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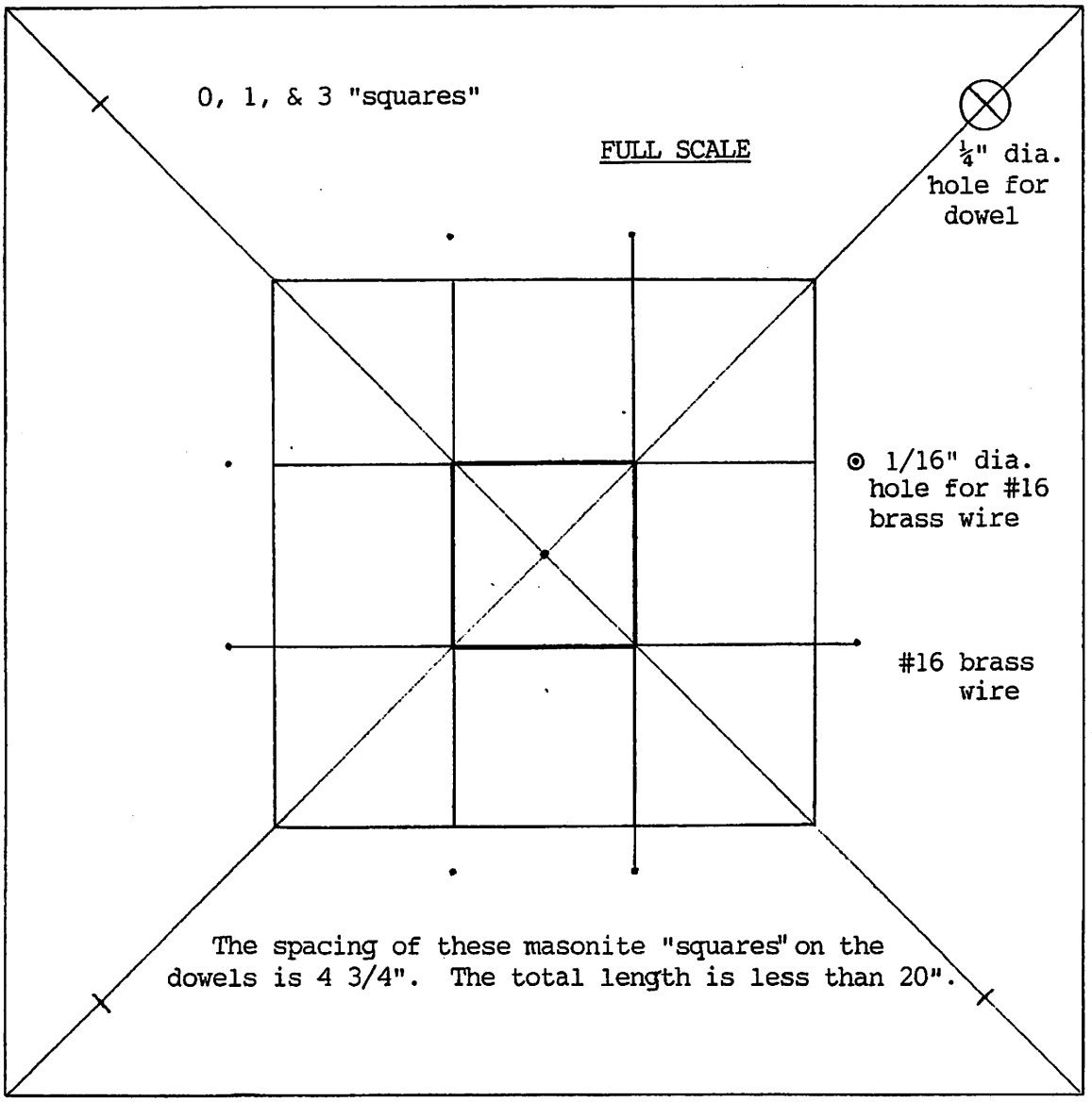
The inverse square relationship ($1/r^2$) - is a fundamental concept in nature (physics). It was first understood by Isaac Newton when he thought about gravity and gravitational fields. He had found the missing link, $1/r^2$, and immediately incorporated it into his Law of Universal Gravitation, $F = G\ m\ m'/r^2$. A hundred years later, Charles Coulomb would apply $1/r^2$ to electricity and electric fields. Shortly thereafter $1/r^2$ would be used with magnetic fields, radiation, and acoustics. Because the concept is so important, a simple, inexpensive, 3-D model is called for to help students understand it better. My sturdy model is made of 1/8" tempered masonite, ¼" dowel, #16 brass wire, and glue. Of course, you may design your own version which might use corrugated cardboard, dowel, and string instead. I chose a size that works well with my "earth", a 9½" dia. basketball; thus, r = 4 3/4" or 4,000 mi. The size requires a minimum of material and storage room.

Construction: I decided to make the model in two sections that can be butted together. The five masonite "square" patterns are illustrated in full scale. Cut out the six 6" squares on a table saw and the openings on a jig saw. Drill the ¼" (17/64"?) dowel holes on a drill press, aligned as best you can. A hand drill is good enough for the 1/16" wire holes.

Before final assembly, add the wire to "squares" 2, 3, and 4. Make the wire as straight as possible. Poke one end through a hole, and bend it over about 3/16". Stretch it across the opening to the opposite hole. Figure the length needed to go through the hole and be bent on the backside to secure it. Cut the wire and finish. You may wish to "weave" the wires to make a stronger grid.



For final assembly, slip the 2 "square" on one end of the dowels and the 3 "square" on the other end to their final, marked positions. Then slip the 1 and 4 "squares" on their ends. Once in place, add glue. Repeat for the 0-1 "squares".

Presentation: When discussing the earth's gravitational field and the lines of force (radial lines), show the class a basketball and this model. On the basketball, draw a 1" square. The first section, 0-1 (r = 4,000 mi.), represents a uniform field of expanding lines within the earth from center to surface. Placing the second section's 1" square (2 "square") on the basketball's 1" square represents the earth's field lines expanding out into space. Doing the simple math as you go out each additional r = 4,000 mi. should make clear what $1/r^2$ means and what the earth's gravitational field is like. I always use a 100 lines of force through the 1 "square" on a 100 lb. girl. Thus, a 1" square in the 2 "square" has only 25 lines of force going through it, or the girl would only weigh 25 lb. Out at the imaginary 5 "square" or 16,000 mi. above the earth, she would only weigh 1/25 or 4 lb. Only at the beginning (liftoff) is escaping the earth's gravity really difficult.