



Machine Booklet

2015 Engineering Games

Version 1.0

Revision: September 17, 2014



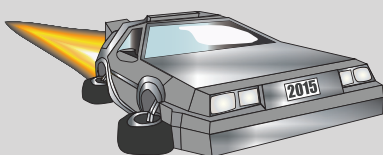
ArcelorMittal

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** In case of dispute, the French version prevails.*



Preface



In this new and even more fantastic adventure, Dr. Brown and Marty McFly find themselves in ancient Rome.

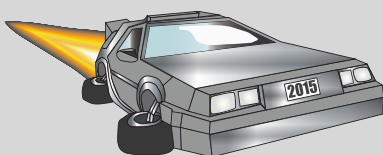
Unfortunately, Maximus Macflyus, the ancestor of Marty, has been robbed of his chariot and he risks being thrown to the crocodiles by Julius Caesar if he does not win the next race of the World Series.

As you may have guessed, the two acolytes must help Marty's ancestor to ensure the survival of their own bloodline.

They decide to use the DeLorean and camouflage it to allow Maximus Macflyus to win the race.

Thus, like in the chariot races, your machine will be required to perform laps as well as the challenge of Julius Caesar. Alas, energy sources were rare back then, this is why your machine will have to use the power of man to propel itself to victory.

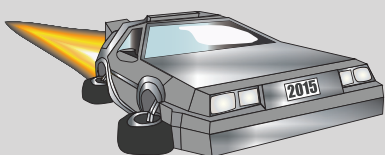
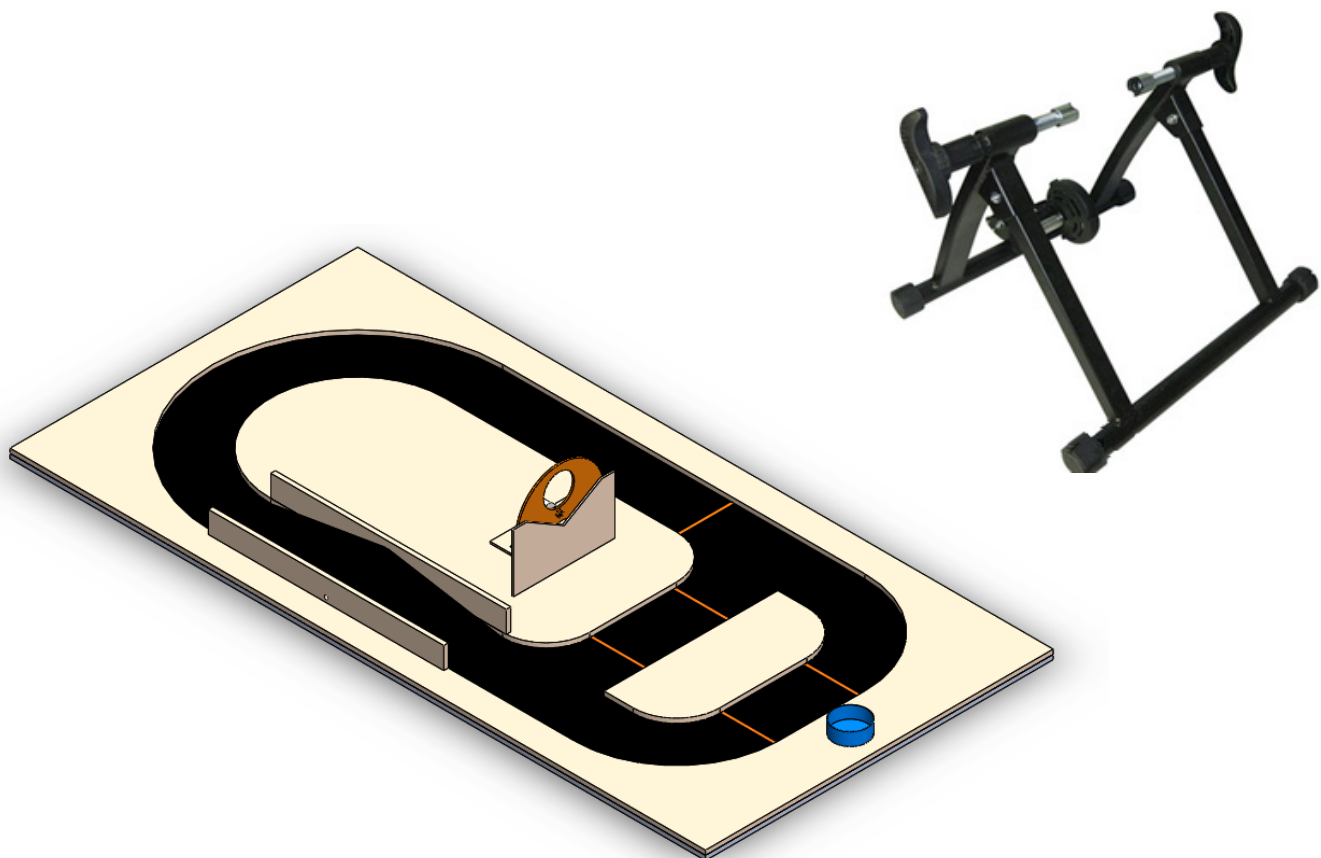
Will you be the one to save Macflyus Maximus and his descendants?



