



## Maryland Engineering Challenges™ 2011

# Hovercraft Engineering Challenge

**Level: Middle School—Grades 6 to 8**

### Important Dates for Coaches

#### *Information Session for Coaches*

Thursday, November 11, 2010  
4:00 p.m. – 7:00 p.m.  
Baltimore Museum of Industry

#### *Hands-On Workshop for Coaches*

Saturday, January 29, 2011  
10:00 a.m. – 2:00 p.m.  
Baltimore Museum of Industry

#### *Registration of Teams*

Friday, March 11, 2011 by 4:00 p.m.  
Online at <http://tp1.clearlearning.com/hshealey/EC.tp4>  
Please note there is a \$5 PER COACH registration fee. Only one Coach is needed per team, although a team may have as many adult helpers as needed.

*Supported by the  
American Institute of  
Chemical Engineers  
Maryland Section*



### Important Dates for Teams

#### *Due Date for Written Report, submit as HARD COPIES*

Friday, March 11, 2011  
4:00 p.m. at the Baltimore Museum of Industry  
Reports may be mailed or shipped, but must arrive  
by March 11<sup>th</sup>

#### *Competition Date*

Saturday, March 26, 2011  
9:00 a.m. – 1:00 p.m.  
MSU Mitchell Engineering Building  
Detailed information about the competition event will be sent to Coaches after the registration deadline.

#### *Snow Date*

To be determined as needed

#### Addresses:

Baltimore Museum of Industry  
1415 Key Highway  
Baltimore, Maryland 21230

Send reports to the attention of: James Keffer

Clarence M. Mitchell, Jr. Engineering Building  
Morgan State University  
1700 E. Coldspring Lane  
Baltimore, Maryland 21251

Address questions about the Hovercraft Challenge to Kathryn Gunkel at [wildwoodenvironmental@comcast.net](mailto:wildwoodenvironmental@comcast.net)

Address general questions about the Maryland Engineering Challenges™ program to Melinda Cané at [mcane@thebmi.org](mailto:mcane@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!*

□□ For the benefit of the students, it is recommended that the team not exceed four students. □□

### 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](http://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.
- 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.
- NOTE: A limited number of free kits are available to Coaches who attend the Information Session for Coaches.

### Performance Guidelines:

- 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.
- 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.
- 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 1<sup>st</sup> and 2<sup>nd</sup> place! **Use the attached Report Format 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-2<sup>nd</sup> fastest time
  - 25 points-3<sup>rd</sup> fastest time
  - 20 points-4<sup>th</sup> 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:

- 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.)
- 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?
- 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).
- 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.<sup>1</sup> 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.

<sup>1</sup>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.