ORLANDO SCIENCE CENTER

Title: Car Crash Challenge

Grade Level: Pre-K

Duration: 60 minutes

Objective: Students will use the engineering design process to design and create a prototype safety mechanism that will protect an egg inside of toy car from breaking when rolled down a steep ramp and crashing into a solid wall. Students will understand that engineers use the engineering design process to create and improve technology. Students will explore kinetic and potential energy, and the force of gravity by applying it to car crash simulations. Students will understand that simulation technology can make transportation safer.

Overall Materials:

- 1 Trash Bag Roll
- 45 Eggs
- 45 Dixie Cups
- 11 Plastic Cars
- 2 Paper Towel Rolls
- 30 Worksheets
- 2 Large Tarps
- 1 Measuring Tape
- 1 Laptop
- 1 Projector
- 1 Extension Cord
- 1 Power Strip
- 3 rolls of masking tape

Group Materials (per group)**:**

- 30 cm masking tape
- 4 popsicle sticks
- 2 drinking straws (non-bendy)
- 3 cotton balls
- 2 index cards
- 1 12x24" piece of aluminium foil
- 1 egg
- 1 pair of scissors
- 1 pen
- 1 ruler

Engage (10 min.)

- *(slide 1)* **The NHTSA (National Highway Traffic Safety Administration under the United States Department of Transportation) are the people in charge of ensuring the motor vehicles we drive are safe, efficient, and economical. These people work in teams of varying sizes to problem-solve solutions to common issues that either arise or we want to prevent – such as developing**

sturdier tires, or developing new braking systems. These people are called Automotive Engineers, and today they need your help!

- **They want to develop a new kind of seatbelt or restraint system for a car.** *(slide 2)* **Your goal today is to be engineers that will design and create a prototype seatbelt/restraint system that will protect an egg inside from breaking when racing down a ramp and crashing into a wall.**

- **What is an engineer?** *(3rd slide- pause to take answers)*

  Engineers develop and improve technology (anything human-made which solves problems or fulfils desires that people have). There are many types of engineers (civil engineers - design and construct public works such as bridges and roads; electrical engineers - find practical uses of electricity; and modelling and simulation engineers- use models and simulators when developing technologies).

- **What is technology?**

  Technology is anything human-made that solves a problem or need that humans have.

  (slide 3) Engineers use the **Engineering Design Process**, which involves 5 main steps. First they define a **GOAL** for the design and **ASK** questions to establish design criteria. They **IMAGINE** at least two possibilities for design. Then they **PLAN** the design before building. They **CREATE** at least one design solution and test it. Then, they **IMPROVE** the design and test it again.

- **During the first step of the Engineering Design Process (Ask), you have the opportunity to ask questions about the goal. What do you need to know in order to solve this problem?** *(pause and take answers - Possible answers may include time to design and build, what materials do we have, why are we using an egg.)*

- **I will cover the criteria (qualities of the design such as size and strength) and constraints (limitations of the design such as time and materials) later. First we are going to explore the forces on the car while moving and upon impact, and why we are using an egg for this challenge.**

- **What forces does a car have to endure when crashing?** *(Pause and take answers)*

- **Gravity**, **energy (potential and kinetic)**, and **weight**.

- **What is gravity?** *(Pause and take answers)* Gravity pulls objects on Earth toward the center of the planet, including cars!

- **What is potential and kinetic energy?** *(Pause and take answers)* Potential energy is stored energy. Kinetic energy is the energy of motion. As an object moves, it converts potential energy into kinetic energy.

- **What is weight?** Weight is an object's mass x gravity. So, the bigger something is, the more weight it has, and the stronger effect gravity will have on it.

- **Why are we using an egg?** (*Pause and take answers*)
  The egg represents the human body and all the fragile elements and components that make up us. We need to ensure we keep all those parts safe and intact.

Activity

1. *(slide 6)* **Now that you know the forces involved, you need to know the materials you have to complete the challenge.**
2. **Goal:** D**esign and create a prototype seatbelt/restraint system for a car that will protect an egg inside from breaking when racing down a ramp and crashing into a wall. For the purposes of this challenge: If the eggshell cracks and no yolk leaks out, your team has succeeded the mission.**
3. **Testing area**: 2 Large tarps taped to lower half of wall and secured to floor. Ramp and support are both on the floor tarp. Paper towels are nearby. Teams will take turns selecting one member from their team to secure their safety device with the egg inside to the car, then letting it fall down the ramp into the wall.
4. Distribute one materials bag to each team. Give each person a worksheet.
5. **You will now have 1 minute to imagine a design for a safety device/mechanism and draw 2 ideas.**
6. (*After 2 minutes*) **Now share your ideas with your group and decide on one plan. You can combine aspects of several different ideas into one Plan for the group. Make sure your plan meets the requirements of the goal.** Time: 2 minutes.
7. **You will have 12 minutes to build your safety device/mechanism.** (Start time. Give regular time updates to teams so they can use their time appropriately.
8. Ask the team member to share their safety device/mechanism with the class.
   - **Describe your design.**
   - **What materials did you choose? Why did you choose those materials?**
9. After each test, ask the team the following questions:
   - **Was it successful? Did it meet the goal?**
   - **What parts worked well? How do you know?**
   - **Which parts didn't work well? How do you know?**
10. After all tests, discuss with students which designs worked best and why. **Which design would NHTSA want to purchase? Why?**
11. Give groups 10 minutes to improve their design. They must first draw their improved design on their worksheet and then make changes according to their new design.
12. **Each group will receive an additional 15 cm of tape at the improve stage.**

13. After 10 minutes, tell groups to stop building and that it is time to test the devices.
14. Before testing, have groups share their improved design with the class.
    - **How did you 'Improve' your design?**
15. Follow the same test procedures done previously. Have students answer the following questions after the test.
    a. **Were your improvements successful? How do you know?**
    b. **What parts of your design worked well? How do you know?**
    c. **What parts did of your design did not work well? How do you know?**
    d. **What would you do to improve this design?**
16. Make sure to leave some time for cleaning at the end.
17. After all tests, discuss with the class the following questions: *(slide #6)*
    - **How did you use your knowledge of gravity, potential energy, kinetic energy, weight, the Engineering Design Process, and our creativity to design a safety device/mechanism?**
    - **Were you able to improve the design?**
    - **What was the easiest part of the challenge?**
    - **What was the hardest part of the challenge?**