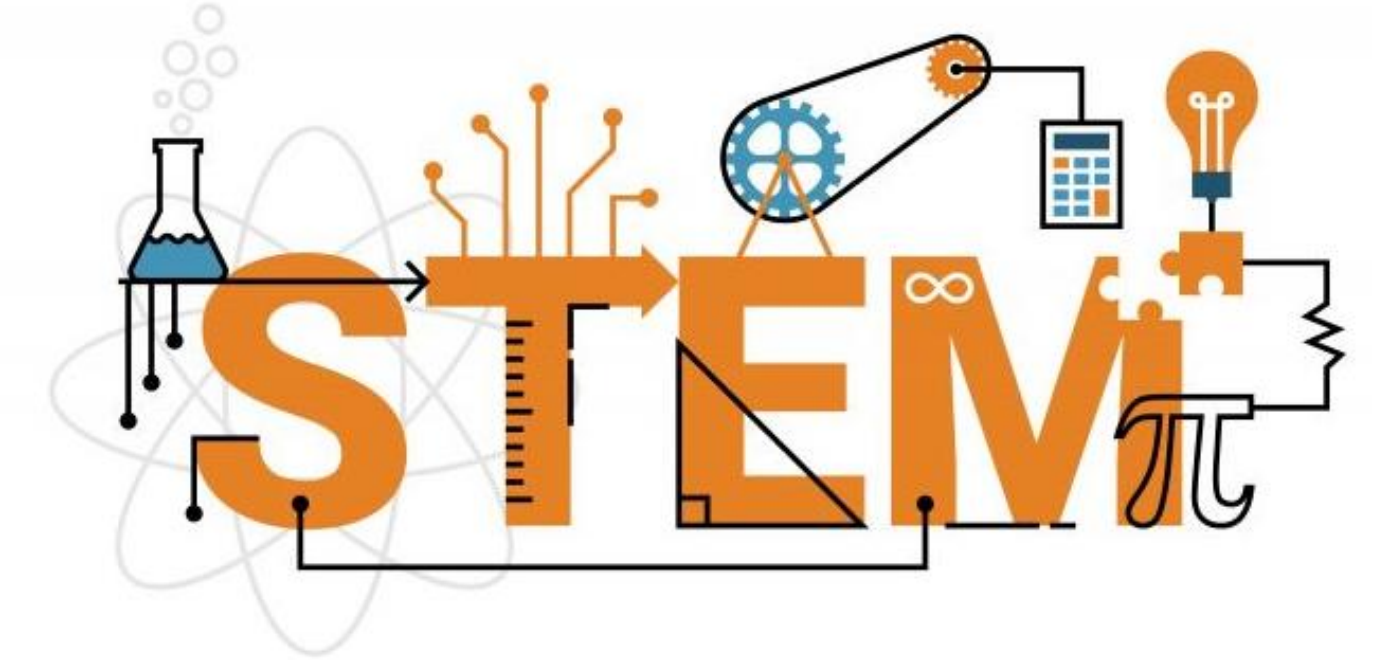
Teaching Robotics to stem the decline of



Monday, July 9, 2:00 PM

Presenter: Mark Lockett

- I always wanted to be an Engineer
- Honours Degrees in Electronic Engineering
- Engineer intern for a couple of summers
- Post Grad in Education in Design Technology
- Taught for 2 years in the UK
- Taught Robotics, Engineering and Design at TSS for 22 years

STEM enrolments hit 20-year low

ABC News Breakfast By Patrick Wood

Updated 30 Mar 2017, 12:57pm

Australian Government Report

STEM in Australia

Decline in University students choosing STEM courses from 30% in 2000 to 18% in 2015.

STEM in China

In 2015, 47% of University Students.

STEM in Singapore

In 2015, 35% of University students.

Australian Bureau of Statistics

STEM-related jobs in Australia will increase by 13%.

STEM in Australia

Reasons: (National surveys)

Lack of interest in STEM subject at school.

Lack of information regarding STEM careers.

How do we combat a lack of interest?

Excuse me Miss,
Why do I need teachers when I have Google?

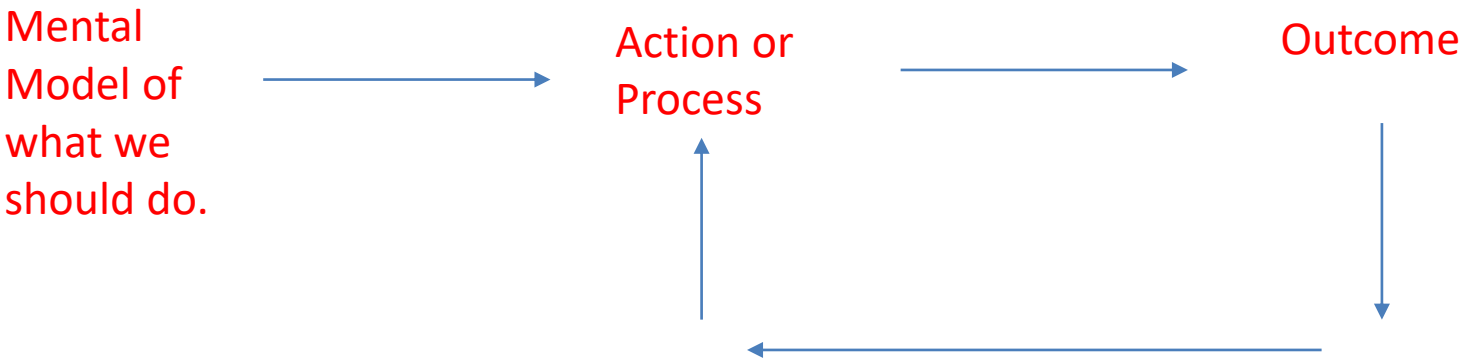
Chicken Soup for the Teacher's Soul :
Stories to Open the Hearts and Rekindle the Spirits of Educators

…. another student answered, saying that she was going to university to study History because her teacher had not taught her everything about history BUT she taught her the love of history.

