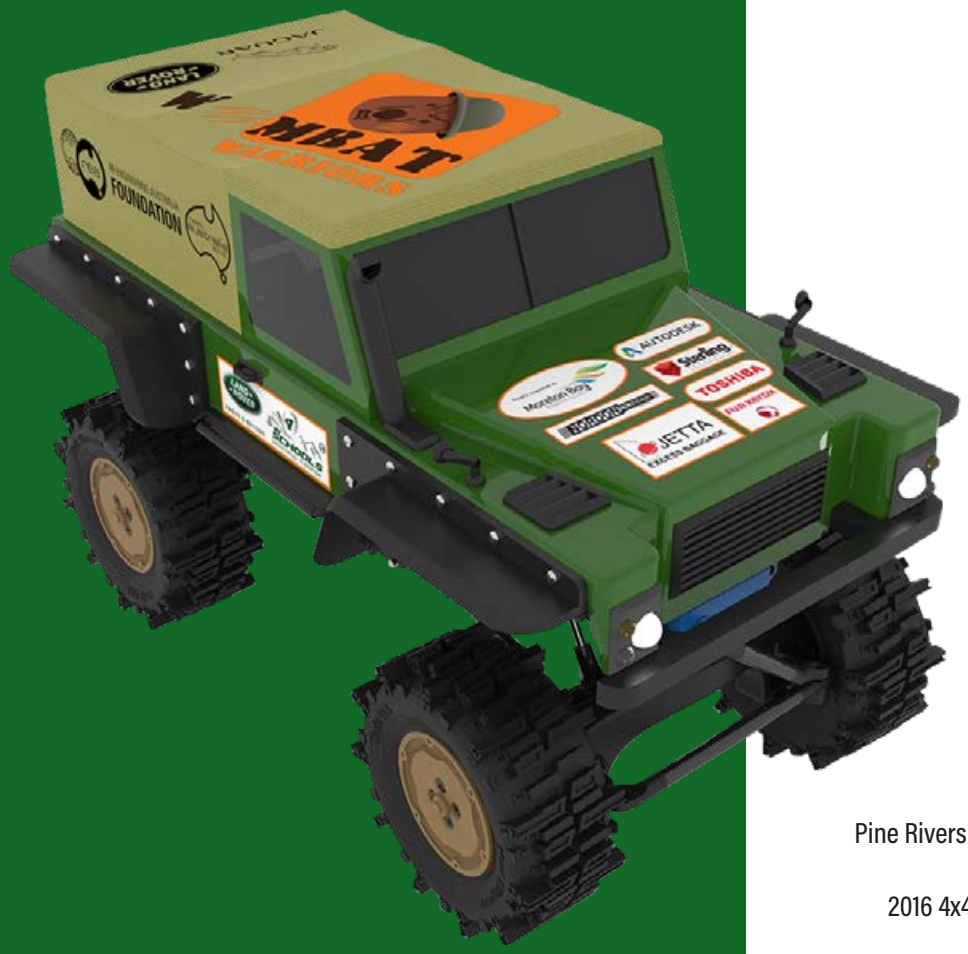
4 x4 IN SCHOOLS Australia

STEM 4.0
LIFE-LONG
LEARNING



Wombat Warriors
Pine Rivers State High School, QLD
World Champions
2016 4x4 in Schools World Final

INTRODUCTORY OVERVIEW

An Introduction to 4x4 in Schools in Australia

Version 1.0

Proudly Supported by

Australian Government
Department of Defence

An Initiative of
RE-ENGINEERING AUSTRALIA FOUNDATION

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ALTERATIONS

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CONTRIBUTORS

Re-Engineering Australia Foundation Ltd. acknowledges the work of Engineering in Motion, UK and Jaguar Land Rover in the development of this Challenge.

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CONTENTS

WHAT IS STEM

STEM in a methodology designed to integrate the four educational disciplines of science, technology, engineering and mathematics into a learning environment based on real-world applications and real world problem solving.

STEM is not just about more mathematics and more science but rather a curriculum based on the concept of educating students in an interdisciplinary and applied learning method. STEM education has proven to create more enjoyable learning, catalysing innovation and creating more capable students.

