



Maryland Engineering Challenges

2021 Safe Racer Challenge

Elementary Level – Grades 2 and 3

Supported By:

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In recognition of the uncertainties resulting from COVID-19, this year's Maryland Engineering Challenge competitions will be held virtually. Competition rules and project requirements are also being adjusted to enable and encourage safe participation for students.

Important Dates

Coaches' Information Session

Wednesday October 21, 2020

6:00 PM to 8:00 PM

This "drop-in" virtual event hosted on Zoom is designed for adults interested in coaching a team to chat with engineers. Find out if a particular Challenge is a good fit for your student(s). The Coaches' Information Session is not required and there is no cost. Attendance is strongly encouraged. Contact Jessica at jcelmer@thebmi.org

Access the Information Session from the link below:

<http://bit.ly/MECInformationSession>

Meeting ID: 835 1931 5106

Passcode: 328410

Registration

⇒ **April 23, 2020**

In order to be a registered team, each team must have their adult Coach complete the registration process at the link below with the **team name and the names of all the team members**:

- Register online at <http://bit.ly/MEC2021Registration>

Written Report Due

⇒ **May 7, 2021**

Prior to 4:00 p.m.

- Submit the team's **Written Report** (Email in PDF format) and the **Poster** (Email photo in JPG format) to jcelmer@thebmi.org AND **Car** (delivery or mailed/shipped) to the Baltimore Museum of Industry at **1415 Key Highway, Baltimore MD 21230**
- AND pay a \$5 Coach's Fee, details at <https://48278.blackbaudhosting.com/48278/MEC-Coach-Fee>

Safe Racer Competition

⇒ **May 15, 2020**

Program Begins at 9:00 a.m.

Full details about the Challenge will be emailed to Coaches after the registration deadline, including dates, times and meeting links for the viewing of the Crash Test, Distance Trials, and the Oral Report.

Questions about Challenge specifications or judging should be sent to the Engineer Contact:

Phil Han phan@WBCM.com

Other questions?

Jessica Celmer jcelmer@thebmi.org

THE CHALLENGE

Design and develop a fast, open-top racecar with suitable safety equipment to enable the racing driver, Eggbert[a]—an uncooked egg—to survive a crash test and then compete for the coveted Safe Racer Cup in the distance trials.

Students design and build model race cars, each containing a fragile raw-egg “driver,” which plunge down a 30-degree ramp and crash into a barrier. The cars will be designed for safety, however, so the eggs survive un-cracked. To demonstrate that the car has also been designed for egg-citement, the barrier is removed and the car is free to speed down the track. Some cars travel more than 75 feet!

ENGINEERING TEAM REQUIREMENT

Each team may consist of 1 to 6 students. **There is no limit to the number of teams a school may have, unless more than 50 teams register. If this happens, then schools with multiple teams will be asked to reduce the number of competing teams as directed by the Safe Racer Challenge Coordinator.**

DESIGN & CONSTRUCTION STANDARDS

Race car

- The car must be constructed by students from readily available recycled materials, except for the wheels and axles and for glue, tape and other materials used to connect car parts to one another. Points may be deducted at the discretion of the judges based on the lack of recycled materials.
- The car must have an open top.
- The team logo must be displayed clearly on the car for identification.
- The car must be no more than 5 inches wide, including the wheels, and no more than 9 inches long. Oversize cars will have points deducted.
- The total weight of car, safety equipment, and Eggbert[a], a **LARGE** uncooked egg, must be less than 12 ounces. Overweight cars will have points deducted.
- The car design must include driver safety equipment. Eggbert[a]’s “face” (a circle one inch in diameter) **must not be covered**, and [s]he must be upright and able to “see” the road.
- The egg must be oriented in the car with the small end of the egg (the head) pointed up.
- It must be possible to easily remove Eggbert[a] from the car and safety equipment to examine him/her for damage. Eggbert[a] should not be wedged in tightly. The “comfort and convenience” of the equipment will be considered when judging the design. **If Eggbert[a] cannot be easily inserted and removed from the car, points will be deducted at the discretion of the judges.**
- Eggbert[a] must wear a safety helmet, which must be easily put on and removed.
- **Nothing** can be fastened to the egg with tape, glue, Silly Putty or any other adhesive.
- Cars will be delivered or mailed/shipped to the BMI with a **LARGE HARD-BOILED EGG** in the driver’s seat, complete with helmet/safety equipment. This will allow the Judges to see the intended driver’s seating position and safety equipment.
- The front end of the car must be clearly identified so that the judges know how to orient the car on the test ramps.
- Obvious excessive help from adults will be penalized at the judges’ discretion.