CHALLENGE DESCRIPTION

Challenge Description

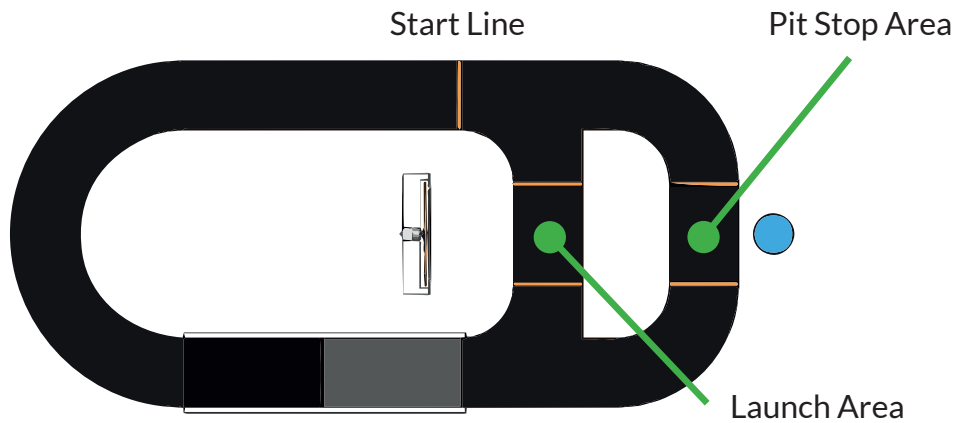
Therefore, as this year's challenge, your team will build an autonomous racing chariot that will complete the maximum amount of laps in the given timeframe. In addition, the vehicle must launch a projectile through a target to complete Caesar's challenge. Finally, your machine must be powered by man, more specifically, by a cyclist pedaling on a supported bicycle. The path to complete the race and Caesar's Challenge are illustrated below. The specific bike support is also shown for your convenience. Each part of the challenge is described in the following sections.



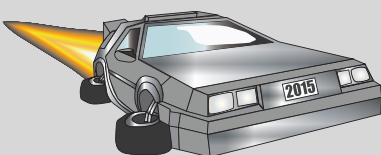
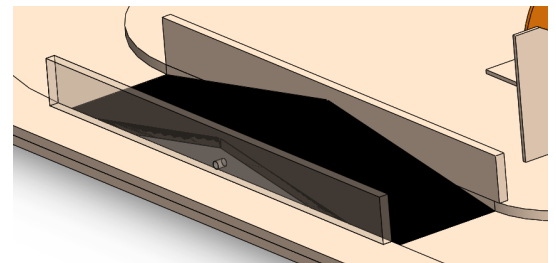
CHALLENGE DESCRIPTION

1. The Race

Just like in modern automobile races, your vehicle will perform the most laps on the track in the time allowed. The pit stop area and the launching area are delineated by straight orange lines on the ground as shown in the following image.



The pit stop area is where you will recharge your vehicle. Another orange “starting line” will be used as a reference to count laps. To make things simpler, laps have to be performed in a counter-clockwise manner. A turn counts when fully completed, this means going past the starting line, around the track and through that same starting line again. You are free to go through the pit stop area or the launching area to complete your laps. Partial laps will not be cumulated in your team’s score. The track is relatively simple; however, please note the presence of a speed bump, as the shown in the following image.



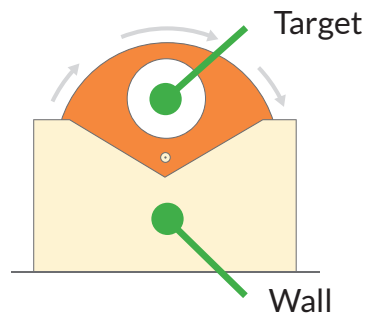
CHALLENGE DESCRIPTION

2. Caesar's Challenge

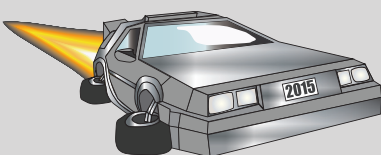
Near the pit stop area is located a blue container with eight (8) small sandbags, similar to those used in a bean toss game. They measure about 2" by 2" and can be found in several stores. A sample sandbag was given for you to a representative of your school at the QCESO CR1.



You will need to carry one or more of these bags with your chariot, from the pit stop area to the launching area. Your chariot can then launch sandbags, one at a time, through the target. These two targets are holes in a wide circle, which is powered by an electric motor that rotates clockwise at about 12 RPM. For a launch to be successful, the projectile must pass through the hole above the wall. If multiple projectiles pass through the target simultaneously, only one of them counts. The target and the wall are shown in the following image:



Once a projectile is launched, it will stay where it falls until the end of the scheduled time given to the team, the only exception being if a bag restricts the rotation of the wheel. Also, if a bag falls on the race track, it stays there until the end of the team's run time and it can't be used again.



