Lesson Plan: The Great Marshmallow Challenge

Subject: Engineering and Design Thinking

Ages: 7-11 (with specific adaptations)

Time Allotment: 45-60 minutes

Materials Needed

- **For each participant/team:**
  - 20 sticks of uncooked spaghetti
  - 1 yard (about 1 meter) of masking tape
  - 1 yard (about 1 meter) of string
  - 1 standard-sized marshmallow
- A measuring tape or ruler
- A flat surface to work on (table or floor)
- Paper and pencil/crayons for planning
- A timer or clock

Learning Objectives

By the end of this lesson, learners will be able to:

- Identify the basic steps of the Engineering Design Process (Ask, Imagine, Plan, Create, Improve).
- Work with limited materials to build a freestanding structure.
- Explain their design choices and identify one way to improve their creation.

Lesson Structure

Part 1: Introduction (5 minutes)

The Hook

Educator says: "Have you ever looked at a super tall skyscraper or a long bridge and wondered, 'How did they build that without it falling over?' People called engineers design those structures. They are expert problem-solvers. Today, YOU get to be engineers! Your mission, should you choose to accept it, is to solve a very important, and very sticky, problem."

State the Challenge & Objectives

Educator says: "Your challenge is to build the tallest possible freestanding tower using only the

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materials I give you. The catch? The entire marshmallow must be on the very top of your tower, and it has to stand on its own for at least 10 seconds. By the time we're done, you'll know the secret steps engineers use to solve problems, and you'll have built an amazing creation!"

Part 2: Body of the Lesson (30-40 minutes)

I Do: Introduce the Engineering Design Process (5 minutes)

Educator explains: "Engineers don't just start building randomly. They follow a recipe for success called the Engineering Design Process. It has five simple steps:"

1. **ASK:** What's the problem we need to solve? (For us: We need to build a tall tower that holds a marshmallow.)
2. **IMAGINE:** What are some crazy ideas for how we could solve it? Let's brainstorm! (Think about strong shapes, like triangles or squares.)
3. **PLAN:** Let's pick our best idea and draw a quick picture or blueprint. This is our map so we know what to do.
4. **CREATE:** Now for the fun part! We follow our plan and build it.
5. **IMPROVE:** Did it work? If it fell over, that’s not a failure, it’s just new information! We figure out what went wrong and make it better. Real engineers have to improve their ideas all the time.

We Do: Plan Together (5-10 minutes)

Educator facilitates a Think-Pair-Share or group discussion:

- "Let's look at our materials. What is the spaghetti good for? (Being the long beams). What are its weaknesses? (It breaks easily!)."
- "What about the tape and string? How can they help us?"
- "What's the most important part of any tall building? (A strong, wide base!). Let's brainstorm some ideas for a base."
- "I want each of you to take 3 minutes to draw a plan for your tower. Don't worry about it being perfect! This is just your plan to get started."

Differentiation for this step:

- **For Troy (age 7):** Encourage a simple drawing. Ask him: "What shape will the bottom of your tower be? A square? A triangle? Let's draw it." Focus on the idea of a plan, not the quality of the drawing.
- **For Vienna (age 11):** Encourage her to label her drawing. Challenge her with questions: "How will you make your joints strong? Have you thought about how using triangles might make it more stable than squares?"

You Do: Create! (20 minutes)

Educator sets the stage: "Alright, engineers! You have your materials and your plans. You have 20 minutes to create the tallest freestanding tower that can support your marshmallow. Ready, set, build!"

- Start a timer.
- Move around the room, acting as a guide, not a director.
- **Formative Assessment:** Ask probing questions as they work:
    - "That's an interesting idea! What made you decide to do that?"

    - "I see your tower is wobbling a bit. What's one thing you could do to make the base stronger?" (This is the 'Improve' step in action).
    - "How is your plan working out? Have you had to change it?"

Part 3: Conclusion (5-10 minutes)

Show and Tell & Test

Educator says: "Time is up! Pencils down, tape down! It's time for the moment of truth."

- Each learner/team brings their tower to the "testing zone."
- Measure the height of each tower that is standing.
- Place the marshmallow on top and count to 10 aloud. Celebrate every attempt, whether it stands or falls! A "glorious failure" is a fantastic learning opportunity.

Recap and Reflect

Educator leads a brief discussion:

- "What was the hardest part of this challenge?"
- "Look at the towers that stood up. What do you notice about their bases or shapes?"
- "Let's go back to our Engineering Design Process. Can someone tell me the five steps we used today?" (Ask, Imagine, Plan, Create, Improve).
- "If you had 10 more minutes, what is ONE thing you would do to **improve** your design?"

Educator reinforces the takeaway: "You all did an amazing job thinking and acting like engineers today. You asked questions, imagined solutions, made a plan, created something new, and thought about how to improve it. That process is how everything from your bike to the video games you play gets made!"

Assessment & Success Criteria

- **Formative (During the lesson):** Observe learners' ability to follow their plan, adapt to problems, and answer questions about their design choices.
- **Summative (End of lesson):** The learner successfully demonstrates their understanding through:
    1. Building a structure (success is the attempt and application of ideas, not just the final height).
    2. Verbally explaining their plan or one design choice they made ("I made a triangle at the bottom because you said it was strong.")
    3. Identifying one way they could improve their tower, showing they understand the final, crucial step of the design process.

Differentiation and Extension

- **For Younger Learners (Troy, age 7):**
  - **Goal:** Focus on the fun of building and the basic cycle of "Try -> Fall -> Try Again."
  - **Scaffolding:** You can pre-cut tape into strips to help with fine motor skills. Offer simple verbal suggestions like, "What if we make a triangle here?"
  - **Success Criteria:** Success is active participation and being able to say what they tried to build.
- **For Older Learners (Vienna, age 11):**
  - **Goal:** Focus on using the vocabulary of the design process and thinking critically about structural integrity.
  - **Extension:** Challenge her to use specific geometric shapes (e.g., "Your tower must be built using at least 5 triangles."). Ask her to write down two things that worked well and one thing that failed on her plan sheet.
  - **Success Criteria:** Success includes a taller, more stable tower and the ability to use terms like "base," "support," and "stable" when explaining her design.
- **Follow-Up Activity:**

  If time allows or for a future lesson, try the challenge again! Let them use their "Improve" ideas. Or, change one constraint, such as "Now you can't use tape, only string," to encourage new creative solutions.