



OBJECTIVE 1:

Students select an appropriate design to build a prototype.



ASSESSMENT:

Design and build portion.

OBJECTIVE 2:

Students determine and record relevant data while testing a prototype.



ASSESSMENT:

Test it! portion.

OBJECTIVE 3:

Students can identify one effective design structure (ex. pillars, arches, triangles, etc.)



ASSESSMENT:

Discussion near end; end review.

Academic Standards:

IL 11.B.3c-e Select the most appropriate design and build a prototype or simulation; test the prototype using available materials, instruments and technology and record the data; evaluate the test results on established criteria, note sources of error and recommend improvements.

Engineering Practices 2-3 Developing and Using Models; Planning and Carrying Out Investigations

Lesson Materials For "Store":

- Popsicle sticks
- Straws
- Paper Plates
- Paper
- Masking Tape
- Scissors

Per Group:

- Golf Balls
- Plastic Cup
- 1 Bag of Coins/fake money for our economy \$20
- 1 Safety Check List
- Design Sheets
- Outline of Regulations

Other Materials:

- Natural Disaster Simulators

Preparation:

- Prepare a materials table with all materials (to be retrieved by groups).
- Pass out coins to each group.

Planning and Procedure:

Background Information:

1. “Store”: This is a table with all of the materials laid out. Students can come to the store when you declare it “open” and can be turned away when the store is “closed”.
2. Token Economy: This is a system to get students thinking about budgeting and the value of a “dollar”. As the instructor, you have the ability to shift prices, inflation, sales, etc.
3. Student “Jobs”:
 - Architect: Finalizes and submits a properly labeled modeled for the hotel. They must list all the materials needed.
 - Structural Engineer: Approve the architect’s design and purchase necessary materials for the building project.
 - City Inspector: Responsible for testing the structure to ensure that it can withstand “mother nature”.
4. The “Moon Hotel” Story: Millionaire Larry Luna wants to open the most impressive moon-themed hotel in the world in downtown St. Louis. The MoonRise will feature real parts of a U.S. shuttle, moon rocks, space suits, and most impressively - a large rotating moon at the top of the building. The hotel will be approximately 40 stories, placing the large fake moon high above the city skyline. You may be asking yourself “so where do I come in?” Larry Luna wants YOU to design a prototype building for the MoonRise Hotel. The trick? It needs to hold a fake moon at its top – and survive an earthquake and windstorm to make sure it will stand through anything.
*NOTE: This is the story that works for our program. Find a story that fits your location and one that will engage your students!
5. Goal: To create the most indestructible tower with a 1.5 feet height requirement that can hold a golf ball in a cup at its top.

Introduction:

1. Ask if anyone has ever designed or built something before. Ask more specifically if they have ever built a tower or structure.
2. Introduce the problem to the students: they must engineer a tower that can hold a ball-like structure at its top. In order to do so effectively, they will need to first create a model of the tower.
3. Split students into groups of 3 and explain the possible roles each kid can take while going over the provided handout. While covering the handout, be sure to place an emphasis on the token economy, the sequence of events (design before building), and the necessity for students to record any changes they make to their initial design while building. After explaining what each role entails, allow a minute or two for each group to decide who has what position. Have all architects hold up their hands, then all structural engineers, and finally all city inspectors.
4. Set a time limit for students to accomplish the task before allowing them to begin.

Body of Lesson:

5. Students will follow their data collection sheet in order to design and purchase materials for their structure, after which the structure will be built. During the design and building times, the store will be closed or run by a second volunteer so that the activity leader can ask the group questions leading them to explain their design and to get them thinking about why they chose to do certain things (ex. use or not use triangles, arches, columns).
 - The suggested amount of time for group planning is 5-10 minutes for building prototype 1 - 20 minutes and for prototype 2 – 10 minutes.
 - Due to the need for questioning and monitoring, the instructor may choose the times that the materials store is open. He/she may also choose to increase or decrease rate for sales or inflation.
6. Extension: If a group has finished before the time has expired, they should discuss how to present their design and why they designed it the way they did. They should mention their strengths and what they think could be improved.
7. When the time limit has expired, inspectors will need to test the building's design using the shaker table to simulate an earthquake and by using a variable speed fan to simulate high speed/tornadic winds. (OPTIONAL) Students can still use a wrecking ball as an additional measure if their structure survives these two tests.
8. Extension: If groups finish early, have them create a second design/redesign on their "Design 2" page.

Closure:

9. Ask students what they might change if they were to design this again. Explain that redesigning is part of the design process and is the reason for prototypes.
10. Ask students what their structures strengths were and why they think those strengths helped. If it doesn't come up, explain the common structures (arches, triangles, and columns) that are typically used in architecture, asking each student if they used that design method for each.
11. Ask why we need to consider destruction when designing and constructing buildings and what some more recent events/examples make this point (Haiti, New Orleans, Japan).
12. Ask students what they learned in a review mini-game or quick activity.



THE PROBLEM: Millionaire Larry Luna wants to open the most impressive moon-themed hotel in the world in downtown Saint Louis. The MoonRise will feature real parts of a U.S. shuttle, moon rocks, space suits, and most impressively – a large rotating moon at the top of the building. The hotel will be approximately 40 stories, placing the large fake moon high above the city skyline. You may be asking yourself “so where do I come in?” Larry Luna wants YOU to design a prototype building for the MoonRise Hotel. The trick? It needs to hold a fake moon at its top – and survive an earthquake and windstorm to make sure it will stand through anything.

The Requirements: The model for the structure needs to be at least 1 foot high, be able to support the Moon the top of the structure, and survive an earthquake and windstorm. You will have to design and build the structure with a strict deadline (time limits) and a limited budget (only so many coins).

Stage 1: Design it! _____

Architect – this is where we need you! Work together with your team to create a proposed design for the new Moonrise Hotel. Using the design sheet, draw your proposed model for the hotel. Be sure to properly label all components of the design, especially the materials used. Don't forget to keep all of the building requirements in mind!

Stage 2: Build it! _____

Structural Engineer – this is where we need you! Work with your team to build your proposed design for the structure. Purchase the supplies from the County Construction Store. You have 25 coins to spend on supplies. The costs of materials are listed below.

Straw Bundle (5 Straws).....	1 Coin
Popsicle Stick Bundle (3 Sticks).....	1 Coin
Paper (2 Pieces).....	3 Coins
Tape (1 Foot).....	1 Coin
Paper Plate (1 Plate with Scissors).....	5 Coins

Stage 3: Test it! _____

City Inspector – this is where we need you! Test your structure to make sure it passes the requirements listed on the **Safety Check List**. Be sure to ask for help to use the earthquake and windstorm simulators!

Stage 4: Redesign it! _____

Everyone – this is where we need you! Use what you've learned from the discussion and the test of your original structure to construct an even better structure for the MoonRise.

Safety Check List

City Inspector – use this check list to make sure structure meets requirements

- _____ Structure is at least 1 foot high
- _____ Structure can hold a ball in a cup at the top
- _____ Structure can withstand an earthquake simulation
- _____ Structure can withstand a wind simulation. Highest level that it DIDN'T Break: _____

Safety Check List

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DESIGN DRAFT

