Appendix E

Plans for the Construction of Selected Lab Equipment

Lab equipment can be a major cost for any science class. A number of items described in the CREST Activity Book can be constructed from commonly available materials at a fraction of the cost of the catalog counterparts. The items described below were constructed with minimal use of power tools from materials (except hardware) that were “on hand". People with access to a more sophisticated wood shop will no doubt wish to add refinements and touches that were left out of the "economy" models.

Since some power tool usage is involved, teachers should check with school officials before enlisting students in the construction of these items.

Part I: Adjustable Line and Station Rack for Use in Activity #38 (A Magnet as a Magnetometer)

Materials:

Items needed: (all dimensions are in inches)

- Number 3 pine dressed
  - 4 pieces .75 x 3.25 x 17.75
  - 1 piece .75 x 6.5 x 11.25
  - 2 pieces .75 x 3.25 x 14.75
  - 4 pieces .75 x 3.25 x 20
  - 1 piece .75 x 3 x 3
  - The above wood can usually be obtained gratis from some source - parents who are carpenters, the school shop, local contractors, etc.
- 2.5 inch sheet rock screw
- 48 (.5 pounds) galvanized 1.25 inch nails
- 4 2 x .25 inch hex head bolt
- 4 .25 inch washers, .25 inch nuts
- 3 foot 1.125 inch hardwood dowel
- 8 medium screw eyes
- white glue as needed

Tools:

- Table saw
- Electric drill with 1/4, 5/32, 7/64 bits, 1.25 wood bit, and a sheetrock drill bit.
- Hammer
- Tape measure and 12 inch square
- 2 inch C clamps
- Sandpaper.

A drill press makes part of this work much easier; the model in the photograph was constructed using a hand held drill.

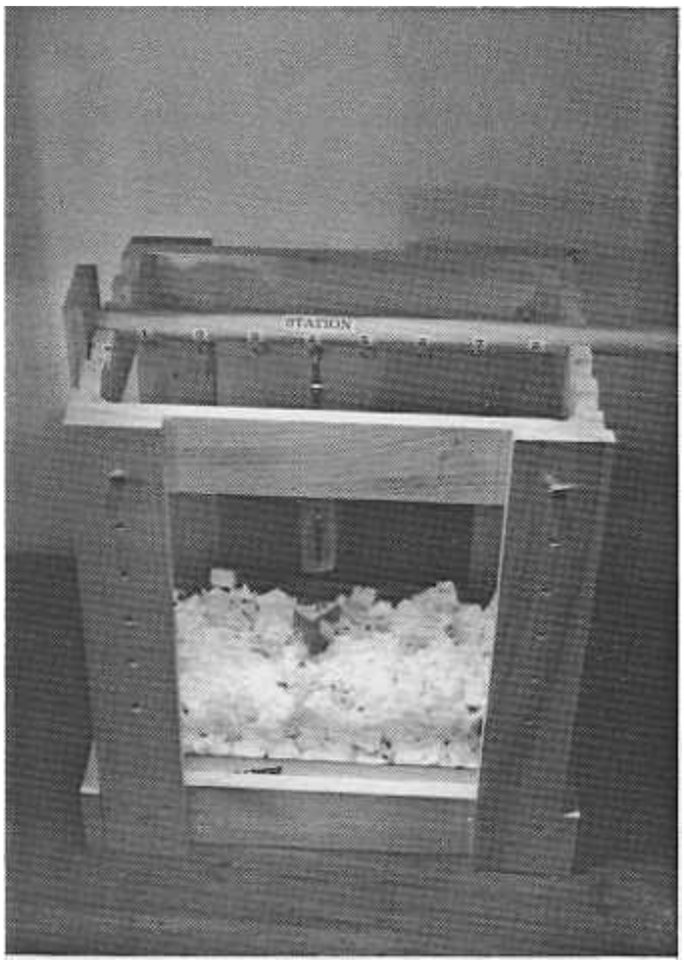
Directions:

1. Cut all wooden stock to sizes given in materials list.
2. Clamp all four uprights (20" long) together and drill a 1/4 inch hole at 2, 4, 6, 8, 10, and 12 inches respectively. These holes should be in the center of the board.
3. Nail and glue one of the 4 uprights to each end of 2 of the pieces of 17.75 inch stock. The holes drilled in step 1 should be away from the nailed end.
4. Nail and glue the 2 pieces of 14.75 inch stock to the parts from step 3. This will produce a rectangle with four uprights on the OUTSIDE. This framework will accept the standard cardboard box that duplicator paper is shipped in.
5. Take the piece of 6.5 x 11.5 inch stock and draw a line down its center. Measuring in from the left, mark the center line at 1.5, 3.75, 6, 8.25, and 10.5 inches. Use the 1.25 inch wood bit and bore holes at these distances.
6. Cut the piece of stock from number 5 above down the center line. Use sand paper to smooth the holes. (Note: a flat bottom "Forstner" type bit will cut these a lot more smoothly, but the bits are expensive.)
7. Nail and glue the two pieces from number 6 above and the last two pieces of 17.75 inch stock to make a second square. The half holes should "line up" or start the same distance in from one of the edges.
8. Line the smaller rectangle up inside the four uprights and, using the top hole in each upright as a guide, drill one hole in the end of each long side of the rectangle. Use the bolts, washers, and nuts to affix this smaller rectangle to the top of the uprights.
9. Cut the dowel to a length of 21.25 inches.
10. Use the drill and the 5/32 inch drill bit to drill a lead hole in one end of the wooden dowel and the center of the 3x3 inch block.
11. Use the 2.50 inch sheetrock screw and some glue to attach the square block to one end of the dowel.
12. Use the drill and the 7/64 inch drill bit to drill pilot holes at 2, 4, 6, 8, 10, 12, 14, 16 inches in the dowel. Measure from the end with the block.
13. Soap and screw the screw eyes into the pilot holes.
14. Label lines A, B, C, D, and E at the bottom of the holes along one end. Label stations 1 - 8 along the screw eyes starting with the eye nearest the wooden block.
15. Finish as desired.

