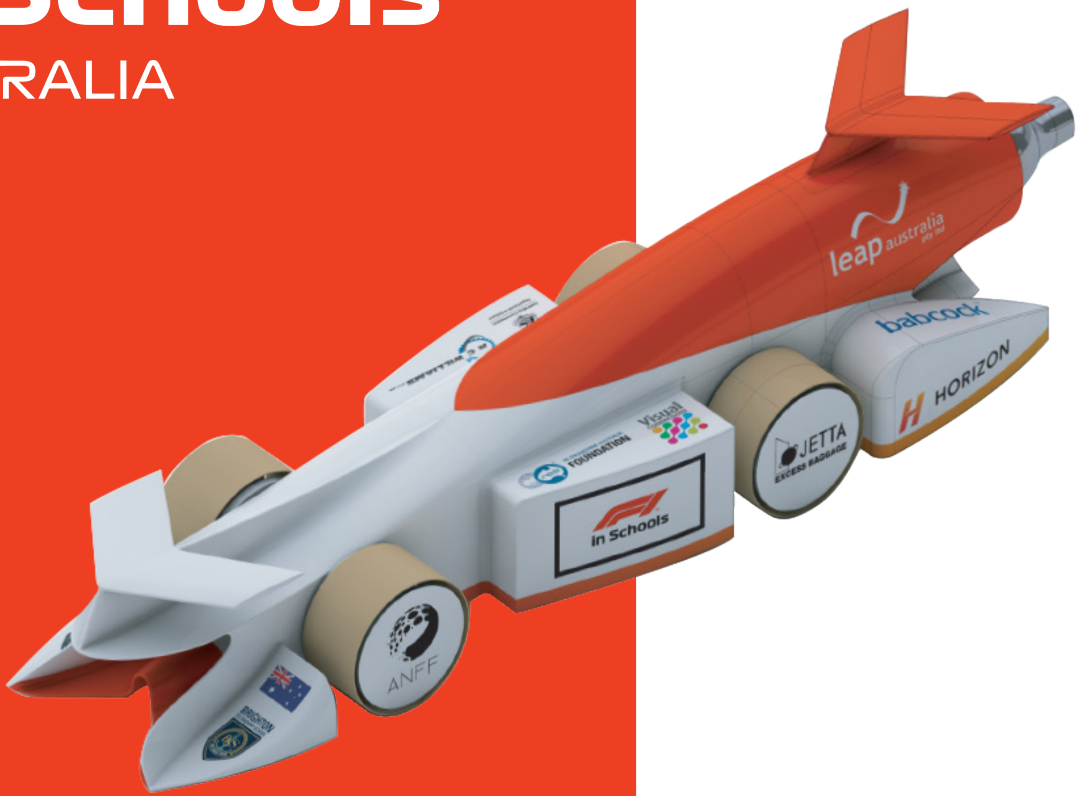
RE-ENGINEERING AUSTRALIA FOUNDATION

F1 in Schools AUSTRALIA




# INTRODUCTORY OVERVIEW

An Introduction to F1 in Schools in Australia

## AUTHORISED AGENT

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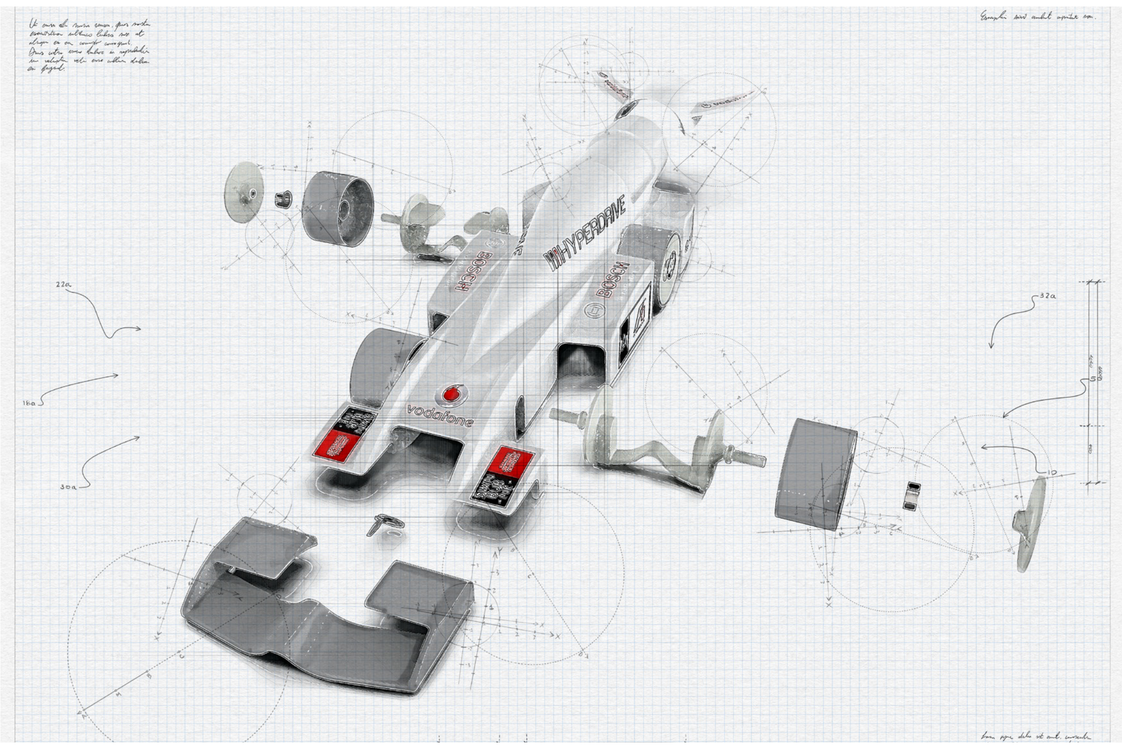
## About REA

Re-Engineering Australia Foundation (REA) is a not-for-profit charity focusing on the implementation of a STEM 4.0 Life-long Learning platform which takes the concept of STEM education to another level. By focusing on the development of the analytical problem-solving capacity of students and by the development of their communication and collaboration skills, we help build resilience and character in students, preparing them for the world of work and their future careers.

REA's programs promote career relevance, supporting the transition of knowledge from primary school, through high school into university and directly into industry. We want students in primary school to start the process of developing a set of skills based on analytical problem-solving and communication that they can take with them and build on as they traverse high school and into university or a career.



# BACKGROUND

The F1 in Schools program is founded on a STEM 4.0 philosophy which brings links to industry and real-world career relevance to students. It aims to facilitate a cross-curricular learning platform which builds in students the employability skills industry is seeking. The program is open-ended, and students can achieve at a level that fits with their skills and desires. It also provides a platform where students can go on to compete on a world stage.

F1 in Schools currently runs in 17,000 schools in 55 countries around the world.

Building skills in 3D modelling is an essential component of the initial design phase. It is crucial, however, for students to realise that F1 in Schools is much more than just a model. Students new to the program sometimes spend a large portion of their time thinking about different car design criteria before producing a viable design. They need to careful not to over-focus on one element of the process.

Students experienced with the process split the components of the design-manufacture-marketing process between team members early in the planning stage and have selected a team manager early in the process. The manager's role is to keep the team on track; they should understand the importance of each component of the project sharing time and resources between the different team members.


## The Excitement of F1 in Schools

Students participating in F1 in Schools follow the process of Design, Analyse, Make, Test, Race and Review as they create a miniature F1 race car. The journey for students is an iterative journey where they undertake research, come up with concept solutions and then manufacture and test their car. They will most likely make mistakes along their way and acquire new learnings which will facilitate them revisiting their design to apply improvements. They can then go on to compete against other students within their school, their state, their nation or progress to representing Australia at an international F1 in Schools competition. The students can choose how far along the competition journey they would like to travel.

