



# WKU Engineering LEGO Robotics

## Rules for February 27, 2016 Competition

*Competition check-in starts at 8:00 am, the competition begins ~9:00*



In a galaxy far away, the idea for the 2016 WKU Engineering LEGO competition **LEGO Wars: The Courses Re-Awaken** was born. Although none of the competitors, and perhaps only a few of the coaches and parents actually saw the first Star Wars movie at a theater in 1977, we assume that EVERYONE is at least a bit of a Star Wars fan. The 2016 LEGO competition is our tribute to all seven Star Wars movies, most recently *Star Wars: The Force Awakens*. For this year's LEGO competition challenge your team must design a LEGO Mindstorm device that can accomplish two different tasks: (1) reach and "attack" the **Death Star** taking one of two possible routes: follow a safe path avoiding space debris or take a shortcut through an asteroid field and (2) work with the Rebels/Resistance to battle the Empire/First Order across the history of Star Wars movies to complete tasks and acquire points for your team. Details of the rules for each of these competition challenges and the rules for building and operating your device are provided below.

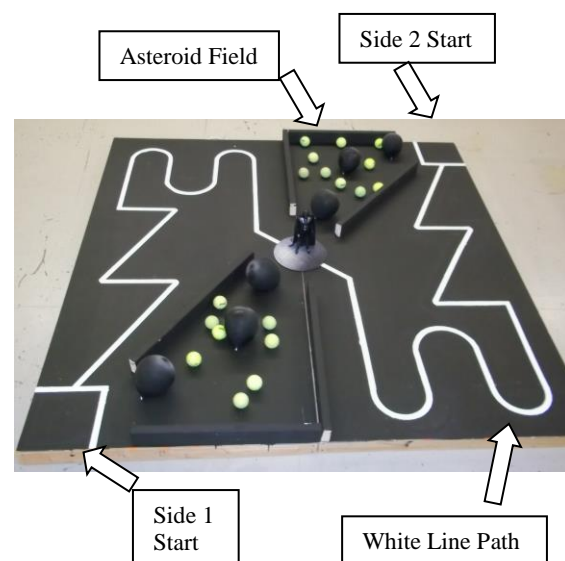
There are no differences between the courses for the EIT and PE Divisions, but EIT teams may only use the materials from a single LEGO Mindstorm kit (any of the various editions are acceptable). PE teams may use any LEGO materials they have access to, including materials from more than one kit. Teams with older students, or with considerable LEGO competition experience might consider registering for the PE Division even if you only use one kit – however this is not required.

### Device Construction and Competition Day Modification Rules

- EIT division devices must be entirely from **a single** LEGO Mindstorm kit (any kit version is allowed) – use of additional materials not in a single kit may result in your team being disqualified. PE division teams do not have this restriction.
- ALL teams are allowed to use ONE non-LEGO component: something sharp or pointed that can pop a small balloon. You must attach this component using only other LEGO components.**
- No bonding element, such as glue, may be used in construction. Failure to comply may result in disqualification.
- The device must fit in an 8 inch x 8 inch x 8 inch cube at the start of each round.
- All devices will be inspected for compliance with the regulations before the contest. The winning devices may be inspected again following the tournament.
- You must bring your own batteries; plan to charge an extra battery that you can swap out between your rounds.
- You may make program modifications following the first round of the competition; you must provide your own computer.
- While physical changes are allowed between rounds to your device, it must still meet all design and construction rules after the modifications are made. No substitute devices are allowed, the same device must be used for all competition rounds.
- All modifications will take place in a pit area. Only team participants are allowed in the area – **no coaches, friends, family, etc.** – violation of this rule may result in team disqualification.