How do we create a 'Love of STEM'?

Single Loop Learning/Teaching
V's
Double Loop Learning/Teaching

Single Loop Learning



Using the Single Loop Learning Approach

Problem: Car in the Harbour. SLL Solution: Get a Crane.

Process/Action


© Nicholas Griffin


© Nicholas Griffin

Outcome: Car and Crane in the Harbour

SLL Solution: Get a Crane


REDMOND BROS
TRUCK & CRANE HIRE
© Nicholas Griffin


TRUCK & CRANE HIRE

Outcome: 2 Cranes in the Harbour

SLL Solution : Get a Crane.

Single Loop Learning/Teaching
How we teach STEM

Mental Model of how we should teach STEM
(often set at University or by the curriculum)

→

Action or Process of Teaching STEM

→

Outcomes of Teaching STEM

Sage on the Stage

(Instructor Model)

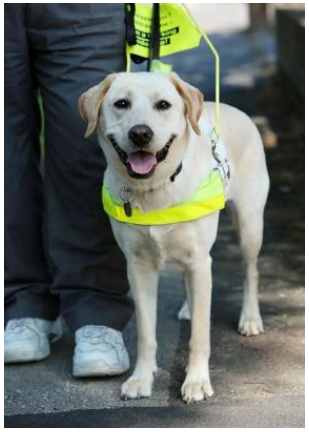
STEM and the Instructor Mental Model

Double Loop Learning/Teaching

Mental Model of how we should teach STEM

Action or Process of Teaching

Outcomes of Teaching



Guide on the Side (Facilitator)

+

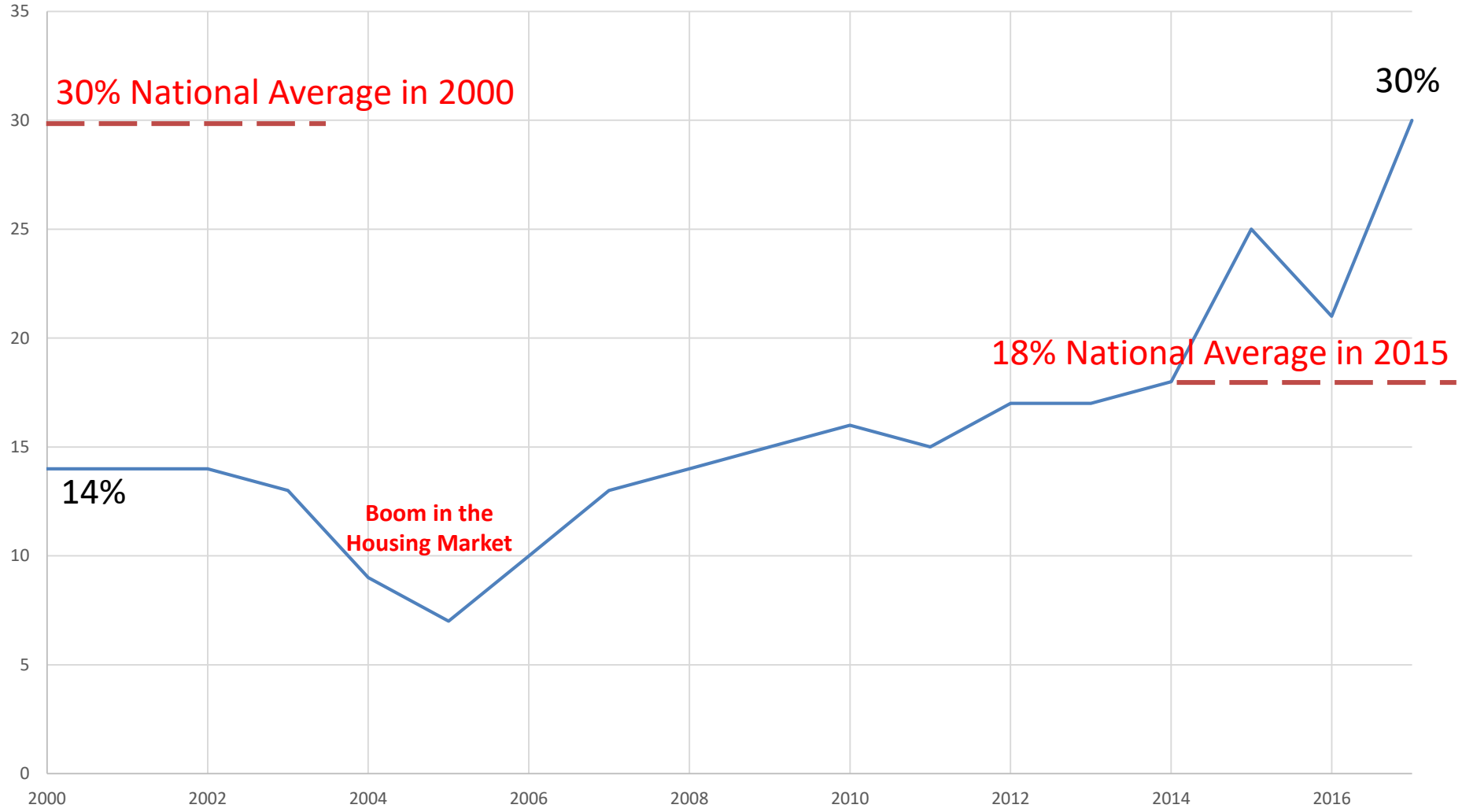
Sage on the Stage (Instructor)

Testing Gear Ratios V's Generator Output

STEM and the Facilitator Mental Model

What has been the impact of using a Double Loop Learning approach at TSS?