Designing an F1 car will require the students to form a team involving several students, all with different skills. As with a real F1 team, they will need expertise in engineering, management, industrial and graphic design and industry collaboration. Research shows that teams formed from non-heterogenous groups of students continuously outperform heterogeneous groups.

Depending on student skills and interests, they may focus on different aspects of the team.

Students must document the processes and decision making they undertake throughout the project. Recording progress is great classroom practice but also allows students to look back on their work and understand how they have developed a concept to produce a final product. Recording observations is also invaluable when it comes to competitions as it gives students a range of data to select from when developing their portfolios.

Students will go through the design to review process multiple times before reaching a practical design. By the end of their F1 in Schools journey, the students will be able to look back and realise that they have enjoyed the possible hundreds of hours they have spent learning. The process of bringing an idea into reality is empowering, helping them identify their capacity to produce solutions to real-world problems. .

# Implementation In School

## Coordinating F1 in Schools at your school

F1 in Schools can be implemented in a variety of ways. It's essential to consider the learning context within your school before developing an implementation plan. There is no relationship between how schools implement the program and success, even at an international level. Schools will have processes in place, which will influence implementation. It is, however, important that the school understands the vale of cross-curricular STEM to maximise student opportunities.

Below are some scheduling suggestions based on observations from schools currently running F1 in Schools.

### 1. After School as an Extra-Curricula Activity

Many schools run the program outside school hours as an extracurricular activity. A dedicated day every week where students can spend time in their team groups with supervision goes a long way. When it comes around to competitions, teams might need to spend more days after school or their lunchtime working on the project.

### 2. As an in-class activity

Many Schools will run the program within their teaching faculties. For example, a Technology faculty might make one of their junior projects the F1 in Schools program and all students in the cohort will form groups to design and build a car. The program has a natural fit as a cross-curricular teaching platform as it fits comfortably with Design, Art, Science and Maths. Cross-faculty collaboration, however, can be challenging to achieve, but the benefits for the students are numerous.

For students to succeed in competitions, being able to collaborate is an essential skill and a mandatory task. If they can work in an environment where they see teachers collaborating, it can be inspiring for the students. Students taking on the program do much better when they drive decision making via collaboration.

### 3. Running a dedicated subject

Running the program as a dedicated subject is something that has been taken up by many schools. Fortunately, some schools are moving away from the siloed style of education and recognise that showing the practical applications of STEM subjects benefits students when they go back into individual subject lessons. Cross-Curricular education can be a challenge and requires a broader school commitment to the program for timetabling.

Whichever the method of implementation, F1 in Schools promotes and facilitates students engagement and collaboration with industry.

## Fundamental Tasks - The basics

In the program, students form teams to produce a complete product which includes a model F1 car outlining their processes for engineering and enterprise along the way.

### 1. Plan:

Students form teams and assign roles to each member. Example team roles can include Design Engineer, Manufacturing Engineer, Project Manager, Team Manager, Resource Manager, Graphic Designer. There are no strict guidelines on roles and students should take ownership of delegating tasks and functions as they see fit.

### 2. Design & Analysis:

Students use Computer-Aided Design (CAD) software to design a model F1 car. CAD software allows analysis of the car's design via applications like Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA). These are tools regularly used by industry and will help students connect their efforts with real-world projects.

### 3. Make:

Students manufacture their cars using a CNC router, bringing their models to life. Other manufacturing methods are also an option with many teams using 3D printing, carbon fibre, and different creative ways to produce the fastest car possible.

### 4. Testing & Racing:

Students race their cars on a 20m track powred by $CO_2$ canisters and reaching speeds of up to 80km/h. Racing is always fun for students, but to achieve a winning car in competition, students must ensure that they stick to the rules and limit car breakages through sound engineering.

# Competition

## Does a school need to compete externally?

Entering external competitions is not critical in running the F1 in Schools program. Internal school competitions may be as far as you would like to take the process initially as you build skills in the school.

