Advanced DataSnap™

Air Racer Experience Curriculum

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The DataSnap Air Racer Experience modernizes the CO_2 racer experience, bringing standards-driven content to life with easily accessible race performance data. Students 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.

Authors

Justin Bitar graduated from the University of North Carolina at Charlotte with a Bachelor of Science in Mechanical Engineering. He later went on to work in the automotive industry as a research and development engineer, where he earned multiple patents for his work. He then transitioned into the consumer products industry as a product development engineer.

In 2019, Justin started his own company, Bitar Machine Design, which now employs four full-time engineers and helps both individual clients and businesses alike bring new products to market. His company also sponsors student competition teams in robotics and rocketry. In his free time, Bitar enjoys working on cars, racing, and hiking with his wife.

Michael Russell is the Managing Director of Tinker with Purpose, LLC (tinkerwithpurpose.org) and administrator of NativityMiguel Middle School of Buffalo. He is a graduate of the University of Rochester, where he earned a Bachelor of Science in Mechanical Engineering and two minors in English. He later earned a Master of Curriculum and Instruction from the University of Cincinnati. Prior to becoming an educator, Michael worked as a field engineer in construction management and oilfield services.

As a school administrator, Michael focuses on creating new pathways for students to learn through play, authentic experiences, complex problem-solving, and collaborative projects. As an education consultant, he partners with organizations on product development, instructional design, leadership coaching, and change management. He lives in Buffalo, New York with his spouse, Liesel, and their son, Avery. He is a huge fan of the New York Mets, Batman, professional wrestling, 1970s science fiction, and amateur woodworking.

Curriculum Structure

The Advanced DataSnap Air Racer Experience Curriculum is composed of the following lessons. Approximate lesson times are included.

Lesson	Title	Approximate Time
One	Building and Racing Basics	50-120 minutes
Two	Newton's Laws of Motion	50-80 minutes
Three	Pneumatic Power, Work, and Energy Transfer	50-80 minutes
Four	Weight Distribution	50-80 minutes
Five	Wheel and Axle Placement	50-80 minutes
Six	Aerodynamics	50-80 minutes
Seven	Collision Dynamics	50-80 minutes
Eight	Engineering Design Challenges	50-80 minutes
	Total	**6-12 hours**

Lesson Structure

Each lesson begins with a Lesson Overview, Lesson Objectives, and a Lesson at a Glance table, which lists lesson activities, materials required, suggested preparation steps, and approximate class time.

Lesson Components

Pre-Assessment: These are quick primers to get students focused and ready to engage. They are short-response questions that elicit prior-knowledge thinking and can serve as a good whole-class opening discussion or a quick LMS check-in.

Content and Learning Guide Slide Presentation: This curriculum is designed to give teachers the flexibility to implement instruction in ways that best meet their classroom needs. The slide presentations can support teacher-led, whole-class instruction, or they may be used by student teams for independent or collaborative learning. Many educators choose to upload the slides to their LMS, allowing for easy student access and flexible pacing.

Student Engineering Workbook: As students follow the guided lessons in the slide presentations they should complete the corresponding sections of their Student Engineering Workbook.

Post-Assessment: Similar to the pre-assessment, these are short-response questions that can be used as an exit ticket or implemented in whatever way best supports your instructional goals.

Lesson One – Building and Racing Basics

Lesson Overview

Students will be introduced to drag racing fundamentals, guided through Air Racer building and how the launch system works, and how to connect the DataSnap Motion Sensor and conduct a data collection

Lesson Objectives

After completing this lesson, participants will:

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

Lesson at a Glance

Activity	Materials	Preparation	Approximate Class Time
Pre-Assessment	• Building and Racing Basics Pre-Assessment	1. Print/photocopy the Building and Racing Basics Pre-Assessment (one per student) or load it into your LMS.	5 minutes
Content and Learning Guide	• Lesson 1 slide presentation • 1 Air Racer Kit per team • 2+ DataSnap Motion Sensors • Pneumatic Race System	1. Share the slides with students. 2. Gather Air Racer materials.	40-110 minutes
Student Workbook	• Student Engineering Workbook • Student Engineering Workbook – Answer Key	1. Share workbooks with students. 2. Access the answer key.	
Post-Assessment	• Building and Racing Basics Post-Assessment • Building and Racing Basics Post-Assessment – Answer Key	1. Print/photocopy the Building and Racing Basics Post-Assessment (one per student) or load it into your LMS. 2. Access the answer key.	5 minutes

Lesson One – Building and Racing Basics

50-120 minutes

Materials:

- 1 Air Racer Kit per team
- 2+ DataSnap Motion Sensors
- 1 Pneumatic Race System
- Building and Racing Basics Pre-Assessment
- Lesson 1 slide presentation
- Student Engineering Workbook
- Student Engineering Workbook – Answer Key
- Building and Racing Basics Post-Assessment
- Building and Racing Basics Post-Assessment – Answer Key

Facilitation Steps:

1. Provide students with the pre-assessment to complete. Use it in the way that best supports your instruction; many teachers use it to guide team or whole-class discussion.
2. Students should have access to the Lesson 1 slide presentation. These can be uploaded to your LMS for individual or group work, or you can work through the slides collectively as a whole class.
3. As students work through the slides, they should complete the corresponding Lesson 1 questions in their Student Engineering Workbook.
4. Each team will need one Air Racer Kit, which includes the Air Racer's frame, components, hardware, and tools.
5. The DataSnap App can be accessed at datasnap.crexo.com
6. Once students finish viewing the Lesson 1 slides and completing the corresponding workbook questions, provide time for them to check their work using the answer key. This can be done in a variety of ways, including:
    a. Post the printed answer key in the room for students to compare answers with.
    b. Go over the answers as a class.
    c. Have students exchange workbooks and complete a peer check.
7. Teams are encouraged to share and compare data as part of the Test and Evaluate step of the Engineering Design Process. This is a good opportunity to post or display a whole-class data table that each team can contribute to.

    A data table can make discussion and wrap-up more effective by incorporating real data points, along with helping you identify teams that may have struggled during the lesson.
8. Provide students with the post-assessment to complete. Use it in the way that best supports your instruction; many teachers have students self- or peer-grade, while others prefer to digitize the assessment through their LMS.

Name: _____ Class: _____

Building and Racing Basics Pre-Assessment

1. Thinking about race car design, what are some important properties that allow them to go so fast?

2. What is an axle?

3. What does mm stand for? For example, 8 mm.

4. What does psi stand for? For example, 30 psi.

5. What is the difference between speed and velocity?

6. How do you calculate the average of a set of data?

Name: _____ Class: _____

Building and Racing Basics Post-Assessment

Instructions: Complete the following questions. Choose one answer per question. Show your work when completing calculations.

1. What is an axle?
   a. A type of musical instrument
   b. A mounting shaft for rotating wheel
   c. An attachment point for airfoils
   d. A weight-distribution compartment on an Air Racer frame

2. What does mm stand for? For example, 8 mm.
   a. Multimeter
   b. Metric mile
   c. Millimeter
   d. Mass measure

3. What does psi stand for? For example, 30 psi.
   a. Pounds Per Square Inch
   b. Puppies Standing Indoors
   c. Pressure State Interior
   d. Prototype Silica Intrusion

4. What is the difference between speed and velocity?
   a. Velocity has direction; speed does not
   b. They are the same
   c. Velocity is a change in speed
   d. Speed is metric; velocity is standard

5. How do you calculate the average of a data set?
   a. Ask a friend
   b. Add the data values together and divide by 2
   c. Divide the values by the sum, then multiply by the quantity of values
   d. Add together the data values, then divide that sum by the quantity of values that were added together