Percentage of TSS Year 12s accepting a STEM courses at University



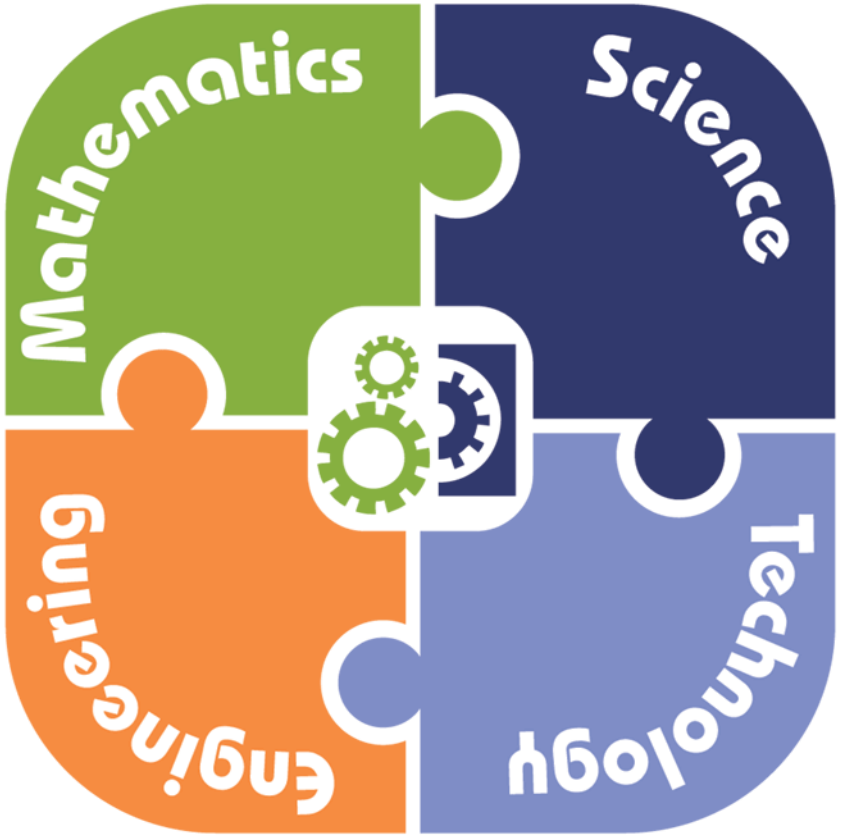
Engaging TSS Students in STEM courses

- Science – Inquiry Based Learning.
- Technology – CAD, CAM, 3D, VR, Game Design.
- **Engineering – Robotics and Drones.**
- Maths – Real World Problems.

Why Robotics?

Teaching STEM through Robotics

Trigonometry
Geometry
Percentage Error
Maths for PID control
Data Functions



Dynamics
Statics
Datalogging and Sensors
Autonomous Testing Rigs
Scientific Method