Once students step above the in-school competition, they enter a very competitive international market. Competing outside of the school provides a platform where students have to operate outside their comfort zone. The number of competitors increases as does the quality of the competition. They can compare their progress against others outside their environment, which is no different from the real world where they will soon be competing for places at University and jobs. The better they can be prepared to take on the fierce competition, the better they will be able to make the transition to the world of work.

F1 in Schools is the academic equivalent of team sports which provides an opportunity to undertake competition based on an academic pathway.

Students are required to adhere to strict rules and regulations, documented in two separate documents, the Technical Regulations and the Competition Regulations. These documents, while extensive, can be simplified for internal school competitions but should form the basis for implementing F1 in Schools internally.

## What's involved in competitions?

There are many levels and classes of competitions through which teams can progress. To deliver this project within your school, teachers must first register the school via the REA website. There is **no cost** for a school to register. The registration process will allow REA to understand the communications protocol and points of contact within your school. It will enable REA to keep you briefed about upcoming competitions, public exposure events, government grants and opportunities for support and collaboration with industry.

Team registration is independent to school registration and is only for teams looking to compete in the competition at the regional, state, national or international level. Currently only NSW and Queensland have regional competitions which are required before teams progress to state finals. Similarly, national final progression is dependent on performance in the state finals. The top teams progress based on performance with some wildcard opportunities offered to teams with the potential or capacity to step up and operate at a higher level.

### Technical & Competition Regulations

The F1 in Schools STEM Challenge requires competing teams to adhere to the regulations outlined in the official regulation documents. It's important that competing teams are aware of the competition & technical regulations and adhere to the rules outlined. The regulations can be found on the REA website using the following link - https://rea.org.au/f1-in-schools/resources/.

There are two documents, the Technical Regulations and the Competition Regulations which can be found under the "Rules & Regulations" heading.

## Competition Deliverables

There are several deliverables required for competition. An overview of these deliverables follows. The judging criteria for each of these deliverables are set out within rubrics contained in the Competition Regulations.

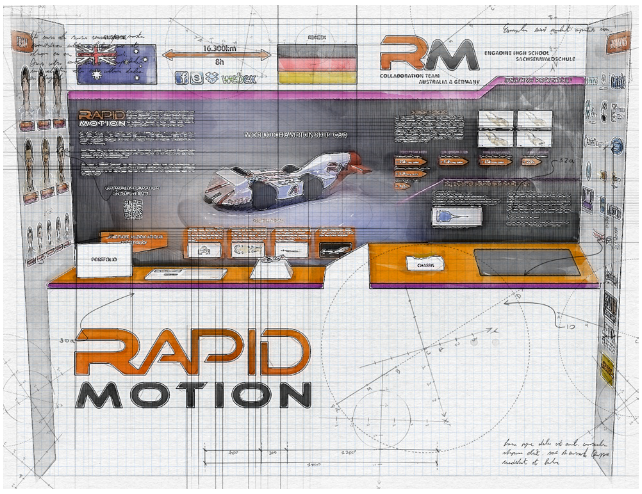
1. Portfolios:

Students produce portfolios outlining both their Engineering and Enterprise processes, decisions and learnings. The production of high-quality folios is a critical component of the program. They should evidence a wide range of topics including career development, marketing, collaboration, project management budgeting and engineering design and development.

Well produced portfolios have assisted students in gaining subject credits at university and be the differentiator in job applications.

2. Trade Display:

In the real world, many great ideas fail if not presented adequately to the audience. Students produce a trade display and marketing material designed to pitch their team to prospective sponsors and investors. Visual articulation via the trade booth also drives a critical reflection of their engineering processes as students sell their ideas and concepts to an outside audience. Trade booths should articulate details about the team, the process they followed, and provide an opportunity to deliver a return on investment (ROI) for sponsors and collaborators. They should be structured to captivate an onlooker who is not familiar with their project.




