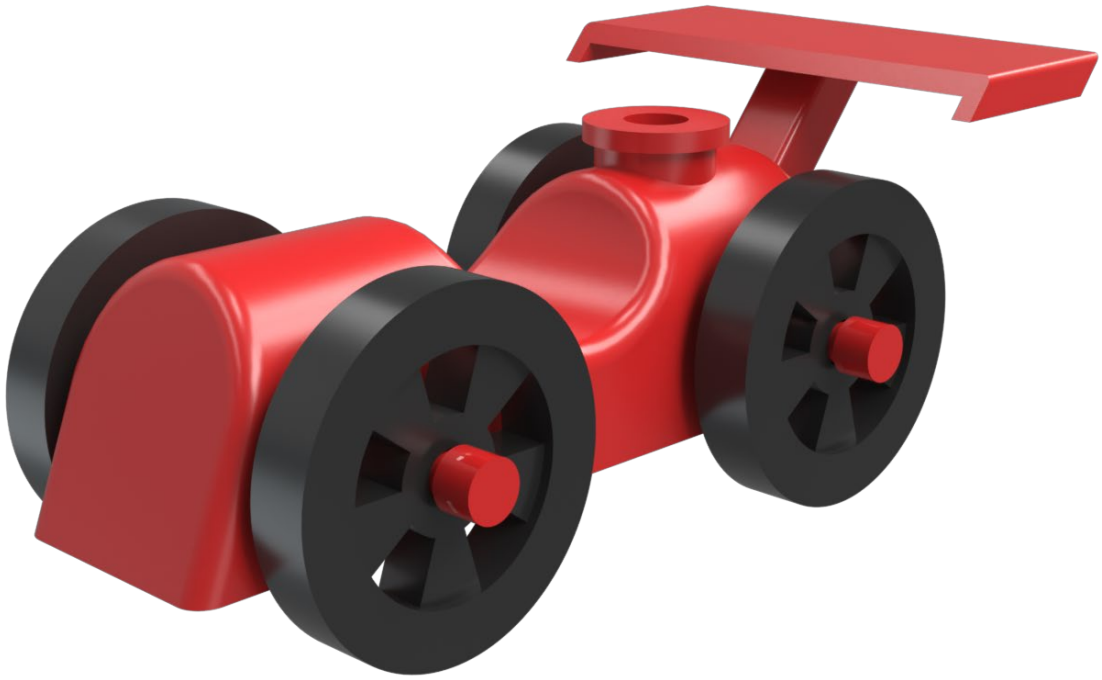
DESIGN PROJECTS



BALLOON-POWERED RACERS

GRADE LEVEL

Grades 6-8

MODELING TIME

2-4 hours

DESIGN OBJECTIVES

- 3D Printed
- Balloon propulsion propels car forward

MATERIALS

- PLA (or similar 3D printing filament) – Approx. 57g
- 1 package of standard latex balloons
- Hot Glue or other Liquid Glue (optional)

DESCRIPTION

Rev your engines and prepare to launch into the world of Newtonian motion! In this STEM project, students with little to no CAD experience will design their own balloon powered car using CAD software.

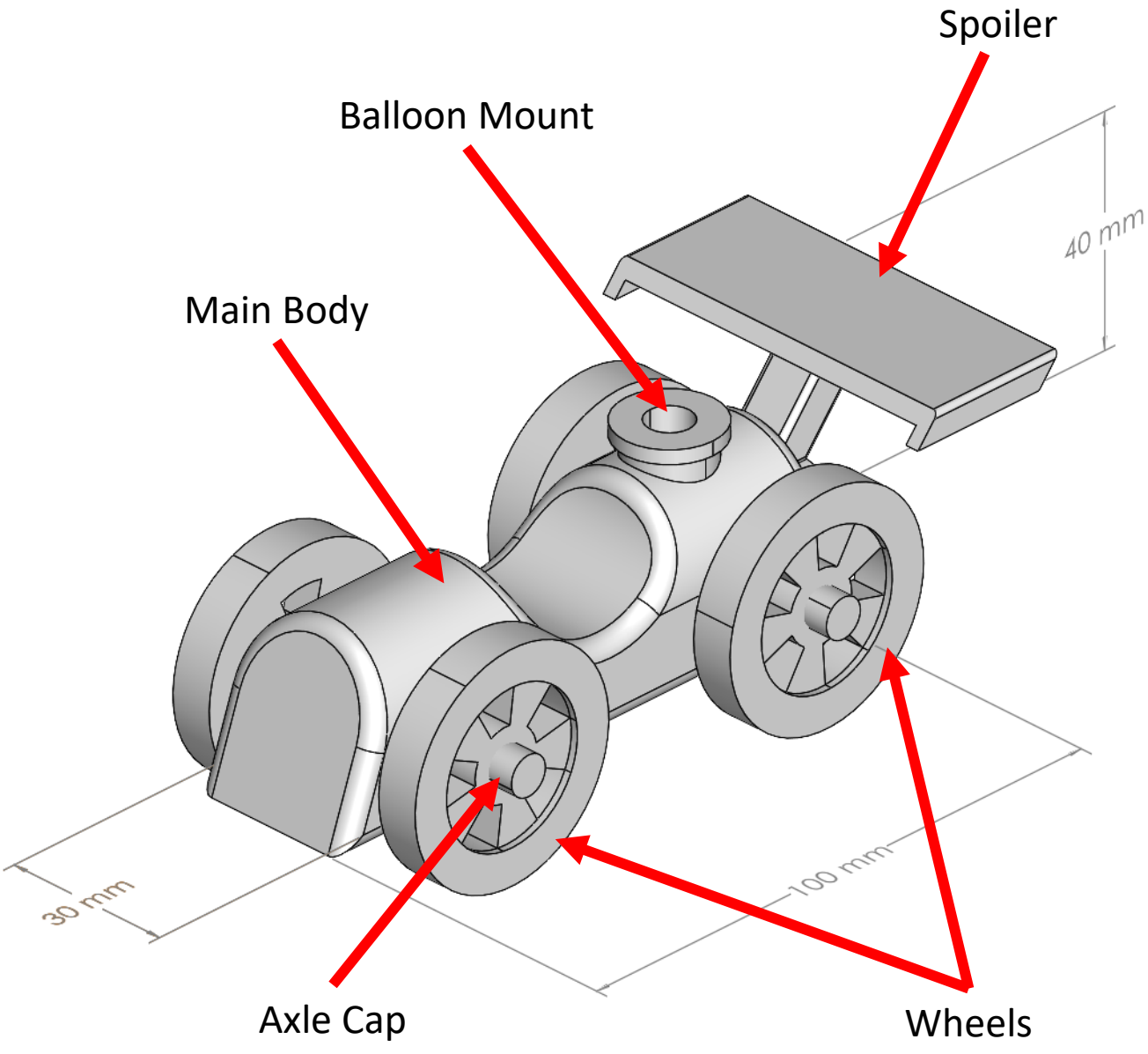
Students will begin by modelling a simplified racer that runs on balloon power. They will then be challenged to customize features like wheel diameter, spoiler design, or even body shape based on their goals—whether it's maximizing speed, stability, or aesthetics.