CHALLENGE DESCRIPTION

3. The Energy Source: Man

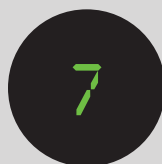
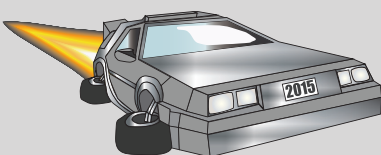
To provide energy to your machine, the best athlete of your delegation will be called upon to pedal frantically. To do this, you'll need to use a bike rack that allows you to use your outdoor bike indoors during the cold season. The same support will be used by all teams in the competition. You can find it by following this link :

<http://supportvelo.com/produit/support-dentrainement-a-velo-magnetique/>



All changes and additions to this support shall in no case be permanent or damage it. The support will be placed a few steps away from the track. A bike will also be provided, but you are free to bring your own. The bicycle wheel needs to drive the shaft normally used to imitate friction on the road. Therefore, the device used to harvest the energy of the rider will be attached to this part.

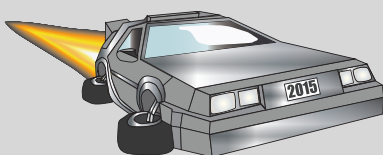
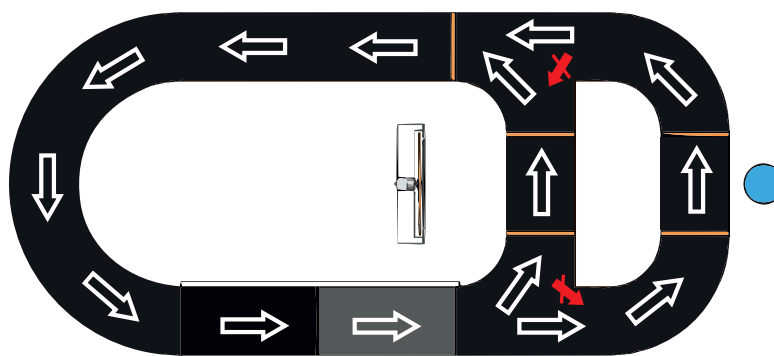
You can still choose not to use the power of man as a power source for your machine, but a different score will be granted based on your choice. A 12V power supply with a maximum current of 2A will also be available to refill your chariot. For powering your machine, you can even opt for pre-charged batteries located directly in your vehicle or in your recharging device.



Rules

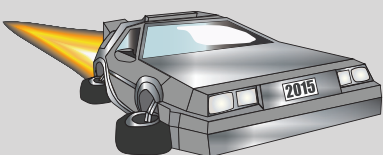
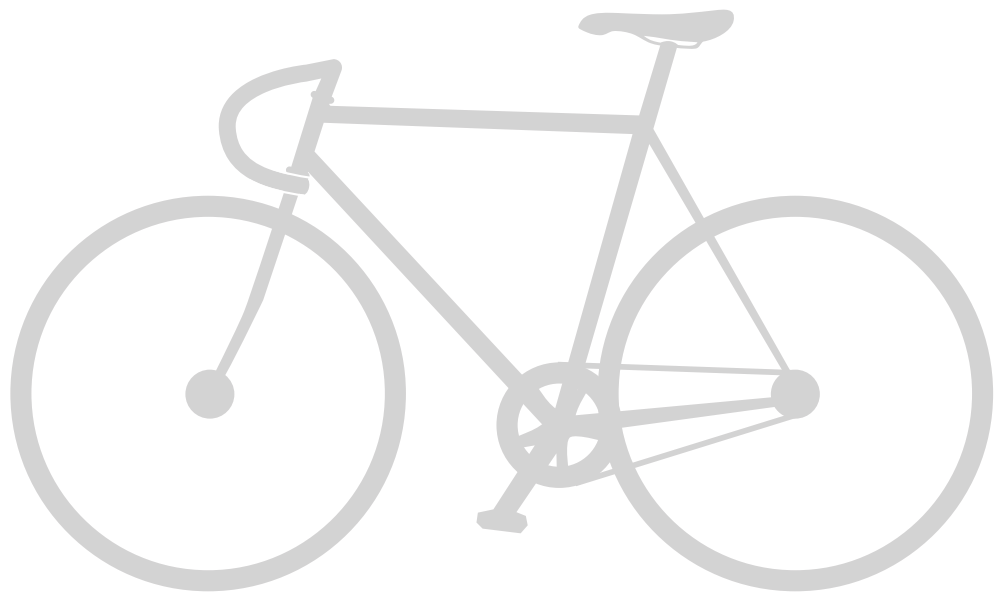
In addition to the terms set in the previous section, your team must also comply with the following regulations:

- There shall be **no damage** to the course or to the bike rack.
- All items must be **safe** for participants and spectators. No pressurized reservoir or explosives allowed.
- The chariot must exit the pit stop area **entirely** to accomplish its laps. There can be no permanent connection between the vehicle and the charging device once it has left the pit stop area.
- No **physical contact** is allowed between the chariot and the top surface of the course (in beige). However, it may touch the edge of the track.
- Sandbags must be carried **by the chariot** in order to get to the launching area.
- To launch a projectile or multiple projectiles, the chariot must go past the **start line** prior to entering the launching area. So it makes almost a complete lap before it can enter the launching area. It needs to follow a trajectory such as depicted by gray arrows in the following figure. The path shown by the red arrows is not allowed.



