Welcome to the 2015-2016 METALS Competition!
Ping Pong Pi

Mathematics is all around us; it flows through the very veins of the universe. We use math in every area of our lives. Math is more than a tool for calculating it is the science of patterns. In the 2015-2016 e3 Robotics METALS Competition students in elementary and middle school will have an opportunity to explore the fascinating world of math. Join e3 Robotics teams this year for Ping Pong Pi to discover the amazing world of math!

e3 Robotics wants to Excite, Educate and Encourage children to develop their math, engineering, technology, art, leadership and science skills. (METALS™) During the 2015-2016 Ping Pong Pi season, teams will choose an area of mathematics to research. They will also design and build a robot using any technology of their choice to solve a set of missions in the Robot Games. Companies can compete in all, some or one of the areas at competition.

C-1.0: Creating a Company

Individuals who have entrepreneurial skills are in high demand today and stand out in the crowd of potential job candidates. What are entrepreneurial skills? They include the ability to understand business operations (e.g., finances, research and development, media outreach), work as an important part of a team, think critically, and apply technical knowledge and skills in new and innovative ways. To help you to better understand and develop these skills, e3 Robotics METALS competition challenges you to think of yourself as an entrepreneur. View the Marketing Section for how it will be judged.

- What is your company name?
  - Your first task is to create a company or organization name that reflects your team as a whole. It can be serious or silly.
- Who are its leaders?
  - Which student is the CEO—President of the company?
- Who is in charge of managing research? Who is in charge of managing the robot and its technical book?
- Who is in charge of your company's image?
  - Such as making buttons to give out, flyers, t-shirt design, colors, and SWAG
- Who are your potential clients?
  - In this case, e3 Robotics and any industry that uses math to solve real-world problems are your "clients" who recently released a request for proposals. Students will be presenting their ideas to Judges,

C-2.0: Product Demonstration (Robot Game)

If your company chooses to participate on the day of the tournament each team will be judged based on the total of points at the end of the 3.14 min. playing period.

Game Objective: Elementary School Level

Welcome to Ping Pong Pie. Your mission is to collect and place the most ping pong balls in the pie pans before your time of 3.14mins expires.

Game Rules & Instructions

• Each team will place their robot in "base "prior to robot run. You are only allowed to touch your robot when it has come to a complete stop in "base". No hands are allowed in the playing fields (zones A, B or C) unless the robot is in "base". Teams are subjected to disqualification if hands are on the robot in any area other than "base".

• Teams will have 2 competitive rounds of Ping Pong Pie, 3mins 14secs each round.
Collect and place as many ping pong balls in the pie pans as possible. Teams must navigate their robot to the center field and dislodge the ping pong balls from the 4" PVC tubes into their playing field. Each zone has a 4" PVC tube and pie pan at different heights.

Round One:
(Standard size ping pong balls)
Teams are challenged to collect as many ping pong balls as possible and place them in the pie pans before the allotted time of 3mins and 14secs expires.

Scoring for round one is as follows:
Pie Pan 12 in height = 1 point each
Pie Pan 14 in height = 2 points each

Round Two:
(Large colored balls)
Teams are challenged to collect as many large colored balls as possible and place them in the pie pans before the allotted time of 3mins and 14secs expires. There will be red, blue and yellow colored balls, each with a different value.

Scoring for round two is as follows:
Pie Pan 12 in height = 1 point each
Pie Pan 14 in height = 2 points each

