DataSnap™ Air Racer Experience

Advanced Curriculum Overview

Designed for:

- High school students in engineering, automotive, robotics, or STEM/science courses

Length:

This 12-hour curriculum is comprised of eight lessons. With supplemental materials, this curriculum can be adapted to a longer block of time. You can also select individual lessons or activities to use in your current curriculum.

Goal:

To modernize the CO^2 racer experience, bringing standards-driven content to life with easily accessible race performance data.

Synopsis:

The DataSnap Air Racer STEM Lab and its advanced curriculum allow students to learn, explore, and design solutions to engineering challenges, using the compressed air launcher to repeatedly conduct test races and evaluate their customized Air Racer designs. Students will learn about and experiment with Newton's Laws, power, work, and more. The lessons and activities feature objectives, materials required, and approximate class time.

Curriculum Components:

- Curriculum
- Student materials
- Slide presentations
- Stident Engineering Workbook

Learning Objectives:

Lesson 1 – Building and Racing Basics

- Build a simple Air Racer
- Successfully run a simple race with the Air Racer
- Access and view data with the DataSnap Motion Sensor

Lesson 2 – Newton's Laws of Motion

- Collect race data and compute average acceleration
- Predict qualitatively how changing either mass or pressure will affect the Air Racer's motion and then test that prediction
- Optimize an Air Racer for maximum acceleration within the given safety constraints

Lesson 3 – Pneumatic Power, Work, and Energy Transfer

- Calculate work, power, and kinetic energy
- Design and run experiments that vary pneumatic pressure while holding others constant to see its effect on performance
- Interpret data to decide which variable most improves Air Racer speed

Lesson 4 – Weight Distribution

- Understand how shifting center of mass influences the stability and steering of a car
- Know how to mount ballast weights onto the Air Racer
- Identify lateral drift measurement data using the DataSnap Motion Sensor

Lesson 5 – Wheel and Axle Placement

- Measure and calculate wheel diameter, circumference, and travel
- Understand the influence of wheel properties and axle spacing on performance
- Design and build an Air Racer that maximizes stability

Lesson 6 – Aerodynamics

- Understand how friction, air resistance, lift, downforce, and drag influence Air Racer design
- Modify their Air Racer's design to influence aerodynamic performance

Lesson 7 – Collision Dynamics

- Calculate momentum
- Understand the variables involved in collision dynamics
- Design, build, and test a collision bumper with a crumple zone

Lesson 8 – Engineering Design Challenges

- Describe the Engineering Design Process
- Use the Engineering Design Process to identify, build, and test solutions to challenges related to velocity, safety, and stability

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