RULES

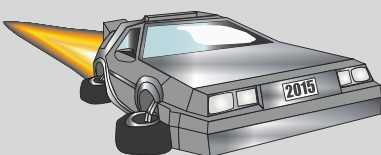
- To use your own bike, it must meet the following criteria :
 - Have a single driven wheel in contact with the bike support
 - Have a brake for fast stopping of the driven wheel
 - Require and use only one cyclist
 - Have a single pair of pedals
 - Be safe for the cyclist and the audience
 - May not have any other source of energy than the legs of the rider



Program

Prior to the event

- A discussion forum will be available to answer your team's questions. All teams will see questions that are asked, so make good use of this tool. When a response is present in this book, you will be redirected to it. However, if it is a response that complements this book, it is then worth as much as information in this document. The forum administrator will be the VP Machine of the organizing committee – he holds the right to ban a member for discrimination, for harassment or for asking too many questions for which answers are in this booklet or already answered in the forum. The VP Machine will warn you on your first and last infraction, he will then be intransigent on these issues. Judges will also have access to the forum if they wish to visit it.
- You must submit a design report to the VP Machine of the organizing committee before **November 7th, 2014 at 23:59**, otherwise a 5 point penalty will be applied. This short report must contain pictures as well as a short description of your design. It must also show your progress. You can submit the report by email to: machine@jeuxdegenie.qc.ca.
- The arrangements for the delivery of the machines at the start of the 2015 Engineering Games will be clarified during the *meeting des chefs*, which will take place around mid-November 2014.
- Specific timeframes will be granted to work on your machine during the 2015 Engineering Games. These periods are to enable you to test your machine on the official track. Expect that these periods will be limited: your machine should be completed prior to your arrival at the games. A schedule for these periods will also be given at the *meeting des chefs*. The time allowed should primarily be used to configure your robot on the official track. It would therefore be advisable that your machine can easily adapt to a slightly different course than the one built by your team.
- During periods of work, it will be forbidden for delegations to bring their own track to test their machine. However, it is strongly encouraged to bring your own bike rack to accelerate testing setup on the official



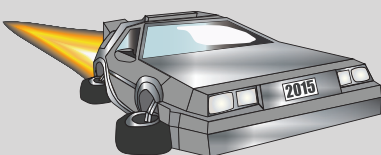
PROGRAM

course. One bike will be provided for the work periods, it will be the same as the one provided for the competition.

- Inspection of the bicycles brought by the teams will be done during these work periods.
- The order of presentation for the judges and the competition will be determined by draw during work periods.
- It is important that each team participating in the competition be present during work periods since some decisions that require the consent of all teams may be taken. Absence of a team without a valid reason can lead to its disqualification.
- The maximum number of delegates allowed during work periods will be disclosed at the *meeting des chefs* depending on the amount of teams participating in the challenge.

Morning of the competition

- A period of fifteen (15) minutes will be allowed for each team to make their last tests on the official course and bike support.
- Each team will have 10 minutes of presentation to the judges, who will determine the points awarded for the quality of the build and originality of concepts. Prepare for about 8 minutes of presentation and 2 minutes of questions from the judges.



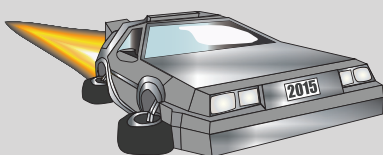
Time of the competition

Each team of up to 8 delegates is entitled to a maximum of 20 minutes on the stage:

1. The first 5 are reserved for the viewing of the machine video and any other presentation by team members. This same timeframe is used to prepare the machine for its run.
2. The next 10 minutes are used to perform your official run and accumulate as many points as possible.
3. The last 5 minutes are the comments and other questions from the judges. During this period the team must also uninstall and make the course and bike rack available for the next team.

Official run

1. All run departures will begin in the pit stop area.
2. If your chariot uses the 12V DC / 2A power supply or strength of man as energy, the first step is to prove that the machine has no accumulated energy before starting the race. To do this, you must perform the same action as when starting up your machine. If nothing happens, you will have proof that your machine is not already charged. If you fail to prove your machine starts without energy, your score will be the same as if you used pre-charged batteries.
3. If you use the power of man, your cyclist can start pedaling at this time.
4. You are allowed a single action with one hand to start your machine, and from that moment on it needs to be completely autonomous.
5. Once your vehicle leaves the pit stop area, the rider must apply the brakes and the 12V / 2A supply will be turned off. The cyclist cannot pedal and the supply will not be relit until the chariot has returned to the pit stop area. Your chariot can come back to this area as many times as required to be recharged or to take one or more projectiles.

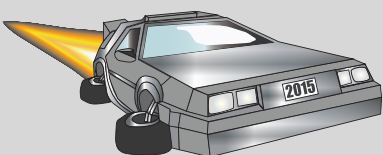


6. The point counting stops when:

- a) The time dedicated to the official performance has run out
- b) Any human interaction has occurred with your chariot
- c) The chariot touches the surface of the course (beige).

Subsequent attempts

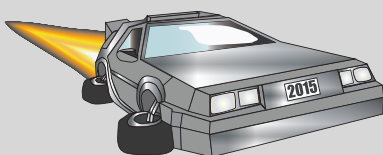
When the point counting stops, if there is still time, you are free to start a new run. For this new run, the start is also done in the pit stop area. However, you are free to charge or not your vehicle before restarting it with the same one handed single action specified earlier. When you start a new test, the counted number of turns is reset. However, you retain the points obtained for Caesar's challenge since the projectiles maintain their position and do not return to the blue container.



