may have a small staple—that's OK). Have one on hand and unfold it to help the students understand the geometry of folding technology. This is an excellent time to introduce origami technology and explore folding and overlapping of materials for structural integrity and strength. These food container products are made from a special wax finished paper that allows the containers to be liquid-proof.

Techniques

Paper, such as Bristol board or a heavy cardstock, can make a convincing first study model that will indicate the size, function, and proportions of a designed object. The pattern for the design may be unfolded from the completed design, and parts yield per sheet can be determined. This might form an additional criterion that could serve as a goal in designing for minimum use of materials and maximize how many parts one could make from a larger (e.g., 4' x 8') sheet of material. Consider also that many objects that are designed in paper can be made in stamped or pressed metal. For stronger structural parts, illustration board may be used in conjunction with Bristol board or other papers.

These model patterns may be marked with indicated dimensions, corrections and other types of notes as a first edition. The process of executing a very finished looking prototype model is to repeat the process and make it three or four times, thus perfecting the skill; i.e., the accuracy of cuts and the overall craft. This fosters good skills in three-dimensional thinking while seeking solutions for attachment, construction problems, and exploring different fastening technologies. The first edition can be made of standard photocopier paper using tape or glue, and drawing on it to indicate size, dimension, slots, and other details. This forms the pattern for the next improved version. The next version should be done in the cardboard material, again allowing taped connections with masking or double-sided tape. Challenge the students to attempt a final version with no tape or glue, using paper to paper attachments with no fasteners.

Basic projects such as a paper birdhouse or a holder of some type such as a desktop organizer (e.g., CD rack) make a good choice. Limit the size to that of a small birdhouse or a CD holder for three to five favorite CDs. Final models may be waxed or polyurethane-coated or painted, with very good results. Birdhouses, if to be used by actual birds outdoors, would need to be made from more durable materials and water proofed more intensively to withstand the weather. A corrugated, waxed board would work for this and waxed, corrugated cartons that can be cut up may be found at a grocery store. The paper model is also a good route to follow in determining the design of a thin wooden board structure and assembly system for constructing a birdhouse with no fasteners. This does imply woodworking tools and a scenario for older students in a supervised shop. However, it illustrates the saving of development time in creating advanced building systems through application of three-dimensional visualization via paper modeling techniques.

Miscellaneous Details

Tapes - masking, electrical, and cellophane plus double-sided adhesive varieties as well as low-tack adhesive masking and cellophane tapes.

Glues - Elmer's, Sobo, wood glue, superglue, hot glue guns

Joints - lap, tongue and groove, slot key, origami type, corrugated box type, sheet metal ductwork type

Clamps - tape, pins, rubber bands, paper clips, binder clips, clothes pins, books

Laminations - colored paper, paper foils, plastic foils, adhesive-backed papers and shelf liner for appearance or waterproofing

Coatings - brush-on or wipe-on furniture waxes, water-based polyurethane brush on or wipe on, Future floor wax

Paper Tools - scribes, edge of ruler, ballpoint pens (with no ink), knife edge, scissors large, scissors small, rolling tools such as PVC pipes, metal pipes, wood dowels, etc., plastic triangles, framing squares

Cutting tools - X-acto knives, scissors, mat knives, rolling cutters, saws, punches

Modeling techniques - embossing surface indentations with a dull knife, scribe, scratch awl or ballpoint pen with no ink in order to form precisely folded edges

A photocopier is useful as it allows patterns and shapes to be drawn and sketched, photocopied onto cover stock or Bristol board and then cut out with scissors or hobby knife.

Resources for materials:

- Art supply and hobby stores.
- Local carton fabrication shop or corrugated dealer.
- Paper suppliers (Often they will donate small amounts of specialized paper or board).