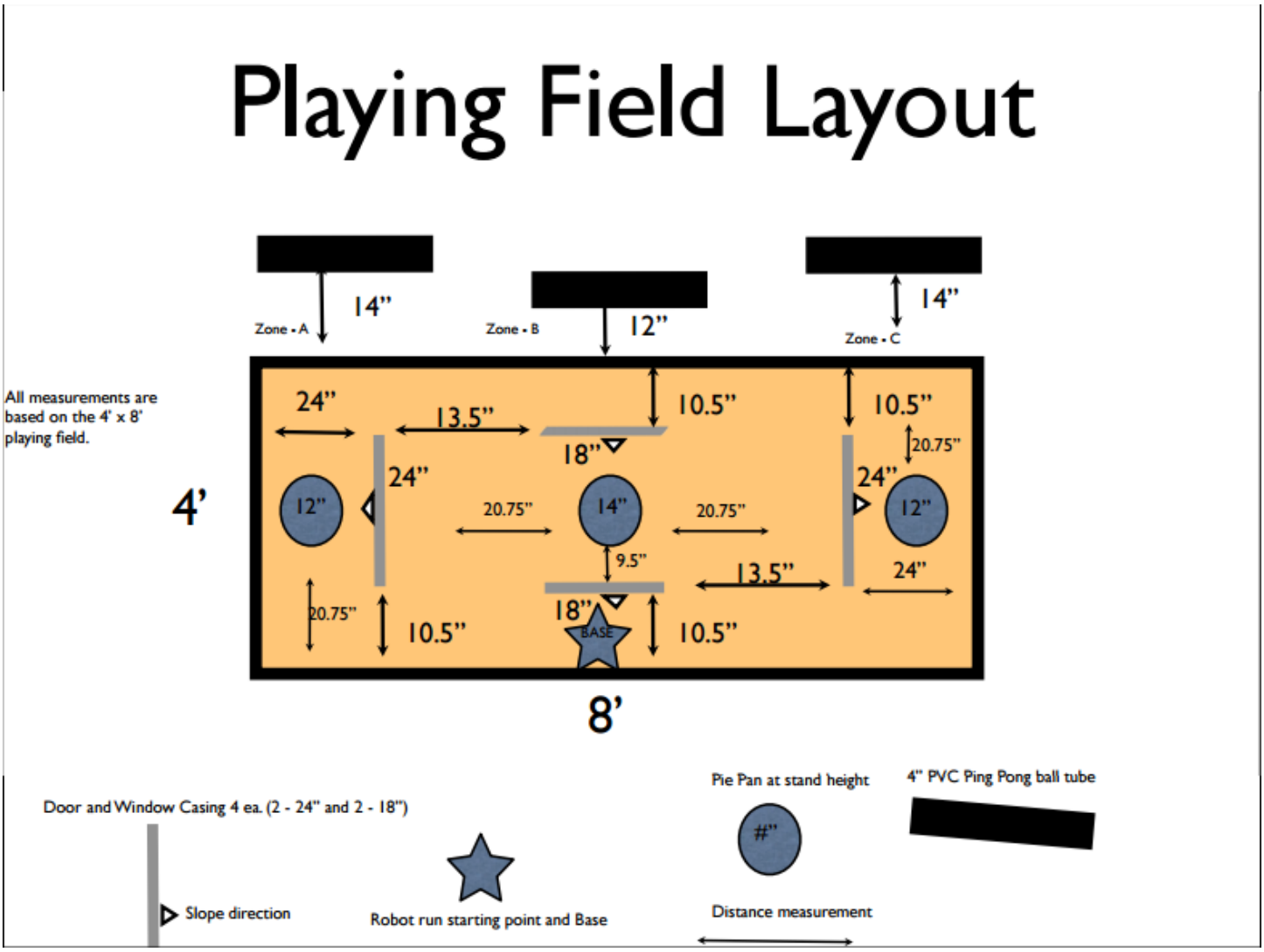
Additional Points:

Red = 1 point
Blue = 2 points
Yellow = 3 points

Totals are calculated based on number of colored balls plus height of pie pan.

Examples of Scoring:

Example1: 1 red and 2 yellow balls in a 12in pie pan = 1+(3+3)+1=8 Points
Example 2: 2 red, 3 blue and 1 yellow balls in a 14in pie = (1+1)+(2+2+2)+3+2 = 13 Points



Game Objective: Middle School Level

Welcome to Ping Pong Pie. Your mission is to collect and place the most ping pong balls in the pie pans before your time of 3.14mins expires.

Game Rules & Instructions

- Each team will place their robot in "base "prior to robot run. You are only allowed to touch your robot when it has come to a complete stop in "base". No hands are allowed in the playing fields (zones A, B or C) unless the robot is in "base". Teams are subjected to disqualification if hands are on the robot in any area other than "base".

- Teams will have 2 competitive rounds of ping pong pie, 3mins 14secs each round. Collect and place as many ping pong balls in the pie pans as possible. Teams must navigate their robot to the center field and dislodge the ping pong balls from the 4" PVC tubes into their playing field. Each zone has a 4" PVC tube and pie pan at different heights.

Round One:
(standard size ping pong balls)
Teams are challenged to collect as many ping pong balls as possible and place them in the pie pans before the allotted time of 3mins and 14secs expires.

