LEGO BricQ & Spike Earth and Space Program – Peter Sugden - Cabbage Tree Island Public School

Unit Overview

This unit will explore the planets of our solar system and our moon, with the students to create a rover to explore their chosen celestial object. As Aboriginal Australians were the first astronomers, the students will start by talking to elders and researching the native animals represented by the constellations and our solar system and identifying key characteristics of the planets and moon. Once students have identified key characteristics of their planet or moon they will use the BricQ Motion Essential kits in combination with the SPIKE Essential kits to explore forces required to make their rovers move around the surface of their chosen planet or moon and create a rover to explore their chosen planet or moon, with their rover targeted to the characteristics of their planet and having features representing a chosen native animal.

Lesson length for this unit is 2 hours per session, this could be split up into smaller blocks as necessary to fit different timetables.

Language used in build examples is Bundjalung, the local language of where Cabbage Tree Island Public School is located.

NSW Curriculum Outcomes (Science & Technology K-6 2017)

Stage 2:
ST2-1WS-S questions, plans and conducts scientific investigations, collects and summarises data and communicates using scientific representations
ST2-2DP-T selects and uses materials, tools and equipment to develop solutions for a need or opportunity
ST2-3DP-T defines problems, describes and follows algorithms to develop solutions
ST2-10ES-S investigates regular changes caused by interactions between the Earth and the Sun, and changes to the Earth's surface

Stage 3:
ST3-1WS-S plans and conducts scientific investigations to answer testable questions, and collects and summarises data to communicate conclusions
ST3-2DP-T plans and uses materials, tools and equipment to develop solutions for a need or opportunity
ST3-3DP-T defines problems, describes and follows algorithms to develop solutions
ST3-10ES-S explains regular events in the solar system and geological events on the Earth's surface

Lesson	***Content***	***Activities***	***Registration & Evaluation***
1	Investigation of Aboriginal histories relating to the stars and planets.	Identify local Aboriginal elders who are able to help with locally relevant stories about the stars and planets to share with students. Speak to your AEO, Principal or AECG for assistance if needed. If this is not possible, the following resources may help:	

		Aboriginal Astronomy Website – Stories can be found by Aboriginal Nation in Content section, Curricula section includes lots of resources including BTN videos. http://www.aboriginalastronomy.com.au/ Australian Indigenous Astronomy Video Conference run by the Powerhouse Museum in Sydney https://www.maas.museum/program/video-conference-australian-indigenous-astronomy/ Aboriginal Astronomer talking about Astronomy https://aiatsis.gov.au/explore/aboriginal-astronomy Map of Australian Aboriginal and Torres Strait Islander Nations: https://aiatsis.gov.au/explore/map-indigenous-australia Non-Fiction Book "The First Scientists" by Corey Tutt https://www.hardiegrant.com/au/publishing/bookfinder/book/the-first-scientists-by-corey-tutt/9781741177527 Story Book "Brother Moon" by Maree McCarthy Yoelu https://www.magabala.com/products/brother-moon *Australia has many Aboriginal nations, it is important to acknowledge that all stories of the stars are not the same and acknowledge whose stories you are presenting, especially if they are not from your local area as there may be differences.* *There are approximately 250 different Aboriginal language groups and 250-500 different dialects with different names for animals in different language groups, where possible, use names of animals in your local language.* Students are asked to sketch a plan of their rover at the end of the lesson, showing its connection to their chosen native animal for this part explaining the contents of the BricQ and Spike kits and having them available to look through will help to make designs more feasible and faster to produce. **Lesson outcome:** Students should understand the connection between the sky and country. Students should be able to identify a part of the sky and the name in local language. Students should identify a native animal represented in stories of the stars that they would like to include in their rover design. Students should identify how the animal moves as this will affect their rover design. Students should sketch a rough outline of what their rover will look like, considering how it will move (the easiest way to get spike creations moving is with wheels).	