Machine Video

The OC of the 2015 Edition and its VP Machine wish to review the formula for the machine video. We ask that you send one email per delegation, with your comments and suggestions on the issue, to machine@jeuxdegenie.qc.ca before **October 20th at 23:59**.

Based on the comments received and the views of members of the OC, instructions and evaluation grid for the machine video will be transmitted and explained at the *meeting des chefs* in November 2014. You will then receive an updated version of this booklet.



Evaluation Grid

Criteria	Points
Performance	50
Judges' Evaluation	45
Machine Video	5
Total	100

Performance

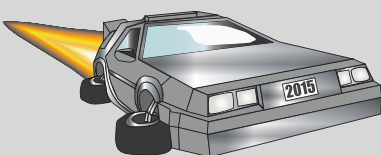
Criteria	Points
Number of laps completed *	30
Amount of sand bags on target (5 points per successful throw)	40
Total	50 (max) x S.F.**

* This score is based on your number of turns versus the highest number of laps completed by any team, using the following formula:

$$30 \times (\text{Amount of valid laps} / \text{Largest amount of laps by any team})$$

** S.F. is the **source factor**, which varies depending on the energy source used. For the power of man, **S.F. = 1**. If you decide to use the 12V / 2A power supply, **S.F. = 0.5**. If you choose the pre-charged batteries, **S.F. = 0.15**.

The total points for laps and Caesar's challenge are added and then cut to a maximum of 50. Lastly, that sum is multiplied by the source factor, which amounts to the total of the "Performance" category.



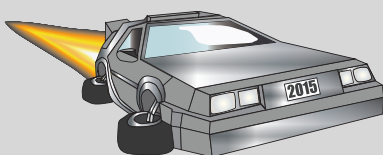
EVALUATION GRID

Judges' Evaluation

Criteria	Points
Utilized concepts and quality of build	20
Originality of solutions	15
Cleanliness, aesthetics and environmental	10
Total	45

Machine Video

*The Machine Video evaluation grid will be available when comments and suggestions have been received and processed by the organizing committee. See « **Machine Video** » section of the booklet for more details.*



Annex #1 – Building the course

All measurements are in inches.

It is very important to note that since the route is wood, a fair tolerance will be required on all measures.

The CAD drawings for the course are attached to this document.

Consider that the figures shown further in this document may not be to scale.

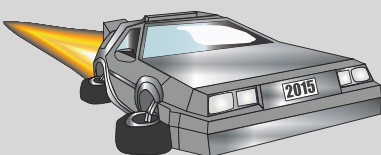
The route is constructed from two 4' x 8' x 5/8" sheets of plywood. One for the base and one for the edges. These two sheets are screwed into one another. There are small crevices (2) on the course caused by knots falling out from the topmost plywood lamination.

The first sheet is the base of the course. Only one cut is necessary where the speed bump will be located. The base of the course and the two boards used for the bump are the only elements to be painted in black. Three layers of black paint were applied. It goes without saying that it is more environmentally friendly to paint only the visible section of the track rather than the whole sheet.

The second sheet is used, amongst other things, to create the edges of the track. With a bit of planning before cutting, it is easily possible to fit all other plywood parts on this one same sheet. A suggestion for cutting different pieces to minimize waste available below.

The target is cut from a 2' x 4' x 1/4" masonite panel and painted orange. Orange lines are made with orange electrical tape.

All other parts are painted with two coats of beige paint. The top of the course and the side of the runway edge are also painted.



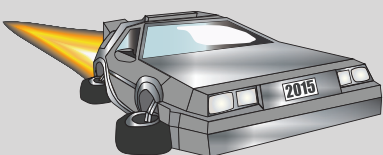
BUILDING THE COURSE

Except for the target, a primer was applied to all surfaces before applying colored paint.

The engine used by the target is directly connected to a 12V / 2A power supply. This supply is identical to the one used to recharge your vehicle, if you opted for this option.

Metal brackets were used to attach and support certain components.

Here is a picture of the official course in its current state. It should not undergo many changes by the time of the competition:



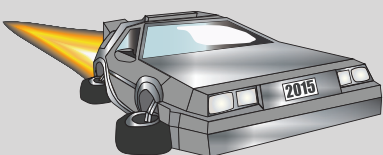
BIKE STAND INSTRUCTIONS

Annex #2 – Bike Stand Instructions

When you receive your bike stand, we advise to assemble it according to the instruction manual that comes with it. It should then look like the one below :



It is then possible to take off the little cover on the side to have access to the rotating components. You only need to take out the three screws circled in red on the photo below.



BIKE STAND INSTRUCTIONS

When the cover has been taken off, there are a few components inside that you can remove, because you won't be using them. They are identified below.

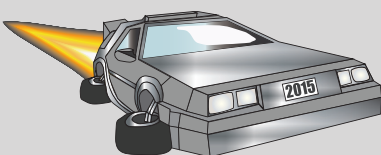


Permanent Magnets

Nut

Turbine

Finally, once these components are removed, you will have access to the shaft where you will harvest the energy from the cyclist. For your information, the thread at the end of the shaft is an M8 X1.25 thread. The picture below shows how you will receive this part of the bike support during the competition. It will also have to be returned exactly the same for the next team, after you have completed your attempts.