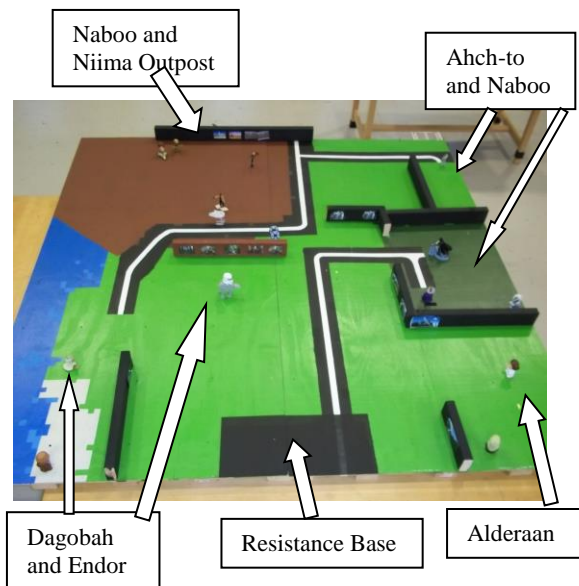
### The Death Star Course

The Death Star Course is shown to the right. It is a flat, 8 ft. x 8 ft. surface. Two teams will run simultaneously, starting at opposite corners of the course, but heading to a common finish in the center at the Death Star. Each team must decide to either follow their white line to the Death Star, or attempt to negotiate the *asteroid field*. The time it takes for the device to get from the start to the Death Star will be recorded for each attempt. If the white line path is chosen, devices must always remain over the white line from the start to finish. If the device strays off the line the judge will instruct the driver to place the device back on the line where it veered off, and give one Touch Penalty each time. If a team chooses the asteroid field route they may attempt to destroy the asteroids (pop the balloons) and move around the defensive debris (tennis balls). The balloons will be secured to the ground, the tennis balls will roll around. If a device needs to be touched by the driver one Touch Penalty will be given and the device must be placed at the entrance to the asteroid field nearest the starting area. This will be a double elimination competition, so all teams will get at least two chances to run the course. The opportunity will be allowed for modifications after the first chance. The final team score will be the best (lowest) of all attempts. See additional comments and photos later in this document.



$$\text{Death Star Course Score} = \{\text{Finish Time (in seconds)}\} + 10 \times \{\text{\# of Touch Penalties}\}$$

(for example, a 30.6 second run time, with one touch required yields a score of 40.6 seconds)



### ***The Star Wars (Over the Years) Course***

Now that your Resistance ship has destroyed the Death Star to reach the battle zone, it is time to fight the Empire/First Order as it has existed throughout the many years of the movies! The Star Wars Course shown at left (and below in greater detail) is a flat, 8 ft. x 8 ft surface. Each team will have two minutes to score as many points as possible by completing tasks on the course. The team's driver will start the device anywhere within the **Resistance Base** area (shown at bottom center) and send the device out to battle the Empire/First Order. Points can be earned if your device completes any of the tasks listed below. Teams can perform one task at a time, or can complete several tasks on a single mission. The driver must re-start the device after each mission from inside the Rebel Base starting area. There are no touch penalties, and teams may perform as many missions as possible in 2 minutes, but may only earn points once for any of the tasks.

Scoring Task	If Your Device...*	Points Earned
<b>Alderaan</b> – Contact Princess Leia	Touches Leia/brings Leia back to base	10/50
<b>Naboo</b> – Reach Padme Amidala	Touches Amidala	50
<b>Endor</b> – Help Ewoks battle the Imperial forces	Knocks over Imperial robot/brings back to base	10/50
<b>Dagobah</b> – Find Yoda to receive training	Touches Yoda	50
<b>Tatooine</b> – Meet up with young Anakin Skywalker and C-3PO	Touches either Anakin or C-3PO	100
<b>Ahch-to</b> – Locate Luke Skywalker	Touches Luke	200
<b>Niima Outpost</b> – Find the Millennium Falcon	Touches the Falcon	100

*\*there are also obstacles that will cause your robot to be reset; see details below*

