

PrintACar

2021



A Centre of Excellence & Innovation in Science & Mathematics

PrintACar

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Print A Car

Overview

The PrintACar challenge engages teams of 2-4 students in the racing of 3D printed cars designed by the students. A school may enter a maximum of 2 teams into the competition from primary year levels (3-6) and 2 teams from secondary year levels (7 – 12), with the possibility of an additional team upon written request.

Qualifying Day/s

Qualifying will take place at Quantum Victoria. Each team must bring 1 car, but may bring up to 2 different cars to race on the day (we highly recommend bringing two different car designs so that they can both be tested on the track).

Teams must produce a portfolio that provides information on the team and its members, the design and the printing process of their car and the relevant physics associated with the design. (Please refer to portfolio specifications, see page 5).

Feedback on how a team performed will be provided at the end of the Qualifying Day.

Racing (20 Marks)

Each car will race 3 times and will receive a final time based on their fastest race time (including their reaction time for launching the car) and any time penalties that may have been incurred for breaching car rules.

The fastest final time will receive full racing marks, with each team racing after that point, receiving less marks. Any car that races and completes the race, will still receive marks, however, it will be 1 mark less than the slowest race time. Any car that does not race will not receive any marks.

Portfolio (20 Marks)

Teams will be awarded marks for their portfolio based on the inclusion of **all the required information**, the **level of detail of the information** and the **presentation of the information**. Teams are encouraged to invest in presenting a portfolio that addresses **all three areas**.

Winners

The team with the **fastest car** (including reaction time and penalties) and the team with the **best portfolio** will automatically proceed to the finals. Each team will be marked out of 40. The teams with the highest overall scores will receive entry into the finals.

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Finals Day

Each qualifying team must bring **1 car, a portfolio AND a poster to be eligible** to compete on **Finals Day**.

Teams will receive marks for their **race times, their portfolio and poster**, the **originality and creativity of the car**.

Racing (15 Marks)

Cars will compete in time trials to determine which cars progress to the semi-finals and then to the final. Each car will receive a mark based on their position in the time trials (this is determined by the fastest average race time adjusted to include penalties due to nonconformance with this field guide), with the winning car receiving full race marks.

Portfolio (15 Marks)

Teams will be awarded marks for their portfolio based on the **inclusion of all the required information, the level of detail of the information, and the presentation of that information.**

Poster (5 Marks)

Teams will be awarded marks for their poster based on the **inclusion of the required information, the level of detail, and the visual presentation of the display.**

Originality / Creativity (5 Marks)

Teams will be awarded marks based on the originality / creativity of their car design. We encourage teams to submit unique car designs, in particular, teams that are competing again. This criterion will be judged both on the **appearance of the car**, and through the **process of how the final design was reached, as described in the portfolio.**

Winners

There will be an **overall Primary** and an **overall Secondary** winner. The team with the **highest combined scores for each category**, will be the **PrintACar Champions**. The **Primary and Secondary overall winning teams** will receive a **3D printer and trophy** for their school.

In addition, to the overall prizes, awards will be given to the finalist Primary and Secondary teams in the following categories:

- Fastest Time Trial Race
- Faster Time Trial Reaction
- Best Portfolio
- Best Poster
- Most Original Car Design

Please note: As a condition of entry into the PrintACar competition, any of the major prizes will only be awarded to schools not individual students. Quantum Victoria reserves the right to reclaim the

prize should any requirement be compromised. Quantum Victoria's decision is final and no correspondence will be entered into.

Qualifying Portfolio Specifications

Portfolio Requirements

Qualifying Day

Teams are required to produce a **physical portfolio** that is **4-8 pages long and A3 in size** with the following information:

- **Team Profile** (1 to 2 pages)
 - Name of School
 - Name of team
 - Team Logo
 - Name of team members
 - Roles of team members
 - Photos of team members
- **The Design Process and Physics** (including aerodynamics) (2 to 4 pages)
 - The 3D modelling software used.
 - What was the inspiration for final design? Explain this through the features of your design.
 - Discuss design features of your car that you think will make it faster in terms of the relevant Physics.
 - Discuss your wheel design and how this will make your car faster.
 - Detail the steps involved to get to your final design.
 - What modifications were made as you progressed and why were they made?
 - Include a **minimum of 3 images** of your car design throughout the 3D modelling process. These images must illustrate (as a minimum) **the beginning, middle and the end of the process.**
 - Images of the car from **at least 3 angles** showing:
 - Exact measurements of the car. Measurements must be in **millimeters.**
 - Different feature measurements of at **least 3 different features.**
 - Features that have changed (these should explicitly be pointed out on the image).
- **The Printing Process** (1 to 2 pages)
 - What model printer did you use?
 - What type of material did you use? Why did you choose this?
 - What printing software did you use?