		Assessment: Students record their plan in their science books. - Part of sky identified and name in local language - Native animal represented in the sky, name in local language - Identification of how the animal moves – legs (short or long), fins etc. - Sketched diagram of planned rover – labelled with key features	
2	Facts about our planets and how these affect design of rover.	Rovers are sent to planets to explore and are tailored to target planets. Show students video about NASA's recent perseverance rover, sent to mars: https://mars.nasa.gov/mars2020/mission/overview/ A number of Australians were involved in this mission: https://www.abc.net.au/news/science/2021-02-17/mars-nasa-perserverance-rover-abigail-allwood-david-flannery/13149766 Students need to decide which planet they will send their rover to and how the characteristics of the planet will affect the design of their rover. The way some animals move are more suited to some planets and some animals may have restricted movement on certain planets. Students to find at least 6 facts about their planet including; Surface type – *this is the most important feature for rovers* Surface temperature Length of day Length of year Number of moons Other interesting facts Facts to be posted to google classroom or emailed so teacher can collate and print out and display with pictures of each planet as a wall display. Resources: Planet information, photos and details - https://solarsystem.nasa.gov/ **Lesson Outcome:** Discovery of facts about the key characteristics of each chosen planet. Justification of key design features of rover based on planet characteristics. **Assessment:**	

		Facts in Google Classroom Justification of design features in science books	
3	Using BricQ and Spike kits to create rovers for planet exploration.	Rovers are frequently sent to new destinations before manned spaceflight to explore new planets. They must be able to move on the target planet, BricQ kits can make a number of different methods of movement possible for example, moving with longer legs like walking, multiple smaller legs like a crawling animal, rolling on wheels, using gravity to start moving, using wind power from a fan (but this will not result in actual movement but could be a design suitable for water planets). Remind students that they are creating rovers to look like native animals, while they may not move exactly like those animals, they should have features and additions look like them (The next lesson includes specific time for decorating the rovers). Encourage students to experiment with using the gears in the BricQ kits to transfer power to all parts of the rover to control movement with a single motor. Motors will need to be built into the rover at this point as they must be integrated into the design. Students will need to think about hub placement as well, but the Colour Light Matrix or colour sensor can be added later if needed. *Spike Essential kits have 2 ports for input and output – using a single motor for movement will enable a second motor for secondary movement or the light display or colour sensor.* **Lesson Outcome:** Students create a model using BricQ and SPIKE kits that can become a moving rover of a rover. **Assessment:** At the end of this session, students should have built the base of the rover, with a plan for adding the remaining key parts of the spike kit.	
4	Adding Spike sensors to enable automation, completion and decoration of rovers.	SPIKE hubs have 2 ports, if only one port has been used for a motor, the second port can be used for either the Colour Light Matrix or the colour sensor. Colour Light Matrix can be used for decoration or to emulate eyes, if the planet surface is a certain colour, using a colour sensor will enable the rover to start moving once it reaches the surface. This lesson will complete the construction of the rover, connecting the Spike Hub to the motors so that it can be programmed in the next lesson.	

		Finally, students should decorate the rover to represent the student's chosen native animal, this may include modifying the body of the rover to make it look more like the chosen native animal. **Lesson Outcome:** Students will add sensors so that all ports are used in the hub. Students will complete the construction of their rover. Students will complete decorations of their rover to represent their chosen native animal **Assessment:** At the end of the lesson students should have a completed rover that represents their chosen native animal. The rover should use two ports on the spike hub.	
5	Programming Spike to make the rovers autonomous	Making the rovers move autonomously requires coding using the Spike Education App. Create a new project using word blocks. Students will need to identify what will trigger the rovers to start moving. Is it a colour? If student programs are planned to start with a colour sensor (to match a planet surface colour), choose the colour sensor start block in the controls tab. Otherwise, students should start their programs with the when program starts block (a wait block (in the control tab) may help to get rovers to start independently without interference. Students will need to identify which ports motors are attached to (this can be seen in the spike app when the hub is connected) so they can be programmed. Which way will motors need to turn, how long for to make the rover move a certain distance? If multiple motors are used, how will they be combined? Will the rover turn or draw a pattern relating to their native animal's movement? Once the motor is programmed, how will the Colour Light Matrix be used if it is connected to the rover? Indication of movement? Emulation of a feature on the chosen native animal? **Lesson Outcome:**	

		Students should create a program to make their rovers move independently. The choice of program should reflect their native animal or planet surface. **Assessment:** Functional program, using all connected motors and sensors or displays. Program uses motors to emulate animal movement or light sensor to trigger or Colour Light Matrix to represent part of the animal.	
6	Extension: Using BriQ to create a dock and launching device	Some students will complete their rovers and programming faster than other students, this extension expands skills in building simple machines and links with their rover design to make it more representative of real space exploration rovers. Rovers are sent into space on rockets and are enclosed in a device that opens on arrival on the planet. This lesson focuses on creating a dock or releasing device to allow the rover to launch. This device may use gears to open doors, a ramp to start movement or similar. **Lesson Outcome:** Students will create a launching cradle to fit their rover design. **Assessment:** Functional launching cradle	
7	Gallery walk – sharing of rover designs.	Students present their rovers to the class, explaining their rover's connection to their native animal and how their rover is adapted to their target planet. Students then demonstrate how their rover works. **Lesson Outcome:** Students will present their rovers to others and self-assess against the marking rubric. **Assessment:** See assessment rubric, to be self-assessed by students and then discussed with teacher.	

Assessment

Assessable outcomes of program:

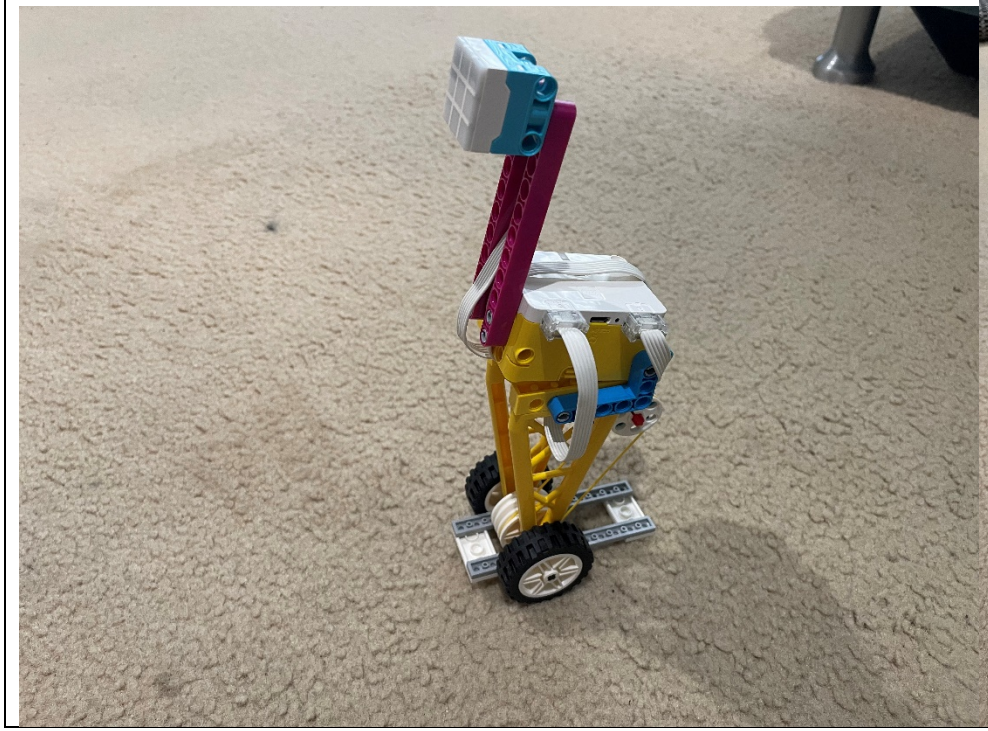
- Results of research on Aboriginal histories and planet characteristics. (ST2/3-10ES-S, ST2/3-1WS-S)
- Creation of rover that is relevant to planet characteristics. (ST2/3-2DP-T, ST2/3-3DP-T)

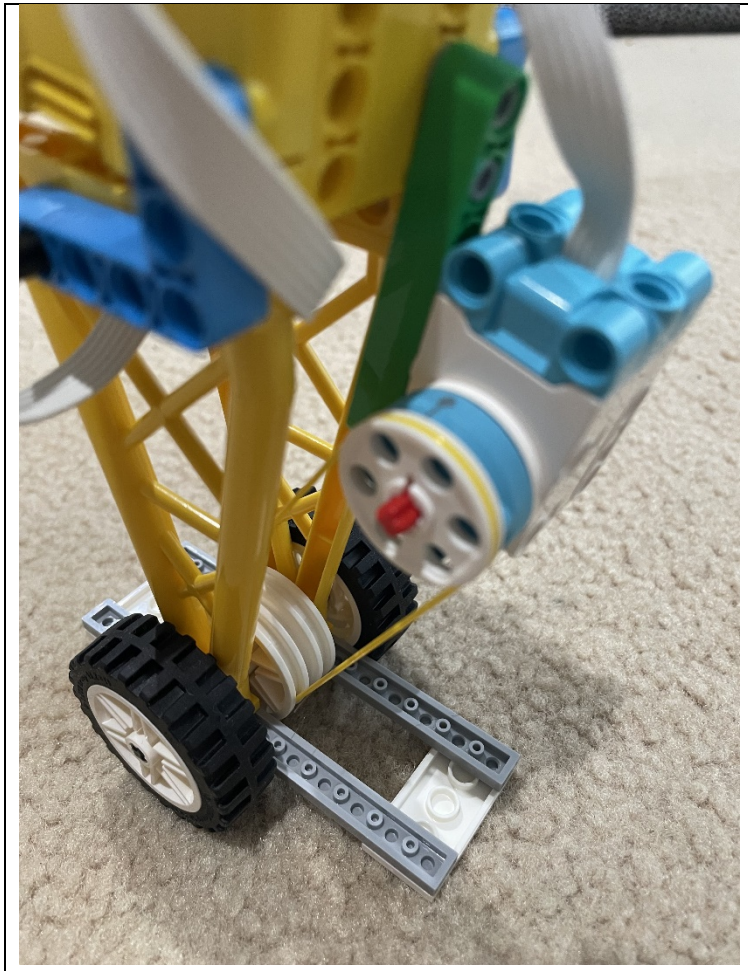
Marking Rubric for Completed Rover and Presentation (Lesson 7)

This marking rubric uses a single point style for achieving outcomes. If students are working towards outcomes or are exceeding, write why in the spaces left. This is done to reflect the myriad ways that students can exceed outcomes and allow recognition of a range of creative outcomes.

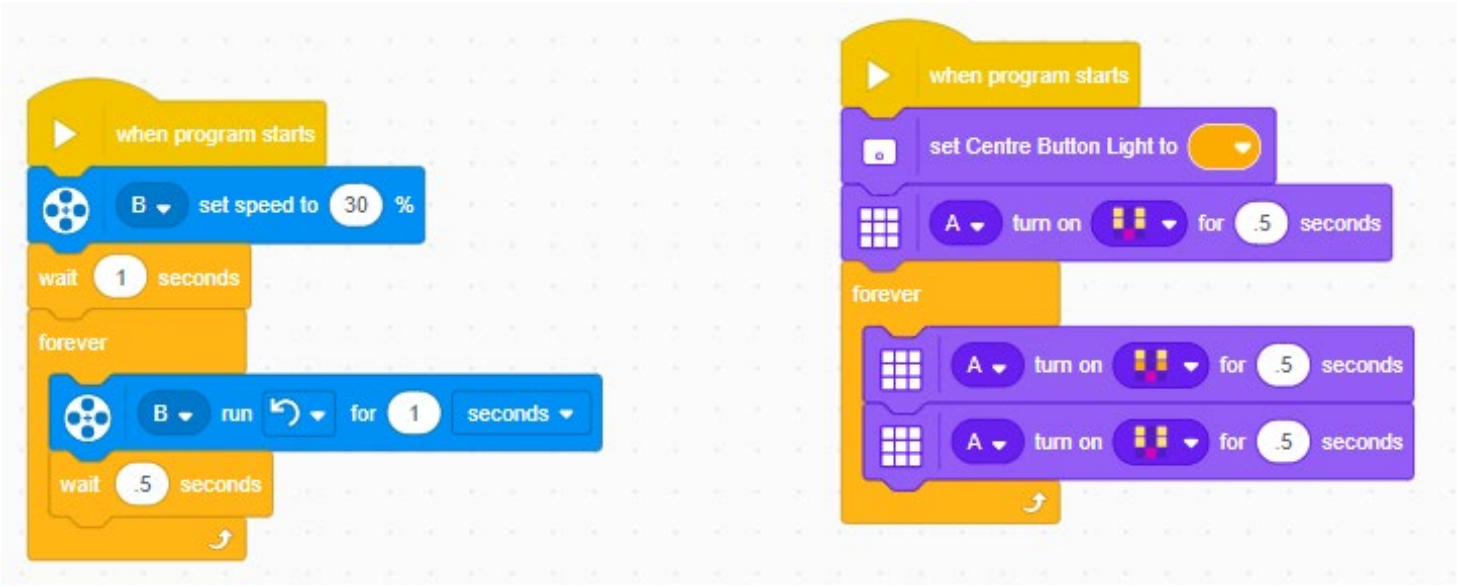
Marking rubric for LEGO native animal rover		
Name:	Native animal chosen:	Planet Target:
Our local language is:		
Name of rover in local language:		
Working Towards	***Achieving***	***Exceeding***
	I can explain the area of the sky which represents my chosen native animal	
	I can describe how my rover is suited to my target planet	
	I have made a rover capable of movement	
	My rover uses a combination of motors, the colour sensor or the Colour Light Matrix together to move and represent my chosen native animal	
	I have programmed my rover to function as I intended it	
		I have created a launching device or cradle for my rover
	I can present my rover to the class and justify my design choices.	

Example of rover build – ngooding (emu)





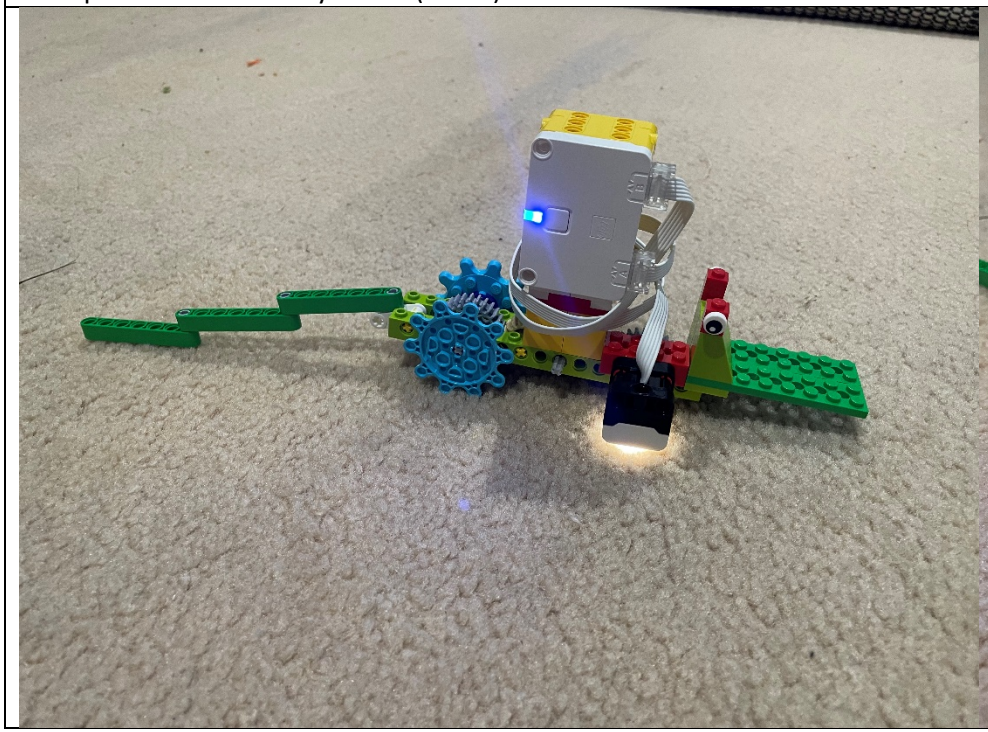
Program example (Word Blocks)

