Robots in the 2018 Australian Classroom

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More and more robots are appearing in Australian classrooms. This document should guide teachers interested in gaining an overview about robots in the Australian classroom and at what age the technology could be introduced. It isn't the last word or a shopping guide.

It was inspired by response posted to the OzTeachers list by Ken Price to Damien Kee asking what is working well (and perhaps what isn't). It was a labour of collaboration across Australia and is shared on with a creative commons licence and follows on from our 2016 report that you can read here.

It is my hope that we can organise a survey about the use of these robots in our classrooms.

Edited by Roland Gesthuizen

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Contributors

Full name	Contact	Classroom Experience
Roland Gesthuizen	rgesthuizen@gmail.com @rgesthuizen	STEM Lecturer at Monash University, Faculty of Education
Ken Price	kenjprice@gmail.com	Curriculum Officer
Peter Whitehouse	peterwhitehouse@terrace.qld.edu.au @wonko42	Teacher Digital Technologies, IPT
Ivan Dean	oz-teachers@ivandean.com	Year 3 &4, volunteer 5 & 6
Chris Woldhuis	cwoldhuis@nbcs.nsw.edu.au @cwoldhuis	Secondary
Mark Weber	weberscience@gmail.com @numbatmark	Secondary
Simon Brodie	grabman66@gmail.com @simonbrodie1	Primary (yr6)
Carlin Grieve	grieve.carlin.c@edumail.vic.gov.au @carlingrieve	Year 7, 9 & 10
Vickie Vance	v.vance@bth.catholic.edu.au @mrsvsquared	Contemporary Learning & ICT K-12 Catholic Education Diocese of Bathurst NSW
Leeanne King	king.leeanne.m@edumail.vic.gov.au	Primary F-6
Michael Graffin	graffin.michael@cathednet.wa.edu.au @mgraffin	Primary PP-6, FLL robotics coach
John Hession	john.hession@dbb.catholic.edu.au @john_hession	Education Officer: eLearning K-12
Damien Kee	damien@domabotics.com	Domabotics K-12, RoboCupJunior
Nick Jackson	largerama@gmail.com	Senior Leader (various responsibilities) / Y10 Dig Tech class
Geoff McIver	mciveredubots@gmail.com @mciveredubots	McIverEduBots P-12, Beebots, Bluebots, Mice, WeDo, NXT, EV3 & Edison with system and teacher PL Support & classroom modelling experience.
Grant Fitzgerald	gfitzgerald@ceosand.catholic.edu.au @gfitzger62	K-12 System Support

Yvonne Harrison	harrisonyvonne4@gmail.com @yharrison	Deputy Principal Government Primary School, W.A.
Sean M Elliott	sean@roughscience.net @seanmelliott	Director, Rough Science Previous experience with Scienceworks, CSIRO Education, Bio21, VSSEC, Edinburgh International Science Festival
Lisa Nash	lnash@parra.catholic.edu.au @lisanash9	Digital Learning and Library Services Officer PL support Technology integration K-12 Catholic Education Diocese of Parramatta
Dee Poole	deanne.poole@acara.edu.au @DumDeeDah	Curriculum Officer, WA Digital Technologies in Focus Project ACARA
Mel Yuan	melyuan@hotmail.com myuan@fintona.vic.edu.au	Fintona Girls School
John Pearce	mrpbps@gmail.com @mrpbps	Primary F-6

Random list of new Robots

Unless we can find a school that is using these robots, we will leave out of the report.

Flip Robot
http://actura.com.au/fliprobot/

What should I get for my school?

This is a common question yet it really doesn't really matter all that much. In the education realm, we never 'Teach Robotics', instead we use 'Robots to Teach'. Use these platforms to teach programming, computational thinking, problem decomposition, mechanical engineering, branching statements, directional terminology and so on, and so on. The robot itself is just a platform that is used to teach these concepts so it doesn't really matter which one you choose.

The best robotics platform is the one that teacher feels most comfortable using. If they are comfortable with it, then they will teach with it, just like any other tool at their disposal. If the desire is for all students to be involved, then the classroom teacher must feel confident with what they are using. It has to be simple and work every time.

Choosing a Robotics Platform

There will be a bunch of factors that will guide teachers in to choosing a platform that suits their school best and they should include;

- Price. If there is a robot platform that is amazing, but it costs $5000 / robot, is that a better investment than a great platform that is $200 / robot? For the same amount of money, a cheaper robot can engage more students.
- Availability: Are spare parts or add-on easy to source from overseas?
- Age appropriate Programming Language: Graphical or Text based? Do you need a platform that can span across both to appeal to a wide range of ages? Does the platform support multiple languages within the same robot eg Blockly and Python?
- Curriculum Resources: Are educational based activities easy to come by? While it would be awesome to have the time to use robots in class because they are fun, in reality everything we do needs to be meeting some parts of the Australian Curriculum. Does the robot enable students to be creative eg to arrive at uses other than those envisaged by the manufacturers? Are those activities affordable/ adaptable/ assessable?
- Teacher support: Often the 'robotics' teacher/s at a school might be only one or two teachers which makes it a little more difficult to bounce ideas around. Many robotics platforms have good extended Educator communities in the form of mailing lists, forums etc.
- Professional Development opportunities: Are your staff comfortable in using the equipment in class. Too often I've seen cupboards of equipment sitting idle in a classroom because the teacher who originally used it has now moved on and no-one else at school knows how to use the gear. Is the equipment easy to use and it is just missing a teacher willing to take it on?
- Reliability: If you are spending too much time just getting the platform up and running, then that is time that could have been time spent solving challenges.
- Control Platform: The command interface, IDE or development space is really important - ideally it should visibly surface algorithmic components of the control solution rather than hide it among esoteric and/or clumsy visual symbology. Wherever possible it should encourage code-reuse, enable defined sub-programming and be extensible with the inclusion of external libraries.

- Collaboration: The best robots will encourage students to work together and collaborate rather than do so as individuals, especially when programming and solving problems. Students should also be involved in peer assessment of other student's work/algorithms.

The Big List

Anki Cozmo

Home page
https://www.anki.com/en-gb/cozmo

This robot seems to have a an attitude problem, interesting mash of AI and coding. Check out the video on the home page. Cozmo appeals to the landscape of AI in classrooms, opens up opportunities to explore what the potential possibilities for robotics in classrooms and how these sorts of technology can be used as a interaction & collaboration tool.

Contributor: Reggie Ganji

BeeBot / BlueBot

Homepage https://www.bee-bot.us/bee-bot.html

Simon: We started with these in yr6 but quickly moved them to JP area. This friendly little robot is a perfect tool for teaching sequencing, estimation, problem-solving, and just having fun. They are easy to use and quick to setup. Coding is completed by button presses on device itself.

Michael: We have used these very successfully in PP-2 for developing sequencing skills and an introduction to algorithms (representing instructions using arrows). The beebot resources from Barefoot Computing UK (need to sign up) are brilliant.

Vickie : We have used this as a concrete introduction to computational thinking for Primary teachers as an introduction - non threatening to teachers and can see uses for cross subject use in higher primary years - ie the Australian Money Mat; World Map; Australian Map can be used for challenge tasks at Years 3 - 6 level if they have no prior intro to coding/robotics.

Vickie 2017 update: Blue Bots extend the BeeBot concept with the concrete level coding moving from the button pressing to the block-base on an iPad app - this would give a larger window from K-4 quite easily.

Damien: I love these for Prep-2. They are very user friendly and great for teaching Sequence and directional language. By time you get to Grade 3, they tend to lose a bit of interest as the challenges are usually solved quite quickly.

Ken: BlueBot allows editable stored programs, which makes them more usable for older students.

Yvonne: Our Kindy and Pre-Primary teachers are using these to introduce the idea of how the robot works - in the context of the community map, directional language, counting and the required step sequence. I love the hands on aspect of these robots.

Dee: The BeeBot is a great simple robot that can be integrated into many learning areas and multiple age groups. It can add an engaging sequencing skill to in class tasks. I have seen it used successfully in teaching Indonesian, maths, literacy, HASS and science by teachers who are not overly ‘tech savy’. Students can work in small groups to develop a game board that requires them applying design skills, which is then an opportunity to introduce User Interface Design (UID) conversations.

Geoff: I agree with the comments above but would like to add that developing social skills is one of the highest mentioned benefits by teachers when I survey them. The BeeBot is just another great educational tool which can engage even the most difficult of students. Whilst I agree their main use is in Pre-school to Year 2, creative teachers can have students developing complex games using Dice for example to encourage students to do mental calculations and develop strategies to outfox their opponents. This works even with adults! Mapping games are also a fairly age open challenge as well. Robots in my experience are very reliable and resistant to “rough-ish” treatment.

John: If you can afford to purchase the BlueBot I would do that as they are just that more flexible. In addition to the capabilities of the BeeBot,

- BlueBots can load 240 commands compared with 40 for the BeeBots
- BlueBots can do 45 degree turns as opposed to the 90 degree turns of the BeeBot
- BlueBots can be controlled via an app, (iOS and Android). The app enables multiple groups of students to share one BlueBot
- The BlueBot app allows for repeat functions and algorithm edits

When using the BeeBot it can be useful to “plot the program” initially using arrow cards and later using pen and paper to record the algorithm. This allows students to make visible the steps taken enabling discussion around de-bugging, a vital part of computational thinking.

Once the algorithm has been recorded students can be asked to look for repetition and/or patterns. They can then be asked to devise ‘commands’ to simplify these eg ‘ → → →’ could be simplified as ‘3 →’ or ‘→ ↓ → ↓’ could be ‘2 foright’ or 2 forward-right.

As an adjunct to the BeeBot students might like to play with the free BeeBot app.

Cubetto

Home page:
https://www.kickstarter.com/projects/primotoys/cubetto-hands-on-coding-for-girls-and-boys-aged-3

Children can code the wooden Cubetto robot to find his way home using a set of colorful coding blocks to write their first program. It is a playful programming language that they can touch, learning programming away from the screen. Claims to be Montessori approved, and LOGO Turtle inspired

Launched by a very successful kickstart funding campaign mid 2007, promoted as a STEM toy.
https://www.primotoys.com/

No reports of any classroom use as yet

Contributor: Roland Gesthuizen

ProBot

Home page https://www.bee-bot.us/probot.html

Ivan: The Probot is a more advanced version of the BeeBot built as a small car (approximately 30cm in length). The programming options on the Probot are more advanced than the Beebot, for instance, year 6 students quickly discovered they could program the Probot to advance a specific number of centimetres using the inbuilt LCD screen. The Probot can also be programmed using an application from a computer, but I haven't tried that option out yet.

Contributor: Ivan Dean

Edison Robot

Homepage https://meetedison.com
Geoff: The Edison robot has been designed in Adelaide Australia by Microbric in collaboration with teachers. Through its built in sensors it can work autonomously making it a true robot. At a cost of under $50 each, Edison can:

- Be programmed with the free online software from basically any device with internet access and a headphone jack e.g. Chromebooks, iPads, laptops, desktops etc.
- Follow lines and avoid obstacles
- Respond to light and sound
- Communicate with other Edison robots
- Play sound and flash its LEDs
- Connect to other Edison robots and LEGO bricks
- Have now released Edcreate kits of Lego Technic compatible pieces to ramp up teachers understanding of Engineering in STEM
  https://mailchi.mp/meetedison/meet-edcreate-the-edison-robot-creators-kit

The Edison has a progression of 4 levels of programming making it ideal to use in the classroom as well as G&T and computer club situations. This software is free online. I have used these robots with classes from Year 2 to Year 9 for coding and computational thinking lessons as well as G&T students. Differentiating for students in the one class is a breeze. I have also used the robots using the barcodes and a TV remote with children as young as 3 years old.

edscratchapp.com is a vertical block-based visual programming language based on Scratch
Reading barcodes to trigger inbuilt programmes.
Edblocksapp.com - The Horizontal version of Scratch3
EdPyapp.com - Python 2

Teacher support: Their website has some excellent resources which are well worth checking out. It includes printable teaching programmes as well as support videos.

Reliability: Having used both the V1 robot which is no longer sold and the V2 across over 40 schools and more than 3000 different students, I have found the present Version 2 model very reliable. I run them on 4 rechargeable AAA batteries and they run for over 5 hours constantly on one charge. In normal classroom use, this would cover 5 or 6 lessons between charges.

Classroom management: Given that the Edison comes with its sensors, lights (LEDs) and sound inbuilt the Edisons are exceptionally easy to manage in the classroom. A class set of up to 24 can fit into a plastic box purchased from Bunnings/Kmart and the associated communication headphone cables. This encourages teachers to actually use the robots regularly in the classroom situation across STEM and literacy units of work.

Roland: Have used with year 9 and 10 Robotics. Good price, especially if you are looking to buy a class set. Novel approach using an audio-optical connection so that it connects any device to an Edison Robot. This can also be used to program using a bar-code reader. Programming interface is free to download and similar to the Lego Mindstorms layout. Seems to be tough but we have had some wheels jam. Can be programmed for basic line tracking. Keep a supply of batteries handy

Vickie : We have a kit of 15 that travels around to schools on a 5 week loan basis. Teachers have found them easy and from 15, only 2 have been issues. Looking forward to v2.

Vickie 2017 update: We now have 2 kits - one 15 x V1 and the other 15 x V2. We have had some issues with breakages however all seem to have been easily solved. The price point means they are an easy kit for the whole class to experience in pairs - some great peer learning happens in this set-up. The first V1 kits has been in constant use moving between schools for over a year now, and we have found it fairly reliable.

Yvonne: Our Department just provided us with a set of 15 which takes our total to 25 V1 robots. My colleague and I used the 10 we purchased during Term 3 with our Year 5 and 6 students in a combined Science/Digital tech project. The bar code lessons were fun and the kids really enjoyed that aspect - we used those to introduce the kids to the idea of a system and why/how this system works. The remainder of the sessions (400 minutes across the term) were taken up with firstly introducing the students to the Edware software and helping them to get the basic idea of programming (we related the loop, if/else and event time aspects to Scratch so that those students who had already used Scratch understood what the yellow icons were all about). Then time was spent on developing an understanding of timing and speed and timing for turns. This proved challenging as did the final activity which involved developing a “map” which related to a specific purpose for which they designed a robot. The design thinking and systems thinking aspect came into play within this particular challenge. The students had a really good go - though some of the Edisons didn’t perform well - specifically the wheels not turning was an issue. However, one robot which I had tried to update Firmware using our Windows & laptops and desktops at school was brought out of the stuck cycle once I used my Mac laptop. Not sure why that proved more efficient - it just worked better!

The Edware software was challenging for the students as they thought just pulling the event icons into sequence would work. We will be working on this again next year with our Year 5 and 6 students and hammering the use of variables within each event so that their programs work. Also thinking of taking these down to Years 3 and 4. Year 3 will use the barcodes and we will discuss systems and how they work as well as continuing their programming mathematical shapes with Turtle Blocks. The Year 4’s we will do the barcodes and then the first 5 lessons with Edware like we did this year with our Year 5 and 6 students. Plan is to strategically have these in place in Years 3 and 4 and move on to something else in Years 5 and 6.

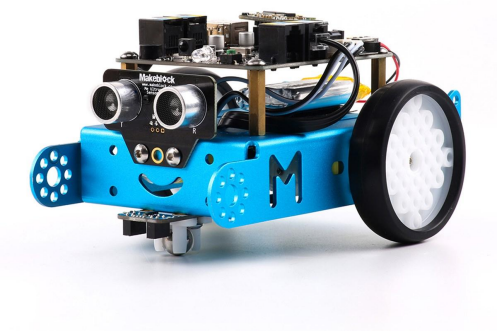
Dee: As mentioned above, I found the V1 Edison's very problematic. After speaking to their support they have said there is a new Firmware update that should alleviate any issues and they also suggested contacting them directly. They were very enthusiastic about supporting tech issues in school. https://meetedison.com/edison-robot-support/ There are also a great deal of teaching resources on the web site https://meetedison.com/robotics-lesson-plans/
My main hesitation in using Edware is the connectivity to the code - each time the student's need to change the code they have to plug it back in - download the code etc. Far more simpler auditing code in a bluetooth device with instant changes.

John: Because they are relatively affordable students can use Edisons to explore other aspects of robotics such as "swarm" technology where multiple robots interact to do tasks or solve problems as a system. The capability to connect LEGO type blocks enables students to add features to the basic robot including decoration, costume or other components such as probes and/or light displays. Students can then use them to choreograph art installations.

Edison have also just released EdCreate which is a pack of LEGO type components to build functionality including a digger, claw and crane. Another product that could be used is a flexible LEGO type product called Flexo.

mBot

Homepage http://www.makeblock.com/mbot



Roland: Have used these with year 9 and 10 Robotics. Very easy to assemble, keep an eye on regularly tightening the screws. Assembled Robot fits nicely back into the original box. Tricky coding the first time. Many sensors including line tracking, collision detection, Infrared communication, etc. Remember to start with the mBlock software, install the arduino driver, then attach USB lead. mBlock software permits programming with a drag-and-drop block interface but it also permits directly coding the arduino chip.

Michael: I love the mBots! I bought a mBot and MBot Ranger for my gifted Year 5 coders. Makeblock are working on developing online tutorials, which you really need to read to get your head around how to program them. Highly recommended for coding extension from late Year 5 up. They are harder to program than EV3 Mindstorms. Price range around $140-230 depending on model.

Carlin: These are used as an introduction to robotics for all students at Year 7 level. We have 13 which makes a class set (1 between 2). This allows a class set, which made it achievable in terms of cost, but students responded extremely well to the collaborative learning. With a small amount of initial scaffolding (Specifically how Scratch/individual blocks work) students are able to assemble code for small tasks. Within the first lesson (72 mins), Students are able to connect, program and control an mBot using the arrow keys on the keyboard, turn on flashing lights, and have a basic siren sound. Differentiated Learning is also easily managed, as students complete at their own pace, completing a variety of activities that can include make an automatic xylophone player or even building a 3D Printer with this ecosystem

Dee: mBots are a great cheaper alternative to the more expensive Lego EV3. Can use Scratch blocks for mBot which converts into arduino code.

Promo Video: https://www.youtube.com/watch?v=-hQtdYd5i-Y

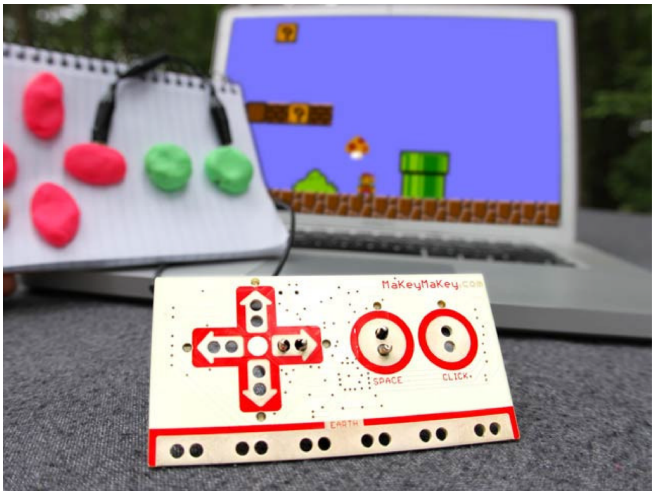
Programming Examples*: http://learn.makeblock.com/en/mbot-programming/
*These coding examples would be at the end, just prior to assessment (Except music example)

Learning Path: to provide the skills and knowledge needed for VCE Computing.

Year 7	mBot	Drag & Drop Coding Allows for Direct Arduino coding for extension
Year 9	mBot / Arduino	Combination, ensures that the transfer occurs Similarities & Differences highlighted. Basic Projects
Year 10	Arduino / Unity3D	Coding via Arduino C or elective C# (Unity3D)

Makey Makey

Homepage: https://makeymakey.com/



Mel Y: In 2017 I used 10 Makey Makeys Classics for pair projects, with 2 different grade 6 classes for the Operation Game (https://makeymakey.com/guides/#operation) and Musical Instruments (The Invent to Learn Guide to Fun book). Connecting the Makey Makeys between cardboard (or other) craft materials and Scratch is easy and fun. Will try this again with different year levels and project choices. The kits are expensive (USD $49.95, AUD $47.94-87.71), so consider buying the boards only and adding in cheaper alligator clips and accessories.

John: Makey Makey can be used to think about adaptive technology where users are unable to to use the standard keyboard or where movement can be used to trigger actions on a computer. For ideas have a look at:

- USE THE MAKEY MAKEY TO MAKE DIY ASSISTIVE TECHNOLOGY FOR COMPUTER ACCESS at https://goo.gl/7aRJ8K
- Build your own custom assistive technology interfaces with a MaKey MaKey! at https://goo.gl/htwM8s

Students should also be encouraged to invert the Makey Makey and look at the connections on the other side of the board.

LEGO Mindstorms (EV3/NXT/RCX)

Chris W: RoboCup Junior is an awesome resource for those wanting an excellent place to start and to continue down the path of structured learning where students are driving the learning and pushing the boundaries. It is a very easy path to start down (resource packs are available from MTA - they cost a lot of money, but are not expensive as they last a long time and very reusable).

Chris W: We have had a long experience with RoboCup, and then linking to World Robot Olympiad to expand students' horizons in many areas. The competition is strong, but also very collegial and supportive. It is a growing community of learners.

Chris W: We are starting to use some of the older Lego devices (NXT and even trying to get the old Yellow bricks working) as the brains behind simple controlled or controllable devices. Eg Camera sliders, camera following device, controlling an old electric wheelchair. Sometimes linked to remote control gear.

MIchael: The LEGO EV3 can be used from Year 5 up. We currently have five for our FIRST LEGO League robotics teams. FLL is a fantastic competition to be a part of, but it is a lot harder than RoboCup Junior! Highly recommended, but pricey!

Vickie : We have 5 EV3s that form part of a loan kit that is borrowed by schools. We find they lend themselves, as Michael suggests, to Year 5 onwards, and as a second stage - currently using Edisons as the step between these and BeeBots/We Dos.

Damien: I've been using these for 15 years now and I still love them. The construction element to them really ties into the STEM ideas, but if you are only interested in 'programming' there are other cheaper options. That being said, they are an extremely robust platform and I have robots that are 10 years old and still going strong. You can program in Graphical or Text based languages making them suitable for a wide range of age groups. I teach with them down to Grade 3/4 and all the way up to Grade 12 and beyond (university level). The datalogging aspect is an added bonus allowing the platform to be used for Science as well as Technologies.
There are plenty of resources available and the learning curve to get up and running is very easy. These would be my pick for a robotics platform that can cover a variety of age groups and subjects.

Yvonne: Would love to use our old RCX bricks but I need to find a way that will work. Thought about the EV3 software but people tell me it's not compatible. Used to use the RCX's for Robocup from around 2003-2009 with Year 4-7 Talented and Gifted students for an extension program. Can't afford to upgrade.

Peter: We have been using NXT-based kits for over 6 years with year 10 robotics and junior robotics club. In year 10 we abandoned the Mindstorms development platform in favour of Enchanting - a scratch-like programming language that requires flashing the BIOS of the brick. We prefer Enchanting because, like scratch, the programs make visual sense, naturally use variables, functions etc and have found kids pick up the control aspects really quickly.

Mel Y: In 2017 I upgraded the existing NXT set by simply purchasing EV3 bricks ($399.95) and gyro sensors ($55.95). Happily, although the bricks have slightly different designs, it was relatively straightforward to use all the existing Lego pieces. This was a massive saving on purchasing entire EV3 kits ($629.95). In order to get extra axles and wheels, I used Lego's single part service which allows you to buy single parts at extremely reasonable prices (https://www.lego.com/en-us/service/replacementparts). Lego's own interoperability and the range of additional platforms that support it (such as Swift Playgrounds) make it hard to beat.

LEGO WeDo 2.0

Michael: We are testing the 2nd generation of these kits in Year 5, programming them with Scratch. It is a bit tricky to get it connected, but well worth it. We will program the robots on iPads in Year 2 and 3, and then with Scratch in Year 4. They are much simpler than EV3, and I'm looking forward to learning more next year.

Tip: To get Australian Curriculum Pack on iPad, you need to change the language settings to English- Australia.

Home page https://education.lego.com/wedo-2

Damien: Even though you cannot buy them anymore, I continue to use version 1.0 in class. I use it at a grade 3 and 4 level and the software is very easy for students to pick up. There are plenty of good activities and support for teachers available.

Yvonne: I'm interested in these! Apparently One Education sold the kits as they used to connect WeDo to the XO Duos with Scratch - don't know if that will work now. Would love to know if anyone has experience with this.

Mel Y: Used WeDo 2.0 with iPads in grades 3 and 4 with the out-of-the-box curriculum and the girls enjoyed it very much. The curriculum builds from step-by-step basics to "guided projects" then "open projects". Ideal for grades 3-4 but easy to see it useful for grades 2-6 although I imagine that grades 5-6 will need more interesting or contextual engineering challenges (see Invent to Learn Guide to Fun, https://inventtolearn.com/the-invent-to-learn-guide-to-fun/). Watch out if buying storage as the WeDo boxes are shaped differently to the EV3s and so need different trolleys.

John: I must admit that I am not a great fan of the WeDo 2.0 as they are relatively limited in movement options and rather didactic in how they 'teach' students. As with most LEGO, the number of components in the kit can be problematic as far as loss. On a positive note you can program the WeDo 2.0 using Tynker though this does tend to amplify the comparative lack of functionality.

VEX IQ

Homepage http://www.vexrobotics.com/vexiq/

Roland: Seen used by http://DATTAVic.edu.au with Victorian secondary students. Perhaps more for challenges

Damien: The VEX IQ platform is relatively new to Australia but has a big following in the US. Similar to LEGO, it is a modular building system which means you can use the elements to build countless different types of robots. The controller is fantastic, with 12 ports that can be configured as either input or output. The sensors and motors are easy to work into your system which makes building quite easy. Software is available in either Graphical or Text based allowing it to be used in a wide range of classes. The IQ system also comes with a remote control unit, which means it is easy to have things working quickly if you want to focus more on the 'Engineering' side of things instead of 'Programming'. Availability in Australia is limited but no doubt will become more accessible in time. I've seen them used from grade 7 and above.

Ozobots

Homepage: http://ozobot.com/

Grant: I have used Ozobots and really like them. I find they are useful as you move from a line following robot, with the students creating the tracks, to drawing codes and then moving into the programming side - with http://ozoblockly.com/editor. The way the program transfers the code to the Ozobot is amazing - just place the Ozobot on the screen and click ***load***. The screen flashes and the Ozobot gets the program!

There are also apps for the Ozobots on iOS and I presume Android, although I haven't used them on Android.
They are really flexible to use. I have targeted them at Grade 3 and 4, but used them equally as well with 5 and 6.
Good price for 6 robots (with some extras) - about AU$550.

Yvonne: I will be looking at these for Year 1 and 2 students as I think patterning and systems thinking can be developed through firstly using the coloured lines and then gradually introducing them to block coding.

Lisa: We have recently bought Ozobots and I agree with Grant, I see a lot of potential in them. The fact that you can program them simply via colour (pens, stickers, etc) and then with block code

via the web based program - Ozoblockly via placing on the screen to load the program means that they can develop across grades. Also they are not App dependent and work across any device - Laptops, iPads, Chromebooks etc.

Students could program 3 Ozobots to the same program simultaneously using the screen loading feature. This is a great idea for the students to collaborate on a program to setup a synchronised robotic display. Also Ozoblockly includes a staged programming menu from Beginners to Advanced with inbuilt examples. We are still exploring so will let you know more as we work with it.

John: The latest addition to the Ozobot range is the Evo. These come with Marvel character skins which are very hard to remove once added to the robot. In addition to the line following and programming via OzoBlockly the Evo is slightly larger and has proximity sensors as well as a range of additional 'expressive' sounds. The Evo can also be programmed through a separate app which incorporates OzoBlockly. Note the Evo app has inbuilt social aspects as well as links to YouTube which may not be as appealing to use in the school environment.

With either robot I particularly like that the OzoBlockly interface can be accessed across a range of 4 levels from simple block by block movement through to more sophisticated Logic Statements, Loops and Functions amongst other options.

Ozobot also has a specific dance app, OzoGroove which students can use to choreograph up to five robots on a tablet, or four on a phone. User can begin with pre-loaded demos before moving on to creating their own dances.

When using pens to draw on paper you get best results using the Ozobot pens rather than generic markers as the green especially is a different tone. Students need to take care that the lines are thick enough also. Care needs to be taken to regularly calibrate the Ozobots especially if you are moving from screen use to paper use. Remember too to turn up the brightness on your screen to maximum, (especially when using tablets).

Ozobot has a range of add-ons including printable mazes and games as well as accessories such as skins, which can be used as exemplars for students to design their own.

Programmable minidrones and droids

Ken: A series of affordable drones and related devices has been developed to be programmed through the Tickle app https://tickleapp.com/ for iOS (iPads). This is a comprehensive programming environment which adapts to the selected hardware (and also allows programming with no specific device selected) The supported hardware is listed at https://tickleapp.com/devices/ and includes various devices from Parrot and devices like Sphero, LEGO WeDo, Dot, Ollie, BlueBean etc. We've successfully used the Parrot Rolling Spider and Hydrofoil. The Rolling Spider is very suited to classroom environments, including collisions.

The Hydrofoil is a boat powered by a drone that can be detached and used on its own.

John: Tickle used to be my app of choice for devices such as Parrot Drones as well as the other robots mentioned by Ken however new users of the app need to create an account and then use this to purchase in app credits to access the full range of connected devices as well as other options such as lesson plans. This may be problematic for some schools however generic accounts could be created to access the options and app developers do need to monetize their products to continue developing them. One of the really neat options which Tickle have added is the opportunity to view the visual code generated on screen in the Apple Swift language.

Another coding option is Tynker available on iTunes at https://goo.gl/WfBjNb. The app is part of a larger Tynker program that is a pay for curriculum. The one drawback is that Tynker app doesn't have the range of connected devices that Tickle does, (probably because it is offered for free).

A pretty neat free downloadable resource for schools looking to introduce drones, (specifically Parrot Mambo drones is provided by SheFlies at https://sheflies.com.au/ebook-download.pdf. SheFlies also provide school based and other programs related to the use of drones.

Dee: The Rolling Spider Drone is an easy to use and connect drone. No camera, but it does allow for coding and remote control driving. It is essential you confirm what safety requirements are required in your state, protective eyewear should be a minimum. They are better used in a closed space, as even the smallest of breezes will see them drift away, they do not have an auto return function as some other drones have. There can be some battery connection issues but there are some simple solution videos online and I would recommend teaching the students how to problem solve those easy fixes. I would also refer you to an iTunes U course which is an amazing resource https://itunes.apple.com/au/course/coding-drones-in-primary-education/id1133006669

Sphero / Ollie

Home page: http://www.sphero.com

Ivan:The Sphero is very engaging for students as it can move quite quickly, has a bright RGB (programmable, colour changing) LED inside it and is of course reminiscent of BB8 from the new Star Wars movies. The Sphero includes an accelerometer so it can detect running into obstacles or falling off drops. The Sphero typically costs $AUD200. Sphero released a "Power Pack case" version in 2017 that would be great as a classroom set as the Spheros are all charged up by plugging the case in! Twelve Spheros for a little over $1000 is also good value compared to retail prices.

Roland: Water proof, totally sealed and robust. It is worth looking up how to reboot and factory reset these devices, not intuitive but easy to do and listed on the website. The bluetooth name gives a clue about the flashing colour of each sphero. Very fun for younger kids. If you are buying

one, get the transparent SPRK+ or education version. Consider customising by 3DPrinting a chariot.

Make sure you get the SPRK+ edition as it has some subtle advantages and comes recommended for classroom use, for instance, a transparent shell so you can see how it works, and also information in the box for getting started with classroom activities. A variety of apps allow students to engage in different ways, including:

- Simple remote control, change light colour & mode, etc.
- Drag & drop style programming using Tickle
- Code using “Oval”, a Javascript like language using the provided apps (Oval can also be displayed next to your blocks of code to guide students into the language)

There are many resources around using the Sphero in classrooms, especially year 5&6, e.g. this YouTube video from the United States provides some examples: https://www.youtube.com/watch?v=0yQYr7CIxBc
Here is just one good example of the sort of information that can easily be found by Googling “Sphero challenges” (meaning challenges for students to undertake, not problems working with Sphero robots!) http://www.coolcatteacher.com/super-sphero-teaching-methods/

Yvonne: We have been provided with three of these by the Department. I’m looking at the SPRK Lab software and thinking probably useful in a design/digital tech context for trying out some kind of challenge relating to theme parks or something like that. There are so many blocks of code and some of them are beyond the comprehension of the younger students - I see this as another robot for older students who have a knowledge of coding.

Sean: For further resources, look at the SPRK (Schools, Parents, Robots, Kids) blog: https://medium.com/@SPRK This blog is useful for ideas about how to use Sphero in the classroom, as well as suggested apps for programming Sphero on a range of platforms. (I particularly like the photos of Sphero in underwater locations https://medium.com/@SPRK/sprk-like-youve-never-seen-before-a5d91a66c663)

Lisa: Our schools are starting to use Sphero’s. We are documenting as much as possible and robotics/coding use at our Learning with Bots and Code blog. One of our latest posts captures information from one of our primary schools using Spheros in the Sphero Olympic Challenge. Also a good resource is an iBook - Activity ideas with Sphero - includes activities, rubrics and categorised by grade

Dee: Sphero are my favourite of the BlueTooth robots for F-6. The first version has had some problems and I would highly recommend contacting Sphero support directly (after troubleshooting) as they are extremely helpful in solving any issues, even replacing Spheros if necessary. https://support.sphero.com/support/home
So many easy ways to use Sphero in DT or integrated lessons. Please note that Sphero also works well as the motor/engine for construction of STEM engineering projects. A student favourite with Sphero is a school wide Sphero Bocce competition. So easy, and allows younger students to win against older students. Putting the fun into coding and robotics.

Further note: There is a new Mini Sphero released with an hour of drive time. At $80, it is a cheaper alternative to the Sphero. http://www.sphero.com/sphero-mini

John: The Sphero mini is pretty neat as an entry level robot. Note though that you need to remove the outer shell to charge the mini via a USB cable. This means that it isn't waterproof. The mini also travels at half the speed of the SPRK.

Dash and Dot

Home page: https://www.makewonder.com/dash

Dash is a robot, charged and ready to play out of the box. It responds to voice, navigating objects, dancing, and singing, You can use Wonder, Blockly, and other apps to create new behaviors for Dash.

Damien: These guys have so much personality and really engaging for kids. They have 'personality' built in so that as soon as you turn them on, they look around and act like curious little kids. You can drive them around from a tablet app which is a great way to introduce them to kids before moving on to the programming. Programming is done through the Blockly App which is very similar to Scratch which makes it easy to introduce to kids. There are a good range of sensors built in which allows for programming for lots of different behaviours. Best use in the Grade 2-7 age group.

There are lots of teacher resources available on the website.

Yvonne: Strategically I'm thinking Year 1-2 as the Department also supplied us with iPads loaded with apps. I'll be looking for an App that is similar to Kodable or Scratch Junior to drive Dash and Dot as they are the apps our Kindy and Pre-Primary students will be familiar with. I can see lots of scope for cross-curricular projects with these robots.

Vickie 2017 update: We have purchased a kit of 10, with 10 ipads that are loaned out to our schools. They have received good evaluation - and I agree with Damien - they are engaging. I see quite a large age range as they move from simple to more complex functions.

Dee: There is a new robot release from WonderWorkshop aiming Dash at an older age group. **Cue.**

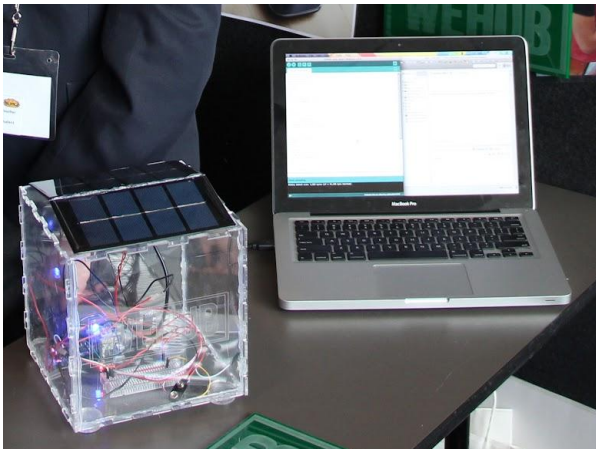
https://www.makewonder.com/cue_the_cleverbot

Finch Robot

Home page http://finchrobot.com

Roland: Similar to the robots that can be built using the Hummingbird Robotics kits. Requires a permanently connected USB interface with the computer. Provision for adding a pen to the back of the robot. Some sensory monitoring for collision avoidance, LED, motor and sound controls, Interesting controller using an Arduino board that can be programmed directly or flipped over and programmed using the drag-and-drop Birdbrain software.

Peter: we have a few Finch robots that have been used with years 5+6 as part of an introduction to coding activity. They are fairly simple, require a computer with live USB connection and have limited functionality but if you have BYO or laptops, they represent an interesting platform so long as you do not mind carrying a laptop around with the moving robot.



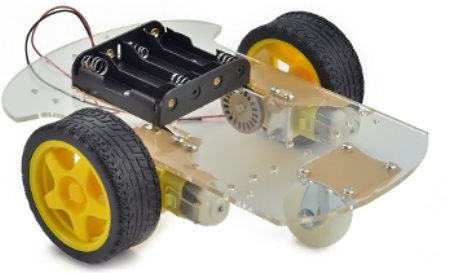
Arduino (raw)

Chris W: Much of our experience in robotics other than Lego has been through our Student Opportunities Week program called “Hi Tech Toys” (think Outdoor Education with student choice). During this time students choose their high tech project, many choose Lego, but we have encouraged the use of Arduino, and some of the more adventurous have chosen to design and start to build a robot of some kind.
Some of them are more applications, and less robotics.

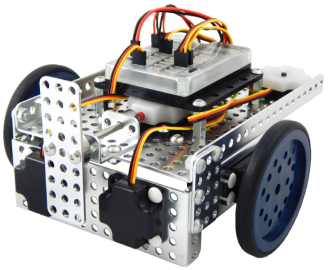
E.g.
WeHub - Remote Weather Station) - Arduinio based with weather measuring sensors and Bluetooth updates, made from laser cut acrylic.

Chris W: Others have been more about control and interaction. Some examples are:
Wifi controlled robot: An Arduino based vehicle that is controllable via wifi. The theory was wifi allows control of the robot from anywhere in the world or universe.
FireDrone 3000 - Modified Parrot AR Drone for fire monitoring purposes. A mini Arduino mounted on the drone to simulate monitoring of back burning operations.

Arduino (Deal Extreme, Ebay)



Mark: Another approach is to build the robot from the ground up. As Seymour Papert put it, “hard fun”. This kit can be purchased from around $aus10 off Ebay. The students can then add Arduino, sensors and actuators to make line followers etc. We found we needed extra power so replaced 4 AA battery pack with 6. You also need a switch to turn off and on. But for $10 plus say another $15 for incidentals, a perfect, low cost solution. Incidental teaching involved the Arduino IDE, soldering, using a screwdriver and problem solving. We had a couple of girls turn up to just learn these skills.
After a while, some students independently went down to manual arts and learned how to use CAD software and the laser cutter. The arrival of a 3D printer also generated some excitement. This robot fits in nicely to a makerspace approach and involves reals STEM.

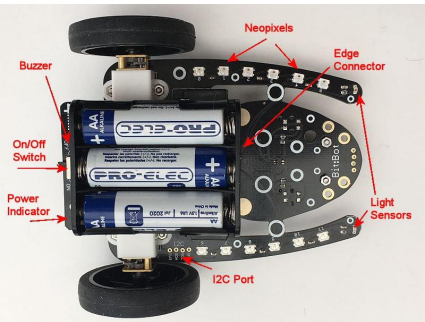


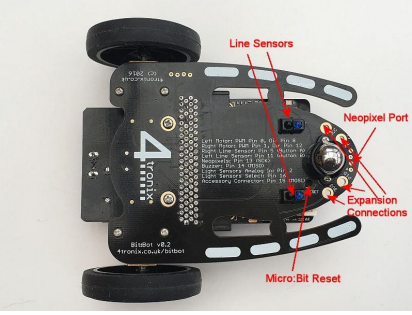
Peter: We were going down this route. We planned to do a term of arduino programming, circuits and sensors, lights and bits and bobs then the next term we will velcro the arduino onto a robot chassis and use it to control the physical robot. The aim would be also to get the kids to build the rig. There are lots of this sort of stuff

available, I bought my test rig from Jaycar but will order class sets from somewhere like AliExpress as the cost difference is breathtaking. No idea if this approach is a good one but we have to replace our aging NXT systems and cannot afford to replace them with like. See next entry...

Micro:bit Bitbot

4tronics website - https://4tronix.co.uk/blog/?p=1490





Peter W: We stumbled across a fairly new product when looking for accessories for our Micro:bits - these little buggies are fantastic because you have to build them yourself and the programming is in a number of languages and levels. The rig gives you an RGB LED pixel array, a good collection of sensors and a fairly funky set of geared wheels. We chose to program in micropython, using MU as an editor, but there are visual coding editors available online and a growing collection of tutorials. I like this device because the programming is explicit - the calls to micropython library functions feels fairly sensible and there are some really good discussions to be had about PWM (Pulse Width Modulation) as a means of getting a digital device to act analogue. Because it is powered by a micro:bit, and because these have built in radio, you can pair them with a second microbit and use that as a controller, display, serial monitor etc. Considering the micro:bit costs very little, the bit:bot rig is also very inexpensive (compared to most out there), this represents a cost-effective addition to control technology programming (even if it does look a little like a cockroach - I for one welcome our robot overlords). We added ping (ultrasonic) sensors (there is a bracket that bolts on the nose) and it allows distance/obstacle sensing also. I would suggest you purchase 90 degree USB port adapters so you can easily connect to the micro:bit when it is in its socket to save wear and tear on the components.

Arduino variant

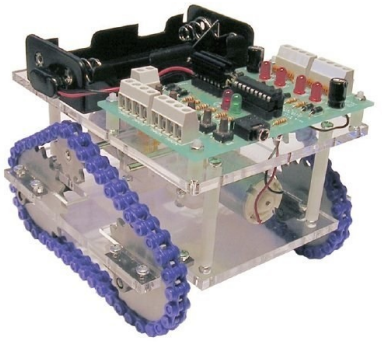
Home page Modern Robotics http://modernroboticsinc.com/

Ken: One product is the Spartan robot, based on an Arduino controller and a well-engineered aluminium frame machined with a matrix of holes that are compatible with a well-known metal toy building system. The Spartan has proprietary sensors, switches and motor modules, which is both a plus (assembly is easy) and a minus (not easy to add cheap sensors, expensive, single source). Tasmania has received a generous donation of a large number of these robots. A block-based coding environment (ModKIt) is under development by the parent company but is (at time of writing) incomplete - in particular it has no Save facility and has “blocks” written for a small number of input and output devices. This limits the current use of the graphical coding environment. It can still be coded in Arduino as normal.

Laser Cut it Yourself Tank Kit

Available from Kitronik in the UK

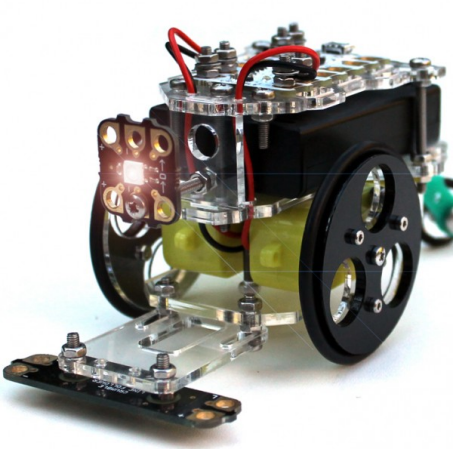
Mark: Just started to build these today with year 10. Will provide more info as we progress.



Crumble Robotic Vehicle ç

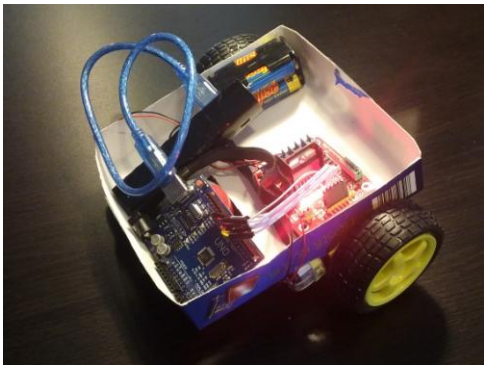
Available from Redfernelectronics in the UK

Mark: Just started to build these today with year 10. Will provide more info as we progress. Very cheap.



RoughBot

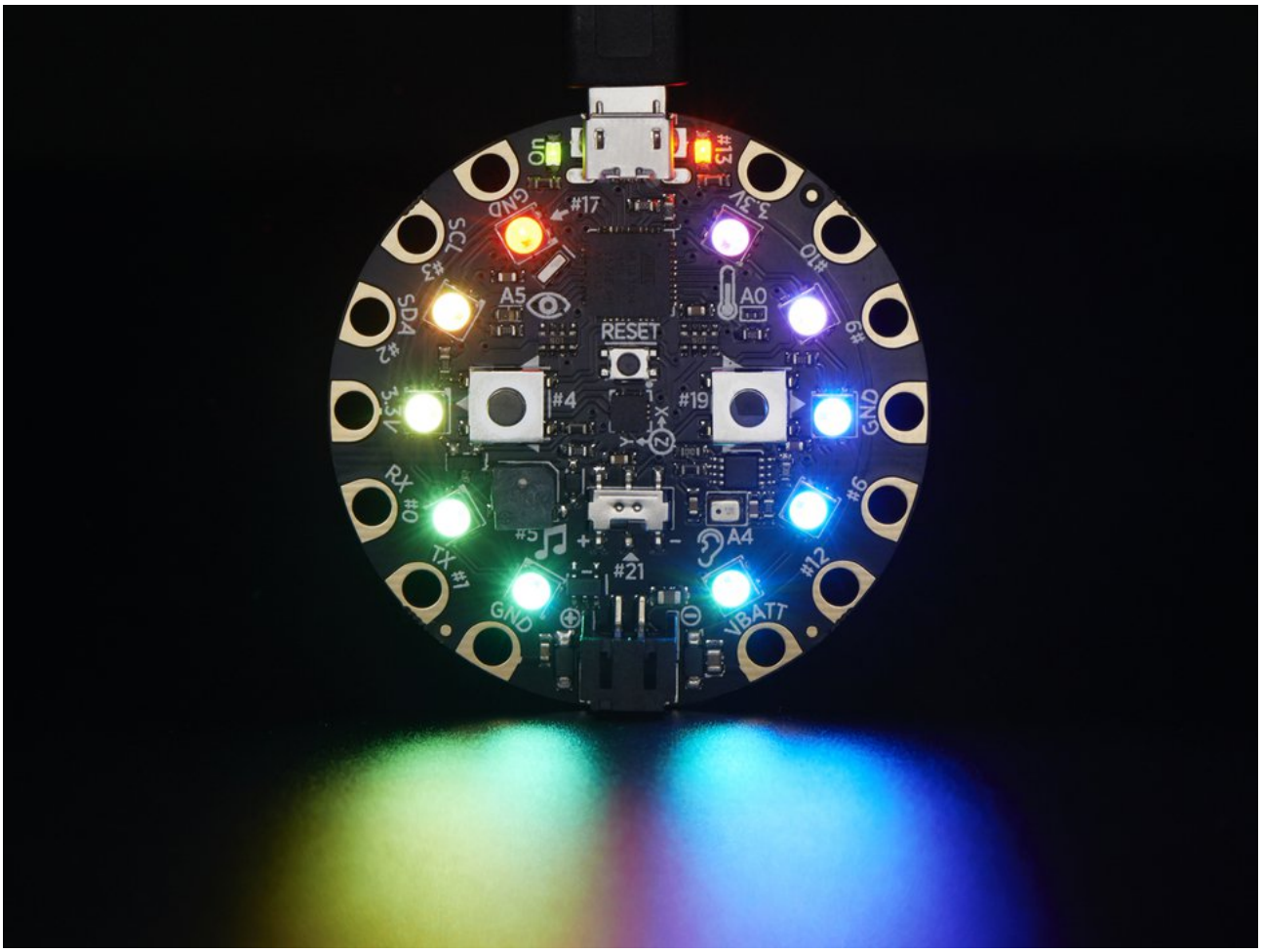
Sean: The intention of the RoughBot was to compile the simplest starter-kit for an Ardiuno-based wheeled robot. You will find a shopping list of parts that you can order from an electronics retailer like Jaycar. Alternatively you can order a pack directly through the Rough Science website.
The page also includes basic Arduino code for programming the RoughBot, as well as extensions to the original project, such as Bluetooth control via an Android phone/device.
http://www.roughscience.net/roughbot



- Prototyped in an extra-curricular tech team group with students from Year 7-12. Going very well. Very affordable. Coded with Arduino, so doesn't have proprietary software and is developing coding knowledge that can be applied to other projects.
- It's scaleable. We construct onto a baseboard so students can continue to build the robot by constructing 3D chassis. (If we had more time we could do that in the class but time is limited).
- 4. students develop an understanding of the components and how they all fit together rather than just coding an expensive 'robot' that they have to leave at school and their family can not afford to buy for them to have one at home.

Circuit Playground

Homepage: https://www.adafruit.com/product/3000



Mel Y: code.org offers an integrated curriculum with Code Studio and Circuit Playground as part of the Computer Science Discoveries for years 6-10 (https://studio.code.org/s/csd6). The Circuit Playground is relatively inexpensive (USD$19.95) and only needs a USB cable. The code.org curriculum is very much focused on coding principles and less about engineering/ construction. Be very careful which model you purchase as their are “developer” and “express” versions that run with Microsoft MakeCode, Python and Arduino.

Feature Summary Table

	Bluetooth DL	Water proof	Scratch friendly	Block coding	Touch	Light	Sound	Distance (IR & US)
BeeBot								
BlueBot	x			x				
ProBot								
Edison Robot Python version online			Own version.	x	x	x	x	x
mBot			x			x	x	x
LEGO Mindstorms	x			x	x	x	x	x
LEGO WeDo 2.0	x		x	x	x		x	x
VEX IQ	x							
Programmable minidrones droids	SpiderDrone - Yes			x				
Sphero/Ollie	x	x		x			x	
Ozobot (also line following)	x			x				
Dash & Dot	x			x		x	x	x
Finch Robot								
Arduino (raw)	Possible				x	x	x	x
Arduino (Deal Extreme)								
Arduino variant								
RoughBot	x				x	x	x	x
Micro:bit: Bitbot	x		x	x		x	x	x

Recommended Age Group Table

	P-1-2	3-4	5-6	7-8	9-10	11-12
BeeBot	x	x	x			
BlueBot	x	x				
ProBot		x				
Edison Robot	x*	x	x	x	x	x
mBot			x	x	x	x
LEGO Mindstorms		o	x	x	x	x
LEGO WeDo 2.0		x	x			
VEX IQ			x	x	x	x
Programmable minidrones droids			x	x	x	
Sphero/Ollie	P-2 can use with oral coding or as motor	x	x	x	x	
Ozobot		x	x			
Dash & Dot	x	x	x			
Finch Robot			x	x	x	
Arduino (raw)				x	x	x
Arduino (Deal Extreme)				x	x	x
Arduino variant				x	x	x
Laser Cut it Yourself			x	x	x	

Tank Kit						
Crumble Robotic Vehicle			x	x	x	
RoughBot			x	x	x	x
Micro:bit - Bitbot		x	x	x	x	x

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