Engineering Process
Electronics
Mechanics
Structures
Pneumatics
Hydraulics

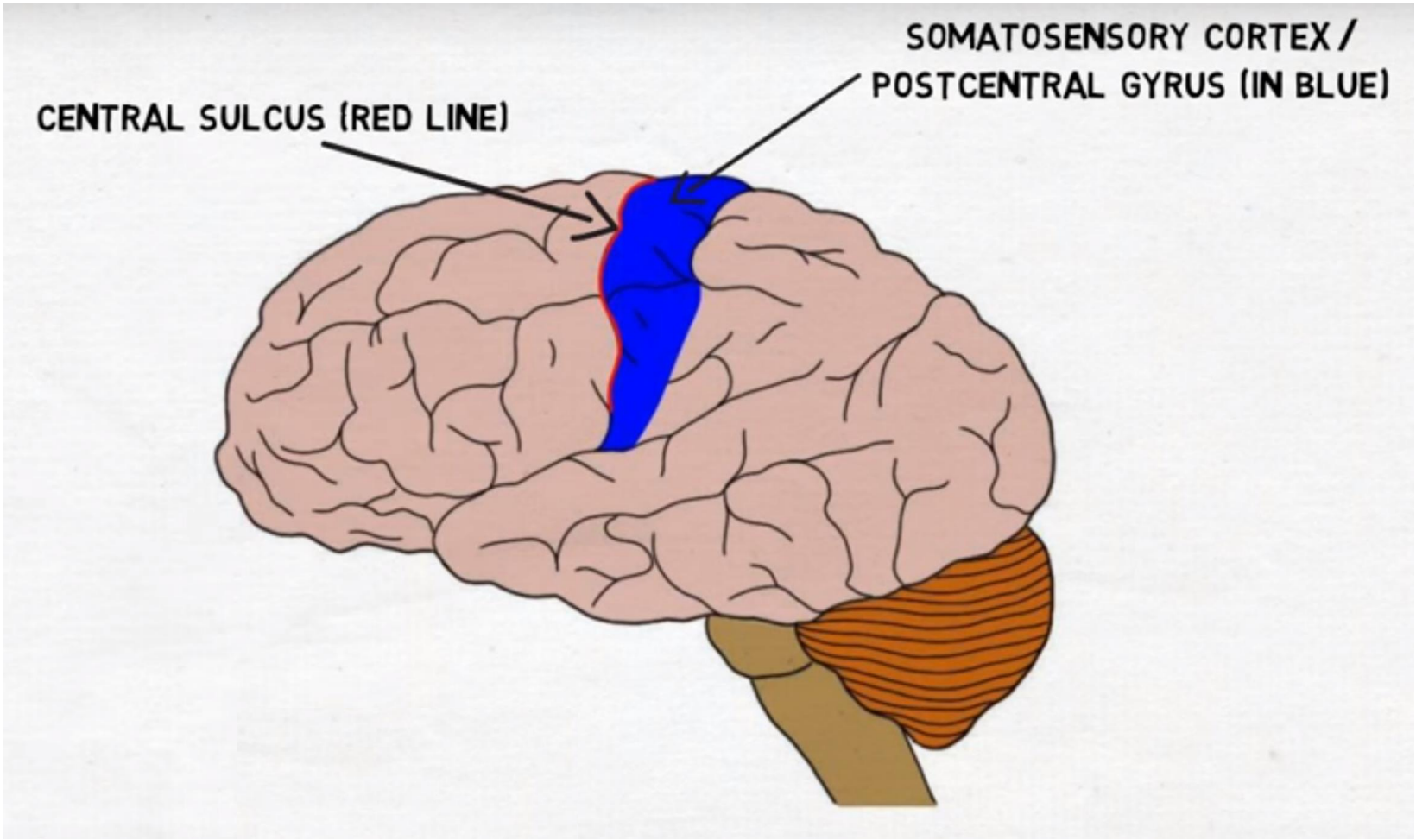
Systems
Coding
P.I.Ds
Image Processing
Electronics
Design
Boolean Logic

How do boys learn best?

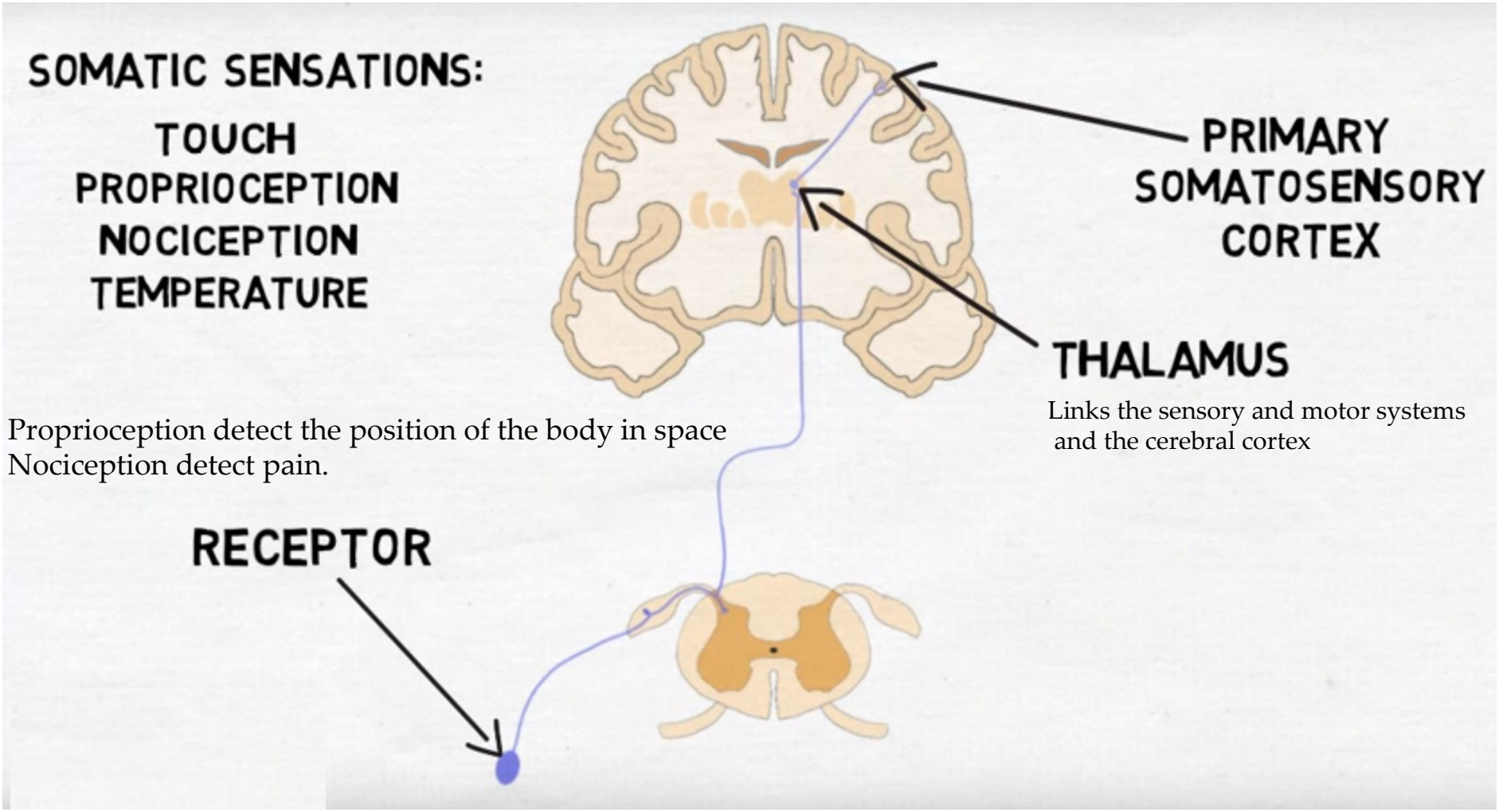
- ‘Hands-on, Minds-on’ approach.
- Project based assessment.
- Small groups.
- Movement in the classroom.
- Competitions.
- Real world application.
- Creativity.
- Support failure and redesign iterations.

