Challenge:

With your partner, research, design, and construct a 3 story "earthquake resistant" building that is the least expensive to construct using only the materials available through the supply company, and their own ingenuity. and can withstand the effects of an earthquake. You will then actually test whether your structure withstands an "earthquake" by using the specially designed "Earthquaker" board. Your design must follow the criteria below.

Criteria:

Buildings must be no more than 45cm tall.
Buildings must have 3 stories.
Each story must be 15cm high.
Each story must have a floor; however the floor does not have to be solid.
Buildings must have flat roofs.
Buildings cannot have solid walls; instead the structures should be more like scaffolding.
Building bases must be 11cm X 11cm.
Buildings to be designed so that the metal strappings (at least one) can be inserted and will anchor it to the ground.

Day 1 Design

Task: Your group will need to draw a blueprint of your building design. All blueprints must be drawn to scale. Use the graph paper to help you with this. Decide on a scale for your building, for example 1cm = ____. As your group is drawing and making engineering decisions, provide written support with brief descriptions as to what you are doing and why. These descriptions should outline the qualities and characteristics that make your building earthquake resistant. All designs must be in **final draft quality** and approved by the building inspector. See binder for information about building tips.

Day 2 Construction

Task: Follow the design of your building so your final product matches your original drawing.

Hints:

1. For tightest hold, apply glue to both surfaces being glued; then press the two surfaces together.
2. You may find it helpful to use binder clips, clothespins etc. to hold glued surfaces together until the glue is completely dry. These must be taken off before testing.
3. Allow the glue to completely dry before adding more stress or weight to the structure.
4. Most people begin by constructing the vertical and horizontal supports (aka walls, ceilings, floors, and beams) for each story. Once the walls are complete, they add any necessary trusses, and then glue the walls for only a single story together, until they have three 11cm X 11cm boxes. The first story is then glued to the base. The floor/ceiling is then placed atop each story, and three stories are stacked and glued on top of one another. The roof is usually the last structural piece to be placed on the building.

Day 3 Testing

Task: You will use the specially designed "Earthquaker" board to test whether the structure you designed might actually withstand an "earthquake". After you have completed the "shake tests", answer the following questions in your ISN.

1. Where was the weakest and first part of the building that failed? Explain what happened.
2. What would you do differently next time?
3. What part of the building design was a success? Explain why.

Building Tips:

The design of the building itself plays an important role in how it withstands destructive forces produced by seismic waves. In general, the most earthquake resistant buildings are symmetrical and us materials that are strong yet somewhat flexible (or ductile, meaning bendable).

The best way to describe the term symmetrical is to think of a mirror image. If you were to draw an imaginary line through the middle of the design, both sides would look exactly the same. Symmetry helps a building maintain its balance in the event of an earthquake. In buildings that are not symmetrical, mass is unevenly distributed, and horizontal forces produced by seismic waves cause twisting and distortion of the structure. Once this occurs, the building may become unsafe and eventually collapse.

When you design your walls, remember that they must be strong enough to hold up the ceilings, walls and roof above. Likewise, floors and ceilings, which must be horizontal, must be designed to support both vertical forces (like the people and equipment that will be placed on the floor) and horizontal forces (wind, motion, etc.) You can increase the strength of these structural components by adding joists or support beams. Remember, however, that you also want floors to be flexible, in order to absorb some of the energy from the earthquake.

The following diagrams show examples of various structural components. You may want to use these components, as shown, in your design, or you might want to revise the structures, or completely ignore then and make up your own designs. Whatever you do, remember the requirements listed earlier; make sure that your design meets these requirements and that it uses only those materials which are allowed.