**Star Wars Course Score = {Sum of all Points Earned}**

### ***General Competition Details***

- Each team will compete at least four times: two times on the Star Wars course, and the Death Star course will be double elimination – everyone will go at least twice, some teams more. Teams will be placed (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, etc.) according to the best score from each course. A low score is best on the Death Star Course, a high score is best on the Star Wars Course (in the case of a tie for either course, the tiebreaker is the 2<sup>nd</sup> best score).
- Each team's overall competition score will be the sum of the place you get from the Death Star course and the Star Wars course (for example 5<sup>th</sup> place in Death Star and 7<sup>th</sup> place in Star Wars = 12 points). Lowest total wins! (In the case of a tie, the tiebreaker is best time on the Death Star Course.)
- The team driver will set the device on either course at the beginning of the run within the designated starting location, and will activate the device when designated by the official. A maximum setup time of 30 seconds will be allowed once the team arrives at either playing surface.
- Drivers cannot wave something or shine a light or in any way signal to the device to do something. For the Star Wars Course the driver pick up the device at any time, but must always return the device to the Resistance Base starting area.
- On the Death Star Course, the device will be considered "off course" and needing correction by the team driver when the entire device is off the white line. If a device's line-tracking motion results in the device consistently moving off the line but self correcting to the line, the judge will decide if this becomes "off course".

### ***Student Participation***

- Student eligibility is left to each individual school. **At device check-in the teams will sign a sheet pledging that they were responsible for the design, construction and all testing of their device.** Coaches/mentors are expected to guide and assist the teams, but this is not a competition between the coaches!
- It is expected that different team members will act as device starters for each round (where possible).
- The designated starter is the only team member that may touch the device and course surface during a round.

## ***Miscellaneous Comments***

### ***Videos of the competition courses are available on YouTube***

General Overview: <https://www.youtube.com/watch?v=2csIZdUrSp8>

Death Star Course: <https://www.youtube.com/watch?v=odCN4yri8no>

Star Wars Course: <https://www.youtube.com/watch?v=p-g7QMJkpYc>

Photos and a drawing with dimensions of the Death Star course are provided below, and photos of the Star Wars course are provided on following pages.

- The courses will be available for viewing and for practice at WKU starting early February.
- Practice time on the competition surfaces will be made available as often as possible in the weeks preceding the competition at the request of teams. Requests for access should be submitted appropriately in advance, via email to [kevin.schmaltz@wku.edu](mailto:kevin.schmaltz@wku.edu).
- There will be several referees during each match. A team will have one referee to keep the time, enforce touch penalties, count points earned for each round.
- Judges decisions are final and should not be questioned.
- An effort will be made to allow teams to practice on Competition Day prior to team/device check in. After check in the device will be impounded. Competition Day practice will only be allowed if **ALL** teams are behaving graciously towards each other and sharing the courses and are not damaging the surfaces. Practice may be cancelled at any time if it impedes the preparation for the competition.
- Most questions about the game can be answered by **READING THE RULES THOROUGHLY FIRST**. All questions concerning these rules during the design and construction phase should be submitted via email to [kevin.schmaltz@wku.edu](mailto:kevin.schmaltz@wku.edu). All coach questions and suggestions will be forwarded to the entire e-mail distribution list, so that every team receives the same assistance.

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## Star Wars Course Images and Comments



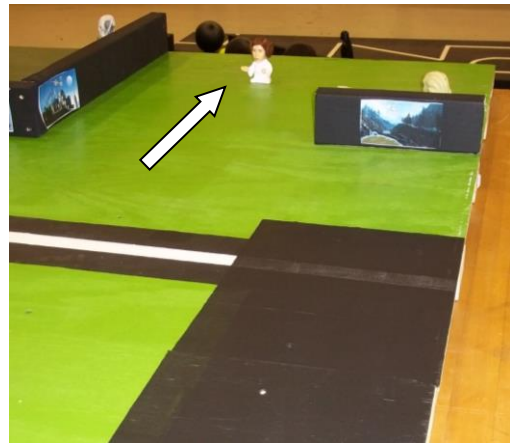
The Resistance Base is the entire black area located along the middle lower edge of course. All tasks must be started from this area.

The Imperial robot for the Battle of Endor task is located in the area in front of the Resistance Base.

Devices must always restart in the Resistance Base area.