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- What challenges did you encounter when you printed the car(s)?
For example:
 - Print quality challenges.
 - Software challenges.
 - Team dynamics.
- Pictures of any prototype cars.
- Pictures of final car(s) **straight from the printer AND before any finishing.**
- Pages in excess of the page limits for each of the above sections **WILL NOT** be marked.
- Portfolios will be marked for the **inclusion of all the required elements, the level of detail in responses and the visual presentation of the portfolio.**

Finals Portfolio / Poster Requirements

Finals Day

Teams are required to produce a **Physical Portfolio** that is **6-12 pages long, in A3 size AND a Poster of A2 size.**

Portfolio Requirements

The **Portfolio** may add additional information to the Qualifying Day Portfolio and **must include all the information required on the Qualifying Day (see page 4) as well as following information:**

- Changes from Qualifying Day (2 to 4 pages)
 - Did you change your car from Qualifying Day?
 - If so, why did you change it and what changes were made?
 - If not, why didn't you change your car?
 - Discuss any finishing to your car and why you think this may make your car faster.
 - Were you able to improve your print quality since Qualifying Day? If so, how?
 - Pictures of any prototype cars and the final car straight from the printer (before any finishing).
- As before, **pages exceeding the page limits for each section (including the Changes from Qualifying Day) WILL NOT be marked.**
- **Portfolios will be marked for the inclusion of all the required elements, the level of detail in responses and the visual presentation of the Portfolio.**

Poster Requirements

The **purpose** of your **Poster** is to promote your team and your car.

The A2 poster **must include** the following information:

- School name
- Year Level(s) of team members
- Name of team
- Team Logo
- Name of team members
- Roles of team members
- Pictures of team members
- Pictures of your car
- Summary of unique / important features of your car
- Inclusion of all the required elements, level of detail in responses and creative flair in the presentation

Car Rules and Regulations

Note: penalties that may result in your car being disqualified are shown in **red**, all other time penalties are shown in **blue**.

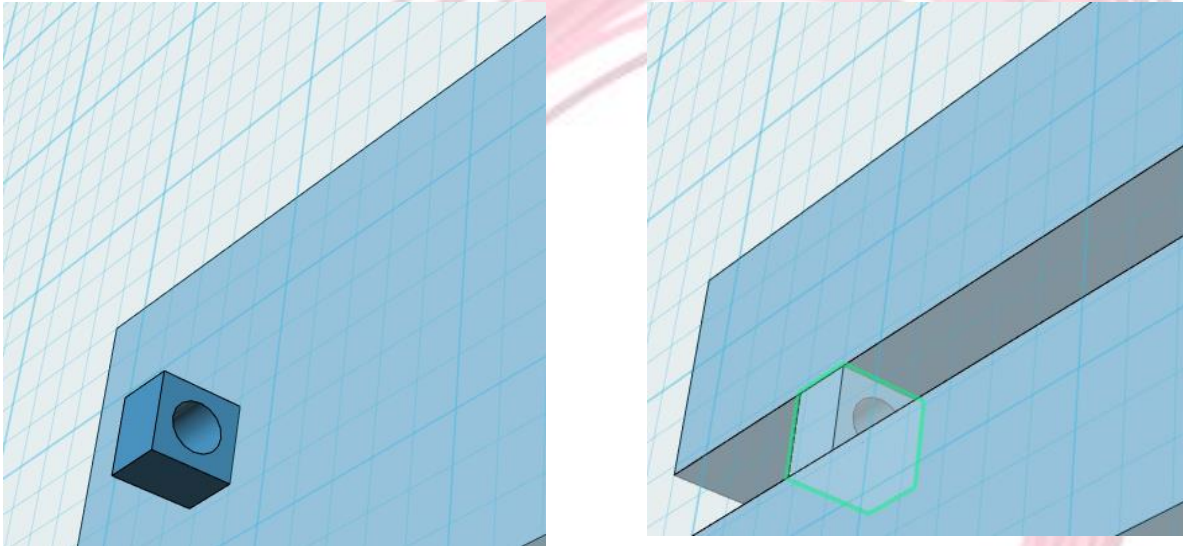
1. All components of the car **must be manufactured using 3D Fused Deposition Modeling (FDM) printing technology with ABS or PLA filaments**. **0.2s time penalty**