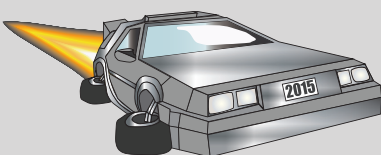
REQUIRED MATERIAL

Annex #3 – Required Material

The following list includes everything needed to build the course:

- 2 sheet of plywood (4' x 8' x 5/8")
- 1 masonite panel (2' x 4' x 1/4")
- Some metal brackets and wood screws (as needed)
- Black paint: CIL Secret noir 00NN 05/000 * A, Semi-Gloss
- Beige paint: CIL Cour de Brownington 90YR 36/203 M, satin
- Orange paint: Tremclad rust paint - real orange (340g Aerosol)
- ~ 40" orange electric tape
- 4-40 X 1/2" machine screw
- 1 blue test end cap for 4" PVC
- 1 x [Sandbag package for bean bag toss](#)
- 2 x [Phidgets Commutation Power Supply, 12V DC](#) (12V / 2A power source)
- 1 x [Cylindrical Geared 12V Motor \(12RPM, 166oz-in, Cytron\)](#)
- 1 x [Metal Geared motor support, Pololu 37D \(Pair\)](#)
- 1 x [Universal Aluminum Hub, 6mm \(4-40\), Pololu](#)
- 1 x [Bike Stand](#)

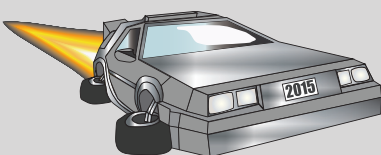
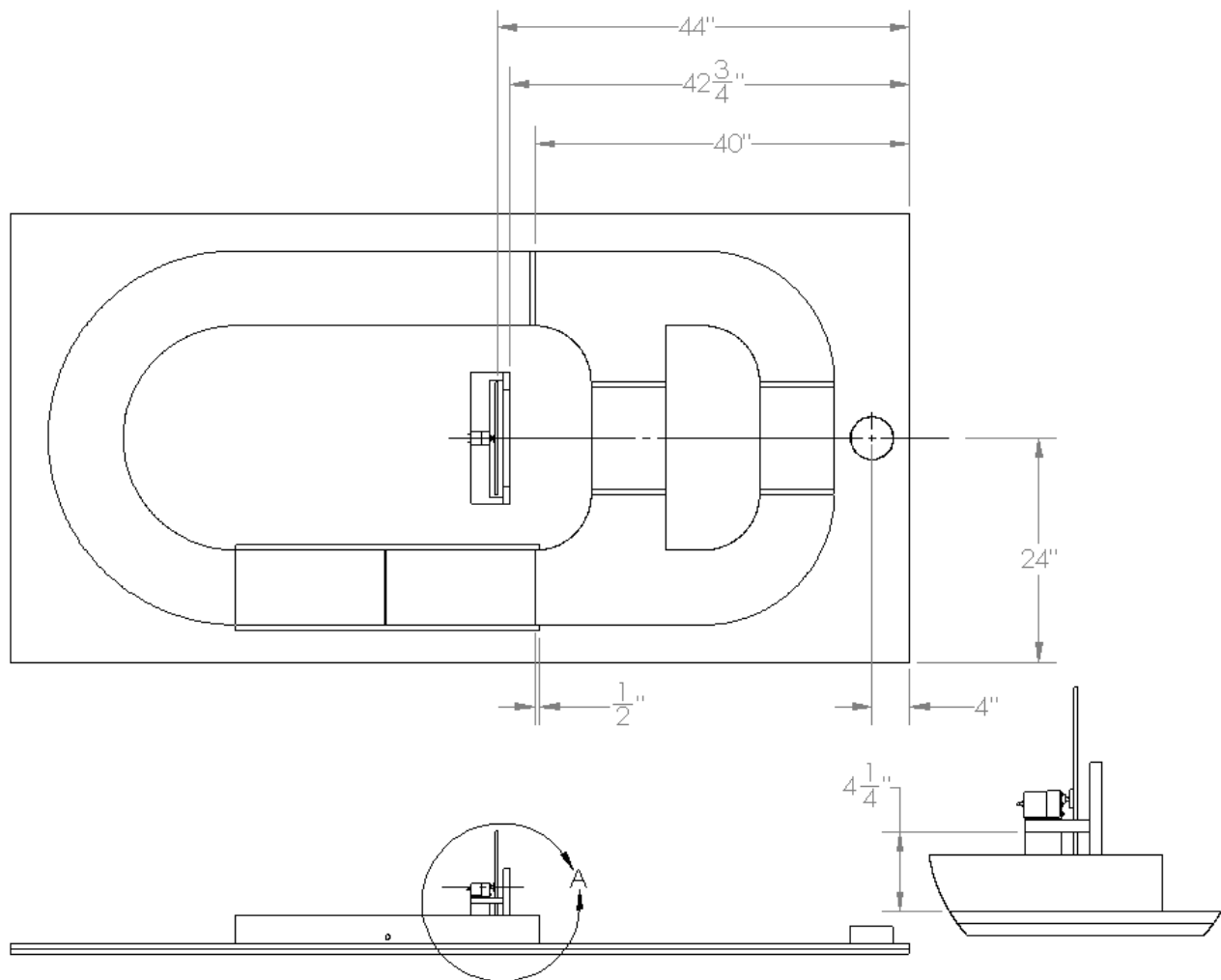
Note that color samples and a sandbag were delivered to a representative of your school at the QCESO CR1 in September 2014.