This project is about developing engineering intuition, creative problem solving skills, and a deeper understanding of physics concepts like force, motion, and energy transfer. After fabricating their cars, students can race them, troubleshoot design flaws, and reflect on how design choices impacted performance.

HISTORY

This design was inspired by several iconic early racers, such as the Alfa Romeo 158, Cooper T43, and Lotus 49. These vehicles were among the most advanced of their time, featuring streamlined bodies, open cockpits, and exposed wheels—all trademarks of early Grand Prix racing. Their designs prioritized speed and mechanical simplicity, each new model rapidly innovating over the competition of the mid 20th Century. Despite a lack of advanced tools, these cars handled exceptionally well at high speeds, laying the groundwork for modern racecar aerodynamics and design. This project pays tribute to their timeless style and engineering spirit, allowing for simplified CAD modeling for students beginning their engineering journey.

RACER COMPONENTS



EDUCATIONAL CONCEPTS

This project is an engaging way to connect real world engineering thinking with STEM concepts taught in the classroom. Below are example topics:

SCIENCE

- Explore Newton's laws of motion, specifically the third law, to discuss how the balloon propels the car forward.
- Discuss energy transfer: from potential energy in the ballon to the kinetic energy of the moving car.
- Investigate friction present on the wheels and axles and how drag may slow the car down due to the design.

TECHNOLOGY

- Teach students to use 3D modeling for creating their racer designs.
- Demonstrate how 3D printers work, from slicing software to the actual printing process.
- Emphasize the importance of DFAM, Designing for Additive Manufacturing, by minimizing waste through smart design.

ENGINEERING

- Talk about how wheel size, body shape, or exhaust design may affect performance.
- Introduce inertia and moment of inertia in the context of wheel size and mass distribution.
- Compare how the balloon performs to a real internal combustion engine.
- Discuss how different F1 designs through the years approach aerodynamics to improve speed and handling.

MATHEMATICS

- Use measurements or equations to determine unknown variables such as velocity, distance travelled, and acceleration.
- Challenge students to estimate material costs, factoring in 3D printer filament usage and design complexity.
- Calculate specific dimensions and tolerances needed to complete a custom body, wheel, or spoiler design in CAD.

OPTIONAL CHALLENGES

- Design Iteration: Have students alter one aspect of their car (e.g., wheel diameter, exhaust design, body/spoiler shape) and make predictions on how this will affect performance. Test the hypotheses after fabrication.
- Role Based Collaboration: If students are working in teams, assign roles such as design, fabrication, and testing, to mimic real world engineering and collaboration.
- Competition: Host a drag race to assess the cars based on criteria such as speed, stability, endurance, or aesthetics. Consider creating categories to award students' different strengths.

DISCUSSION STARTERS

- How does the balloon make the car move forward?
- How is the rotational motion of the wheels converted into the lateral motion of the car?
- What might happen if we change the design of the wheels or exhaust?
- Why do we need space between the axle and the wheel? What might happen if it were too tight or too loose?

ASSESSMENT CRITERIA

- **SUSTAINABILITY** – Did the project minimize waste material necessary for 3D printing fabrication?
- **ASSEMBLY** – Without adhesives or glue, does the model hold together on its own during a race?
- **MANUFACTURABILITY** – Do the components fit within the parameters of the 3D printer?
- **PERFORMANCE** – Does the balloon propel the car forward effectively and consistently?

ADDITIONAL RESOURCES

LINK TO DOCUMENTS

LINK TO YOUTUBE VIDEO

LINK TO STEP-BY-STEP