EXCEPTIONS

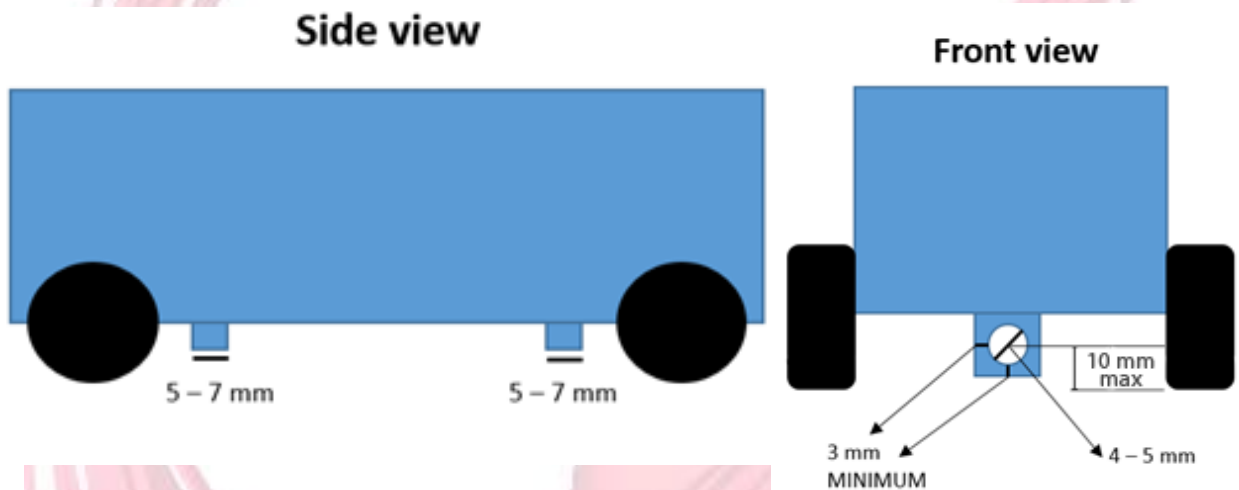
- a. Axels (We recommend the use of brass rod).
 - b. Adhesives (Used to stick wheels to axels or parts of the car together).
 - c. Paints, Sealants and Stickers (**FINALS DAY ONLY**) (You may finish your car with paint or sealant for finals ONLY and these **must be dry**).
2. The car must have exactly 4 wheels and 2 axles that freely rotate. **0.05s time penalty**
 3. Assembly and finishing of the car must be done **before** race day. This includes gluing pieces of the car together, attaching of wheels or painting (paint must be dry by race day). **0.5s time penalty**
 4. The **completed car must have a mass of 50g or greater (fully assembled, without the CO₂ canister)**. **0.3s time penalty**
 5. Length of car **MUST** be between 100 mm – 200 mm. **0.1s time penalty**
 6. Height of car **MUST** be between 45 mm – 75 mm. **0.1s time penalty**
 7. The widest part of the car **MUST** be between 40 mm – 75 mm. **0.1s time penalty**
 8. Cars **MUST** have a cylindrical hole for the CO₂ canister to be inserted in.
 - a. The hole **MUST** run parallel to the ground (once the wheels are attached) and in-line with the center of the car. **0.1 s time penalty**
 - b. The hole **MUST** have:
 - i. A diameter between 19 and 20 mm. **0.1 s time penalty**
 - ii. A depth between 50 – 52 mm. **0.1 s time penalty**
 - iii. A minimum wall thickness of 3 mm. **0.1 s time penalty**
 - c. To facilitate launching, the entrance to the CO₂ canister hole **MUST**:
 - i. Be the most rear point of the car (no part of the car including wheels should stick out behind the canister entrance point). **0.05 s time penalty**
 - ii. Have its centre between 25mm and 50mm from the ground (fully assembled). **0.05 s time penalty**
 9. The car will race along a guide wire, therefore eyelets **MUST** be included in your print so that your car can be threaded onto the wire.
 - a. Your car **MUST** have exactly two distinct eyelets. **0.1 s time penalty**
 - b. The eyelets **MUST**:
 - i. Be at least 50 mm apart. **0.05 s time penalty**
 - ii. Be in-line with the center of the car. **0.05 s time penalty**
 - iii. Have a hole between 4 - 5 mm in diameter. **0.05 s time penalty**
 - iv. Have the center of the hole **no more** than 10mm off the ground when fully assembled (including wheels). **0.05 s time penalty**

