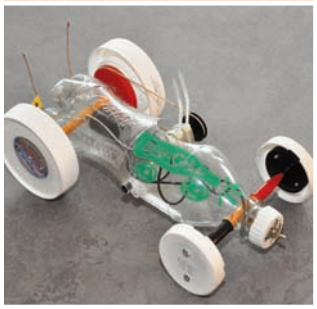
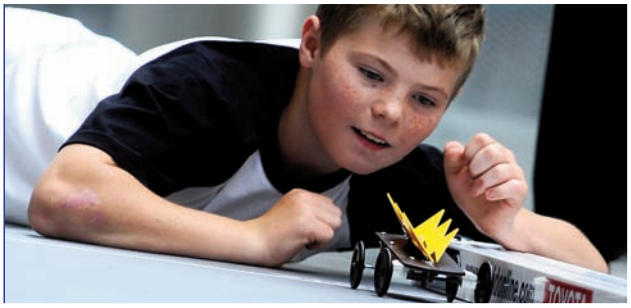
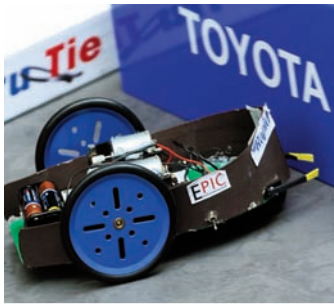
TOYOTA

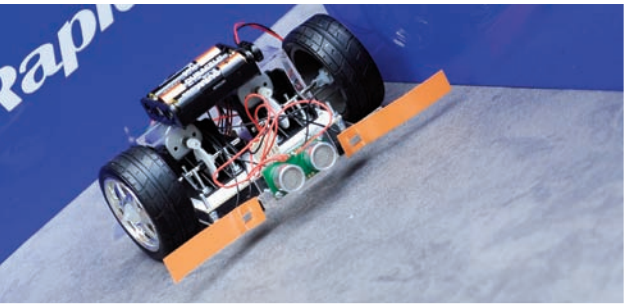
in partnership with Rapid

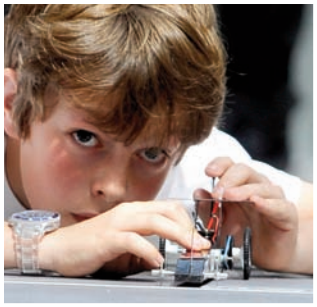
Toyota Technology Challenge











Handbook 2011-12

Toyota Technology Challenge

National Winners 2010-11

SOLAR

'Hot Fuel'
Beechwood Park School

PIC

'Lucky Duckies'
Flint High School

Toyota Technology Challenge
2011-12

Introduction

The Toyota Technology Challenge is a fun and affordable national competition aimed at Key Stages 3 & 4 (age 11-16) for Design and Technology, ICT and Science students. The challenge invites you to design and build an environmentally friendly model vehicle and apply knowledge and understanding from a wide range of curriculum subjects including Mathematics and English. There are two categories to the challenge: the Solar power category and the PIC microcontroller category. To pick up some tips, view the DVD on the Rapid website or check out You Tube.

Benefits you can gain from the Challenge

For students:
- Experience of concept, design & manufacture
- Teamwork
- Marketing & sales skills
- Practical problem solving
- Environmental awareness (recycling, sustainability & carbon footprint)
- Most importantly… fun!

For schools & teachers:
- Development and resources with technical support that is linked to the Design & Technology course requirement
- Opportunity to update Continuing Professional Development (CPD)

Contents

Challenge stages

There are 3 stages to the Challenge:

Stage 1 – Project folder

Produce a project folder detailing your approach to the Challenge, the project stages, your results and conclusions. For further information on the marking criteria and a suggested content for the project folder see page 6. The deadline for project folder submissions is **Wednesday 29th February 2012**.
After submitting your folder, the teams with the best entries will be invited to participate in the next stage of the competition – a regional final with the chance to win £250 for your school and entry into the National Final.

Stage 2 – Regional Competition Day:

- Finished vehicle assessment
- Oral presentation to the Judges and other teams
- Vehicle race
- Points will also be awarded for the use of recycled materials this could include waste items such as plastic bottles
- Points will also be awarded for your team identity
- £250 prize money will be awarded to the winning team in each category plus travel expenses at 26 pence per mile to attend the National Final Competition

Competition dates:

TTC Region	**Date**
Scotland Regional Final*	Monday 23rd April 2012
North Regional Final	Tuesday 24th April 2012
Wales Regional Final	Wednesday 25th April 2012
Ireland Regional Final*	Friday 27th April 2012
South East Regional Final	Monday 30th April 2012
South West Regional Final	Tuesday 1st May 2012
Midlands Regional Final	Thursday 3rd May 2012
National Final	
Toyota Manufacturing UK Burnaston, Derbyshire	**Saturday 26th May 2012**

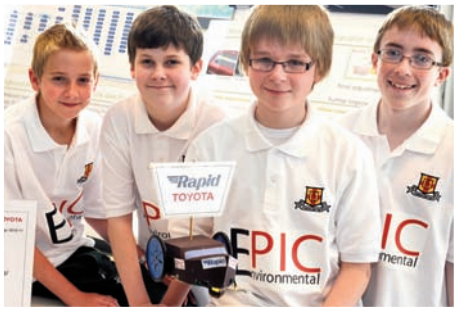
* potentially these two finals could be combined at either Wales or Burnaston, Derby (Midlands)
All venues will be confirmed on the Toyota Technology Challenge website **www.rapidonline.com/toyota**
Regional finals may take place on more than one day due to number of teams participating.

Stage 3 – National Final Day:

- Finished vehicle assessment
- Oral presentation to the Judges, other teams and the audience
- Vehicle race
- Points will also be awarded for the use of recycled materials and your team identity

£750 prize money and an activity holiday in France will be awarded to the winning team in each category. Accompanying teachers must reflect the gender of the students participating during the holiday. For single gender teams, 1 teacher can attend the trip paid for by Toyota. For mixed gender teams, 2 teachers can attend the trip paid for by Toyota.