Scoring for round one is as follows:
Pie Pan 12 in height = 1 point each
Pie Pan 14 in height = 2 points each
Pie Pan 16 in height = 3 points each

Round Two:
(large colored balls)
Teams are challenged to collect as many large colored balls as possible and place them in the pie pans before the allotted time of 3mins and 14secs expires. There will be red, blue and yellow colored balls, each with a different value.

Scoring for round Two is as follows:
Pie Pan 12 in height = 1 point each
Pie Pan 14 in height = 2 points each
Pie Pan 16 in height = 3 points each

Additional Points:
Red = 1 point
Blue = 2 points
Yellow = 3 points

Totals are calculated based on number of colored balls plus height of pie pan.

Examples of Scoring:

Example1: 1 red and 2 yellow balls in a 12in pie pan = 1+(3+3)+1=8
Example 2: 1 red and 2 yellow balls in a 16in pie pan = 1+(3+3)+2 = 9
Example 3: 2 red, 3 blue and 1 yellow balls in a 14in pie = (1+1)+(2+2+2)+3+2 = 13

Building the Game Pieces

Recommended Tools:
Safety Glasses and Gloves
Drill
Saw
Screw Drive
Tape Measure
Drill Bits (1” spade & 7/64” wood)

Ping Pong Pi single play will be constructed on a 4X8 game board. See the appendix for more information. The following building instructions will be mirrored for two team play and playing field will be 8X8 with a shared center.

To construct the game field maze use 1 Door and Window Casing Moulding (WM 442-11/16in. x 2-1/4in. x 84in.) Cut two 24in. and two 18in. lengths and apply sticky back velcro (velcro suggested from home depot link). View placement of case moulding on page four of power point (playing field layout).

Game Props and Pieces

There are several simple and easy to build props and pieces you and your students will have educational fun constructing. There are three pie pans required for both middle and elementary school ping pong pi competitive team challenge. Middle school measurements are: 12in., 14in., and 16in., - Elementary school measurements are: two 12in., and one 14in.

PIE PAN Stand Instructions:

- To construct the pie pan and stand you will need to cut 1in.x 4in. x 8ft. furring strip board into three 5in squares.
- Next locate the center and use a 1in. spade bit to drill a 1/4in hole.
- You will also need a dowel cut to accommodate the two or three lengths required for middle or elementary school ping pong pi challenge.
- The required heights are based on height of all included items, (stand + dowel + pie pan = desired height).
- Locate the center of the pie pan and drill a 7/64in. pilot hole. Use a small amount of wood glue inside of the 1in hole x 1/4 deep of the stand block, insert the correctly measured dowel and use wood screw to further strengthen the bond.

- On the backside of the pie pan and on one the top of the dowel, place a small amount of glue and use a wood screw to further strengthen the bond.
- Again, the final assembled pie pan and stand should equal the desired height of 12in., 14in., or 16in.

Ping Pong Ball Tube Instructions:

- Ping Pong balls will be held and dislodged in the 4" tubes.
- View the Field map to see illustrated location and placement.
- There are three total tubes at three different heights for middle school (12in, 14in and 16in) and two for elementary (12in and two 14in).
- To construct the ping pong ball tube, you will need one 2in x 4in x 96in, one 4in. x 10ft PVC drain pipe, the remainder of the 1in.x 4in. x 8ft. furring strip board, would screws and 3ft of twine.
- Cut three lengths of the furring strip board and three lengths of the 4in drain pipe, all at 2ft.

- Part one of constructing the ping pong ball tube requires you to measure, cut and assemble the wood frame.
- Teachers should guide students in measuring and using all tools safely.
- Keep in mind your measurement should be taken from the base of the table to the bottom of the 4in drain pipe.
- You will need to cut two pieces of the 2in x 4in, one should be the appropriate length and the other should be two inches less, allowing a slight slope in the ping pong ball tube.
- Again your measurement should be from the base of the playing field to the bottom of the drain tube

- In part two; the higher angled part of the tube is considered the front and will be angled back to hold the ping pong balls securely.
- You also must cut the 2in x 4in to have trimmed edges only allowing a 2in. surface in the center for the tube.
- Insert two wood screws on each corner.
- Drill a 7/64in hole into the 4in. tube and use a wood screw to secure it to the back side of the frame.

The placement of the frame will be in the center of the two playing fields and should be able to dislodge in either directions.

We understand tools and materials maybe difficult for you to obtain. Please feel free to ask e3-Robotics if you need any assistance! Schedule an appointment with our team and we will be more than happy to assist you. “Excellence is the gradual result of always striving to do better.” Pat Riley Contact: Maria Rosato (mrosato@e3-robotics.org) Adrian Wright (awright@e3-robotics.org)

C-3.0: Research Development

If your company chooses to participate in the Research Development on the day of the tournament. Your company will present to a group of judges who represent science, engineering, and industry. This year our theme is math. Judging will be based on the Rubric located in the Appendix

Think about it…..

Students often say …. "When will we ever use this in the real world?" when referring to math concepts.

It's no secret a lot of students hate math. Most students view math as just a bunch of random skills they need to memorize and regurgitate. When polled a majority of middle school students would rather take out the garbage then do math.

But what would the world be like if the first calculation of pi was never done by Archimedes of Syracuse (287–212 BC), one of the greatest mathematicians of the ancient world. Pi appears in all sorts of calculations for physics, engineering, electrical systems. The double-helix in DNA revolves around pi. Pi is in the rainbow, the pupil of the eye, and when a raindrop falls into water pi emerges in the spreading rings. It appears in colors and in music. It is also used in probability and statistics.

That sure is a lot of Pi!

Your company needs to explore the math behind real-world topics, from sports to shopping to the odds of finding life on other planets. Teams have an opportunity to discover what makes math so amazing by researching real world problems being solved by mathematicians today.

Select *any* Real-World Problem that is being solved using *math*.

For Example:

How do public health agencies prevent an outbreak of the flu from becoming an epidemic?

How should Hydrocephalus ("Water on the Brain") be treated to minimize the need for repeated brain surgery? What type of math is being used to solve this problem?

How chemotherapy treatments and resting periods should be spaced in order to best target cancer cells without harming healthy cells? What type of math is being used to solve this problem?

Research the math concepts that are being used in the problem. Describe how this math concept is important to solving the problem? Explain the concept in your own words as if you were teaching it to other people. Where else could this math concept be used? Why is this math concept important? Who discovered it? Etc.

Your presentation should describe:

- Your real-world problem that is solved using math;
- An example or visual for the judges to see
- Why your company chose this real world problem
- What have you learned about the area of math used to solve your real world problem?
- What other areas is that particular math being used.
- Show examples using charts, graphs, pictures, video and anything else that you can think of to use to teach us about the math concept.
- Presented in any format, skit, game show, puppet show, dance song etc.
- No less than 5 minutes and no more than 7 minutes in length.

Presentation:

- The judges will ask the members of your company questions about your research.
- Each judge will evaluate both your presentation and responses to their questions and award a score (50 points max) based on your presentation and how you answer their questions.

Example Questions:

How did you decide on this area of math?
What steps did you take in doing your research?
What have you learned the most from researching the topic?

C-4.0: Company Dynamics

If your company chooses to participate in the Company Dynamics challenge on the day of the tournament. Each company will have an opportunity to demonstrate how they work together through communication and relationships and ultimately their productivity.

Throughout the Tournament

- Judges will looking at how your company communicates with each other, helps other teams, and your company's overall attitude throughout the day.

Company Challenge

- Companies will be scored on their ability to face an unknown challenge and solve a problem within a 15 minute time period.
- Each judge will evaluate both your responses to the challenge, their questions and their observations on the Tournament floor. An award score of (50 points max) based on how your company communicated, how you answer their questions and their observations.
- The judges will ask the members of your company questions about your company.

Example of a Company Challenge

A large circular space is made on the floor with a rope by the judges. Your company stands inside the space. Gradually the judge shrinks the space. Your team will have to think fast and work together to keep everyone within the shrinking boundaries.

C-5.0: Technical Presentation

If your company chooses to participate in the Technical Presentation Challenge. They will need to send a PDF copy of their Technical Manual to the Judges to be scored 2 weeks prior to the tournament.

Guidelines and Required Components

- Length is less than 10 pages
- Font size of at least 12 points (font type can vary)
- All measurements are in SI units (metric) Exceptions other items described or sold in imperial units.
- Title page that includes:
  - Your company's name
  - School, club, or community organization's name, city, state, and country.
  - COMPLETE list of the members of your company and their role (CEO, CFO, pilot, etc.).
  - You can also include grade level/career goals and expected graduation date.
  - Names of your instructor(s) and/or mentor(s)
- Abstract (150 words or less) that is concise and clearly summarizes the Research.
- Photograph(s) of your completed ROV You are permitted to make changes to your vehicle between the time you submit your documentation and the competition; however this must be a photo(s) of your completed, intact vehicle, not photos of individual part or tools.
- Budget (If any)
  - Keep an accounting of how much money you spent, items (building materials, equipment, travel stipends, etc.) that were donated, and items that were
  - For donated items, make sure that you list the organization or individual who made the donation. For both donated and re-used items, make sure that you include an estimate of the item's present-day value.

- Design rationale presented in a clear and logical manner. This section should comprise the bulk of your documentation. It should focus on the technical aspects of your vehicle and how your robot vehicle was built to perform the specific tasks.
- Description of at least one challenge that your company faced and how you overcame it. This can include both a technical challenge and a challenge related to working as a team.
- Description of at least one lesson learned or skill gained during the design and building process.
- Reflections on the experience. This can be written from the point of view of your company as a whole or individual members of your company can contribute a reflection. It can include personal or professional accomplishments that you achieved as a result of participating in the competition.
- References List any books, journal articles, magazines, trade publications, web sites, and professional advice that you used as sources of information.
- Acknowledgements please recognize your sponsors (companies, organizations (including E3 Robotics), professionals from industry, and/or mentors) and the type of support that they provided (funds, building supplies, equipment, site visits to facilities, time, and/or technical expertise). You can include organizations and/or individuals that provided logistical and/or moral support (e.g. your parents, siblings, or pets).

C-6.0: Marketing

If your company chooses to participate in the Marketing Display Judging on the day of the tournament each company will be judged based on the display

Display

- Each Company will have a space approximately 3 feet x 3 feet for its display.
- Each Judge will award a score (50 points max).

Guidelines

- Font size that is clearly legible from a distance of 1.5 meters
- Choose a font style and use it throughout
- All measurements are in SI units (metric). Exceptions include other items described or sold in imperial units.
- Include headers (see REQUIRED COMPONENTS below)
- Photos should be clear and high-quality for the print sizes that you choose
- EVERY PHOTO MUST HAVE A CAPTION! No caption = no credit for that photo. Also include photo credits if the photo was not taken by someone in your company.
- Items that you MAY include on your marketing display:
  Diagrams or sketches (CAD drawings, for example).
  The diagrams should be clearly labeled with a brief explanation that is understandable to a general, non-technical audience. If they are overly complicated and require more technical knowledge, do not include them; technical drawings belong in the technical documentation.
- Items that you MAY have on display include:
  Photo journals, pamphlets, business cards
  Copies of your company's technical documentation
  Resumes of the members of your company
  Descriptions of mentoring or community outreach that your company participated in
  Newspaper articles or other media featuring your company
- Items that you MAY NOT include in your marketing display:
  Flip charts on the poster board
  Video screens on or in the actual poster board

REQUIRED COMPONENTS

Note: The following are REQUIRED headers. These headers not only assist the judges in evaluating your display, they also make your marketing display easy to read.

- **Company name and school**, club, or community organization name (note that this is the only personalized header) make sure that your company name is in large, bold font (larger than any other font on your marketing display). Include your school, club, or community organization name as well as your company name. Include your geographic location (i.e. city and state). If you are an international company, include the city and country.
- **Abstract** (concise – 150 word limit)
  Include a written introduction to your company and how your company designed and built a specialized robot vehicle and tools to complete the mission tasks. Make sure to relate the mission to how robot vehicles can be used in the real world. Don't assume that your audience knows what a robot

vehicle is or the details about the competition missions. You can view this section as a summary of your company information, robot vehicle design, and theme.

- **Company information**

  Include photo(s) (group or individual) of all of the members of your company. Provide a brief description of each member. This description should include the person's name, role in the company (e.g. CEO, CFO, pilot, marketing and communications specialist, etc.) and their qualifications, such as grade level, career goals, etc.

- **Robot Vehicle Design**

  This section should be the bulk of your marketing display. It will be worth the most points.

  Why did your company build your robot vehicle the way that you did?

  Include photos of your ROV. Make sure to highlight the various systems of your vehicle.

.