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- v. Have the depth of the hole (along the direction of the hole) between 5 - 7 mm. **0.05 s time penalty**
- vi. Have a minimum wall thickness around the hole of 3 mm. **0.05 s time penalty**
- vii. Have a clear path between the eyelet holes and the front and back of the car.
Note: axles must not impede the path of the guide string. 0.3s time penalty



The diagram above shows eyelets protruding from the bottom of the car (left) and embedded into the car (right) with a trench to clearly distinguish that there are two present.



The diagram above shows the dimension ranges for the eyelets as stated in rule 9.

Note: Quantum Victoria has the right to refuse the racing of any car deemed to be unsafe to race or cause damage to the track.

Other Information

Frequently Asked Questions

Q. How many axles are we allowed per car?

A. Two (dual axle car).

Q. Are we allowed to use a lubricant on the axles?

A. No.

Q. How much teacher input is allowed, if any?

A. We want teachers to act as a guide to their teams. Teachers can discuss and clarify the requirements as listed in '*The Field Guide*' and also teach skills needed to complete the tasks required for the students to compete, **HOWEVER**, students **MUST design** and **create** their cars, **Portfolio** and **Poster** themselves. Teachers can familiarise the students with the use of the 3D printer, but the students **MUST** print their designs themselves.

Q. Do we have to use our school printer to print our car?

A. The **Quantum Victoria PrintACar Challenge** has been designed to engage students in **authentic experiential learning** through the disciplines of **Science, Technology, Engineering and Mathematics (STEM)** and for schools to use their printers with their students to help spark ideas for future projects. If you **DO NOT** have access to a printer at your school or your printer is **unable** to print anything of reasonable quality, you **MUST** notify us before proceeding.

Q. Does it have to be printed with a specific type of 3D printer? If so, what type?

A. Students can use any 3D printer that uses filament. Note that only one of **ABS** or **PLA filament** can be used.

Q. Do the wheels need to be printed?

A. **YES**, all parts of the car **MUST** be **manufactured with a 3D printer except for the exceptions listed in rule 1** of the **Car Rules and Regulations** (see page 7).

Q. What are the tolerances for printed shapes?

A. Tolerances will vary depending on your printer and materials used. Some trial and error might be needed. You can initially allow for up to 1mm variance in your printed objects. However, judging **WILL NOT** take tolerances into account.

Q. How does the car launch?

A. A CO₂ canister is inserted into the cavity at the back of the car. A launch pod is placed at the back of the car, the CO₂ canister is placed inside the launch pod and then a firing pin is triggered to puncture the CO₂ canister.

Q. Does the Portfolio / Poster need to be printed or can it be hand written?

A. Portfolios and posters can be either printed or handwritten, however the design, neatness, appearance and the information included of both, will be taken into consideration when marked.

Register

Teams must register by Friday 4th of June. A waiting list will be created if the competition numbers reach capacity. **Places are limited and we encourage you to register your teams as soon as they have been created.**

Please complete the online form via the below link to register your interest

[Registration Form](#)

Once registration is confirmed the following information will be required:

- School name
- Team name
- Team members
- Year level of each student
- Supervising Teacher(s) names
- Supervising Teacher(s) contact details (email and mobile number)
- School contact telephone number and email address

2021 Qualifying Days will be held on Monday 16th and Tuesday the 17th of August during National Science Week and competing teams will be allocated a day upon confirmation.

The PrintACar Final will be held late November 2021, with the date and the venue to be confirmed.

Please note that due to circumstances beyond the control of Quantum Victoria, dates may change.

Contact Details

If you have any further questions or queries, please contact us at: admin@quantumvictoria.vic.edu.au