Test Ramp

- All cars will be tested on the same design crash test ramp and distance trial ramp.
- Test ramp size = 6 feet long set at an angle of 30 degrees. The ramp is made with a 1x6 board ($\frac{3}{4}$ " thick by 5 $\frac{1}{2}$ " wide) with 1x2 board ($\frac{3}{4}$ " thick x 1 $\frac{1}{2}$ " wide) side rails, providing a chute 5 $\frac{1}{2}$ inches wide (maximum width of car is 5 inches).
- The distance test ramp should have a curved surface made from stiff cardboard (such as the backing of a pad of paper) at the base to allow a smooth transition from the angled ramp to the floor or track surface.
- A crash barrier made of $\frac{1}{2}$ " x 8" x 8" plywood [minimum] should be fastened to the end of the crash test ramp for the crash test element of the performance demonstration.
- *Note: A LIMITED number of Safe Racer test ramps are available from the BMI. A ramp may be purchased for \$50 or may be rented for \$20 with an additional \$30 refundable deposit. In addition, free construction plans are available electronically. To arrange, contact Jessica at jcelmer@thebmi.org after November 1, 2020.*

Required Construction Elements

- All cars must use the same wheel and axle components.
- Wheels: 1 $\frac{3}{8}$ " diameter, 3/16" tread width, $\frac{1}{8}$ " axle size. Source: www.kelvin.com item # 990171
- Axles: 1/8" diameter metal rod, length to suit width of car. Source: any hobby store. (For the specified wheels, the maximum length of the axles is 4 $\frac{3}{4}$ " to stay within the 5 inches overall width limitation.)
- *Each Coach for the Safe Racer Challenge may request one free Safe Racer kit per team registered. Each kit consists of 4 wheels, two axles, and two straws to serve as axle bushings. It is not mandatory to use the axles in the kit; you may use axles of any length up to a maximum of 4 $\frac{3}{4}$ ". Also, it is not mandatory to use the straws provided in the kit as axle bushings, you may use any other recycled material for axle bushings (No ball bearings). To request your kit(s), contact Jessica at jcelmer@thebmi.org after November 1, 2020. Kits will be mailed to those that request them.*
- Additional wheels may be purchased from www.kelvin.com item # 990171
- There will be no external propulsion or braking of the car during the crash test and distance trials. Only the potential energy of the car due to gravity will propel the car freely down the test ramps; and only the friction of inadvertent rubbing of the wheels against the side rails will be allowed to retard the car.
- Only a dry lubricant can be used on the axles. Oil or grease will not only be messy, but will attract dust causing the oil or grease to gum up and be less slippery than no lubricant at all.
- Cars will be tested as received, no repairs or modifications to the cars will be allowed or made by the Judges once the car has been submitted.

PERFORMANCE DEMONSTRATION GUIDELINES

The winner of the Safe Racer Cup is the car that travels furthest, but the overall Challenge grading also takes into account a written report, an interview with the judges, team poster design, and the design and construction of the vehicle. The team that is the overall winner must demonstrate a wide range of skills. Teams must submit a photo via email (in JPG format) of their 20" x 30" poster displaying the school name and team name in 3" high letters and the team logo that is also displayed on the car.

PERFORMANCE DEMONSTRATIONS are conducted as follows:

- **Part 1 – Written Report**

The written reports will be reviewed by a group of Judges several days before the day of the Safe Racer Engineering Challenge. The Judges will be evaluating the reports for the following:

- Completeness
- Neatness
- Presentation, including use of drawings and photos
- Originality of design ideas
- Safety features
- Report Cover and Logo
- Other aspects that the Judges may deem worthy of recognition
- Only PDF versions of the Written Reports will be accepted.

Each team will be awarded a certificate of achievement for some outstanding aspect of its written report. One team will be awarded a certificate for the Best Written Report.

DESIGN REPORT REQUIREMENTS

The Team shall submit a formal written report containing the minimum information listed below. It is recommended that each team member keep a personal journal addressing the topics below. Teams are encouraged to provide additional information as well as each Team members' journals. You should keep the order of the presentation as outlined below; but, the team is encouraged to personalize the report with photos, sketches, art work, etc...and add supplemental sections that you believe the judges may find useful. All written reports must have the Coaches' names and email addresses clearly indicated. The report should be preferably typed or neatly printed by the students. The reports will not be judged for spelling or grammar, but for the design and construction process and for content and presentation.

- REPORT COVER - The report cover should have the team name, the school (if applicable) and the team logo as a minimum.
- TEAM INFORMATION – Provide Team Name, Grade Level, Team Member names, Team's School Name (if applicable) and County, Adult Coach(es) and email addresses
- SKETCHES/DRAWINGS – Provide sketch (with date) of your final Safe Racer Car design. Provide any supplemental sketches made during design.
- DESCRIPTION OF CAR – Provide final car measurements (length, width, & weight) of the car and describe how your design was selected.
- TESTING - Describe how your design was tested (include sketches and drawings), explain the improvements or changes made to your design after testing, describe distances measured during distance testing, and describe if the egg survived during testing.
- PROJECT MILESTONES AND RESEARCH - List the dates of important milestones in your project and describe those milestones, describe math and science skills needed in this challenge, list all the information resources used to solve the challenge problem (Include books, pictures, and websites), and list the materials used in developing and constructing your project (materials, cost, tools used).
- ADULT ASSISTANCE - Explain what help adults gave your team (name of adults and type of assistance provided).

- **CERTIFICATION** - Reports shall conclude with the following certification statement, **TO BE SIGNED BY ALL STUDENTS, ADULT HELPERS, AND TEAM COACH:**

We hereby certify that the majority of the ideas, design, and work was originated and performed by the students, with limited assistance by adults, as described above.

Printed Name

Signature

Date

- **Part 2 – Registration**

Team registration will occur online weeks before the day of the challenge. There will be no registration on the day of the challenge, however it is expected that teams will arrive promptly for any assigned virtual meeting times on the day of the challenge.

- **Part 3 – Egg Selection**

The Judges will remove the hard-boiled egg (required and supplied by the team) that the car was delivered with and replace it with an uncooked **LARGE** egg. Judges will inspect the eggs to be sure they are not cracked and add a “smiley face” sticker so Eggbert[a] can see to drive.

- **Part 4 – Construction Judging**

Each car will be carefully examined for conformance to the construction rules. Points will be deducted for cars that do not meet the requirements of the rules. If the submitted car does not conform to the size requirements and can’t be tested (ie., won’t fit on the track properly), the car will be disqualified.

- **Part 5 – Crash Test**

The car and Eggbert[a] will be rolled down the BMI's test ramp to crash into the barrier at the end. Eggbert[a] will then be carefully examined by the judges. A maximum of 20 points will be awarded based on the performance of the car and the condition of Eggbert[a]. Injured drivers (damaged eggs) will be replaced with an alternate driver (a fresh egg) for the distance trial.

- **Part 6 – Distance Trials**

Each car will be run 3 times and the best (longest) run used for scoring. The car that travels the furthest will receive the coveted Safe Racer Cup and 10 points. The second furthest will be awarded 8 points, the third furthest 7 points, and so on.

Should Eggbert(a) be injured before the conclusion of the Distance Trials, injured drivers (damaged eggs) will be replaced with an alternate driver (a fresh egg) until the Distance Trials are complete.

- **Part 7 – Oral Report**

Each team will present an Oral Report to several Judges. This is anticipated to take place virtually on the day of the Challenge. Each team will be assigned a time slot for their virtual Oral Report meeting. It is the responsibility of the team to make sure it attends their designated Oral Report meeting. The Oral Report has two parts:

- The Judges will ask several questions of each team from a list of prepared questions. (No, you cannot have a copy of the questions.)

- The Judges may ask the team to explain certain aspects of the design of their car, their design process, problems encountered, help from grownups, the safety features of the car, and other questions that may come to their minds.

The Orals will be from 5 to 8 minutes depending on the number of teams competing and the number of available Orals Judges. The Judges will base the scoring on:

- Preparation
- Knowledge
- Poise of team members

- **Part 8 – Judging of Posters and Race Cars**

The Judges will review all of the Written Reports, Posters, and Race Cars and determine which team will receive the following award certificates:

- Best Poster
- Best Logo
- Best Engineered Car
- Best Constructed Car
- Cutest/Coollest Car
- Most Aerodynamic Car
- Best Safety Features
- Other aspects that the Judges may deem worthy of recognition

- **Part 10 – Challenge Final Results**

After the completion of all judging, results will be posted on the BMI website. We do not anticipate posting final results until a few days after the day of the Challenge. Certificates and awards, including the coveted Safe Racer Cup, will be emailed to teachers or adult coaches. Teams can contact the BMI to arrange for pickup of their cars.

EVALUATION STANDARDS

This elementary school-level competition involves four main components: the design and construction of the project, a written report, an oral report, and the performance demonstration.

1. WRITTEN REPORT

- a. Competition value: 15 points
- b. Late penalty: (-)5 points
- c. One point will be deducted for each ounce or portion thereof over the 12 oz. weight limit. There will be no bonus points for underweight cars. Oversize cars will be disqualified.

2. PERFORMANCE DEMONSTRATION

- a. Distance Trials: Competition value: 10 points
- b. Crash Test: Competition value: 20 points

General guidance on preparing for the competition amidst a pandemic can be found in the “Elementary Information Sheet” which should be read in connection with this document. This document can be found on the BMI website at this link: <https://www.thebmi.org/visit/maryland-engineering-challenges/>

GOOD LUCK TO YOUR TEAM!