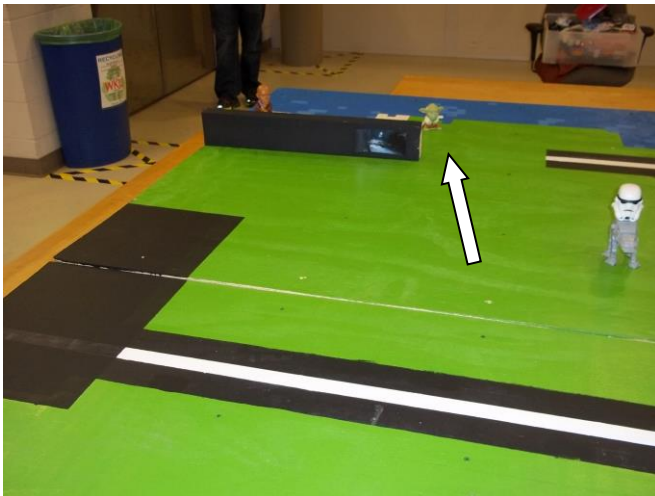
**Alderaan:** There is a direct path to Princess Leia from the Resistance Base.

Touching the Leia figure is worth 10 points; bringing the figure back to the Resistance Base is worth 50 points.



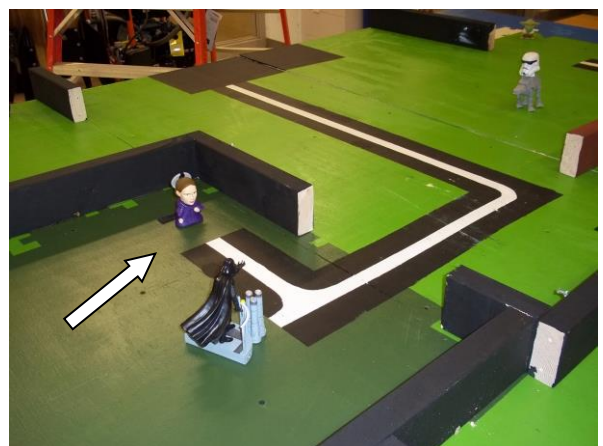
**Dagobah:** Yoda cannot be seen from the Resistance Base.

Touching the Yoda figure is worth 50 points; however if your robot touches the blue water area, you will be “stuck in the swamp” and must return to the Resistance Base and try again.

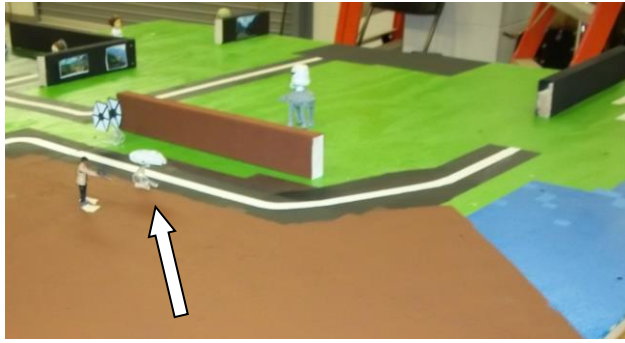


**Naboo:** A white lined road leads to Padme Amidala at Naboo, however you must not touch Darth Vader.

Touching the Amidala figure is worth 50 points; if your robot touches Vader you must return to the Resistance Base and try again.



