Teacher Guide: Jack's Great Escape - Designing a Safe Descent Device

I. Lesson Overview

- **Title:** Jack's Great Escape: Designing a Safe Descent Device
- **Grade Level:** 3rd Grade
- **Subject Integration:** Language Arts, Science, Technology, Math, Engineering
- **Time Allotment:** 5-7 days (approximately 45-60 minutes per day, but flexible)
- **Central Challenge:** Students will design and build a prototype of a device to help Jack safely descend from the giant's castle at the top of the beanstalk.
- **Texas Essential Knowledge and Skills (TEKS) Alignment:** (See detailed TEKS below)

II. Learning Objectives

Students will be able to:

- Apply the engineering design process to solve a problem.
- Design and build a prototype of a descent device.
- Test and evaluate their prototype, making improvements as needed.
- Explain the scientific principles involved in their design (gravity, air resistance).
- Use measurement and data collection skills.
- Communicate their design process and findings through a presentation.
- Work collaboratively in a team.

III. TEKS Alignment

- **Language Arts:**
  - 3.6 Reading/Comprehension: Students analyze, make inferences and draw conclusions about the author’s purpose in cultural, historical, and contemporary contexts and provide evidence from the text to support their understanding
  - 3.8 Reading/Vocabulary Development: Students determine the meaning of grade-level academic English words derived from Latin, Greek, or other linguistic roots and affixes.
  - 3.15 Writing/Composition: Students write informative texts to communicate ideas and information to an audience in a clear and coherent manner.
  - 3.23 Speaking and Listening/Speaking: Students speak clearly and to the point, using the conventions of language.
- **Science:**
  - 3.5 Matter and energy. The student knows that matter has measurable physical properties and those properties determine how matter is classified, changed, and used.

    - 3.6 Force and motion. The student knows that forces cause change in motion and position in everyday situations.
- **Math:**
    - 3.6 Geometry and measurement. The student applies mathematical process standards to analyze attributes of two-dimensional geometric figures to develop generalizations about their attributes.
    - 3.7 Geometry and measurement. The student applies mathematical process standards to solve problems involving length, area, perimeter, time, temperature, volume, and mass/weight.
- **Technology Applications:**
    - (Specific TEKS will vary by state, but focus on using technology for communication and presentations)
    - Examples:
        - Use presentation software to create a slideshow.
        - Use digital cameras to capture images.
        - Gather information from digital sources.

IV. Materials

- **For each group:**
    - Variety of materials for prototyping (e.g., string, fabric scraps, paper, cardboard tubes, straws, tape, rubber bands, small toy figures to represent "Jack")
    - Measuring tools (rulers, meter sticks, timers)
    - Safety scissors
    - Buckets or containers to drop prototypes from (representing the height of the beanstalk – start with a safe, manageable height and increase as appropriate)
    - Scales (optional, for measuring weight)
- **Technology:**
    - Computer or tablets for research and presentations
    - Projector to display presentations
    - Digital cameras or devices for taking pictures/videos
- **Other:**
    - Chart paper or whiteboard for brainstorming
    - Markers
    - Copies of student worksheets (design brief, data collection sheets, etc.)
    - "Jack and the Beanstalk" book or read-aloud version

V. Procedure

Day 1: Introduction and Language Arts Connection

1. **Read "Jack and the Beanstalk":** Read the story aloud or have students reread it. Focus on the part where Jack needs to escape from the giant's castle.
2. **Discussion:**
    - What challenges did Jack face in escaping? (Height, speed, danger of falling)
    - What did Jack use to climb the beanstalk? (The beanstalk itself)
    - What did he *not* have for a safe descent? (This sets up the problem)
3. **Language Arts Focus:**
    - Discuss the author's purpose in this part of the story. Why is Jack's escape important? (3.6)
    - Identify any vocabulary words related to height, falling, or safety. (3.8)
4. **Introduce the Challenge:** Explain that students will work in teams to design and build a device to help Jack safely get down from the beanstalk.
5. **Brainstorming:** As a class, brainstorm different ways to descend from a height safely (parachutes, elevators, slides, etc.). Record ideas on chart paper.