The Toyota Technology Challenge can run in parallel to the national curriculum or as part of it. The activity resulting from each task can meet a number of national curriculum requirements, depending on how teachers frame the activity. See pages 8 and 10 for further details. The basic challenges can also be extended by adding new criteria, for example, work relating to weight and structural integrity.

The Race

Solar

Solar teams must charge their vehicle using only the lamps provided by Toyota and Rapid at the competition venue. Any team requiring to charge their vehicle using a DC power source will have points deducted, before charging takes place teams will be required to show the race judges the capacitor has been discharged.

Solar teams are given 15 minutes in the charging area before both their practice session and the final race proper. If the vehicle is removed before the 15 minutes is up, the vehicle cannot be returned to be recharged.

Solar teams will have time to practice on the racetrack, but this practice time may be shared with other teams so you should take it in turns on the track.

For the final race, solar teams will be given up to 3 attempts in 5 minutes to achieve the quickest times across the track. Points are also awarded for consistency.

PIC

PIC teams are given a 10 minute practice session separate from their final race. Within this time teams can 'tweak' the vehicle if necessary.

Teams may bring a laptop or suitable equipment to reprogram or make adjustments to programs between practices. This equipment must be battery powered and fully charged as mains points may not be available.

For the final race, teams will be given up to 3 attempts in 10 minutes to achieve the fastest times across the race track. No reprogramming will be permitted during the final race proper, but multiple microcontrollers with different programs may be interchanged between races.

Race officials may move the position of obstacles on the PIC racetrack between the practice race and the final race.

Race notes

Points are awarded for all 3 attempts during the final race. Teams should aim to build a consistently fast vehicle.

Any team with a vehicle which does not complete the track will be penalised and points will be awarded for distance.

Please test your vehicle on a variety of surfaces in preparation for the race i.e. lino and hard & soft surfaces.

Please note supporting teachers are required to sit at a teacher's station and whilst available to support, teachers must not give direct instructions, otherwise penalties will apply.

The prizes

Win up to £1000 for your school and a 6 day trip to France!

There will be a cash prize of £250 for the regional winning team in each category and £750 for the national winning team in each category. The national winning team in each category will also win a 6 day trip to France.

The trip will be both fun and active, incorporating sightseeing whilst enjoying the outdoors. It will last approximately 6 days and will take place from **Sunday 22nd July – Friday 27th July 2012.**

The prize will be offered for up to 5 team members. Accompanying teachers must reflect the gender of the students participating during the holiday. For single gender teams, 1 teacher can attend the trip paid for by Toyota. For mixed gender teams, 2 teachers can attend the trip paid for by Toyota and will include:

- Transfer to and from the UK airport
- Return flight
- Full board accommodation, continental breakfast, lunch and dinner (packed lunch on excursion days)
- Transfer to and from the continental airport
- Various organised activities i.e. sailing, windsurfing, kayaking and mountain biking

* Please note, the destination, length, dates and itinerary of the trip are to be decided by Toyota Manufacturing UK. We regret that the trip details cannot be altered to suit the preferences of the winning teams.

Marking criteria

There are three stages to the competition:

Stage 1 – Project folder

Stages 2 & 3 – Regional Competition Day and National Final Day

Stage 1 – Project folder

Your project folder should be no more than 15 sheets of A4 paper (30 sides).
The table below gives you some suggested sections and content areas for the project folder:

Suggested folder sections:	Suggested section content:
Design brief	Acknowledgement and understanding of the project you are being asked to complete.
Background research	Research into existing similar products which give an insight into what you could hope to achieve e.g. environmentally friendly vehicles, solar power and solar powered vehicles, electronic items or vehicles using obstacle avoidance, recycling, high speed vehicles and aerodynamics.
Analysis of background research	Conclusions drawn from background research.
Specification	Acknowledgement and understanding of the required vehicle specifications.
Initial ideas	Evidence of a variety of designs from which you chose the best one.
Development of ideas	Evaluation of designs and ideas which led to the choice of the final design. Evidence of testing. Evidence of prototypes. Discussion and evaluation of different materials, components and production methods. Discussion of environmental considerations including the use of recycled and recyclable materials.
Product planning and realisation	Materials and tools used. Stages of production. Evidence of overcoming production problems. Consideration of safe working practices.
Testing of final design (finished vehicle)	Evidence of testing of finished vehicle. Details of modifications/improvements made after testing (if necessary).
Evaluation of final design	Critical evaluation of finished vehicle in terms of specification compliance, vehicle performance, quality, styling aesthetics, innovation etc. Proposals for further development or improvements.

Marks will also be awarded for:

Folder presentation of information	Information is presented in a clear, logical and comprehensible way.
Folder display methods	Information is presented in a variety of ways e.g. text, drawings, photographs of your vehicle/work, graphical techniques, computer generated images etc.
Folder team identity	Team identity is presented and explained in the folder and used throughout the folder
	e.g. team name, team logo, team motto, team photo, evidence of clear team roles and responsibilities.

Your project folder **must** also include the names and ages of your team members, the name(s) of your supporting teacher(s) and school name.

Please fill in the project folder submission form when submitting your folder.

Stages 2 & 3 – Regional Competition Day & National Final Day

Oral presentation

Your oral presentation should last no longer than 5 minutes detailing your work on the challenge, including the research, design, build, testing and evaluation of your vehicle and an explanation of your team identity.
Marks will be awarded for the following:

- Presentation content
- Presentation quality
- Effective use of support materials/visual aids
- Team project knowledge
- Originality and effort
- Adherence to the time limit
- Full team participation in the presentation
- Pupil-led activity (independence from the supporting teacher)

*** Please note that the judges at Regional and National Finals would not have seen your project folder.**

Finished vehicle

Marks will be awarded for the following:

- Compliance with specification
- Recycled/recyclable content
- Originality and technical innovation
- Build quality
- Styling aesthetics (visual appeal)

Race

Marks will be awarded depending on your team position during the race section. The team with the consistently fastest vehicle will be awarded the most marks. Any team with a vehicle which does not complete the track will be penalised.

