People Mover

LEVEL: Middle School – All Grades

TYPE OF CONTEST: Team

COMPOSITION OF TEAMS: 4 – 6 students per team

NUMBER OF TEAMS: 2 teams per school / 3 teams per MESA Center

BACKGROUND: Urban centers continue to attract people who are seeking employment opportunities and who no longer want to spend hours on the road commuting. U.S. commuters lost up to 50 hours in traffic in 2015. Excessive commuting costs employers nearly $100 billion dollars each year. Cities like Los Angeles are struggling to catch up to cities like New York and Chicago in areas of public transit.

OVERVIEW: Teams will design and build a People Mover (i.e. a robot and passenger cars hybrid) that travels on the field and has the ability to utilize “Right of Way” in autonomous mode.

The purpose of the competition is to encourage Gracious Professionalism® that leaves everyone involved feeling valued with a sense of integrity and teamwork. The goal is not just to win, but to participate fairly and to extend gracious professionalism and respect to all teams and students involved.

MATERIALS: ROBOT:
Teams may utilize any robot kit, parts or materials. Robot kits, parts and materials are NOT limited to the following:

LEGO® MINDSTORMS® RIS, NXT or EV3 – The EV3 kit (Item # 31313) and optional parts including rechargeable battery and charger may be purchased through http://www.lego.com/en-us/mindstorms/. The NXT kit, rechargeable battery and charger may be purchased through EBay or Amazon.

VEX IQ Robot – Starter kits may be purchased through http://www.vexrobotics.com/vexiq/products.

PASSENGER CARS:
- 2 – two-by-two sections of an egg carton (any type or brand) able to hold large fresh white eggs; each two-by-two section is identified as one passenger car.
- Any other materials for part of chassis, axles, and wheels for each passenger car is legal; however, materials that will damage field or cause personal injury are NOT legal.
- 1 – metal D-Ring Hanger (any type or brand)
Provided by the Host:

- 5 Traffic Obstacles (red bricks)
- 2 Stop signs
- 24 Passengers (large fresh white eggs)
- Field
- Tables for Academic Displays

Rules:

1. The team must design and build a People Mover (i.e. a robot and passenger cars hybrid) that accomplishes three tasks:
   a. Drive robot from Train Depot to the Loading Zone and attach passenger cars.
   b. Drive People Mover to Train Stops and pick up passengers (i.e. eggs).
   c. Transport and drop off passengers at Union Station.

2. The team must design and build TWO separate passenger cars.
   a. Each of the passenger cars must have two axles.
   b. Each of the passenger cars may hold a maximum of 4 passengers (i.e. two-by-two section of egg carton; each of the four compartments may hold only one passenger at a time). Passengers may NOT be strapped in or covered.
   c. The two passenger cars must be connected by a hinge joint allowing for maneuverability around turns.
   d. NO energy source may be added to the passenger cars (i.e. passenger cars must be solely moved by robot).
   e. One end of the two passenger cars must have a metal D-Ring Hanger attached to the exposed end.

3. The robot MUST fit within a 1 foot by 1 foot square and the passenger cars MUST fit within a 1 foot by 1 foot square; People Mover (i.e. robot and passenger cars hybrid) MUST fit within a 1 foot by 2 foot rectangle.

4. **Task 1:** Drive from Train Depot to Loading Zone and Attach Passenger Cars
   a. Robot must begin completely inside boundaries of Train Depot at the beginning of the run.
   b. Drive to Loading Zone in either remote or autonomous mode.
   c. Designated team member will attach metal D-Ring Hanger of passenger cars to robot and may only touch the robot to begin autonomous mode, if needed.
      i. Robot must be completely inside boundaries of Loading Zone before designated team member may attach passenger cars.

5. **Task 2:** Drive from Loading Zone to either Train Stop 1 or Train Stop 2
   a. Drive People Mover (i.e. robot and passenger cars hybrid) to either Train Stop 1 or Train Stop 2 in either remote or autonomous mode.
   b. Designated team member will load passengers into each passenger car and may only touch the robot to begin autonomous mode, if needed.
i. Only passenger cars of People Mover must be completely inside boundaries of either Train Stop 1 or Train Stop 2 before designated team member may load passengers.