Annex #4 – Course Map

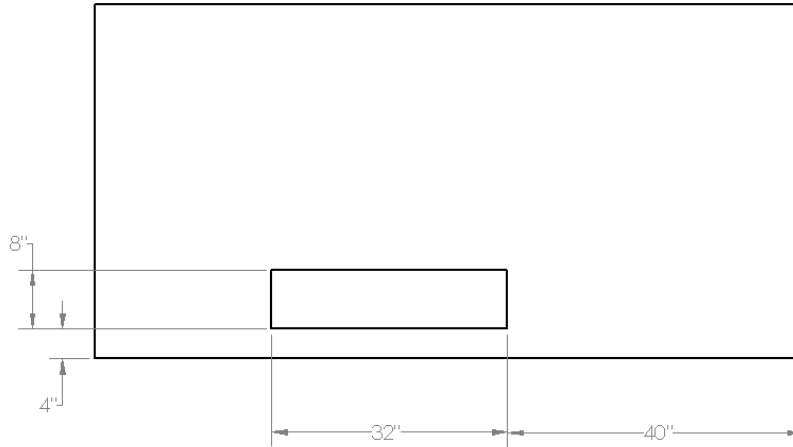
Here are the different drawings needed to construct your track. The drawings are not to scale and the measures are in inches.

Assembly measurements:

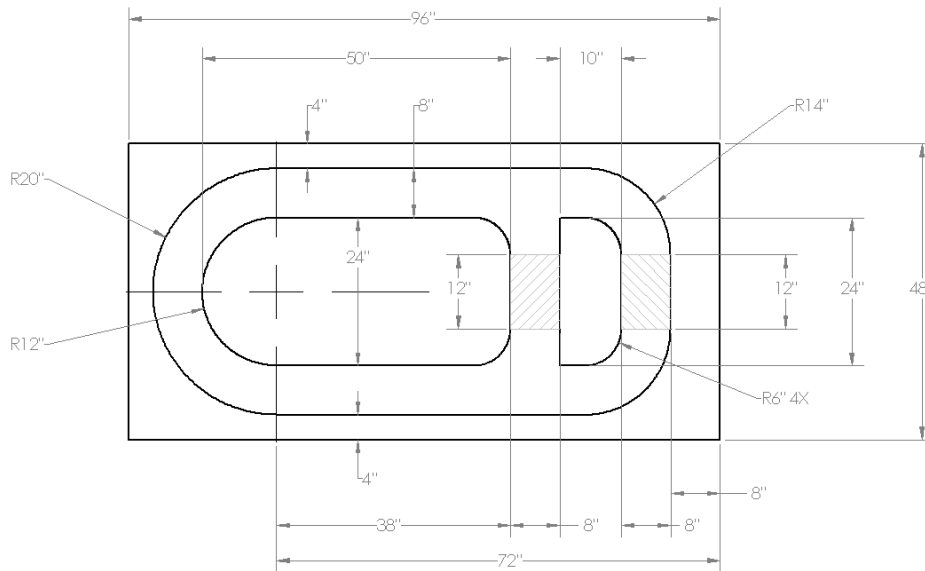


COURSE MAP

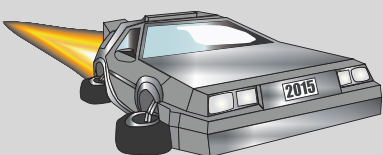
For the base, you only need to make a small cut-out:



For the edges of the track:

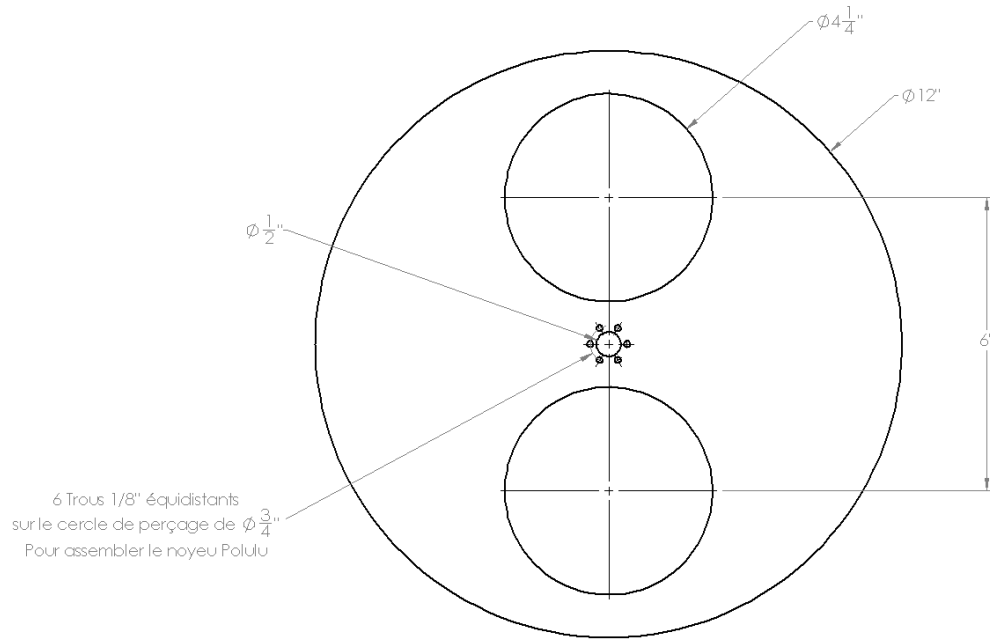


For your information, the hatched areas represent the Launch Area and the Pit Stop Area.