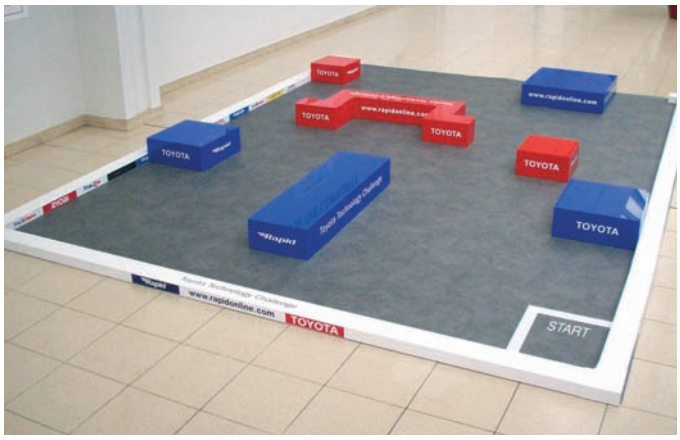
Team identity

Marks will be awarded for creative and full use of team identity during the competition day. This may include a team name, team logo, team uniform, team name badges or even a team motto, mascot or song!

The judges' decision is final

PIC Microcontroller Vehicle

Design criteria and vehicle specifications



PIC Racetrack*
Dimensions: 4 x 3m
* Track walls for both tracks are 50mm in height

PIC Microcontroller vehicle design criteria

Design and build a program-controlled environmentally friendly model vehicle of the future, using a PIC microcontroller to provide in-built intelligence so it can automatically avoid obstacles. The vehicle must include recycled or recyclable components within its design. In competition, the race winning vehicle will be judged to be one that scores the most points over the three attempts. This looks more challenging than it actually is.

Design and Technology National Curriculum coverage includes:

Knowledge and understanding of systems and control: statements 5 (a) (b) (c) (d) (e)
Summary: Recognise the elements of systems that can be broken down and the importance of feedback; understand basic principles of electrical, electronic control systems including sensors; understand basic mechanical systems and how these can be linked to other control systems.

Evaluating process and products: statements 3 (a) (b) (c)
Summary: Evaluation of ideas and comparison with original intention; testing and evaluation of prototypes; use of criteria for judging wider fitness for purpose.

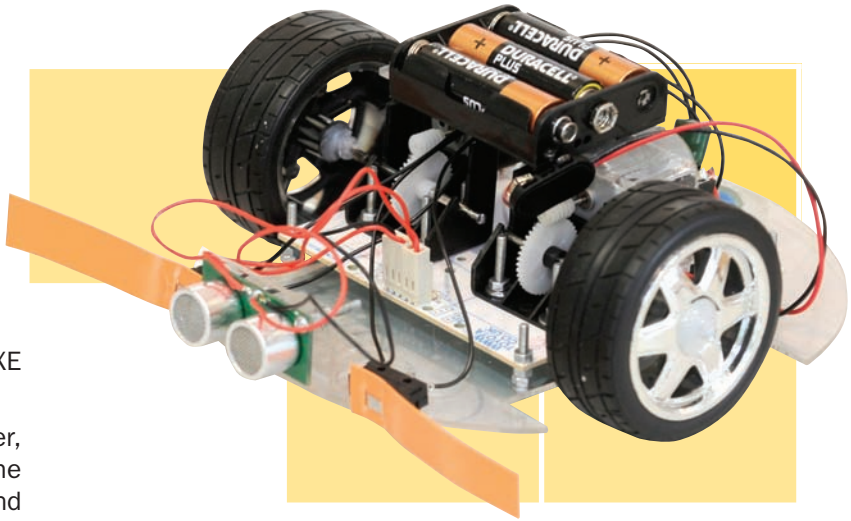
Knowledge and understanding of control systems: statements 5 (a) i; ii; iii.
In summary – knowledge and understanding of control process, design of systems, the concept of feedback and analysis of system performance.

PIC Microcontroller vehicle specifications

1. Your vehicle must include recycled or recyclable items within its design and the team must be able to demonstrate features which make the vehicle environmentally friendly.
2. All electrical components must have been supplied by Rapid (**www.rapidonline.com**).
3. Your vehicle must use a programmable PICAXE Microcontroller and obstacle detection device(s) to navigate an obstacle course in the fastest time possible.
4. Each vehicle must have an on/off switch which is accessible from the outside which enables the power to the motor(s) to be cut.
5. Maximum length (from the furthest point at the rear to the furthest point at the front) must not exceed 300mm.
6. Maximum width (from the widest point at left to the widest point at right) must not exceed 190mm.
7. Maximum height (from ground to highest point) must not exceed 150mm.
   (Please note the track walls are 50mm in height)
8. Teams may like to use a body shell to improve aerodynamics and aesthetics. This may not exceed the maximum dimensions outlined above.
9. All vehicles must have at least three wheels which touch the ground at all times.
10. You must demonstrate that your vehicle uses an environmental power source. Solar cells do not have to be used in the PIC Microcontroller class, although teams may like to make use of this energy source.

Hints & tips available at www.rapidonline.com/toyota

PIC Microcontroller Vehicle



Resources needed

Control board and motor/gearboxes

Computer for developing control program PICAXE chip, software and download cable.

Vehicles of the future are likely to use electric power, stored in batteries, to propel the vehicle at some point. Therefore, very efficient electric motors and gearboxes are required to get the best performance from these batteries.

It is also likely that vehicles will become more intelligent and will, for instance, be able to avoid obstacles to prevent accidents. Microcontroller chips are already being used in vehicles to provide some intelligence (e.g. automatic windscreen wipers that switch on when it rains) and, in the future, these microcontrollers may also automatically control the steering and braking of the vehicle if a dangerous situation arises.

A microcontroller is often described as a 'computer-on-a-chip'. It can be used as an electronic brain to control a product, toy or machine. The microcontroller is an integrated circuit ('chip') that contains memory (to store the program), a processor (to process and carry out the program) and input/output pins (to connect switches, sensors and output devices like motors).

Microcontrollers are purchased 'blank' and then programmed with a specific control program. This program is written on a computer and then 'downloaded' into the computer chip. Once programmed, the microcontroller is built into a product to make the product more intelligent and easier to use.

The Toyota Challenge uses a PICAXE microcontroller to control two motors to provide movement and steering for the vehicle. The obstacle detection sensors and control program must be developed by the team entering the competition.