6. **Task 3:** Transport Passengers from either Train Stop 1 or Train Stop 2 to Union Station
   a. Drive People Mover to Union Station in either remote or autonomous mode.
      i. The Right of Way may ONLY be used in autonomous mode (i.e. the People Mover may NOT use the Right of Way in driver mode).
      ii. People Mover must stop at the Stop Sign for at least 2 seconds in either remote or autonomous mode.
   b. Designated team member will unload passengers from each passenger car.
      i. Only passenger cars of People Mover must be completely inside boundaries of Union Station before designated team member may unload passengers.

7. After completing Task 3, the People Mover may return to Loading Zone in either remote or autonomous mode to complete Task 2 and then Task 3; this may be done multiple times depending on total number of passengers remaining.
   a. People Mover may NOT drive directly to either Train Stops to pick up passengers.
   b. The Right of Way may ONLY be used in autonomous mode (i.e. the People Mover may NOT use the Right of Way in driver mode).
   c. Only robot needs to be within boundaries of Loading Zone in order to continue Task 2. Passenger cars need NOT be detached from robot.

8. A TOTAL of **3 minutes** will be given for each run.

9. Before the commencement of each run, teams will be given the option of a total of 1 minute to calibrate sensors if needed. Immediately after the calibration, the run will begin. If team is not ready after the one minute calibration period, team will forfeit run.

10. At any time during the run, teams may request up to two (2) rescues. Teams may request Judge(s) to retrieve People Mover from anywhere in the field and teams may upload a different program.
    a. Once different program is uploaded, designated team member may place robot in the Train Depot and passenger cars in Loading Zone and resume run.

11. Teams who try to get another team disqualified will be disqualified from one run, thus receiving 0 points for that run.

12. Contestants, teachers, parents or spectators are not allowed to talk to judges during runs.

13. At no time during the run can team members or spectators enter the designated field area.

**Oral Presentation**

14. Teams will randomly select one of five questions to answer.
    a. Teams will have two to four (2 – 4) minutes to answer the randomly drawn question.
    b. Judges will determine the order of questioning.
    c. All team members are required to actively participate in the oral presentation.
d. Teams must utilize the Academic Display in responding to the randomly drawn question.

e. Questions include:

  i. Describe the capability of and how your People Mover works.
  
  ii. Describe the parts and materials, and their functions that your team used to build your People Mover.
  
  iii. Describe the design process and procedures of development your team utilized to build your People Mover.
  
  iv. Discuss three scientific and engineering concepts involved in your project.
  
  v. Discuss the importance of robots and transportation, and how they can be interrelated.

**Academic Display**

15. Teams should present their People Mover and aspects of the design project in a display format. The focus of the display is the actual People Mover presented for performance.

   a. The display should be no larger than 3 feet high by 4 feet wide by 2 feet deep (i.e. the size of a tri-fold presentation board).
   
   b. A brief synopsis of the project, 200 to 250 words, should be attached to the front of the display. The synopsis should include the purpose of the project and explanation of the People Mover.
   
   c. The display should have detailed data and technical information on the front to show exploration and share explanation of the People Mover and the scientific and engineering ideas involved in the project. The data and technical explanation should incorporate text, images, tables, graphs, etc. that share information relevant to the overall project. Teams are encouraged to examine potential and kinetic energy, mechanical advantage, friction, work, Newton’s Laws of Motion, stability, sturdiness, gears, sensors, programming, and any other pertinent topics.
   
   d. The display should have a scaled drawing of the People Mover on the front. The drawing should include a three-view drawing (front, side and top views) depicting the actual People Mover designed and built. Each of the three-view drawings should be on three separate 8 ½ x 11 sheets with the scale used identified (e.g. 1 inch = 1 foot). Photographs are not allowed in place of scaled drawing.


**JUDGING:**

1. Robots and passenger cars will be required to pass a technical inspection before being cleared to compete.

2. Teams will be randomly selected for the order of the Invitational.

   a. **Team On-Deck** will move from designated team area/table to On-Deck Area and prepare for Invitational

   b. **Team Up** will move from On-Deck Area to the field.
3. At the beginning of each run, team will place robot inside boundaries of *Train Depot* and passenger cars inside boundaries of *Loading Zone*.
4. Each team will be allowed 2 non-consecutive runs.

**SCORING:**

1. 1 point for each passenger successfully unloaded from Union Station either using remote or autonomous mode. (maximum of 24 points)
2. Bonus 5 points for each use of autonomous mode to drive between *Loading Zone* and either *Train Stop 1* or *Train Stop 2*. (maximum of 15 points)
3. Bonus 3 points for each passenger successfully unloaded from *Union Station* by using the *Right of Way* in autonomous mode from either *Train Stop 1* or *Train Stop 2*. (maximum of 72 points)
4. 1 point penalty for each passenger that falls out of passenger car. Judge(s) will immediately remove passengers from field and these passengers will no longer be part of the run.
5. 5 points penalty for not stopping at stop sign for at least 2 seconds.
6. Up to 100 points for the Academic Display. (maximum of 100 points)
7. Up to 100 points for the Oral Presentation. (maximum of 100 points)
8. The team with the highest points wins.
9. **In the event of a tie, the team with the lightest People Mover (i.e. robot and passenger cars) wins.**

**AWARDS:**

1. Trophies will be awarded for 1st, 2nd and 3rd place overall winning teams based on the total points tallied from all runs plus points from the oral presentation and academic display. Medals will be awarded to individual team members.
2. Medals will be awarded for 1st, 2nd, and 3rd place performance winners based on the total points tallied from all runs.
3. Ribbons will be awarded for the following categories:
   a. 1st, 2nd, and 3rd place for Oral Presentation
   b. 1st, 2nd, and 3rd place for Academic Display
   c. Best Innovative Design
   d. Most Spirited Team
   e. Gracious Professionalism

**NOTES:**

1. At least 4 team members must participate in each run.
   a. One member will drive or initiate robot/People Mover.
   b. One member will load passengers at Train Stop 1.
   c. One member will load passengers at Train Stop 2.
   d. One member will unload passengers at Union Station.
Field Layout

2017 STEM Educational Outreach Programs
Robotics Invitational
Saturday – April 29, 2017

Scale: 1 cm = 4 in

Legend:
- Gray = 1 inch white masking tape
- Red = Traffic obstacles
- Yellow = Right of Way
- Light Brown = "Right of Way" wall
- Red Circle = Stop Sign

Train Depot
Train Stop 1
Train Stop 2
Union Station

Loading Zone

Train Stop 1

"Right of Way"
(Can ONLY be used in autonomous mode)

Train Stop 2

"Right of Way"
(Can ONLY be used in autonomous mode)

Scale:
1 cm = 4 in
### Field Specifications

<table>
<thead>
<tr>
<th>Dimensions of Field</th>
<th>8 feet by 4 feet</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Train Depot</td>
<td>1 foot by 1 foot (outside to outside edge of tape)</td>
<td>Marked off with 1 inch white masking tape</td>
</tr>
<tr>
<td>Loading Zone</td>
<td>2 feet by 1 foot (outside to outside edge of tape)</td>
<td>Marked off with 1 inch white masking tape</td>
</tr>
<tr>
<td>Train Stops 1 and 2</td>
<td>1 foot by 1 foot (outside to outside edge of tape)</td>
<td>Marked off with 1 inch white masking tape</td>
</tr>
<tr>
<td>Union Station</td>
<td>1 foot by 1 foot (outside edge of tape)</td>
<td>Marked off with 1 inch white masking tape</td>
</tr>
</tbody>
</table>

| Tape for Loading Zone, Train Stops, and Union Station | 1 inch white masking tape | [http://www.discountschoolsupply.com](http://www.discountschoolsupply.com) Item # CMTWH $4.59 per roll |

| “Right of Way” surface | 1/8 inch Plywood/Utility Panel (on top of Field Surface; i.e. EVA foam mats) | [http://www.homedepot.com/](http://www.homedepot.com/) Model # 833096 Nominal Thickness = 1/8 inch Actual Thickness = 0.1063 inches |


| Stop Signs          | “red” circle markings on masking tape |  |
| Traffic Obstacles   | Red brick | 8 inch x 3 ¾ inch |

| Type of field surface (except “Right of Way”) | 3/8 inch textured Multipurpose Interlocking gray EVA foam mats (each mat 2 feet by 2 feet) | For specifications, go to: [http://www.getrung.com/10mm.html](http://www.getrung.com/10mm.html) |

| Location of field  | On the floor: indoors in a lobby area or classroom | Actual indoor location depends on availability |
| Field Boundary     | 2x4 lumber or equivalent |  |