What is ‘Hands-on, Minds-on’?

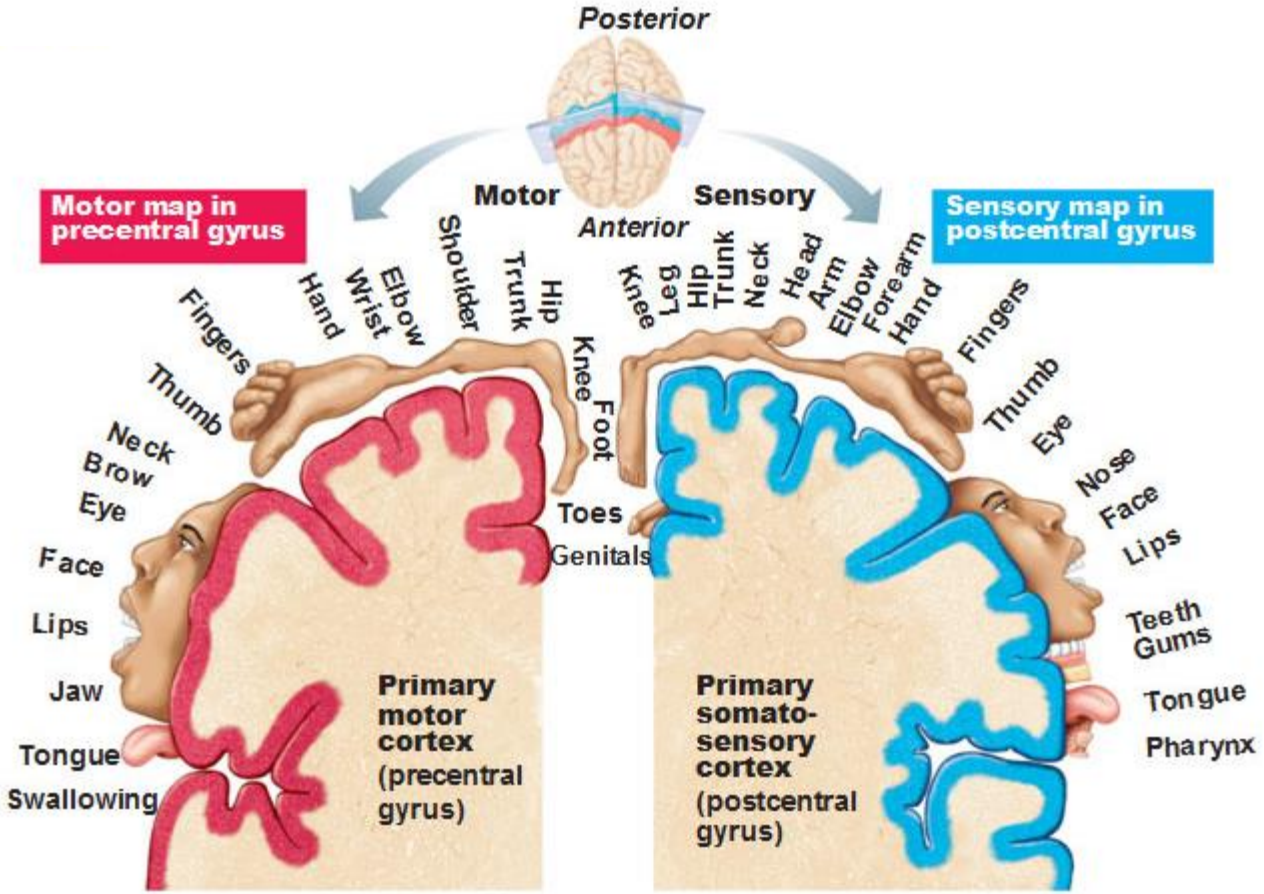
The Somatosensory Cortex



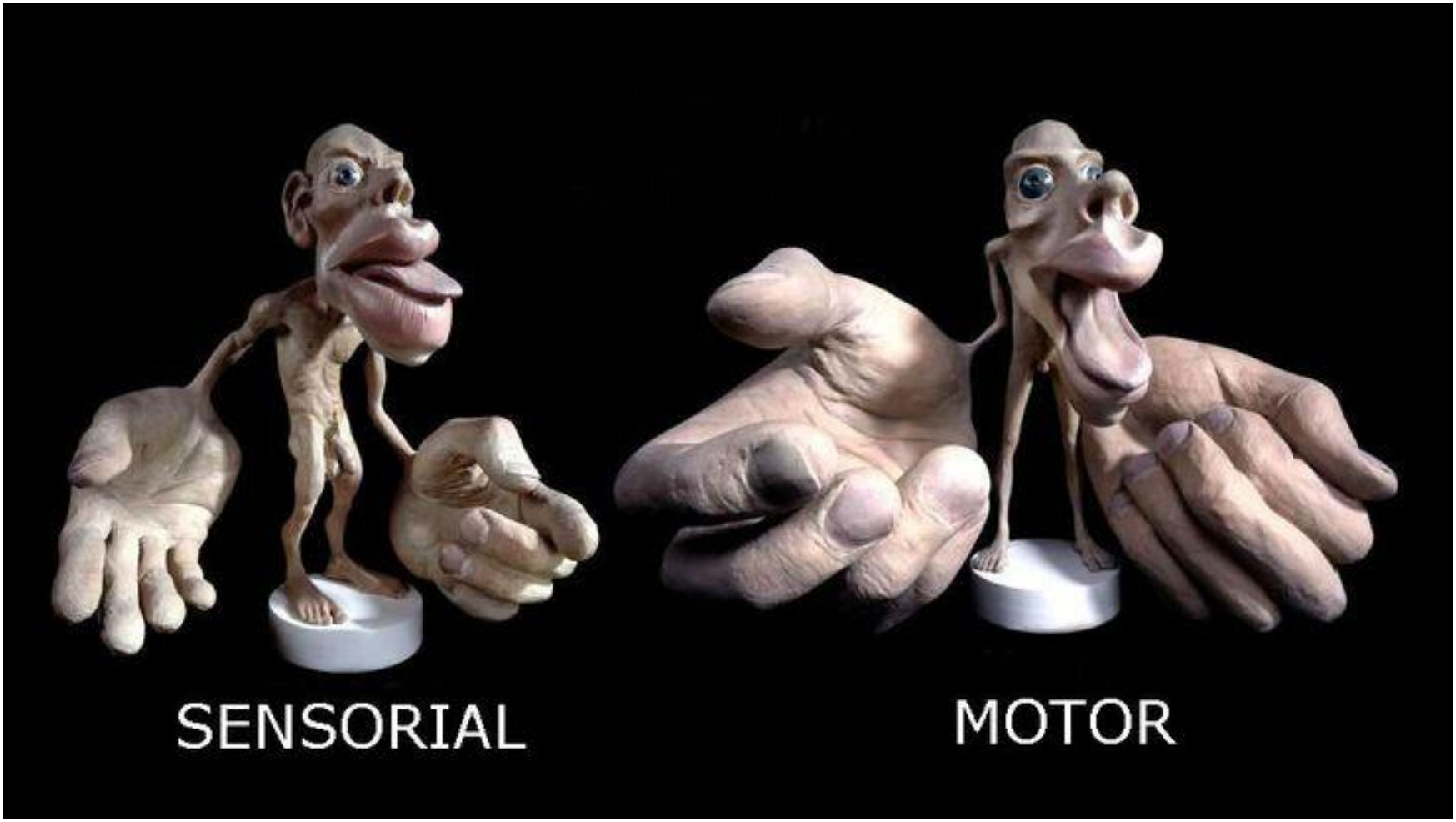