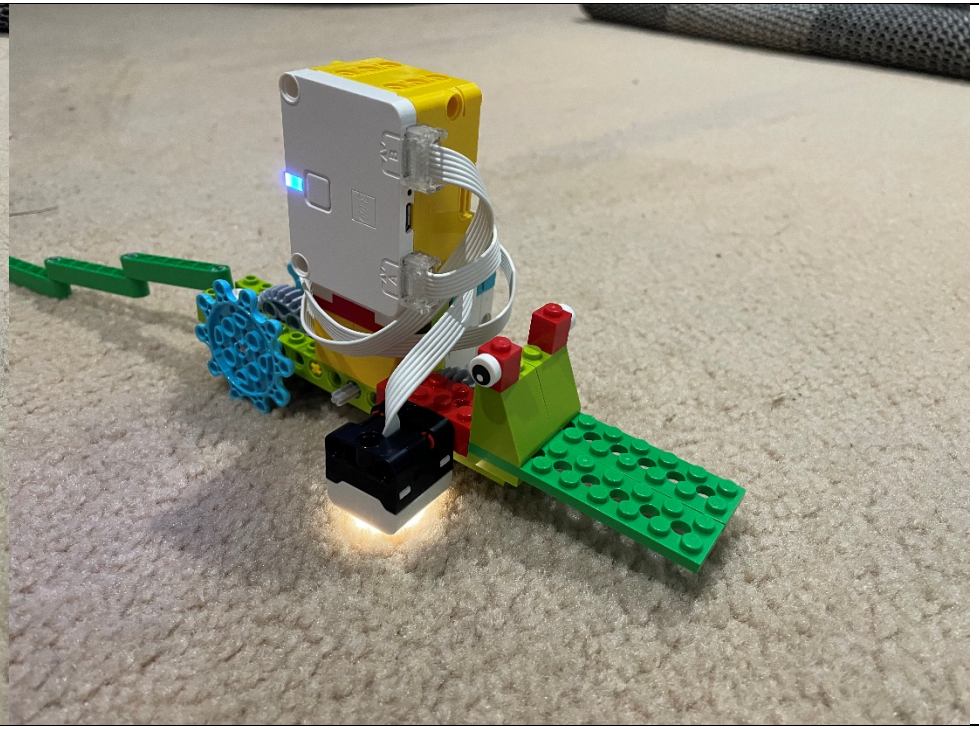


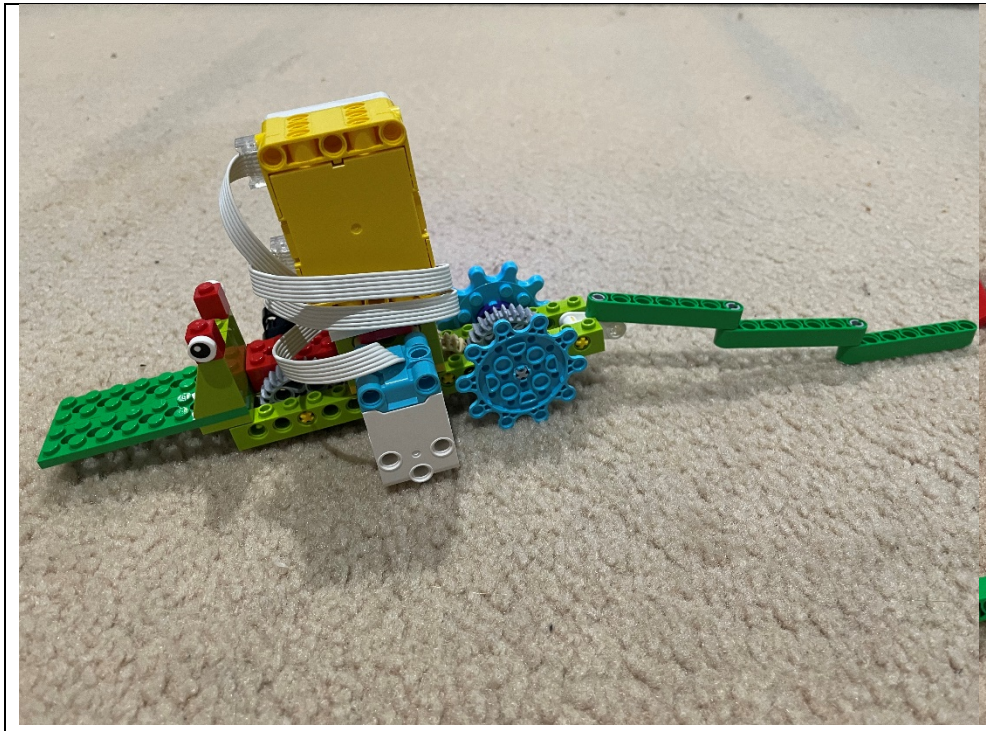
Video of rover in action

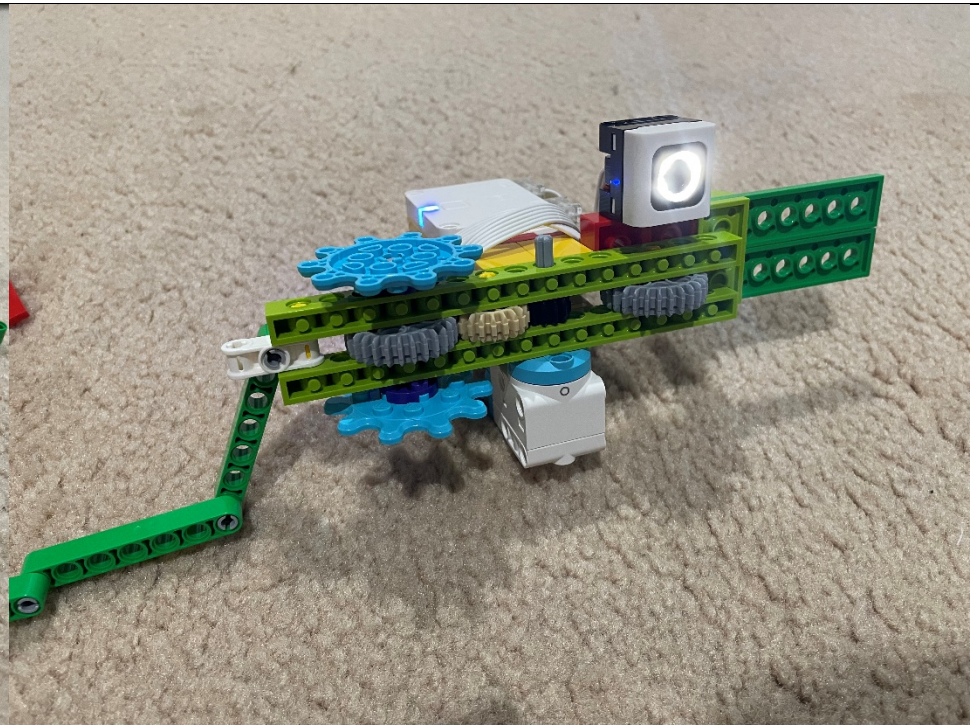
https://schoolsnsw-my.sharepoint.com/:v:/g/personal/peter_sugden1_det_nsw_edu_au/EaFyRD8QGyBDkXjNzkCrQLEB8lOA5P_oq1ZkTPBYkYsV4g?e=9gPygb

Example of rover build – yumbar (snake)









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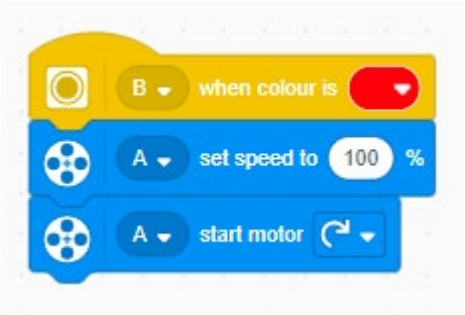

Video of rover in action
https://schoolsnsw-my.sharepoint.com/:v:/g/personal/peter_sugden1_det_nsw_edu_au/EQl1RCWrs2ZAtDe-vasSScQBD85cH6Tr5klAWhNF8Z9HLA?e=yTmcYF