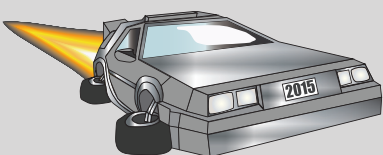
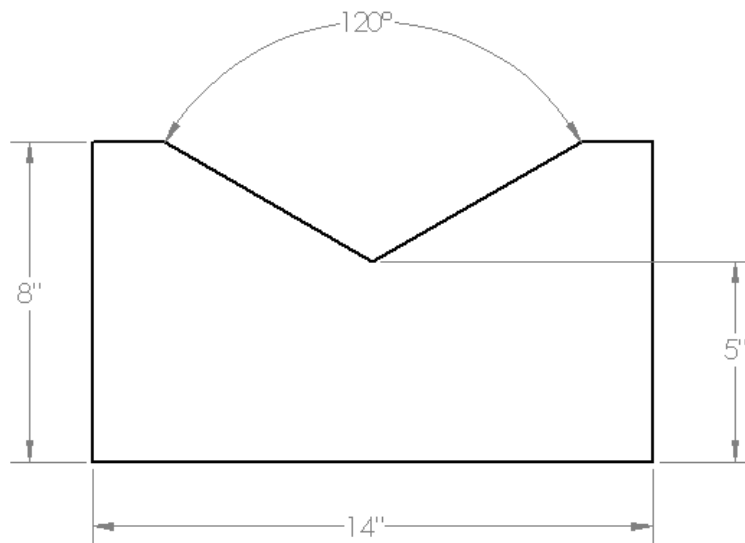


COURSE MAP

The target:

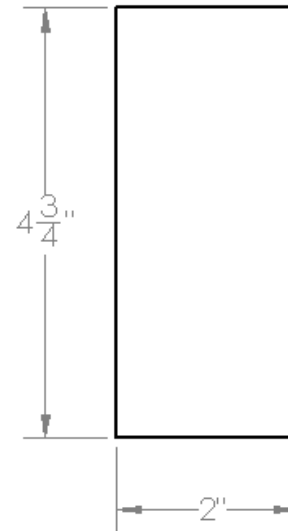
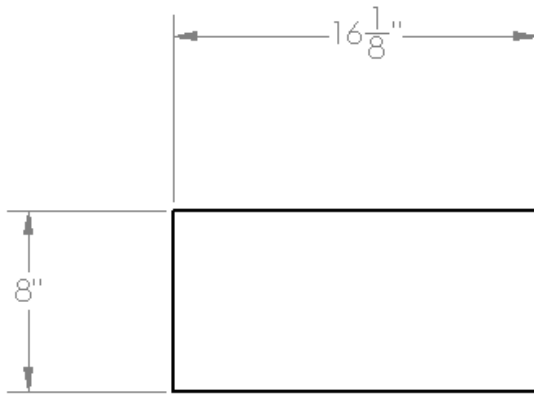


The wall:

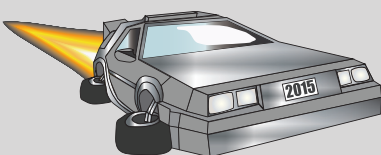
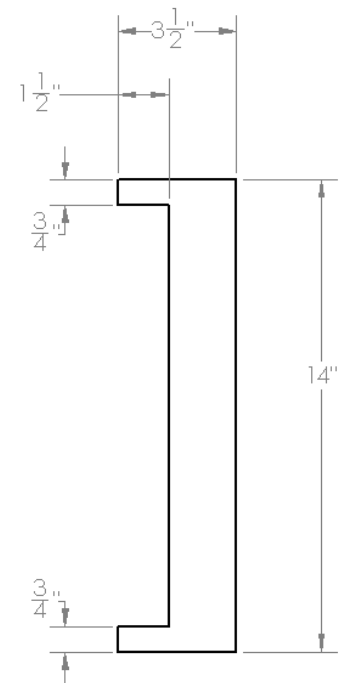
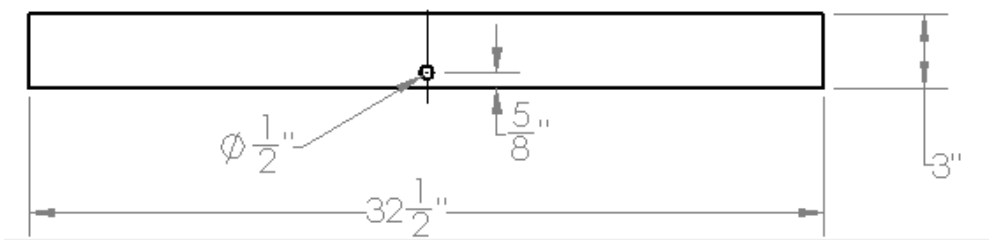


COURSE MAP

Both speed bump slopes and the motor support:



The horizontal motor mount support and both ramp edges:



COURSE MAP

Suggested cutting to minimize material:

