People Mover

LEVEL:  High 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 car hybrid) that travels on the field and has the ability to utilize “right of way” in autonomous mode. Teams will earn points by transporting passengers to Union Station. Teams will earn bonus points for successfully transporting passengers to Union Station using the “Right of Way.” Teams will be partnered in two-robot alliances which will compete to transport the largest number of passengers.

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. Robot kits and parts are NOT limited to the following:
- VEX Dual Control Starter Kit (P/N: 276-2700)
- ROBOTC for VEX Robotics Software (276-1739)
- Programming Hardware Kit (276-2186)
- Optional accessories include, but not limited to, additional sensors and motors

The above may be purchased through www.vexrobotics.com.

PASSENGER CAR:
- Any materials for chassis, axles, and wheels are legal; however, materials that will damage field or cause personal injury are NOT legal.
- 2 – metal D-Ring Hangers (any type or brand)
PROVIDED BY THE HOST:

- Red bricks serving as traffic obstacles
- 2 Stop signs
- 24 Cardinal Alliance Passengers – balsa blocks
- 24 Gold Alliance Passengers – balsa blocks
- Field outside on concrete – weather permitting or inside on floor
- Tables for Academic Displays

RULES:

1. The robot MUST fit within a 12 inch x 12 inch square at the beginning of each match.
2. The passenger car MUST fit within a 6 inch x 6 inch square.
   a. Only one (1) passenger car is allowed.
   b. The passenger car must have at least two axles.
   c. The passenger car may hold a maximum of four passengers and MUST have a separate seat (i.e. compartment space) for each passenger; passengers may NOT be strapped in or covered.
   d. NO energy source may be added to passenger car (i.e. passenger car must be solely moved by robot).
   e. The opposite ends of the passenger car must each have a metal D-Ring Hanger attached to the exposed ends.
3. Prior to the beginning of each match, each alliance must:
   a. Place robots inside boundaries of Designated Alliance Train Depot.
   b. Place passenger cars inside boundaries of Designated Alliance Loading Zone.
   c. Designate three members to be the designated alliance loader; each designated alliance loader will occupy one of the Joint Alliance Loader Zones and must remain inside the boundaries during the duration of the match.
      i. 8 passengers (i.e balsa blocks) will be given to each designated alliance loader. Designated alliance loaders may NOT interchange or share passengers.
      ii. Designated alliance loaders may NOT damage, interfere or have physical contact with People Movers in any way or opposing alliance loaders and passengers will be disqualified from all matches; designated alliance may not replace offending loaders.
4. Each two-robot alliance must drive robots from Designated Alliance Train Depot to Designated Alliance Loading Zone in driver mode and attach either passenger car to robot using the metal D-Ring Hanger.
5. From the Designated Alliance Loading Zone each two-robot alliance must drive People Mover (i.e. robot and passenger car hybrid) in driver mode to any of the Joint Alliances Train Stop to pick up passengers.
   a. Designated alliance loader will place passenger(s) (i.e balsa blocks) into Boarding Zone. Once a passenger is placed onto the field, the passenger may not be removed.
b. *People Mover* will in driver mode load one passenger at a time from the *Boarding Zone* into the passenger car.

c. *People Mover* must leave *Train Stop* within 30 seconds of arriving at *Joint Alliances Train Stop*.

d. Only one (1) *People Mover* may occupy each *Train Stop* at a time.

e. Opposing alliance may steal and load other alliance passengers.

6. Each two-robot alliance must drive *People Mover* between *Joint Alliances Train Stop* and *Union Station* and unload passengers into the *Disembark Zone (DZ).*

   a. The two *Right of Ways* may ONLY be used in autonomous mode in both directions (i.e. the *People Mover* may NOT use the *Right of Way* in driver mode).

   b. Only one *People Mover* may use each *Right of Way* at any given time.

   c. *People Mover* will unload passengers into *Disembark Zone (DZ)*; if *Right of Way* is used, *People Mover* MUST unload passengers in autonomous mode. Once passengers are unloaded, judge(s) will remove passengers from field.

   d. After unloading passengers, robot section of *People Mover* will detach from passenger car. Either robot of two-robot alliance may attach to other end of passenger car.

      i. Opposing alliance robot(s) may NOT steal other alliance’s passenger cars.

7. *People Movers* must stop at *Stop Signs* for two (2) seconds and must **ALWAYS** yield right of way to *People Movers* using the *Right of Ways*.

8. Each match will be **4 minutes**.

9. At any time during the match, teams may request up to two (2) rescues. Teams may request Judge(s) to retrieve *People Mover* from anywhere on the field.

   a. Once *People Mover* is ready, designated team member may place robot in the *Train Depot* and passenger car in *Loading Zone* and resume match.

10. Competing alliance robots may not block or interfere with opposing alliance’s robots. Each team will be given one warning and then accessed penalty points.

11. Teams may make changes to their robot and passenger car between matches (including uploading different programs). Parts can be added and removed. Only ONE robot and ONE passenger car will be allowed to compete per team. Replacement robots or passenger cars are NOT allowed.

12. Team members of each alliance must stay within the assigned team member zones.

13. The following types of robot mechanisms and components are NOT allowed:

   a. Those that could potentially damage playing field components.

   b. Those that could potentially damage other competing robots.

   c. Those that pose an excessive risk of entanglement.

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

15. Contestants, teachers, parents or spectators are not allowed to talk to judges.

16. At no time during the match can non-designated team members or spectators enter the field area.
Oral Presentation
17. 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 are encouraged to use the Academic Display in answering 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
18. 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 3 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 mechanical advantage, friction, work, Newton’s Laws of Motion, voltage and energy, logic, 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. The competition will include qualifying and championship matches. After the qualifying matches, teams will be ranked based on their performance. The top teams will then participate in the championship match to determine the competition champions.
   a. The **qualifying match** schedule will be available on the day of the competition. This schedule will indicate alliance partners and match pairings.
      i. Teams will be randomly assigned an alliance partner to compete against two randomly assigned opponents in each qualifying match.
      ii. The two-robot alliances will be identified as the Cardinal Alliance and the Gold Alliance.
      iii. Teams will **compete in at least two qualifying matches** with each match being randomly assigned a different alliance partner.
      iv. All teams will be ranked based on the scoring below.
      v. In some cases, a team will be randomly selected to play an additional qualifying match. In this instance, the team’s lowest score will be dropped (all teams will have the same number of scores tallied).
   b. The top teams will advance to the **championship match** to determine the champions.
      i. In order of qualifying match ranking, each of the top teams will invite another available team to join their alliance in order to complete four two-robot alliances. Teams should consider the strength of the robots when picking alliance partners.
      ii. A team is available if they are not already part of an alliance, or have not already declined an alliance invitation.

SCORING:

1. At the end of each qualifying and championship matches, each alliance will earn 1 point for each passenger transported by People Mover into the *Union Station Disembarking Zone*. (maximum of 24 points)

2. Each alliance will earn 3 bonus points for each passenger transported and unloaded by People Mover into the Union Station Disembarking Zone using the Right of Ways in autonomous mode. (maximum of 72 points)

3. People Movers that remain at the *Train Stop* for more than 30 seconds will be given a penalty of 1 point for every second in which they remain over 30 seconds.

4. Each two-robot alliance will be given a penalty of 1 point for each interference or blocking of opposing alliance’s robots/People Mover at the discretion of the judge.

5. Each alliance will be given a penalty of 1 point for each passenger that falls out of the passenger cars. Judge(s) will immediately remove passengers from field and these passengers will no longer be part of the match.
6. Each alliance will be given a 2 points penalty for each occurrence of not stopping at Stop Signs for at least 2 seconds.
7. Up to 100 points for the Academic Display. (maximum of 100 points)
8. Up to 100 points for the Oral Presentation. (maximum of 100 points)
9. **In the event of a tie, the team with the lightest People Mover (i.e. robot and passenger car) wins.**

**AWARDS:**
1. Trophies will be awarded for 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> place overall winners, based on the total points tallied from the qualifying and championship matches, points from the oral presentation, and points from the academic display. Medals will be awarded to individual team members.
2. Medals will be awarded for 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> place robot performance winners based on the total points tallied from the qualifying and championship matches.
3. Ribbons will be awarded for the following categories:
   a. Best Innovative Design
   b. Most Spirited Team
   c. Gracious Professionalism
   d. Best Oral Presentation
   e. Best Academic Display

**NOTES:**
1. At least 5 alliance members must participate in each match.
   a. Two alliance members will manually drive People Mover, one from each team.
   b. Three alliance members will be the Designated Alliance Loaders.
Field Layout

Brick representing traffic obstacle

Joint Alliances Loader Zone
Joint Alliances Loader Zone
Joint Alliances Loader Zone

Cardinal Alliance
Team Members Zone

Gold Alliance
Team Members Zone

Train Stop
Train Stop
Train Stop

Cardinal Alliance
Train Depot

Gold Alliance
Train Depot

Right of Way

Right of Way

Right of Way
## Field Specifications

<table>
<thead>
<tr>
<th>Dimensions of Field</th>
<th>18 feet by 8 feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train Depot</td>
<td>1 foot by 2 foot (outside to outside edge of tape)</td>
</tr>
<tr>
<td>Loading Zone</td>
<td>24” x 18” (outside to outside edge of tape)</td>
</tr>
<tr>
<td>Train Stops</td>
<td>18” x 18” (outside to outside edge of tape)</td>
</tr>
<tr>
<td>Union Station (drop off zone)</td>
<td>18”x4” (outside edge of tape)</td>
</tr>
<tr>
<td>Union Station (spaces between drop off zones)</td>
<td>18”</td>
</tr>
<tr>
<td>Tape for Loading Zone, Train Stops, and Union Station</td>
<td>1 inch general masking tape</td>
</tr>
<tr>
<td>“Right of Way” surface</td>
<td>1/8 inch Plywood/Utility Panel (on top of Field Surface)</td>
</tr>
<tr>
<td>Stop Signs</td>
<td>“red” circle markings on masking tape</td>
</tr>
<tr>
<td>Traffic Obstacles</td>
<td>Red brick</td>
</tr>
<tr>
<td>Type of field surface (except “Right of Way”)</td>
<td>• Concrete, outdoors • Carpet, if moved indoors due to weather</td>
</tr>
<tr>
<td>Location of field</td>
<td>Outside, weather permitting</td>
</tr>
<tr>
<td>Field Boundary</td>
<td>2x4 lumber or equivalent</td>
</tr>
<tr>
<td>People</td>
<td>1” x 1” x 6” Balsawood block</td>
</tr>
</tbody>
</table>