4x4 in Schools Background

The 4×4 in Schools Technology Challenge is an international competition which takes in-class STEM learning to a whole new level. Originally created by Engineering in Motion, UK around 2013 with the assistance of Jaguar Land Rover, Re-Engineering Australia Foundation has offered this STEM project in Australia since 2014 and our teams have achieved great success on the international stage.

Student teams not only design and construct an off-road vehicle with a trailer, they have to incorporate remote controlled steering and use it to negotiate an 'extreme' 4×4 obstacle course, whilst the clock is ticking.

This combination of mechanics and electronics is similar to the challenges faced by professional Automotive Engineers. The program involves developing concepts and detailed CAD design through to manufacturing, assembly and testing, whilst at the same time collaborating with industry, teamwork, project management, self promotion and public speaking. The program is focused on engaging student interest in mechatronics and integration of micro processor technologies, and is built on the fundamentals of project-based learning.

Two levels (2) of participation exist within the 4x4 in Schools program with each level designed to help students to explore scientific, engineering, materials and manufacturing techniques, with each level focused on different levels of complexity.

Underlying these activities is an educational pedagogy which develops employability skills (21st Centry Skills) in students which will aid their transmission to the world or work. These skills include communication, collaboration, presentation, teamwork and entrepreneurship. All of which are highly sought after by industry and invaluable in business environments subject to disruptive technologies.

A fundamental and key differentiator of 4x4 in Schools is the requirement for students to work directly with industry partners in the context of their projects.

PROGRAM GOALS

4x4 in Schools is based on Action Learning (AL) principles, which have an extended trajectory in terms of the involvement of the students and the outcomes that are achieved. Our experience has shown that programs which engage intrinsic interest over extended periods of time achieve a much higher impact in influencing children's career decision choices.

The goals of 4x4 in Schools are to:

- Bring career relevance to STEM learning activities,
- Excite and encourage students to consider careers and a learning pathway related to STEM,
- Provide an alternative learning and skills development in schools,
- Building employability skills in students which provide students with increased employment options,
- Facilitate a cross-curricular education environment to enhance the outcomes of the education system,
- Promote innovation and the development of entrepreneurship in young people,
- Develop skills in students which are directly transferable to industry roles,
- Increase the number of students taking up STEM based careers in support of satisfying the skills requirement of large-scale Engineering programs.
- Facilitate technology transfer from industry to schools and the community at large,
- Raise STEM career opportunity awareness within schools and the wider community,
- Provide a catalyst for encouraging interaction and collaboration between schools, industry and the community,
- Encourage the collaboration between schools based in metropolitan environments with schools in country areas and internationally,
- Where appropriate, use the power of role models to guide and support our youth in the process of career development,
- Ensure that Science, Technology, Engineering and Mathematics becomes a part of the everyday language of students.

4x4 in Schools is structured to allow teachers and students to develop their understanding of design and technology over time.

IMPLEMENTATION IN SCHOOL

Coordinating 4x4 in Schools at your school

4x4 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 at the school to maximise student opportunities.

Below are some scheduling suggestions based on observations from schools currently running 4x4 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 4x4 in Schools program and all students in the cohort will form groups to design and build a 4x4 vehicle. 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 several 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.

Note: The WA School Curriculum and Standards Authority has endorsed REA's 4x4 in Schools STEM challenge and students completing this program from 2020 can count this learning towards their Western Australian Certificate of Education (WACE) and have the achievement reported on their WA Statement of Students Achievement .

FUNDAMENTAL TASKS - THE BASICS

Stepping Stones

4x4 in Schools is a multi-disciplinary challenge in which teams of school students between ages 11 - 18 have the opportunity to design and build a radio controlled 4-wheel-drive (4x4) vehicle to set specifications that can successfully negotiate a specially designed test track that will emulate that of real life and what a full scale 4x4 vehicle can do. The program has been designed in two stages with each stage facilitating an increase in students' interaction with the concepts involved in vehicle design allowing students to grow their knowledge and understanding over time.

Levels of Participation

There are two levels you can choose from. You can implement one or both levels depending on how you want to structure the program within your school but when entering the competition, you need to ensure compliance with any eligibility criteria. the two levels of the competition are the Development and Professional Class.