What does it do?



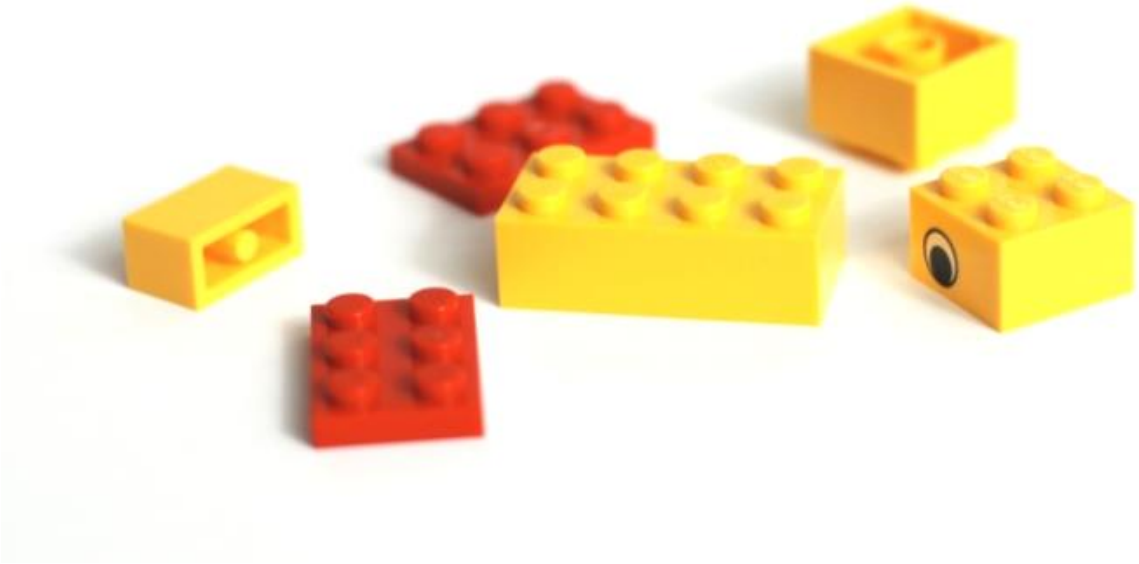
The Somatosensory Cortex



Representation of our body found within our brain.