### 3. Verbal Presentation:

Developing a capacity to communicate effectively is one of the two essential Life-Long STEM skills. The verbal presentation process provides a platform for students to develop these skills. Students deliver a 10-minute oral presentation where they get to tell the story of their team and their project to a panel of industry judges. They also cover the skills and passions they have discovered in themselves and how these relate to their career pathway.

### 4. Collaboration with Industry:

Students are required to collaborate and partner with industry and outline how they achieved these in both their portfolio and oral presentation. Industry collaboration can involve a diverse range of interactions which could include defence industries, large engineering firms, print shops, accountants, project managers, independent graphic designers and marketing professionals.

### 5. Finding sponsors and collaborators:

To fund their project students are encouraged to collaborate with their community, a fundamental skill required for any entrepreneurial activity, but can be a challenge for students to undertake for the first time. Once mastered however, it can be highly rewarding when students succeed. Funding and budgeting is a vital part of the project, and the activities undertaken in this area should be highlighted in their portfolios and oral presentations.

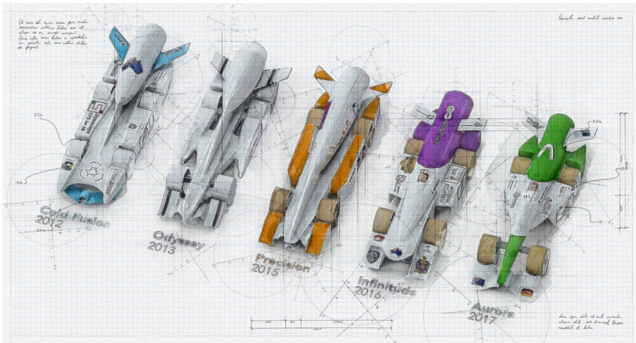
Funding can come from industry sponsorship, simple fundraising activities, government grants or from the school's P&C.

### 6. Judging:

Unique to F1 in Schools is that judges from industry are used rather than teachers. Students often find they perform at a higher level and grow as individuals when compelled to operate in a commercial environment. Industry judges contribute to student learning by providing direct feedback to the students in a way that matches the real world, helping prepare students for life after school.

### 7. Racing

Racing is where the excitement happens. The cars initially race automatically to determine the pure performance, and then the teams come up against each other in manually running for the glory of success. Every race is as exciting as the 100m sprint final at the school carnival or the olympics.




## Classes of Competition

The competition is in three classes, from beginner to expert being cadet class, development class and professional class.

The Cadet class is for students who are new to F1 in Schools competitions and involves modified rules and regulations as compared to the other classes. Restrictions exist for manufacturing the cars. They use standard REA wheels and 3D printing is not permitted. This simplifies the design/build process for new students. The cadet class does not progress past the State level as students are not required to present portfolios, oral presentations or a trade display. Students produce a car, a poster outlining their the engineering design process and an engineering drawing only.

The development class is for students in year nine or below. Students can only enter this class once and must be new to the program or only previously competed in the Cadet class. Some restrictions on this class include using standardised wheels, but 3D printing and other methods of production are permitted.

The professional class is for students who have previously competed or are looking for a more significant challenge. This class is divided further into Junior Professional and Senior Professional based on student age. There aren't many restrictions in this class regarding manufacturing and innovation is encouraged.

## Class-specific Rules and Requirements

The competition regulations and technical regulations outline the rules for each class. Competing teams must be made aware of the regulations documents and adhere to the rules and regulations for their class.

## Competition Levels

There are four levels or stepping stones of competition beyond an internal school competition. The following describes each of these steps.