Each level of the program, whilst having specific outcomes, is designed not to be overly prescriptive in terms of implementation. Teachers are encouraged to implement learning processes that work within their own educational environment.

The task is to build and operate a 4-wheel-drive (4x4) vehicle with the focus being on learning the principles of mechatronic engineering and the integration and progamming of controllers such as arduinos and raspberry pi's.

1. Development Class

Is designed for first time participating students in years 5-9 as an introduction to STEM and vehicle design. Year 5 students can re-register in Year 6.

Teams competing in this class **MUST** use an REA provided 4x4 Starter Kit and adhere to mandatory modifications such as:

- Vehicle Body Shell
- Vehicle Electronics (Light & Tilt Sensor)
- Tow bar

Additionaly, teams have some scope to implementing some optional modifications such as manufacturing or modify the vehicle's:

- Suspension
- Wheels

ECX Gen 2 Rock Crawler Starter Kit

2. Professional Class

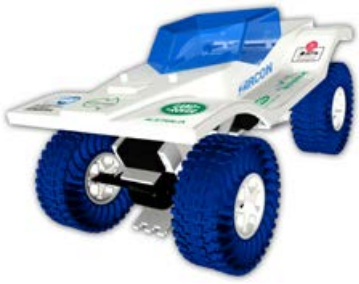
This class is desiged for students who have previously competed in the Development Class or are in Years 7-12 who do not wish to be confined by the restrictions imposed within the Development Class. If any team contains a student in Year 10 or above, it **MUST** be considered a Professional Class team. Students may enter this class multiple times.

As with the Development Class, teams in the Professional Class **MUST** adhere to mandatory requirements of:

- Vehicle Body Shell
- Vehicle Electronics (Light & Tilt Sensor)
- Tow Bar

Additionaly, whilst Professional Class teams **MAY** use the starter kit chassis, they **MUST** manufacture or modify other elements of the kit vehicle such as

- Drive Train
- Suspension
- Steering
- Wheels



(Zircon, Dubbo College Senior Campus 2nd, 2016 4x4 in Schools World Final)

COMPETITIONS

Does a school need to compete externally?

Entering external competitions is not critical in running the 4x4 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.

Running this project in your school and using the resources does require schools to register at no cost. The School 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.

Once students step above the in-school competition, they enter a very competitive 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.

4x4 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, outlined in two separate documents, the Technical Regulations and the Competition Rules. These documents, while extensive, can be simplified for internal school competitions but should form the basis for implementing 4x4 in Schools internally.

What's Involved in Competitions?

There are levels and classes of competitions through which teams can progress. To participate in tournaments, teachers must register their teams. Team Registration is independent to school registration and is only for teams looking to compete in State or National events.

Progression to a National final is dependent on a team's 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.

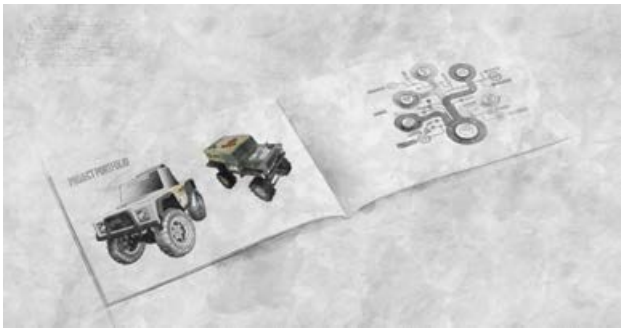
The ultimate opportunity is available for the best National Final teams to represent Australia at the World Final held each year overseas.

Competition Deliverables

There are several deliverables required for competition. An overview of these deliverables follows. The judging criteria for each of these deliverables are setout within rubrics contained in the Australian 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.

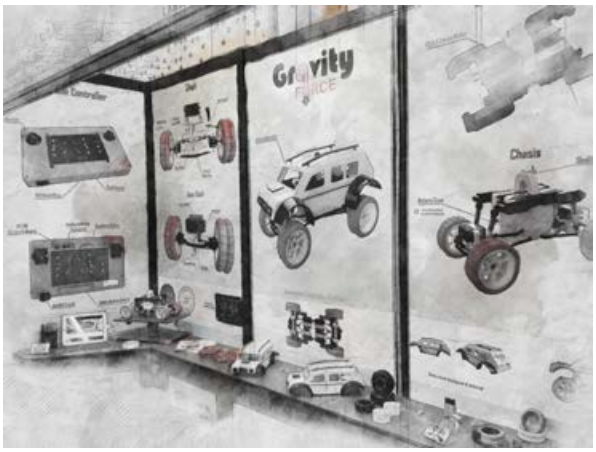


They should evidence a wide range of topics including career development, marketing, collaboration, project management and budgeting.