Let’s try a Hands On, Minds On Activity



Tricks to building with LEGO

- Don’t have a meeting with yourself about what you are going to build.
- Don’t look at what others are doing.
- Just start putting blocks together.
- Let your brain ‘catch up’ to your hands.

Open the bag and place the six bricks in front of you.

Using the bricks, build a duck

Show Time!

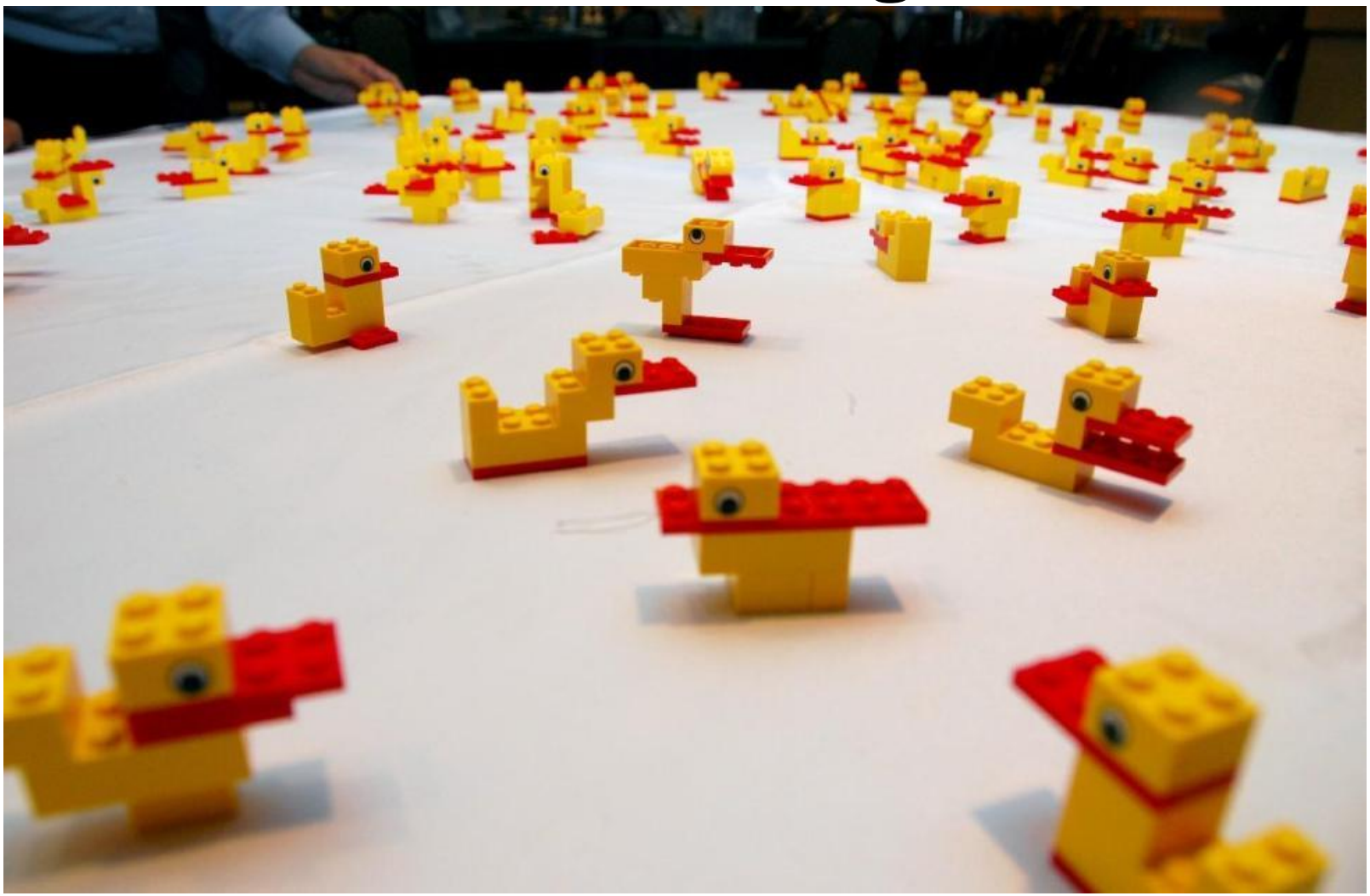
Create a duck pond collection with your colleagues

OR

Hold up your duck and look around the room at the other ducks.

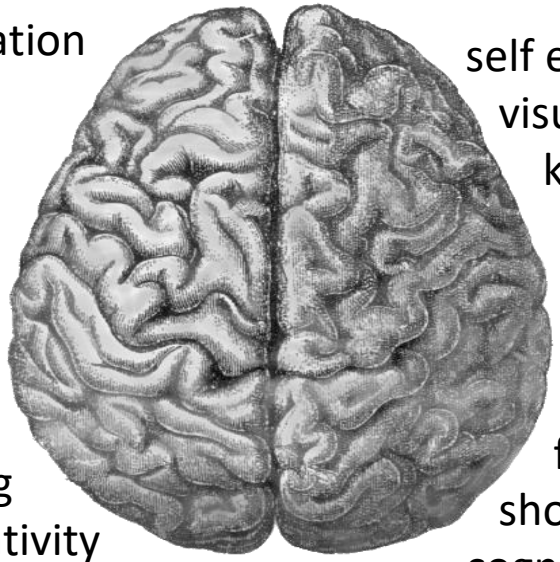
What do you notice about the ducks in the room?