Breaking down the task

The first part of the task is to create a chassis for the vehicle. This can either be designed and built from scratch, or the basic board in the kit can be used. Comprehensive assembly information is provided separately in the control board instructions. The board is fairly easy to construct but should be attempted only by pupils with good soldering skills.

The second part of the task is to design the vehicle, incorporating the control board and user selected sensors/additional output devices. The microcontroller on the control board provides 5 inputs and 8 outputs. Four outputs (4-7) are pre-configured to drive the motors; all other inputs and outputs are available for the students to use for their vehicle.

The final part of the task is to develop and test the control program for the PICAXE microcontroller. Sample programs are provided in the separate control board instructions, but students will need to further develop their control program.

Design decision considerations may include:

Obstacle detection
In its simplest form, two micro switches (**Rapid 78-2408**) may be used as the obstacle detection sensors. Alternatively, a high resolution sonar range finder (**Rapid 78-1085**) may be used to detect obstacles before the vehicle hits them. The sonar sensor can be accurately configured to detect obstacles from 3cm to 3m away.

Choice of motor/gearbox
The choice of motor and gearbox, and accuracy of construction of gearbox, can greatly affect the efficiency of the vehicle. Two gearboxes (**Rapid 37-0310**) are provided in the starter pack, but students may also consider using a more efficient gearbox (such as **Rapid 70-2220**).

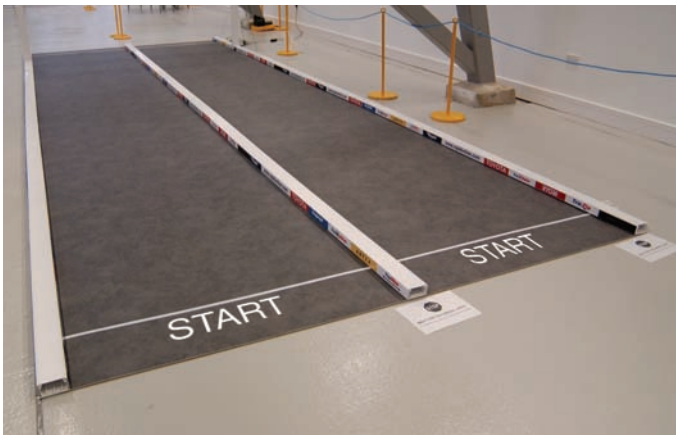
Battery source
Students may also choose to use alkaline or rechargeable cells. A maximum of 6V is recommended, but which cell size (AA, C etc.) and how many alkaline (1.5V) or rechargeable cells (1.2V) give the best power/weight performance ratio?

Solar Power Vehicle

Design criteria and vehicle specifications

Solar vehicle design criteria

Design and build an environmentally friendly solar powered model vehicle which illustrates the idea of a car of the future, capable of harnessing solar energy, storing it and releasing it under controlled conditions. The vehicle must include recycled or recyclable components or materials within its design. In competition, the race winning vehicle will be judged to be the one that accumulates the most points over the three attempts.



Solar Racetrack*
Dimensions: 1.5 x 8m (each lane)
* Track walls for both tracks are 50mm in height

Design and Technology National Curriculum coverage includes:

Knowledge and understanding of systems and control: statements 5 (a) (b) (c) (d) (e)
Summary: Recognise the elements of systems that can be broken down and the importance of feedback; understand basic principles of electrical, electronic control systems including sensors; understand basic mechanical systems and how these can be linked to other control systems.

Evaluating process and products: statements 3 (a) (b) (c)
Summary: Evaluation of ideas and comparison with original intention; testing and evaluation of prototypes; use of criteria for judging wider fitness for purpose.

Solar Vehicle Specifications

1. Your vehicle must include recycled or recyclable items within its design and the team must be able to demonstrate features which make the vehicle environmentally friendly.
2. All electrical components must have been supplied by Rapid (**www.rapidonline.com**).
3. The power used to drive your vehicle must be harnessed by one or more standard Rapid solar panels (**Rapid 42-0240**). This energy should be stored before use in one Rapid 10 farad super capacitor only.
4. In the unlikely event that lighting conditions affect the performance of the solar panel, DC power sources will be available to provide charge to the main 10F capacitor. The design should facilitate disconnection of the solar panel(s) and access to the capacitor leads. However, any team required to charge their vehicle using a DC power source will be penalised.
5. Each vehicle must have an on / off switch, accessible from the outside, which enables the power to the motor(s) to be cut.
6. Maximum length (from the furthest point at the rear to the furthest point at the front) must not exceed 300mm.
7. Maximum width (from the widest point at left to the widest point at right) must not exceed 190mm.
8. Maximum height (from ground to highest point) must not exceed 150mm.
   (Please note the track walls are 50mm in height)
9. Teams may like to use a body shell to improve aerodynamics and aesthetics. This may not exceed the maximum dimensions outlined above.
10. All vehicles must have at least three wheels which touch the ground at all times.

Hints & tips available at www.rapidonline.com/toyota

Solar Power Vehicle

Resources needed

Solar panel
10F capacitor
Motor(s)
Drive units
Chassis

The solar panels convert light into electrical energy but as yet they are not very efficient. However in the last 5 years solar panels have increased from 3% to 15% in their efficiency. A typical solar panel might offer an efficiency of 15% - i.e. just 15% of the energy falling as light on the surface…

However, an alternative approach to solar power involves separating the solar panel array from the vehicle. A large array of fixed solar panels can be used to charge a storage battery which is then transferred to the vehicle. In future practical schemes, the batteries might be exchanged in garages for a price reflecting all the costs of harnessing the energy in the first place. Many car manufacturers, including Toyota, are working on ever more efficient storage batteries and highly efficient electric motors (and control systems) that waste very little energy as heat when they run.

On a much smaller scale, powering even very small electric motors directly can be a problem because of the relatively large area of solar panels needed. However, a new storage medium – the super capacitor – now offers an extremely effective solution. Developed as computer back-up capacitors, these devices offer some of the characteristics of a rechargeable battery and the rapid charge benefits of a capacitor. They can store large amounts of energy, and provide high (and sustained) currents during discharge. Not surprisingly, these super capacitors were quickly taken up by toy manufacturers as light-weight battery substitutes for small models such as electric cars and helicopters.

Super capacitors are available in a range of values from 1 farad to 150 farads – an enormous capacity when one considers that a few years ago even a 1 farad capacitor would have filled a small room! The Toyota Technology Challenge involves the use of a 10 farad capacitor combined with a solar panel providing a maximum output of 100mA at 3 volts. This type of panel is commonly available and used for conventional solar powered battery chargers.

Breaking down the task

The first part of the task requires familiarity with the resources – notably how the solar panel and capacitor work in combination. This calls for both demonstrations and pupil experiments. A very simple demonstration shows that a typical small motor will not run directly from the solar cell if the latter is held close to a 60 watt light source. Under the same conditions, however, a super capacitor can be charged in a short period to give the motor a useful running time!

This demonstration raises a number of questions and might lead to experiments for quantifying and comparing light levels, capacitor charging times and motor running times. An inexpensive photographic light meter would be invaluable here but a light dependent resistor connected to a multimeter provides an uncalibrated substitute. Once the pupils are more familiar with the choice of available resources and how they work, it is time for design decision making. For example:

- Is the capacitor carried permanently on the vehicle or is it charged off-vehicle and plugged in?
- What motors provide optimum performance?
- What transmission system is most efficient (e.g. gears or pulley drive)?
- What kinds of wheels give the least rolling resistance?

The (optional) chassis kit could be used as a quick-fix method of assembling the basic parts for trialling. The parts can be joined by mechanical locking (and gluing if needed) or fastenings such as 4mm screws and nuts.

Rules and regulations

Entry requirements

The Challenge is open to all secondary schools based in the United Kingdom. Each school may enter one vehicle per category, 1 team into PIC and 1 into Solar. We encourage schools to complete multiple projects and run a competition at the school to determine which folder and vehicle you enter into the main competition.

Your project folder, completed model vehicle and oral presentation must be designed and produced at your school.

All entries must be designed and built by a team of students aged 11 to 16 years old. Each team should consist of a minimum of 3 students and a maximum of 5. Mixed gender teams are encouraged.

Entry into the next stage of the competition will be via the submission of the project folder, deadline – **Wednesday 29th February 2012**. Your project folder must provide full details of your team i.e. team name, team member names and ages, supporting teacher(s) name(s) and team identity. The seven best project folders in each category will be selected to take part in a Regional Final. Regional finalists will be notified by **Monday 12th March 2012.**

Teams must have prepared all of the following: a project folder, a completed model vehicle and an oral presentation.

At all stages, judges will be looking for innovation and originality from teams representing schools who entered the challenge in previous years.

The project folder

The project folder should be no more than 15 sheets of A4 size paper (30 sides) including the cover. Teams submitting project folders over this length will be penalised. The marking criteria section of this handbook contains a suggested content for the folder. Your folder and oral presentation should include comments upon recyclability or the use of recycled materials/components within the design of your vehicle.

Your project folder must provide full details of your team i.e. team name, team member names and ages, supporting teacher(s) name(s) and team identity. Please fill in the project folder submission form when you submit your project folder, you can find the submission form available on the CD Rom.

Only one project folder per category must be submitted by each school. With regret, we are unable to return your project folder.

The completed model vehicle

Your vehicle must comply with the specifications set out in this handbook. Please note, as listed in the specifications, all electrical components must have been supplied by Rapid (**www.rapidonline.com**).

Teams are permitted to bring one spare vehicle which must be identical in every way to the main vehicle. The spare vehicle must be declared and will be checked by an official to confirm it is an identical vehicle to the main entry.

No major changes may be made to the physical design of the vehicle after competition day registration, although 'tweaks' and small adjustments are permitted.

The oral presentation

Each team will have 5 minutes to set up for their presentation. Your oral presentation should last a maximum of 5 minutes. Your presentation should explain your approach to the challenge and could comment, for example, on research, design ideas, choice of final design, testing and evaluation, team roles and team identity. Please see the marking criteria section for further details.

Teams wishing to use PowerPoint presentations must bring their presentation both on a CD-Rom or USB memory stick and on a laptop with sound; this equipment must be battery-powered and fully charged as mains points may not be available. Neither Toyota nor Rapid will be held responsible for presentations which, for any reason, do not work on the day. Teams must remember that only 5 minutes are available to set up for the presentation.

Competition photography

Toyota Manufacturing UK and Rapid Electronics Ltd will be taking photographs during the competition days. This photography may be used in the media, in Toyota Technology Challenge material or in future Toyota/Rapid publicity material. If you have any objections to this, please notify us by **Monday 16th April 2012**. Schools are responsible for sending an authorisation sheet home to their students' parents asking for permission to allow for competition attendance, photography to be taken and the use of the photography in publicity material.

Intellectual property rights

The intellectual property rights developed or created exclusively for use in the Toyota Technology Challenge (exclusive of the PIC kit, Picaxe product, software and associated instructions) are assigned to Toyota, inclusive but not limited to trademarks, patents, design rights and copy rights.

Travel arrangements

Toyota will in the event of a participating team (i.e. up to 5 students and 1 or 2 supporting teachers dependent upon mixed or single gender team) needing to travel for more than 3.5 hours to attend the National Final competition, pay towards hotel accommodation for one night and will consider flights in lieu of mileage allowance if appropriate.

Timeline

<table>
<tr><td>September</td><td colspan="3" rowspan="3">Gather information and background research on Solar or PIC vehicles and recycled materials</td><td colspan="3" rowspan="3">Design and build prototype vehicles, test and improve.
Keep notes to use in your project folder</td></tr>
<tr><td>October</td></tr>
<tr><td>November</td></tr>
<tr><td>December</td><td colspan="6"></td></tr>
<tr><td>January</td><td colspan="4">Using your notes for reference, write up your final copy of the project folder</td><td colspan="2" rowspan="3">Continue to test and improve the functionality of your vehicle. Any improvements should be included in your oral presentation</td></tr>
<tr><td>February</td><td colspan="4">29/02/2012
Completed folder must be submitted with folder submission form
Post folders to: Toyota Technology Challenge, Rapid, Severalls Lane, Colchester, Essex CO4 5JS</td></tr>
<tr><td>March</td><td colspan="4">Regional finalists notified by 12th March.
Prepare oral presentation and presentation materials for Regional Finals</td></tr>
<tr><td>April</td><td>23/04/2012
Scotland Regional Final</td><td>24/04/2012
North Regional Final</td><td>25/04/2012
Wales Regional Final</td><td>27/04/2012
Ireland Regional Final</td><td>30/04/2012
South East Regional Final</td><td></td></tr>
<tr><td rowspan="2">May</td><td>01/05/2012
South West Regional Final</td><td>03/05/2012
Midlands Regional Final</td><td colspan="4" rowspan="2"></td></tr>
<tr><td colspan="5">26/05/2012
National Final</td></tr>
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Solar and PIC kit contents and replacement parts

As you know the first kit is free. Additional kits will cost: Solar **£21.95** (order code 70-4444) and PIC **– New Low Price £19.95** (order code 70-5555)

Solar Powered Motor

Kit Contents		Price
• 37-0140	Motor	£0.41
• 37-0360	Motor mount	£2.43
• 11-2143	10F capacitor	£3.39
• 42-0240	Solar panel	£3.87
• 37-0371	8mm pulley	£1.25
• 37-0376	12mm pulley	£1.79
• 37-0381	25mm pulley	£2.39
• 37-0395	50mm pulley	£4.39
• 37-1285	Perforated steel strip 15 x 20cm	£2.54
• 37-1280	Perforated steel strip 30 x 0.8cm	£4.03
• 33-1705	6mm M2.5 nut	£0.51
• 70-0007	Chassis kit	£2.03
• 33-2200	6mm M2.5 bolt	£0.81

Tools Needed

• 85-1135	CS18 mains soldering iron + 13A plug	£14.95
• 85-0586	Stand for the above iron	£4.88
• 85-0595	500g 22SWG solder	£18.95
• 85-4718	Fume extractor	£41.55
• 85-0205	Economy side cutters	£2.38
• 86-0350	Wire strippers	£2.59

All these prices are excluding VAT

For pack sizes check www.rapidonline.com

PIC Power Project

Kit Contents		Price
• 70-0008	PCB	£3.38
• 62-0314	0R CR25 CF resistor	£0.56
• 62-0394	10K CR25 resistor	£0.50
• 62-0358	330R CR25 resistor	£0.50
• 62-0386	4K7 CR25 resistor	£0.50
• 62-0402	22K CR25 resistor	£0.50
• 47-3130	1N4001	£0.04
• 10-3260	100nF capacitor	£0.05
• 11-0870	220µF 10V	£0.08
• 78-0620	Push switch	£0.13
• 76-0265	SPDT slide switch	£0.24
• 55-1790	Red 5mm LED	£3.61
• 20-0137	3.5mm stereo socket	£0.10
• 22-0110	18 pin IC socket	£1.14
• 22-0109	16 pin IC socket	£1.22
• 18-0092	Battery clip PP3	£0.17
• 18-0115	4x AA battery box (6V)	£0.41
• 37-0310	Worm drive gearbox with motor	£1.82
• 37-2228	39mm wheel	£5.20
• 10-0908	220n suppression capacitor	£0.08
• 13-5026	PICAXE-18M	£2.15
• 82-0192	Motor driver IC L293D	£3.03
• 13-0847	Programming cable	£3.16
• 33-2200	6mm M2.5 p/screws	£0.81
• 33-1705	6mm M2.5 nut	£0.51
• 13-1262	PICAXE CD-ROM	£1.00

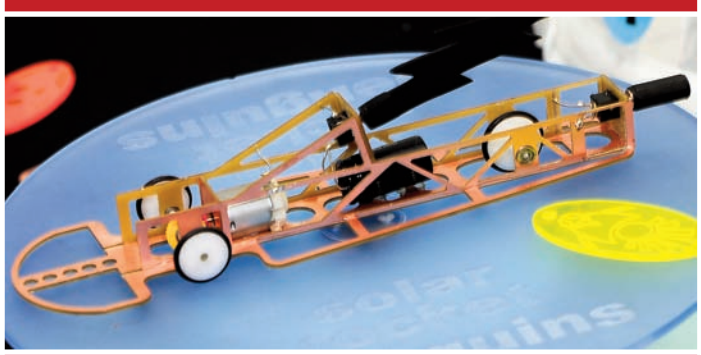
FREE Technical Advice

Contact Rapid on

01206 835566

for professional help on our products

Email: toyotachallenge@rapidelec.co.uk



Useful parts:

Order code	Price	Description	Useful for
Construction materials			
37-3300	£33.35	Foam PVC 3mm pk10	Chassis body and structural parts
37-3305	£55.11	Foam PVC 5mm pk10	
06-0176	£6.76	Greyboard 0.9mm pk12	
06-0178	£7.80	Greyboard 1.1mm pk12	
06-0180	£12.64	Greyboard 1.7mm pk12	
06-0182	£19.75	White modelling board 230 micron pk 100	
06-0600	£31.15	Clear acrylic sheets pk5	
06-0608	£20.75	3.2mm Assorted colours acrylic rods	
37-3100 to 37-3176	From £7.23	High impact polystyrene sheet	Chassis, body and structural parts. Can be vacuum formed
37-3315	£14.55	Polypropylene corrugated board 3mm pk10	Chassis, body and structural parts
37-3325	£35.31	Polypropylene corrugated board 4mm pk20	
37-3320	£3.11	Joiners for 37-3325 10 sheets	
06-0744	£4.42	A4 brass sheet 0.1mm	Can be bent shaped and cut
06-0746	£7.70	A3 brass sheet 0.1mm	
06-0752	£3.59	A4 copper sheet 0.1mm	Can be embossed, bent and cut and can also be used as contact material
06-0754	£6.23	A3 copper sheet 0.1mm	
06-0732	£8.06	Polystyrene sheets pk20	Lightweight material ideal for bodywork and protective layers
06-0734	£16.59	Electric cutter for the above polystyrene	
06-0030	£10.66	A4 foamboard pk20	Body and structural parts
06-0032	£10.35	A3 foamboard pk10	
06-0803	£22.99	Assorted wooden dowels	Chassis, body and structural parts
06-0801	£13.99	8 x 8 Jelutong	
06-0704	£15.99	10 x 10 Jelutong	
87-6022	£6.81	PVA adhesive 5L	For paper and card
87-6024	£0.65	PVA adhesive 180ml	
87-6038	£1.25	Power Pritt 20g (single)	Glue stick for paper, card, plastics and woods
87-0444	£1.77	Polystyrene glue (25ml)	For polystyrene plastics. Not suitable for polystyrene foam
87-0446	£1.77	Balsa glue (25ml)	For balsa wood
06-0709	£2.25	40mm card wheels pk 100	Various types of wheels to drive your vehicle offering differing levels of weight and traction. Recycled card
06-0711	£2.50	50mm card wheels pk 100	*Recycled card or Managed forests*
06-0713	£5.45	40mm MDF wheels pk 100	
06-0715	£7.75	50mm MDF wheels pk100	
37-1310	£1.32	37 x 16mm wheel pk4	Chassis body and structural parts
37-1315	£1.62	44 x 16mm wheel pk4	
37-1320	£2.58	56 x 16mm wheel pk4	
37-2228	£5.20	39mm polythene wheels pk50	
37-2230	£2.07	75mm polythene wheels pk10	
37-2550	£0.85	Caterpillar track	Use **37-2228** as drive wheels
Motor transmission and drive parts			
37-0441	£1.20	Solar motor	Very low power motor which draws little current
37-0142	£0.54	5240 rpm 3V motor	Low rpm low current motor. Round body
37-0144	£0.59	8000 rpm 3V motor	Medium rpm medium current motor. Round body
37-0146	£0.35	12200 3V motor	High rpm high current motor. Round body
37-0140	£0.41	13100 rpm motor	High rpm high current motor. Flat sided body
37-0360	£2.43	Motor mount pk10	Self adhesive for mounting the round body motors
37-0310	£1.82	Worm-drive gearbox & motor (42:1 ratio)	Medium rpm motor with 42:1 worm-drive gear reduction. 3mm axle
70-2220	£14.51	Pair of high quality worm-drive gearboxes	High torque high precision gearboxes for use in PIC controlled vehicles

Useful parts:

Order code	Price	Description	Useful for
13-1020	£2.76	2-in-1 gearbox	Standard gearbox with 2 possible ratios - 60:1 or 288:1
37-1201	£11.96	High quality epicyclic gearbox & motor (4:1 ratio)	Ideal for use in tracked PIC vehicles where high torque is required
37-1202	£16.85	High quality epicyclic gearbox & motor (62:1 ratio)	
37-1203	£16.85	High quality epicyclic gearbox & motor (104:1 ratio)	
37-0190	£7.85	Selection of gears pk80	Allows you to make your own gearboxes to adjust the efficiency or speed of your vehicle
37-0200	£0.98	16 tooth miniature gear pk50	Light weight gears that allow you to make your own gearboxes to adjust the efficiency or speed of your vehicle
37-0205	£1.30	30 tooth miniature gear pk50	
37-0210	£1.70	42 tooth miniature gear pk50	
37-0215	£2.34	60 tooth miniature gear (31mm) pk50	
37-0220	£1.30	30/10 tooth miniature gear (16mm) pk50	
37-0225	£1.70	42/10 tooth miniature gear (22mm) pk50	
37-0371	£1.25	8mm pulley pk10	Pulley systems are an alternative way of changing the gearing of your vehicle
37-0376	£1.79	12mm pulley pk10	
37-0381	£2.59	25mm pulley pk10	
06-0617	£5.50	Card corners pk500	To strengthen your models
06-0618	£1.75	Card axle supports pk500	To hold axles to your vehicles
06-0626	£0.85	2 blade propeller	An alternative drive method
06-0628	£0.50	3 blade propeller	
PICAXE project parts			
78-2408	£0.51	08a 43mm lever solder switch	Used to detect collisions with objects
78-1085	£13.99	Ultrasonic range finder	Used to detect objects without collision
13-5026	£2.15	PICAXE 18A Chip (single)	Spare PICAXE chips allow you to have multiple programs available for different situations
13-0834	£3.25	PICAXE 18X Chip	Larger memory for bigger programs
13-0847	£3.16	PICAXE download cable	
19-8790	£17.64	USB to 9W serial converter	Allows you to use the PICAXE download cable with PCs and laptops that do not have a serial port but do have a USB port
13-1262	£1.00	PICAXE software	PICAXE program editor software on CD-ROM
Solar project parts			
11-2143	£3.39	10F Capacitor	Spare capacitors
42-0240	£3.87	3V Solar panel	Additional solar panels
Tools			
85-0050	£7.69	Economy tool kit	A useful tool kit in a handy case
87-3990	£7.49	Low temp glue gun	A low temperature (100-120°C) general purpose glue gun. Useful for delicate materials that may melt with a standard glue gun and safer for children
87-4002	£1.79	Glue sticks for above pk12	
87-0400	£8.83	Hot melt 25w 240v glue gun	Standard temperature (190-200°C) general purpose glue gun
87-0405	£1.89	Glue sticks for above pk12	
86-8613	£4.03	G-clamps 3-piece	Hold glued surfaces together whilst they set
85-1145	£15.95	Soldering iron with mains plug and heatproof silicone cable	
85-0592	£3.95	Solder - 100g reel - 22swg - 60/40	Approx. 35 metres
85-0595	£18.95	Solder - 500g reel - 22swg - 60/40	Approx. 175 metres
85-0662	£6.58	212 Digital multimeter	Ideal for fault finding the PIC board or monitoring your capacitor in your solar car
86-1596	£2.03	20m tape measure	Measure how far your solar car can travel across your school hall and attempt to improve its efficiency
85-8187	£22.39	Rotary tool kit with accessories, case and power supply	Versatile tool with accessories for drilling, sanding, shaping and engraving

For volume pricing please see the Rapid catalogue. If you do not have a copy of the Rapid catalogue please send an email to sales@rapidelec.co.uk

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About Toyota . . .

Toyota's decision to establish a manufacturing operation in Europe was first announced in 1989 and Toyota Manufacturing UK was established in December of that year. Total investment to date is in excess of £1.85 billion.

There are two manufacturing plants in the UK where over 3,000 members are employed. The vehicle manufacturing plant is located at Burnaston in Derbyshire and the engine manufacturing plant is located at Deeside in Flintshire. Engine production started at the Deeside plant on 8 September 1992. The first car, a Carina E, drove off the Burnaston production line on 16 December 1992. Today, Toyota Manufacturing UK produces Avensis, Auris and Auris Hybrid vehicles along with 1.6, 1.8 and hybrid petrol engines.

In 2007, Toyota selected five 'Sustainable Plants' worldwide to serve as industry leading prototypes for clean and green production. Our UK manufacturing plants were selected as model plants for Toyota in Europe. In our journey towards sustainability, Toyota believes that a Sustainable Plant should be able to operate for more than 100 years with minimal impact on the environment. Toyota Manufacturing UK has completed a solar array consisting of 17,000 solar panels which will be on of, if not the largest solar array in the UK, capable of generating enough energy to produce 7,000 vehicles (equivalent to approx 5% of the site's usage) and saving 2,000 tonnes of CO_2 per year.

Toyota Manufacturing UK at Burnaston, Derbyshire

The Toyota Hybrid Synergy Drive

The introduction of the Toyota Hybrid Synergy Drive (HSD) is Toyota's first step in deploying Hybrid Synergy Drive across its full model range by the 2020s.

The Prius was first introduced in Japan in 1997, making it the first mass produced hybrid vehicle and was subsequently introduced worldwide in 2001. In 2010, the launch of Auris Hybrid, built exclusively at Toyota's Burnaston factory in the UK, marked the introduction of Toyota's Hybrid Synergy Drive (HSD) technology to one of its mainstream models for the first time.

This hybrid vehicle uses a combination of petrol engine and electric motor drive to produce outstandingly efficient performance, safety and a major reduction of unwanted emissions.

How it works

A power split device sends part of the petrol engine power to the wheels and part to a generator. The electricity from the generator may go directly to the electric motor to help drive the car, or it may be converted into direct current to be stored in the battery.

For initial acceleration and during low speed driving, the Auris Hybrid's ultra efficient electric motor uses energy from the battery to power the car. When the energy level is low, the Auris Hybrid uses the petrol engine to power the generator, to recharge the battery.

Above mid range speed, the Auris Hybrid uses both its petrol engine and its electric motor in synergy to power the car. The electric motor gets its energy from a generator also driven by the petrol engine.

When braking and decelerating the Auris Hybrid electric motor is used as a generator which converts otherwise unused kinetic energy into electricity, to recharge the battery.

When the driver activates the EV (Electric Vehicle) mode, the Auris Hybrid is powered solely by the electric motor drawing its energy from the battery.

When stationary, the Auris Hybrid petrol engine switches off to conserve fuel. All other systems including the electric air conditioning continue functioning.

The Environment

When it comes to environmental performance, new Auris Hybrid's achievements are not just about the fuel economy and low emissions.

Toyota's determination to reduce emissions and promote sustainability prompted it to specifically develop its own recyclable plastic called Toyota Super Olefin Polymer. This is a resin which has better recyclability than any conventional reinforced composite polypropylene.

CO_2 emissions are a best-on-the-market 89g/km, a figure unmatched by any other family car. Moreover, when switched to EV (electric vehicle) running, Auris Hybrid gives zero emissions performance for up to 1.2 miles at speeds up to 31 mph. Toyota has made extensive use of high recyclability materials, and huge efforts to reduce the use of any substances of concern in the car's construction.

When the EV driving mode button is pressed, the car is powered by the electric motor alone, allowing zero-emission performance and ultra low-noise and smooth motoring, as well as obviously saving on petrol costs.

The car's engine is designed entirely around conserving energy, while ensuring optimum performance. In a conventional car, each time the brakes are applied, kinetic energy is wasted. Not so in the Auris Hybrid – when braking the electric motor operates as a generator, converting the vehicle's kinetic energy into electricity, which is used to keep the battery charged. In fact the electric motor is self charging, creating energy from the car's motion, so you never have to plug the car into the mains.

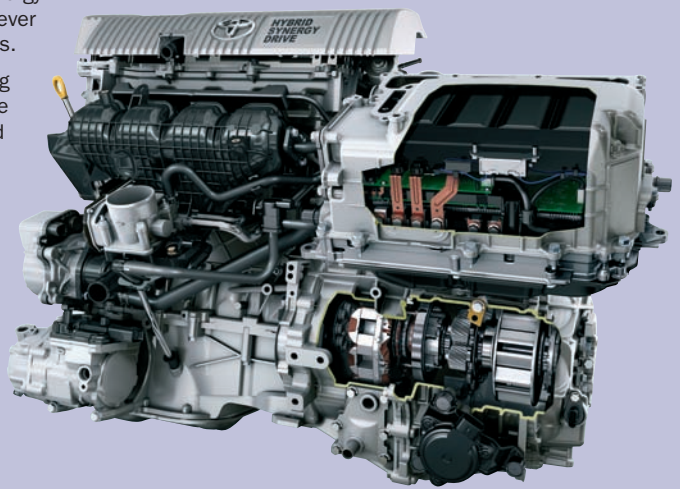
Even the car's power steering system is designed to conserve energy, kicking in gradually as and when it's needed.

When its driving duties are done, more than 85% of new Auris Hybrid can be recycled and more than 95% of its materials can be recovered in a process that only accounts for a tiny proportion (approximately two per cent) of its full lifecycle CO_2 emissions.

How it Looks

The Auris Hybrid is able to achieve 74.3 miles per gallon on the combined cycle thanks to its low drag coefficient figure.

The Toyota Auris Hybrid is a full hybrid and the undisputed reference point for hybrid technology. It works by using a petrol engine in conjunction with an electric motor which means it can run by using the petrol engine only, electric only or a combination of both. At low speeds or in traffic the Auris Hybrid uses electric power which means zero fuel consumption and zero emissions.



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