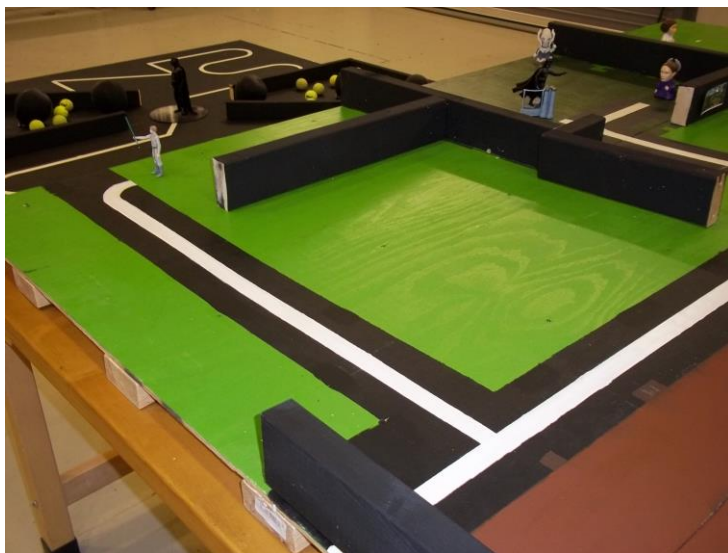




***Niima Outpost:*** The abandoned Millennium Falcon is located along the road at the edge of the desert; Finn is standing beside it. You can earn 100 points by helping Finn recover the Falcon and touch it.

An Imperial TIE fighter guards one end of the road. If you touch this you must restart the task at the Resistance Base.

***Tatooine:*** Annakin and C-3PO are in the desert of Tatooine. You can earn 100 points by meeting up with them (touching either figure), however you must not touch the Imperial fighter standing between them and the road. If your robot touches the fighter you must return to the Resistance Base and try again.



***Ahch-to:*** The missing Luke Skywalker can be found in the farthest reaches of the course at Ahch-to. You can earn 200 points by reaching and touching the figure.

***May the force be with you...***

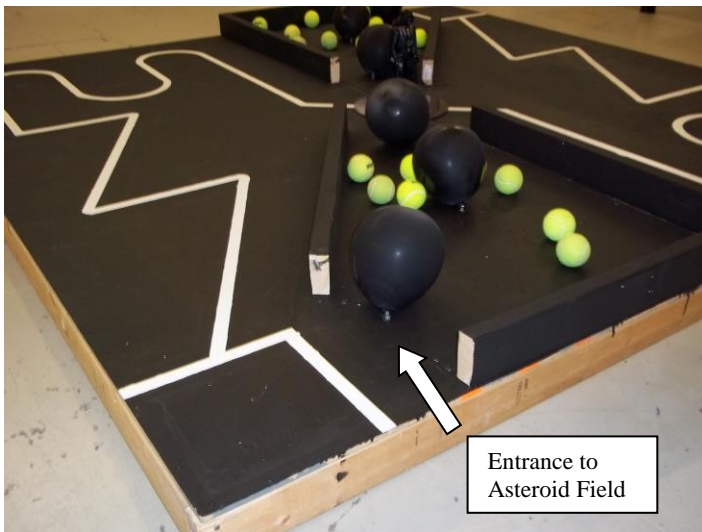
## Death Star Course Images and Comments



Teams will either start in the lower left 12" x 12" starting area, or in the upper right starting area. Drivers must decide to either follow the white line or go through the asteroid field. Judges will determine the time it takes to touch the Death Star in the center, and add penalties for touching the robot

Devices that take the white line path must stay over the line and follow it. Devices cannot take a short cut and go straight to the Death Star. Judges will tell the driver when the robot must be put back on the line, and where the driver must put the robot.

Dimensions for the lines are given in the figure on the next page.



The Asteroid Field will have three asteroids (balloons) that are secured to the ground. They will be at the entrance and exit of the area and in the middle and will be in the same place each time. The walls of the Asteroid Field are fixed. There will be ~10 defensive debris objects placed by the Empire (tennis balls). They will be randomly placed and can move. They will be kept inside the walls (so they don't interfere with a driver following the white line).

