Maryland Engineering Challenges
2022 Robot Challenge

Now in its 26th year!

High School Level – Grades 9 to 12
Middle School Level – Grades 6 to 8
April 23 & 24, 2022

Sponsored by the:
Institute of Electronic and Electrical Engineers (IEEE)

Engineer Contacts:
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Significant features for 2021-2022

1) **The Robot Challenge is available for both Middle School and High School students. They participate together, but Scores and Awards are kept separate.**
2) **These are Walking Robots, and students build them from scratch. The project offers a choice of two kits, one that allows students to build the robots with wood parts that they fabricate hands-on in a wood-shop; or they can select the kit where they use CAD to program the parts and create them with a 3-D printer. If team does not have access to a 3-D printer, the organizers provide this service at no additional cost. The 3-D printer version is fully Covid compliant. The cost of a 2-leg robot kit is $59.**
3) **Robots can have 2 or 4 legs and must be decorated with an external body. Students are required to prepare a Written Report documenting their experience, compete with other teams at a Track event where the robots have to climb over hurdles, and they must also prepare an Oral Presentation to a panel of professional engineers.**
4) **There are 8 levels of challenge, and typically Middle School students choose to use the Manual Controllers, though there are no restrictions on the level of challenge they can sign up for.**
5) **On Saturday, April 23, the Challenge will be held Virtually, and participants can be from Maryland as well as out-of-state; whereas on Sunday, April 24, it will be held In-Person at the Baltimore Museum of Industry, 1415 Key Highway, Baltimore, MD 21230.**
6) **For more details look at the write-up for the project under High School Engineering Challenges.**

Important Dates

Teachers' Virtual Information Sessions

⇒ **Thursday, October 14, 2021** **Choose 3:30 p.m. to 4:30 p.m., or 6:30 p.m. to 7:30 p.m.**

These "drop-in" virtual events hosted on Zoom are designed for adults interested in coaching a team and chat with engineers. Find out if a particular Challenge is a good fit for your students. The Coaches' Information Session is not required and there is no cost. Attendance is strongly encouraged. Contact Jessica at challenges@thebmi.org. Access the Information Session from this link: https://bit.ly/2022MECInformationSession

Teachers and Coaches' Workshops (currently in-person at museum, but could pivot to virtual on Zoom)

⇒ **Thursday, November 11, 2021** **Begins at 4 p.m., ends at 7 p.m.**

⇒ **Saturday, January 22, 2022** **Begins at 10:00 a.m., ends at 2:00 p.m.**

This event is designed for Teachers and Mentors interested in coaching a team and learn more details about the project. Find out from the presentation if this Challenge is a good fit for your students. The Training is not a requirement for this project but is strongly recommended, particularly for first-time participants. There is no cost. Registration is strongly encouraged (by 11/8, 1/19 respectively). Both sessions will include some CAD and automation instruction.

Contact Jessica Celmer at challenges@thebmi.org, or Nevilleed@aol.com.

Register for the Robot Workshops from this link: https://bit.ly/2022RobotWorkshopRegistration

Written Report Due

⇒ **Friday, April 15, 2021** **Prior to 4:00 p.m.**

Written Reports should be delivered electronically, and will represent 25% of the total points awarded. One member of each Team should update their on-line Registration at this time, using the following link: https://bit.ly/RobotChallenge2022

The Robot Challenge

⇒ **Saturday, April 23, 2022 (Virtual)** **8:45 a.m. to 4 p.m.**

⇒ **Sunday, April 24, 2022 (In-Person)** **8:45 a.m. to 4 p.m.** **Awards on-line at 5 p.m.**

Owing to the present level of uncertainty regarding Covid 19 variants, the event will be offered virtual event on Saturday; whereas on Sunday it will be held in person at the Baltimore Museum of Industry (so long as the Museum is unrestricted by the Covid-19 rules that apply at that time). Teams may chose to participate either day, but only on Sunday will we provide a repair station for teams encountering technical difficulties. Teams planning to compete virtually can be from anywhere in the country, but note that technical advice will only be available on-line and must be solicited before the event.

Preparations & Registration

Registrations - two are required:

- **One, for participation and to obtain the Robot Kits and Manuals**
- **A second, to register for the arrival time at the Robot Challenge Event – information will be sent to teachers in March.**
- **If using Google Forms to register (see below), the first registration will generate a response e-mail that should be carefully saved and stored, so it can be updated or corrected by clicking the "Edit Response" block.**

To register your team(s) for participation through the BMI fill out the registration here: https://bit.ly/MEC2022Registration and pay the $5.00 coach's fee here: http://bit.ly/MECcoachfee.

If Teachers/Coaches KNOW how many 2-leg teams and 4-leg teams they plan to have, they can contact the IEEE directly at Nevilleed@aol.com and they will be given a batch of team numbers and the name of their IEEE mentor (no fees if processed this way).
Teachers/Coaches should then assign a team number to each team, and have one representative from each **team** register their team using Google Forms by copying the following URL (note only ONE registration per team): https://bit.ly/RobotChallenge2022

Teams may select either the Classic Robot kit used for building a wooden robot, or the 3DP Robot Kit which involves 3-D printing the plastic parts. The Classic kit requires a school wood-shop for shaping the wood parts, whereas the 3-D plastic robot can be built at home with just basic tools. The actual 3-D printing can be done at school if the school has a 3-D printer; or if teams submit their CAD software, IEEE will fabricate the parts at no additional cost. The cost of the kits will be the same either way, though if Covid-19 is still prevalent, we would recommend the 3DP kits, as they were designed to allow for social distancing and working individually.

Kits should be picked up from the IEEE representative. Please contact Neville Jacobs at Nevilleed@aol.com to arrange for the date, time and place. If kits need to be shipped to other locations, a shipping charge will be added to the cost of the kits. The project should be scheduled so that the robots can be completed approximately 2 weeks before the Robot Challenge Event (for information on how to do this, see later).

- **Note that by signing up for participation in the project, each team is committing to participate in the Robot Challenge Event, as this portion of the project represents a major part of the educational adventure. Photographs and video will be recorded during the Robot Challenge Event for training and documentation (non-commercial) purposes - it will be assumed that all participants give their consent to appearing in these pictures. Any team or team member not wishing to appear in such pictures should notify the organizers in writing,**

JUDGING GUIDELINES

I. Design Development and Fabrication (Competition value: 20 points)*

The team must use the parts provided in the kit, substitutions are not allowed, but additions are permitted. Wheels (if used, though not recommended) may not touch the table or be visible. Except for flexible electrical wiring, Robot should be free-standing and isolated from the students controlling it. Creativity and Artistry are important factors, and the robot body must be designed such that the team can fully expose all parts of the body and mechanism for inspection by the judges.

* Awarded during the Oral Presentation, based on the judges' findings – see below.

II. Written Report Competition value: 25 points

Points will be awarded for creativity, originality, neatness, grammar, sketches, photos, and the Robot's artistic body covering. A Gantt Chart is very helpful for showing the difference between the original schedule and the actual dates resulting from the problems encountered.

III. Performance Demonstration Competition value: 40 points

The course will be a single track on an 8 foot table or floor, with the start and finish lines 6 feet apart. Two half-inch high hurdles (known in a hardware store as a "quarter-round") will have to be climbed over. All robots will first race in manual mode, though Social distancing can only be assured for robots built from 3DP kits. Points will be awarded for the time taken, the smoothness of the robot's movements, and the coordination and cooperation of the operating team. Points are lost if team members touch their robot or cross the Boundary lines. In the event that some degree of automation has been added, the robot shall run a second or third time in that mode for bonus points.

On Saturday the event will be done virtually, and it can either be done at your local school, or on a kitchen table or floor. Each team will be furnished with a cardboard Track (which they can decorate for extra points), and the two hurdles. On Sunday, extra points will be given for the decoration of the shipping containers.

IV. Oral Presentation to Judges Competition value: 15 points

a. The judges are looking for a formal prepared presentation where every team member is expected to participate. They may bring in a video on their laptop so long as the clip does not exceed 3 minutes. Judges are looking for a description of the project and the difficulties they encountered and had to overcome. Students may also fill in the gaps between when the Written Report was submitted up through and including the results

of the Track Run and what they learned from it. Judges will ask questions and grade the students on their answers

b. Review of Fabrication* Competition value: 20 points

Judges are looking for the quality of the fabrication of the robot including the soldering. They will need to examine the robot closely, and may need to expose all the parts to do so.

CURRICULUM TIES-- Maryland Engineering Challenges comply with the listed sections of the Next Generation Science Standards

Core Learning Goals: Science - Goal 1: Skills and Processes - Expectation 1.1 The student will explain why curiosity, honesty, openness, and skepticism are highly regarded in science.	**In preparing for the challenge, students will:** ● Recognize that real problems have more than one solution and decisions to accept one solution over another are made on the basis of many issues. 1.1.1 ● Modify or affirm scientific ideas according to accumulated evidence. 1.1.2
Core Learning Goals: Science - Goal 1: Skills and Processes - Expectation 1.2 The student will pose scientific questions and suggest investigative approaches to provide answers to questions.	**In researching project designs, students will:** ● Identify meaningful, answerable scientific questions. 1.2.1 ● Formulate a working hypothesis. 1.2.2 ● Defend the need for verifiable data. 1.2.8
Core Learning Goals: Science - Goal 1: Skills and Processes - Expectation 1.3 The student will carry out scientific investigations effectively and employ the instruments, systems of measurement, and materials of science appropriately.	**In constructing their projects, students will:** ● Develop and demonstrate skills in using lab and field equipment to perform investigative techniques. 1.3.1 ● Demonstrate safe handling of the chemicals and materials of science. 1.3.3 ● Learn the use of new instruments and equipment by following instructions in a manual or from oral direction. 1.3.4
Core Learning Goals: Science - Goal 1: Skills and Processes - Expectation 1.4 The student will demonstrate that data analysis is a vital aspect of the process of scientific inquiry and communication.	**In testing their projects, students will:** ● Analyze data to make predictions, decisions, or draw conclusions. 1.4.2 ● Describe trends revealed by data. 1.4.6

	● Determine the sources of error that limit the accuracy or precision of experimental results. 1.4.7
Core Learning Goals: Science - Goal 1: Skills and Processes - Expectation 1.5 The student will use appropriate methods for communicating in writing and orally the processes and results of scientific investigation.	**In composing their reports, students will:** ● Demonstrate the ability to summarize data (measurements/observations). 1.5.1 ● Explain scientific concepts and processes through drawing, writing, and/or oral communication. 1.5.2 ● Use, explain, and/or construct various classification systems. 1.5.7 ● Communicate conclusions derived through a synthesis of ideas. 1.5.9
Core Learning Goals: Science - Goal 1: Skills and Processes - Expectation 1.7 The student will show that connections exist both within the various fields of science and among science and other disciplines including mathematics, social studies, language arts, fine arts, and technology.	**In reflecting on the engineering process, students will:** ● Identify and evaluate the impact of scientific ideas and/or advancements in technology on society. 1.7.2 ● Investigate career possibilities in the various areas of science. 1.7.5 ● Explain how development of scientific knowledge leads to the creation of new technology and how technological advances allow for additional scientific accomplishments. 1.7.6

GOOD LUCK TO YOUR TEAM!