Day 2: Engineering Design Process - Ask & Imagine

1. **Review the Engineering Design Process:**
    - **Ask:** What is the problem? What are the requirements and constraints?
    - **Imagine:** Brainstorm possible solutions.
    - **Plan:** Draw a design and choose materials.
    - **Create:** Build a prototype.
    - **Test:** Test the prototype.
    - **Improve:** Make changes to the design.
    - **Communicate:** Share the results.
2. **Ask:**
    - Define the problem clearly: "Design a device to help Jack descend safely from the giant's castle to the ground."
    - Discuss constraints:
        - Materials available (limit what they can use).
        - Safety of the device (emphasize this!).
        - Simplicity of design (age-appropriate).
3. **Imagine:**
    - Students work in their teams to brainstorm design ideas.
    - Encourage all ideas, even silly ones, at this stage.
    - Have students sketch their initial ideas in their design notebooks or on provided worksheets.

Day 3: Engineering Design Process - Plan & Create

1. **Plan:**

- Teams choose their best design and create a detailed plan.
- This plan should include:
  - A labeled drawing of their device.
  - A list of materials they will use.
  - A step-by-step procedure for building their prototype.

2. **Create:**
   - Students build their prototypes using the materials provided.
   - Teacher facilitates, provides support, and ensures safe use of materials.
   - Encourage teamwork and problem-solving.

Day 4: Engineering Design Process - Test & Improve

1. **Test:**
   - Teams test their prototypes by dropping them from a designated height with a small toy figure ("Jack") attached.
   - Students collect data:
     - Time it takes to descend.
     - Observations about the stability and safety of the descent.
   - Record data on data collection sheets.
2. **Improve:**
   - Teams analyze their test results and identify areas for improvement.
   - They modify their designs and retest.
   - This iterative process is crucial to engineering!

Day 5: Technology Integration & Presentation Preparation

1. **Technology Integration:**
   - Students use digital tools to prepare their presentations.
   - This could involve:
     - Taking pictures or videos of their prototype and testing.
     - Creating a slideshow presentation.
     - Researching real-world examples of descent devices (teacher-provided resources).
2. **Presentation Guidelines:**
   - Clearly describe the problem and their design solution.
   - Explain how their device works.
   - Show their prototype and test results.
   - Discuss any challenges they faced and how they overcame them.
   - Use clear and effective language. (3.23)
3. **Language Arts Connection:**
   - Students write a user manual for their device (3.15). This reinforces

informative writing.

Day 6: Presentations

1. **Student Presentations:**
    - Teams present their designs to the class.
    - Encourage active listening and respectful questions from the audience.
2. **Assessment:**
    - Use a rubric to assess both the prototype and the presentation.
    - Provide feedback to students.

Day 7 (Optional): Reflection and Extension

1. **Reflection:**
    - Discuss what students learned about the engineering design process, teamwork, and the science concepts.
    - Have students write a reflection on their experience.
2. **Extension Activities:**
    - Research different types of real-world descent devices.
    - Calculate the cost of materials for their prototype (math connection).
    - Explore how the height of the beanstalk would affect the design (science connection).

VI. Assessment

- **Design Process:** Observe student participation in brainstorming, planning, building, testing, and improving.
- **Prototype:** Evaluate the functionality, safety, and creativity of the descent device.
- **Presentation:** Assess the clarity, organization, and content of the presentation, as well as speaking skills.
- **User Manual:** Evaluate the clarity and completeness of the written instructions.
- **Teamwork:** Observe and assess students' collaboration and communication skills.
- **Rubrics:** Use rubrics to provide clear expectations and consistent grading.

VII. Differentiation

- **Support for struggling learners:**
    - Provide simplified design templates.
    - Offer more direct guidance during the building process.
    - Reduce the complexity of the presentation requirements.
- **Challenge for advanced learners:**
    - Introduce more complex design constraints.
    - Encourage them to research and incorporate more advanced scientific

principles.
    - Have them calculate the efficiency of their device.

VIII. Safety Considerations

- Emphasize safety throughout the activity.
- Supervise students closely during the building and testing phases.
- Ensure that the drop height is safe and appropriate for the materials being used.
- Provide clear instructions on the safe use of tools and materials.

IX. Teacher Notes and Tips

- **Preparation is key:** Gather all materials in advance and organize them for easy access.
- **Flexibility:** Be prepared to adjust the timeline and activities based on student needs and progress.
- **Encourage creativity:** Allow students to explore different ideas and approaches.
- **Focus on the process:** Emphasize the importance of the engineering design process, not just the final product.
- **Positive feedback:** Provide specific and encouraging feedback to students throughout the activity.
- **Real-world connections:** Relate the activity to real-world examples of engineering and design.