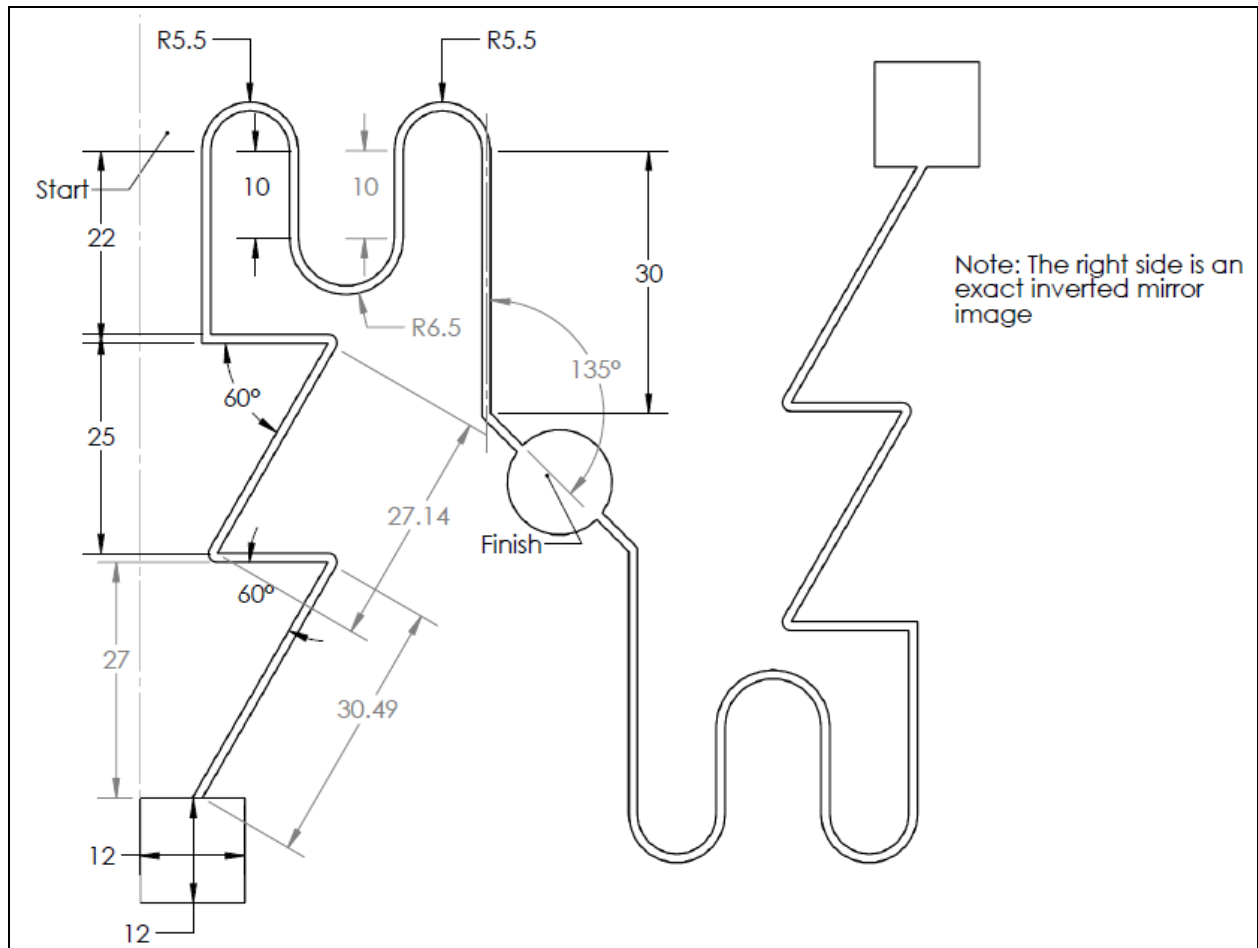
As noted earlier, teams are allowed to add a sharp object to their device to destroy (pop) the asteroids. Please read the rules about attaching any sharp object and be careful with your device if it has a sharp object.

If a device gets stuck, the driver may move it. Each time the device is moved will earn one Touch Penalty, and the device must be put at the Entrance to the Asteroid Field.



The balloons used for the asteroids are these style of 12" party balloons (I got these at Walmart). They will be inflated approximately as shown in the figures, but there can be some slight variation in the inflated size during the competition.

# Drawing of Death Star Course



(dimensions are in inches; "R5.5" means a radius of 5.5 inches)

*May the force be with you...*