NOTES: The bolts and holes let you adjust the level of the magnet above the sand or sawdust. You may wish to nail and glue a piece of plywood on the bottom and forego using cut down paper cartons; this limits your burial depth to about three inches.

If this unit will get "hard use" from students, you may wish to obtain 1-2 shipping pallets and salvage the wood. It is hardwood, often kiln dried and very tough and durable. Use sheet rock screws and yellow wood glue as fasteners. Drill small lead holes for the sheetrock screws. A unit thus constructed just does not break "accidentally."

Total time to build with a hand drill (excluding finishing) is 4.5 hours.



Part II: Percolation Columns and Stand for Use in Activity #5 (A Percolation Revelation) and #32 (The Percolation Rate of a Soil)

Materials:

- 3 one (1) liter plastic soda bottles (15¢)
- 3 plastic eye droppers from children's medicine bottles
- 3 circles of fine mesh screen (window screen) that are 1 inch in diameter
- Number 3 pine
  - 2 pieces 3/4 x 7 x 19 - shelves
  - 2 pieces 3/4 x 7 x 20 - sides
  - 4 pieces 3/4 x 2 x 7 - shelf cleats
- Spruce or hemlock
  - 1 piece 1.5 x 7 x 19 - base
- Plywood (optional)
  - 1 piece 1/4 x 20.5 x 20 - back
  - 1/2 pound 2.5 inch sheetrock screws
- White glue as needed
- 1 tube silicone rubber sealant

Tools:

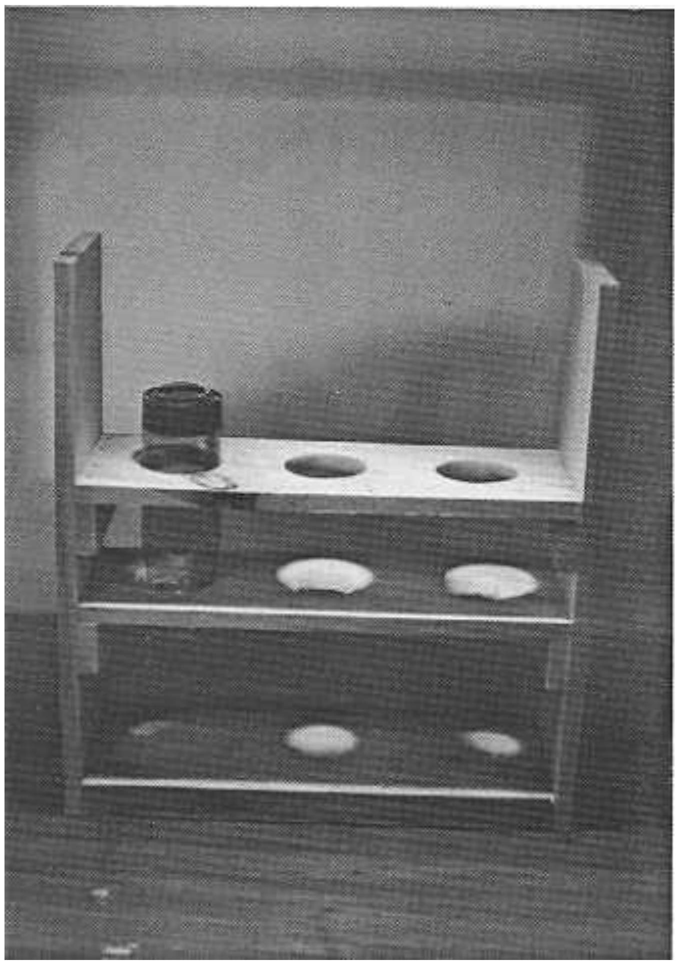
- Table saw
- Electric drill with 3 inch and 2 inch hole saw attachments, sheetrock screw drill bit
- Hammer
- 12 inch square, compass and tape measure
- Drawknife (must be very sharp)
- Sandpaper and round wood rasp
- Pipe clamps (2 feet) are optional
- Scissors

Directions:

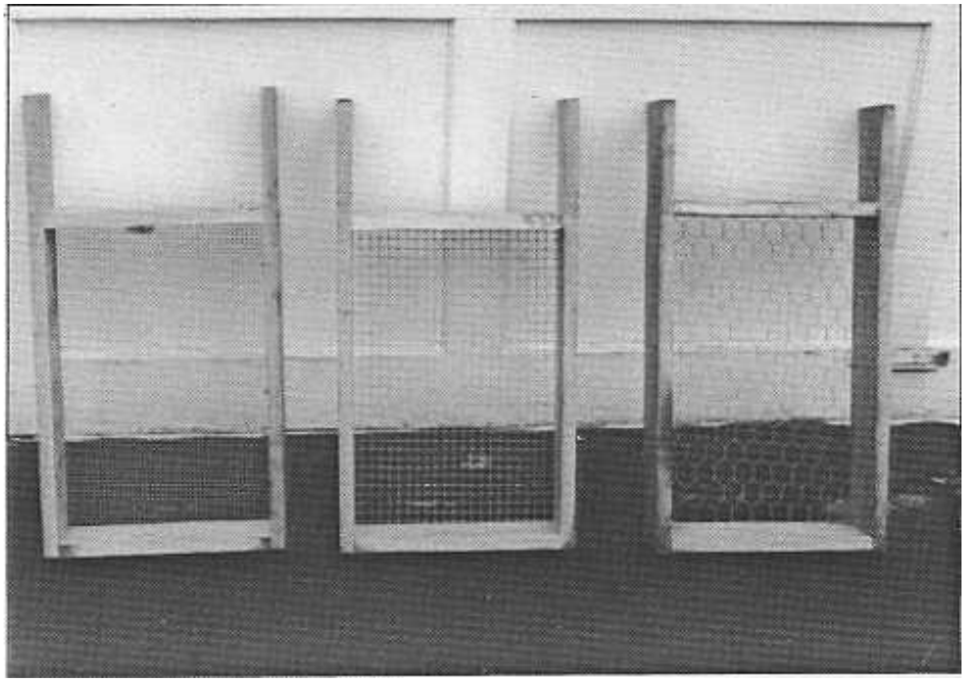
1. Cut all wooden stock to size.
2. Take one of the 3/4 x 7 x 19 inch pieces and draw a line lengthwise down the center of the board.
3. Using the center line as a guide, draw three-inch circles with the centers occurring at 3.5, 9.5, and 15.5 inches respectively.
4. Repeat this process, numbers 2 and 3, with the second piece of 3/4 x 7 x 19 inch stock; in this case draw two-inch circles with centers at 3.5, 9.5, and 15.5 inches.
5. Using the three-inch hole bit, cut out the three-inch circles; repeat this process for the two-inch circles using the 2 inch hole bit.
6. Enlarge holes slightly with wood rasp and sand as needed; large holes should just pass the soda bottle through them. You may wish to bevel the top side of the smaller holes to accommodate the curve of the bottle. Use the drawknife, wood rasp, and sandpaper to smooth out these efforts. The cap and about 1 inch of the neck should protrude below the bottom of the smaller holes.
7. Glue and nail shelf cleats to shelves; the shelf top fits flush with the edge of the cleat.
8. Glue and nail or screw the side pieces to the base; you will probably need either 2.5 inch galvanized nails or sheetrock screws.
9. Position the shelf with the beveled holes up so that the top of the shelf is 7.5 inches above the top of the base; screw and glue into place. Pipe clamps or C clamps may be useful here.
10. Screw and glue the top shelf so that the top of the shelf is 5 inches above the top of the shelf below it.
11. Cut the bottoms off the three 1 liter soda bottles; remove the plastic label; do not remove the plastic sleeve at the base.
12. Remove the soda bottle caps and drill a 5/16 inch hole in the center of each cap; drill hole from the INSIDE of each cap.
13. Take the three plastic eye droppers and cut off the tip of each.
14. Working from inside the cap, push an eye dropper through each hole in each cap. This should be a tight fit. Apply a bead of silicone rubber cement around the eye dropper on the outside of each cap. Set aside to dry.
15. Cut three small, 1 inch diameter circles of screen, trim so that a circle fits inside each soda cap.

16. Attach back, painted white, if desired. This back allows you to measure turbidity on a qualitative scale, when using the unit with clear plastic bottles.
17. Finish as desired.
18. Fill one or more bottles with a soil sample, add 350 -500 ml of water; place soil bottle in rack and measure percolation rate, water absorption and pore space, and turbidity.

Total time to produce using a hand drill is 6 hours, with the majority of the time being in sanding the holes so one has a snug fit with the bottles.



Part III: Additional Projects: Large Screens for Sorting Coarse Soil Samples



Left to right: 1/4, 1/2, and 1 inch shaker screens for sorting sand/gravel and quarried rock materials. Screens are stacked atop each other in decreasing mesh sizes to sort materials and each screen in turn is gently shaken back and forth. Each screen holds approximately 8-10 pounds of material.