TeenDrive365 In School

Toyota Motor North America Research & Development
Virtual Field Trip Educator Guide

As the technology all around us advances, so do the vehicles we drive. The engineers, scientists, and technicians at ***Toyota Motor North America Research & Development*** in Michigan use the latest technology to make Toyota vehicles safe and smarter.

On this Virtual Field Trip, students will go behind the scenes at ***Toyota Motor North America Research & Development*** to see how technology and passion combine to drive the design, research, and development for Toyota North America. The Virtual Field Trip will showcase different careers in vehicle safety engineering and technology and showcase some of the advanced vehicle technology that makes today's vehicles safe and more reliable than ever before. Students will observe how Toyota professionals think critically, communicate effectively, and apply new technologies to the work at the ***Toyota Motor North America Research & Development Center.***

Students will explore three different aspects of the Research and Development center during the Virtual Field Trip:

- The Electromagnetic Compatibility Chamber
- Crash Test Lab
- Toyota Safety Sense Technology
- Collaborative Safety Research Center

This companion guide provides options for in-class activities designed to complement the Virtual Field Trip.

Discovery EDUCATION

Activity Options

Activity 1: Electromagnetism
Time: 45-60 minutes

Materials:

- Electromagnetic wave image

In this exercise, students will research the electromagnetic spectrum in order to answer an engineering design question—can the features included in Toyota Safety Sense be installed without interfering with other electromagnetic signals commonly used in vehicles?

Begin by placing students in home groups of 4. Students will have a capture sheet with the electromagnetic spectrum, beginning from radio waves and then progressing up to X-ray waves (a visual example of this can be found at imagine.gsfc.nasa.gov). The spectrum will have benchmarks with appropriate units of measure in Hz. Each student will then be given a number which corresponds to a specific signal technology that is commonly used in today's automobiles:

- Cell phone signal (1)
- AM/FM radio signal (2)
- Bluetooth signal (3)
- Satellite/GPS signal (4)

Students will leave their home groups and break into their signal research groups. In their groups, students will research the electromagnetic frequency of the signal they have been given and plot the signal on their capture sheet. After learning about their assigned technology, students will return to their home groups and take turns sharing out where their signal falls on the electromagnetic spectrum. All students will then have a diagram of the electromagnetic spectrum with the four signal types places appropriately.

The instructor will then explain Toyota Safety Sense and the three specific technologies that make up these safety features:

- Camera (visible light)
- Radar
- Laser

In their home groups, students will research what area of the electromagnetic spectrum each of the three technologies are on and plot them on their capture sheets. They will then answer the following critical questions:

1.) Why is it important to include technology in cars?
2.) Why is it important to know where each technology falls on the electromagnetic spectrum?

Activity 2: Impact Testing
Time: 45-60 minutes

Materials:

- 1-meter-long section of PVC pipe or a large cardboard shipping tube per group
- 3-4 eggs per student group
- Masking tape
- Ziploc bags (a mix of pint and quart-sized)
- Bubble wrap
- Cardboard
- Cardstock
- Scissors

In this simulation, students will learn how airbags and seatbelts work to help keep passengers safe against the forces of impact. The lesson will draw upon Newton's first and second laws of motion, as students observe inertia and net force in action. Student groups will work together to research, design and build a prototype of an airbag. Students will test their airbag by rolling an egg down a meter-long section of PVC pipe at a 45-degree incline towards the prototype and recording the time from launch to impact and the condition of the egg upon interacting with the airbag. Students will then observe how a seatbelt works to help keep passengers safe by designing a restraining apparatus for their egg. They will then send the restrained egg down the pipe towards the airbag prototype and observe how the restraining device affects the speed and safety of the egg upon impact. The activity will culminate with a class discussion about the effectiveness of the prototype designs. Students will be asked to relate the experiment to the crash testing they observed on the Virtual Field Trip and draw inferences from their activity as to what would help keep vehicle passengers safe upon impact.

National Standards

Next Generation Science Standards

HS-PS3-5 Energy
Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

HS-PS4-5 Waves and their Applications in Technologies for Information Transfer

Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.*

HS-PS2-1 Motion and Stability: Forces and Interactions

Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

HS-PS2-3 Motion and Stability: Forces and Interactions

Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*

National Health Education Standards

Standard 2
Students will analyze the influence of family, peers, culture, media, technology, and other factors on health behaviors.

Standard 4:
Students will demonstrate the ability to use interpersonal communication skills to enhance health and avoid or reduce health risks.

Common Core State Standards: ELA

CCSS.ELA-LITERACY.RST.9-10.7
Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

CCSS.ELA-LITERACY.W.11-12.1
Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.