### 1. Regional Competitions

Managed by regional coordinators, these events run in States with a high volume of teams. Details about regional coordinators is available on the REA website:

https://rea.org.au/f1-in-schools/contacts/

### 2. State Competitions

State Finals are organised by REA and are held during term three each year. Teams must register to be eligible for this level of competition. Event schedules can be found on the REA website using this link:

https://rea.org.au/events-calendar-and-information/

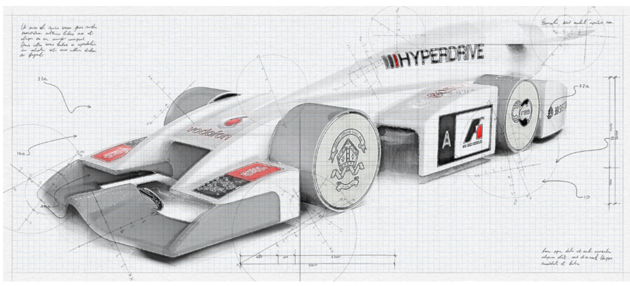
### 3. National Competition

An REA organised event, students from all over Australia gather to compete for the opportunity to represent Australian at an F1 in Schools World Final. The level of the competition at an Australian National Final is close to the level of a World Final.

### 4. World Final

Hosted by F1 in Schools International, this is the pinnacle competition where the best teams from 17,000 schools from 55 countries compete. The winners are eligible for university scholarships and top students have the opportunity to gain internships with F1 organisations.

The most recent events have been hosted in Singapore, Abu Dhabi and Austin, Texas. These events are a tremendous experience for both students and teachers.




## Implementation & Technology Requirements

The technology required in a school to implemet F1 in Schools is the following. Not all items are required to get started.

### Access to computers and a 3D CAD package:

Students are required to design their cars in a 3D CAD package. Most schools will already have a 3D CAD package being used by technology teachers and it is likely that will be adequate for F1 in Schools. REA is able to extend our relationship with Dassault Systemes to provide schools with state of the art CATIA software through Dassault Systemes' 3D Experience Platform.

### Access to a CNC Router:

In competitions it is a requirement for cars to be machined out of a block of Balsa wood using a CNC Router. It's possible that schools have an adequate router and also to outsource the machining. REA is able to offer Denford CNC Equipment which is designed for schools and ideal for F1 in Schools.

Many teams will also 3D print components but it's important to ensure that 3D printing is permitted in the competition class students are competing in.

### Consumables:

Cars are machined out of Balsa wood so this is required to start and can be purchased from around $8 per block from REA. Wheels and axles can also be purchased through REA. Some classes are permitted to make their own wheels but it can be very challenging. CO2 cannisters are also required to power the cars if the school has a track and cost less than $1 each.

### A Race Track:

A track adds to the fun for students and is great to have on site for students to test and race. It's not critical that schools have a track but it's highly recommended. Older tracks are compatible with F1 in Schools models and new tracks can be purchased from REA ranging from $6,000 to $13,000. Track hire is also available from REA.

### A Smoke or Wind Tunnel:

Several new technologies are available for schools that can enhance the learning process. These include Smoke or Wind Tunnels which allow students to undertake visual analysis of the performance of the car designs. For more information about these or other options contact REA.

# MORE INFORMATION

The following are sources of additional information:

### REA Websites

[www.rea.org.au](http://www.rea.org.au)

[www.ENVIZAGE.com.au](http://www.ENVIZAGE.com.au)

### Youtube

youtube.com/c/ReEngineeringAustraliaFoundation

### Above and Beyond Podcast Channel

Above and Beyond showcases stories of student success and the perspectives of teachers and industry toward STEM education and the relevance of STEM in developing the skills industry is seeking.

www.rea.org.au/above-and-beyond/

# NEXT STEPS

1. Schools should register on the REA website. This will notify REA of school interest and opens the line for communication.
2. Getting students on board and engaged with STEM at your school will involve having a schedule for STEM. If competing, the next stage would be to form teams and to then register teams on the REA website for competitions.
3. Be aware of deadlines and competition dates as well as the rules and regulations for the class they will be competing in.
4. Download the following documents from the REA website:
   - STEM 4.0 Life-Long Learning
   - 2019 Educational outcomes

www.rea.org.au/for-students-and-teachers/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