Maryland Engineering Challenges
2020 Hovercraft Challenge
Middle School Level – Grades 6 to 8

Supported By:
American Institute of Chemical Engineers, Maryland Section

Engineer Contact:
Kathy Gunkel wildwoodenvironmental@comcast.net

Important Dates

Coaches' Information Session

⇒ **Wednesday, November 13, 2019** **4:00 p.m. to 7:00 p.m.**

This "drop-in" event is designed for adults interested in coaching a team to stop by and chat with engineers. Find out if a particular Challenge is a good fit for your students. The Information Session is not required and there is no cost. Registration is strongly encouraged. Contact Jessica at jcelmer@thebmi.org

Registration and Written Report Due

⇒ **April 10, 2020** **Prior to 4:00 p.m.**

In order to be a registered team, each team must have their adult Coach do the following:

- Register online https://forms.gle/Sq9ZFXhqLXjC9wj76
- AND submit the team's Written Report as a HARD COPY to the Baltimore Museum of Industry
- AND pay a $5 Coach's Fee, details at https://48278.blackbaudhosting.com/48278/MEC-Coach-Fee

Hovercraft Competition

⇒ **April 26, 2020** **Doors open at 9:00 a.m.**

Competition will take place at the Baltimore Museum of Industry. Full details about the Challenge will be emailed to Coaches after the registration deadline.

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

Kathy Gunkel wildwoodenvironmental@comcast.net

Other questions?

Jessica Celmer jcelmer@thebmi.org

THE CHALLENGE

Design and construct a Hovercraft vehicle (a land-and-water transportation vehicle that Maryland could use for a ferry service across the Chesapeake Bay) from a kit to be the fastest vehicle in a race across a 20-foot stretch of floor. Imagine you are transporting vehicles and families from Fells Point to Kent Island in a "Reach the Beach" program for the State!

ENGINEERING TEAM REQUIREMENT

For the benefit of the students, it is recommended that the team not exceed four students. There is no limit to the number of teams a school may have.

DESIGN & CONSTRUCTION STANDARDS

- Teams will use a Kelvin Hovercraft Competition Kit and other materials of their choice to construct a model Hovercraft.
  - ◊ The Kelvin Hovercraft Competition Kit is available at www.kelvin.com, item # 841109
  - ◊ Be careful which kit you order because Kelvin has two distinctly different kits. You do NOT want the one with the round Styrofoam plate.
- NOTE: Teams may request one free supply kit from the BMI. *Kits will be available at the November Information Session or you may request your kit(s) by contacting Jessica at jcelmer@thebmi.org.*
- The Hovercraft cannot be powered by any means other than the motors provided in the Kelvin kit and a 9-volt battery supplied by the team.

PERFORMANCE DEMONSTRATION GUIDELINES

- Each team can race their Hovercraft, starting from either side of the Bay, twice across the Bay and use the best time between the two runs.
- The Hovercraft cannot be "pushed" at the start of its Bay crossing.
- The Hovercraft cannot be touched or adjusted after the start of its crossing.
- Needed adjustments and/or repairs can be made between the two runs.
- A third run will be allowed, time permitting and after all teams have completed their two runs; however, if successful at scoring points, the points will be reduced by 50%.

SCORING EVALUATION CRITERIA AND POINTS

Written Report and Drawings *20 competition points*

- The quality of the written report has made a difference in the past between 1st and 2nd place! Use the Written Report Format below for maximum point potential.

- Timeliness of report submission is important.
  - ◊ If submitted late, there will be 1 point deducted for each day it is late.
  - ◊ No reports will be accepted after the Sponsor picks up the reports.
- No supplements will be accepted the day of the Performance Demonstration, incorporate that information into your Oral Report.

Oral Report *15 competition points*

- Include answers to the following questions:
  - ◊ Why is the Hovercraft a good choice as an auto transport vehicle?
  - ◊ Why is it a good choice as a rescue vehicle?

Design and Fabrication *30 competition points*

- The design and fabrication of the model vehicle should look like a passenger vehicle. It will be a factor in the award of points for this category.
- Plan the Hovercraft as though the team is presenting the design to MDOT, the Maryland Department of Transportation

Performance Demonstration *35 competition points*

- Each Hovercraft will be required to race across the "Chesapeake Bay", from Fells Point to Kent Island, a 20-foot distance over a flat, dry surface, under the power of a 9-volt battery.
- Performance scoring points will be awarded as follows:
  - ◊ 35 points-fastest time across the Bay
  - ◊ 30 points-2nd fastest time
  - ◊ 25 points-3rd fastest time
  - ◊ 20 points-4th fastest time
  - ◊ 10 points-each successful "Bay" crossing
  - ◊ 5 points-each successful launch that reaches the midpoint of the "Bay"

Written Report Format for the Hovercraft Challenge

The report should be presented in the following format and order (you will lose points if the order is not followed). No reports or supplements will be accepted for grading after they have been picked up by the Sponsor from the BMI. The following report format is provided to help you earn the maximum points possible for the Written Report. Teams that have participated in this challenge in the past which have followed this format, and included EVERYTHING listed, have generally scored better than teams that did not. Twice in the past five years the team with the fastest Hovercraft did not win first place because they did not produce a high quality written report.

Why is a report important to an Engineer? When you practice as an engineer, it will be necessary to convey your thoughts and ideas to somebody (maybe your boss, your client, your employees) and it cannot always be accomplished with an oral presentation, especially with the computer and internet technology we have today: Everyone wants it as an email. Even when you convey your ideas with an oral presentation, you usually have to provide the individuals in your "audience" with a "take-away," something to help them remember the information presented. When an Engineer invents something that's going to be very popular and make lots of money (they hope), s/he will want to make sure everybody has to come to them to have access to it, so they apply for a patent. A patent application requires that everything be submitted in writing, i.e., in the form of a report…no oral presentations allowed!

Title Page —include name of challenge, team name and logo, name of school or organization, names of students, name of teacher or advisor. An original logo design and its details will earn an extra 3 points. **Copying a graphic from a web site and using it for your logo will result in loss of points…better no logo than stealing somebody else's work.**

Table of Contents

Summary (abstract) —clearly and concisely stated. Discuss why the Hovercraft challenge was selected over the other choices available.

Introduction —give background information and set the scene.

- Introduction should include background information about Hovercrafts in "real life" and their uses (potential or actual) in today's world.

Suggestion: talk about how the Hovercraft would have been of use during Hurricane Isabel here in Baltimore in 2003 and during the devastating Hurricane Katrina, in New Orleans – the Superdome housing 20,000 people had to be evacuated – and what advantage the Hovercraft would have over boats in these situations. This might necessitate researching what happened during Isabel and Katrina.

Body —the main part of the report. In general, this part should cover:

- Explain the different options for wiring the battery into the system – in parallel versus in series. Use some references to learn the differences between the wiring options. Explain why the team selected the wiring option used in the Hovercraft used in the competition.
- Discuss the purpose of any changes the team made in the shape and/or construction of the Hovercraft compared to the kit's example. Discuss why the team felt these were improvements that would enhance the performance of the Hovercraft.
- Explain the scientific principles behind the Hovercraft.
- Include *figures* highlighting the major parts of the Hovercraft and provide explanations about

these parts in terms of their function in the Hovercraft and relative importance. Working drawings of YOUR Hovercraft should include dimensions. (Note: copying figures and drawings from internet web sites and representing them as your own IS NOT ACCEPTABLE. You will receive a score of zero for this section.)

- Discuss how the Kelvin Hovercraft is different from actual Hovercrafts found in various internet sites and how it is similar and how it is representative of actual Hovercrafts, as well.
- Explain how your design was tested. Explain the improvements the team determined were necessary. The Hovercraft is simple enough to build (and inexpensive to purchase), so there should be time to build two or more Hovercrafts and experiment with different ideas. If the team builds two or more Hovercrafts, include discussion about the differences between the Hovercrafts that were built (their successes and failures) and why the team selected the craft used in the competition.
- Describe the problems that the team encountered in designing and building the Hovercraft. How did the team solve these problems?

Conclusions and Recommendations —How successful was the project? What did the team learn by participating in an engineering challenge? What did each team member learn about their aptitude for engineering related careers?

Acknowledgments —List the names of the adults who assisted in the project with a brief description of what they did.

Certification —Include a certification, signed by all student team members and adult coaches/assistants, stating: "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."

Bibliography —list all references used, including internet, books and magazines. (An internet website URL address is not enough…provide a caption about the information you obtained from it.)

Appendices —should be introduced, integrated, and discussed in the body text. They should include:

A. *Safety* —List the *general* safety procedures that were followed to make sure that no injuries occurred. (Any *special* safety procedures that were needed should be described in the body of the report.)

B. *Team members* —List the team members, with a short description of how each person helped to make the project a success. What special skills were learned or demonstrated?

C. *Scheduling and Accomplishments* —Show on a time line, or similar method, how the project was scheduled. Include *brief* records of meetings, telling how the schedule was managed and maintained (Hint: keep a log in which you record the date and times of each

meeting with a brief description of what you accomplished).

D. *Tools and Machines* —List and describe any special tools or machines that were used.

Photos – Not required, but could help you earn up to 5 bonus points.

Remember, a good report can make or break a team as far as placing First, Second, or Third. Only 5 points separates the fastest Hovercraft from the 2nd fastest. At least 1 point will be lost for poor grammar, poor spelling, or clear evidence that only "spell check" was used and no proofing was performed.[1] For every section that is present in the report, a team will receive 3 points; points will be added or subtracted according to the judge's opinion regarding the quality of the section. The report is evaluated on a scoring scale of 100 points and the scoring points are scaled to the equivalent of 20 competition points…a score of 100 points on the scoring scale is equivalent to 20 competition points and a score of 50 points is equivalent to 10 competition points.

[1]*How do we know proofing was not performed, only "spell check"? When we see correctly spelled words used out of context, for example, four instead of for, form instead of from, touché instead of touched, we know spell check was used and didn't stop at the word because it was spelled correctly, even though it was the wrong spelling for the context of the discussion.*

CURRICULUM TIES-- Maryland Engineering Challenges and the Next Generation Science Standards

6th-8th Grade - S1.0 Skills and Processes - Topic A. Constructing Knowledge Design, analyze, or carry out simple investigations and formulate appropriate conclusions based on data obtained or provided.	**In preparing for the challenge, students will:** • Develop the ability to clarify questions and direct them toward objects and phenomena that can be described, explained, or predicted by scientific investigations. Objective b • Locate information in reference books, back issues of newspapers, magazines and compact disks, and computer databases. Objective d. • Explain why accurate recordkeeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society. Objective i
6th-8th Grade - S1.0 Skills and Processes - Topic B. Applying Evidence and Reasoning Review data from a simple experiment, summarize the data, and construct a logical argument about the cause-and-effect relationships in the experiment.	**In designing their projects, students will:** • Verify the idea that there is no fixed set of steps all scientists follow. Objective a • Explain that what people expect to observe often affects what they actually do observe. Objective b • Describe the reasoning that lead to the interpretation of data and conclusions drawn. Objective d
6th-8th Grade - S1.0 Skills and Processes - Topic C. Communicating Scientific Information Develop explanations that explicitly link data from investigations conducted, selected readings and, when appropriate, contributions from historical discoveries.	**In composing the written and oral reports, students will:** • Organize and present data in tables and graphs and identify relationships they reveal. Objective a • Explain how different models can be used to represent the same thing. What kind of a model to use and how complex it should be depend on its purpose. Objective e
6th-8th Grade - S1.0 Skills and Processes - Topic D. Technology	**In building and testing their projects, students will:** • Realize that design usually requires

DESIGN CONSTRAINTS: Explain that complex systems require control mechanisms. MAKING MODELS: Analyze the value and the limitations of different types of models in explaining real things and processes.	taking constraints into account. Objective c • Identify reasons that systems fail-they have faulty or poorly matched parts, are used in ways that exceed what was intended by the design, or were poorly designed to begin with. Objective d • Explain that the kind of model to use and how complex it should be depends on its purpose and that it is possible to have different models used to represent the same thing. Objective b • Explain that models may sometimes mislead by suggesting characteristics that are not really shared with what is being modeled. Objective c

GOOD LUCK TO YOUR TEAM