Hands-On Activity

Building for an Earthquake

In this activity, students will demonstrate the following Inquiry Skills:

- Identify Questions
  - Develop predictions/hypotheses that
    - state the expected cause and effect (if-then statement) in an investigation based on prior knowledge and experience (hypothesis)
- Design Investigations
  - Make or use models that:
    - Simulate a real thing that cannot easily be studied or manipulated.
    - Allow the testing of a hypothesis with results that can be extrapolated to the real thing
  - Practice lab safety by:
    - Following lab safety procedures
- Gather Data
  - Chooses appropriate tools to conduct an investigation
    - Clock/stopwatch
  - Uses senses to observe:
    - Seeing (color, shape, size, texture, motion)
    - Touching (temperature, texture, shape, size, vibration, motion)
    - Kinesthetic (balance, position)
  - Uses the appropriate format to record data:
    - Table
    - Video Recording
- Interpret Data
  - Identifies and interprets patterns
    - Tables and graphs
    - Based on an analysis of data collected during an investigation
- Evaluate Evidence
  - Drawing and supporting a conclusion by:
    - Using data to determine the cause-effect relationship observed in the investigation
    - Comparing results to hypotheses
    - Extrapolating results beyond the investigation
- Communication in Science
  - Report results using:
    - Images or video

Materials:

- Safety goggles (1 pair per student)
- Per group:
  - 3 rigid craft foam blocks of varying sizes
  - 3 cardboard blocks of varying sizes
  - 3 wood blocks of varying sizes
  - Stopwatch
  - Shake table:
    - Empty shirt box
    - Marbles
    - Flat, circular piece of cardboard
  - Video camera (optional)

Note that the blocks should vary in size, but avoid having extremely small or extremely large blocks so as to keep the blocks within a reasonable size range. To construct the shake table, fill the empty shirt box with marbles and place the flat piece of cardboard on top of the marbles; the movement of the cardboard on the marbles will simulate lateral shaking caused by an earthquake.

Students working in small groups (3 or 4 students per group) will be challenged to build a variety of structures out of different-sized blocks made of different materials (rigid craft foam, cardboard, wood). Their goal is to determine which combination of blocks produces the most stable structure and the least stable structure in a simulated “earthquake”. Each structure they test should contain exactly three blocks stacked one of top of the other. Students should consider the following factors when designing their structures:

- Weight distribution: Where is the heaviest block? Where is the lightest block?
- Shape: Where is my building the widest? Where is it the narrowest?
- Height: How tall is my building?

Students should build each structure on top of the flat piece of cardboard in the shake table. One student in each group will test the stability of each structure by moving the shake table back and forth on a flat surface; the student should attempt to move the shake table at the same rate for each test. Another student will time how long it takes for each structure to fall. If after 1 minute the structure is still standing, students can declare that design stable and proceed to a new test.

Each group should begin by predicting which combination of blocks will create the most stable structure and which combination will create the least stable structure. They should then begin testing different combinations, keeping track of their results in a data table modeled after the following. (Sample data for several tests are recorded in red.)

Test	Bottom Block	Middle Block	Top Block	Result
1	small wood	small rigid craft foam	small cardboard	stable
2	small wood	medium wood	large wood	toppled after 0:10
3				

If the equipment is available, provide each group with a video camera so that they can videotape their structures as they collapse. Watching the video in slow motion can help them pinpoint where the structure failed more clearly.

Give students approximately 30 minutes to test their designs, then regroup as a class. Ask each group which of their designs was most stable and which was least stable, and ask them to hypothesize why that was. Then ask students to conclude, based on their tests and those of their classmates, which arrangement of weight, shape, and height would likely make the most stable structure. Finally, ask students to brainstorm additional factors real-life engineers must consider when designing earthquake-proof buildings.