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 fall 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 and independent graphic designers.

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 4x4 in Schools is that judges from industry are used where possible. 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, providing direct feedback to the students in a way that matches the real world, helping prepare students for life after school.

7. Track Assessment & Trailer Tow

Each team's 4x4 vehicle will be expected to successfully navigate around speicially made off-road tracks just as demanding as the real thing, to test their vehicle's 4x4 ability. Teams should design their vehicle with considerations to the track challenges and terrain and are encoruraged to include adjustment and tuning capabilities on their vehicle.

Competition Levels

There are currently two levels of competition beyond an internal school competition. The following describes each of these steps.

State Finals

State Finals are organised by REA and are held late in term three and early to mid term 4 each year where sufficient demand requires this. Teams must be registered 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/

National Final

An REA organised event, students from all over Australia gather to compete for the opportunity to crowned National Champions in their representative class of competition.

It is intended in the future, there will be an opportunity for students to participate in this competition at the international level.

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

Competition Structure

All competition requirements are outlined in the 4x4 in Schools Australian Competition Regulations which can be found within the Resources page of the 4x4 in Schools website. Please be sure to read this document and the Australian Technical Regulations.

https://rea.org.au/4x4-in-schools/resources/

IMPLEMENTATION & TECHNOLOGY REQUIREMENTS

The technologies required in a schools to implement 4x4 in Schools iinclude.

Access to a CAD Package

Students will be required to design elements of their 4x4 vehicle's components in a CAD package. Most schools will already have a CAD package being used by technology teachers and it is likely that will be adequate for 4x4 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.

To access this free software click on the following link and select 4x4 in Schools from the list.

https://academy.3ds.com/en/challenges/3DEXPform

CFD, FEA, PLM and simulation platforms are also accessible.

Access to Hardware Technologies

Teams designing and manufacturing their own components may require access to CNC and 3D Printing technologies. Students can choose to purchase 'off the shelf' components.

For more information on CNC and 3D Printing technologies, contact REA.

FEES & COSTS SUMMARY

The funding required by schools to participate, will vary depending on the level at which they enter the program. It will also vary depending upon the financial status of the school.

The following is an estimate of expense involved at each level of the competition.

1. Starter Kit
2. Additional Components and 3D printing
3. Production of Team Uniforms, Portfolios and a Trade Display
4. Participation Fees: There are NO fees associated with schools registering to deliver the 4x4 in Schools competition
5. Team Registration Fees: At State and National Finals, REA will charge team participation fees. These fees will assist in funding the running of events including the provision of expo style booths for displays where relevant. Go to the Fees and Registration page of the 4x4 in Schools website for our fee structure.
6. Competition Costs: Travel and accommodation costs associated with participating in any event. All travel and accommodation costs are the responsibility of teams and teachers.

Teams have the responsibility to raise sponsorship for all levels of the project including registration fees associated with participating at a World Final Competition.

REGISTRATION

Schools delivering the 4x4 in Schools Technology Challenge regardless of whether they intend on entering teams in the competition **MUST** register their school on-line via the REA website by the advertised deadline. There is **NO COST** for registering schools.

For competition planning purposes, teachers wishing to enter student teams in the 4x4 in Schools competition **MUST ALSO** register their team/s on-line via the REA website by the advertised deadline.

To register your school and team, go to: https://rea.org.au/4x4-in-schools/fees-and-registration/

CALENDAR OF EVENTS

To access information on 4x4 in Schools events around Australia, go to: https://rea.org.au/events-calendar-and-information/

State Finals may **NOT** be scheduled in all States around Australia. This will be based on the number of registered teams from each state.

INQUIRIES

All inquiries regarding the 4x4 in Schools Technology Challenge should be directed to:

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