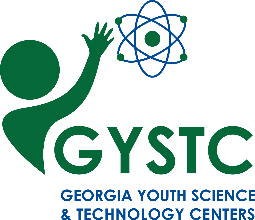
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**In-Class Field Trip:**

**Balloon Racers**

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| **Estimated Time:** 45 minutes or one class period | |
| [**Core Ideas (GSE Standard(s) and elements):**](https://www.georgiastandards.org/Georgia-Standards/Pages/Science.aspx)  **S8P3. Obtain, evaluate, and communicate information about cause and effect relationships between force, mass, and the motion of objects.**   1. Analyze and interpret data to identify patterns in the relationships between speed and distance, and velocity and acceleration. (Clarification statement: Students should be able to analyze motion graphs, but students should not be expected to calculate velocity or acceleration.) | |
| **Science and Engineering Practices:**  Planning & Carrying Out Investigations  Conduct an investigation and evaluate the experimental design to produce data to serve as the basis for evidence that can meet the goals of the investigation. | **Crosscutting Concepts:**  Cause and Effect  Cause and effect relationships may be used to predict phenomena in natural or designed systems. |
| **Authentic Scenario (Phenomena):**  Show students the Saturn V rocket launch: <https://youtu.be/AYzlLhinEeQ> | **Vocabulary:**   * engineer * design * prototype * forces * air resistance * friction * thrust * gravity * atmospheric pressure * independent variable |
| **Guiding Questions:**  How can we calculate the speed of our balloon racers?  What forces are acting upon our balloon racers as they travel down the zipline?  How might we change our designs to make our balloon racers travel even faster? |
| **Materials Needed:**   * Balloon Racers Investigation Worksheet * 4 balloons * 4 straws * 3 pieces of construction paper * 6 meters of string * scissors * masking tape * stopwatch * measuring tool * Optional: Scales to measure the mass of their balloon racer | **Safety Considerations:**   * Students should use caution when working with scissors. * Eye protection is recommended. |
| **Technology Integration:**   * Optional: Devices to use the Arduino Science app |
| **Literacy Connections:**   * *Investigating Forces and Motion* by Jane Weir | |

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| **5E Stage** | **Student Activities**  How will students engage actively in the three dimensions throughout the lesson?  **Teacher Activities**  How will the teacher facilitate and monitor student learning? |
| **Engage** | Show students the footage of the Saturn V rocket launch: <https://youtu.be/AYzlLhinEeQ>  Ask, “What do you notice? What do you wonder?” Inform the students that the Saturn V rocket, that took the Apollo 11 astronauts to the moon in 1969, was made up of over 3 million parts that each had to be rigorously tested and redesigned in order to work properly. Inform them that engineers are the people that designed and tested each of these parts, and engineers also use the same precise testing and measuring procedures to create everyday products such as cars, homes, and even toothbrushes.  Introduce the students to the challenge outlined on the Balloon Racers Investigation Worksheet:  *Imagine you and your partner\* are engineers who just graduated from college. A company is looking to hire two new engineers. Engineers have to be accurate in their measurements and to observe carefully as they test their designs. In addition, you have to be able to quantify your observations so that you can demonstrate the effectiveness of your designs with convincing data. After interviewing, the company narrowed the candidates down to the people in this class. To figure out whom to hire they have one final test: Your team’s balloon racer must travel the 2 to 5-meter zipline in the fastest time.*  \*Feel free to allow the students to work with a partner or in teams of up to 3 students. |
| **Explore** | Present the students with the available materials and review the Engineering Design Process.  Students should begin by sketching and labeling their first balloon racer design before beginning to build. Tell the students they are unable to begin building until they have shown you their design and clarified any questions you have (feel free to sign your initials to the design once you have approved the group to begin building).  Students should test their design at least three times and record the distance the balloon racer traveled, and the time it took to travel that distance. |
| **Explain** | After testing, ask the students to answer the questions in the explain section on their Balloon Racers Investigation Worksheet:   1. What was your Balloon Racer’s fastest time completing the 2-5 meter track (or the furthest distance it could get to)? 2. How might you calculate your Balloon Racer’s speed? Speed is measured in units of “distance” per “time”, for example, “miles per hour”. For our purposes let’s use “meters per second”. Calculate your Balloon Racer’s speed below (feel free to review how to calculate speed by dividing distance by time). 3. Your Balloon Racer was influenced by a lot of forces during its trip across the zipline. Draw a picture below and label each of these forces and draw an arrow showing the direction of the force (an example, “pressurized air” is shown). |
| **Elaborate** | Ask students, “What is one thing you could change about your Balloon Racer to make it travel faster down the zipline?”  Have them make the change to their Balloon Racer (the one thing you change is the independent variable). Then, they need to draw and label the design in the box on their Balloon Racer Investigation Worksheet.  Have the students test their new balloon racer at least 3 times and calculate its top speed. |
| **Evaluate** | * Students should evaluate how fast their second design traveled compared to their first and identify why they think it traveled faster or slower based on what they know about the forces acting upon their Balloon Racer. * Post-Test |