

# Fourth Grade Engineering Design Challenge- Touchdown

Susan Wray

## Phase I- Research and Planning

1. *“Big concept” to be covered by the engineering design challenge:*
  - A. **Design** a shock-absorbing system that will protect two astronauts when they land.
  - B. **Build** a shock-absorbing system that will protect two astronauts when they land.
  - C.
  
2. *Appropriate Oklahoma learning standards associated with the topic:*
  - A. **Oklahoma Science Standards:**
    1. 4-PS3-1 Use evidence to construct an explanation relating the speed of an object to the energy of that object.
    2. 4-PS3-2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
    3. 4-PS3-3: Ask questions and predict outcomes about the changes in energy that occur when objects collide
  - C. **Oklahoma Technology Standards (ISTE):**
    1. ISTE 3d: Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.
    2. ISTE 4a: Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
    3. ISTE 4c: Students develop, test, and refine prototypes as part of a cyclical design process.
  - B. **Next Generation Engineering Standards:**
    1. 3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

# Fourth Grade Engineering

## Design Challenge- Touchdown

Susan Wray

2. 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
3. 3-5-ETS1-3: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

### **C. Oklahoma Mathematics Standards:**

1. 4.GM.1.1: Identify points, lines, line segments, rays, angles, endpoints, and parallel and perpendicular lines in various contexts.
2. 4.GM.1.2: Describe, classify, and sketch quadrilaterals, including squares, rectangles, trapezoids, rhombuses, parallelograms, and kites. Recognize quadrilaterals in various contexts.
3. 4.D.1.3: Solve one and two step problems using data in whole number, decimal, or fraction form in a frequency table and line plot

### **3. Types of problem solving and knowledge needed for the solution:**

#### **A. Moderately Structured/Rule Using Problems/Design Problem:**

1. The engineering design challenge is moderately structured requiring varying strategies and adaptations with more than one acceptable solution strategy. The touchdown requires skills of mental modeling where students invent a strategy to suit the challenge.
2. The engineering design challenge is a “rule using” problem because there is a procedural process constrained by rules. Students must select and apply rules using real-world constraints with unpredictable outcomes.
3. The engineering design challenge is a design problem with goals to produce structuring where there is no right or wrong answer to a real- world problem.

#### **B. Declarative and Procedural Knowledge:**

1. Students will need declarative knowledge to complete the challenges.
  - a. Facts: It is important to get astronauts to and from the moon safely.
  - b. Concepts: Students must understand the concept of a space lander they will build which is a spacecraft that can land safely

# Fourth Grade Engineering

## Design Challenge- Touchdown

Susan Wray

when it is dropped on the floor. Students will also need to understand shock absorbers and how they impact energy.

c. Principals: Students will need to understand the system and the variables of the system which might impact their spacelander.

2. Students will need procedural knowledge to complete the challenge.

a. Students will need to know the directions for building the cabin for the astronauts and how to put the spacecraft together

b. Students will need to follow the engineering design process throughout the design.

c. Students will need to know the different shapes.

d. Students will need to know how to calculate speed.

e. Students will need to know how to take the time and measure the distance.

#### *4. Concepts and Content Covered By the Project:*

A. Students will observe and record evidence and construct

B. explanations that the speed of an object relates to the energy of that object as they calculate and record the speed of the space crafts.

C. Students will investigate the transfer of energy and how different materials and shapes of materials have different impacts on that transfer of energy.

D. Students will investigate the possible shapes of the space crafts.

E. Students will make observations to provide evidence that energy can be transferred from place to place.

F. Students will make predictions about the changes of energy in the spacecrafts as they collide with the ground.

G. Students will be expected to utilize an engineering design process.

H. Students will be expected to recognize constraints and criteria.

#### *5. Possible Activities:*

A. Students brainstorm solutions for the shock absorber in groups as they evaluate supplies.

B. Students evaluate possible shapes and the impact those shapes might have on the speed of the spacecraft.

C. Students build the spacecraft lander using the criteria and constraints.

D. Students weigh the spacecrafts and record the data from all the classroom spacecrafts.

# Fourth Grade Engineering Design Challenge- Touchdown

Susan Wray

- E. Students test the spacecraft landers and record the speed and the impact results.
- F. Students redesign the spacecrafts based on the data collected and the observations made after the collision.
- G. Students make a final landing of the spacecraft landers sharing all their results with the other groups.
- H. Students launch from a higher elevation and record data.
- I. Students draw models identifying the variables that affect the results of the landing.
- J. Students draw models identifying the energy transfer as it moves from place to place.

**6. *Best activity for classroom:*** Students design spacecraft landers using the engineering design process drawing models identifying the energy transferring and variables impacting the collision.