The Power of Imagination



What are the skills being used?

emotional regulation
long term memory
mental imagery
systems thinking
visual perception imitation
adaptive social functioning
perspective taking
self assessment
problem solving
creativity
decision making



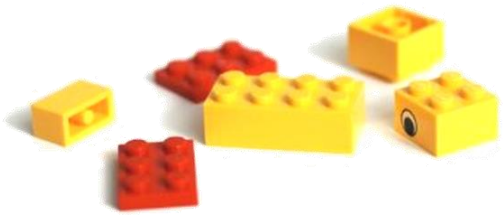
self efficacy
visual search
kinaesthetic awareness
spatial visualisation
sensory motor skills
mental rotation
working memory
fine motor skills
short term memory
cognitive flexibility

6

LEGO® bricks…

21

skills are used…



Future Job Skills

Top 10 skills by 2020
World Economic Forum

1. Complex Problem Solving
2. Critical Thinking
3. Creativity
4. People Management
5. Coordinating with Others
6. Emotional Intelligence
7. Judgement and Decision Making
8. Service Orientation
9. Negotiation
10. Cognitive Flexibility

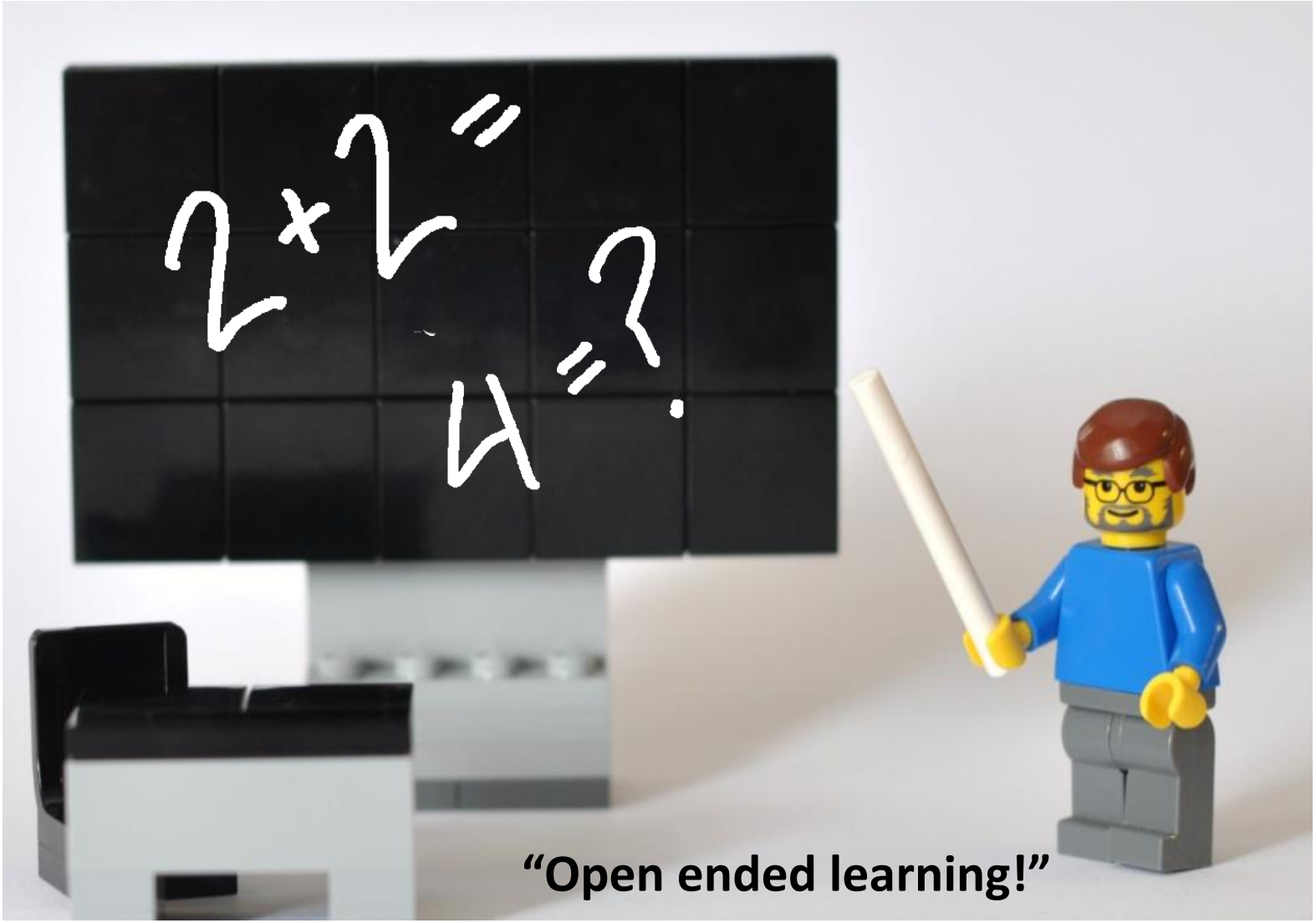
Google's top skills

1. Being a good coach
2. Communicating and listening well
3. Possessing insights into others
4. Having empathy
5. Being a critical thinker and problem solver
6. Making connections across complex ideas

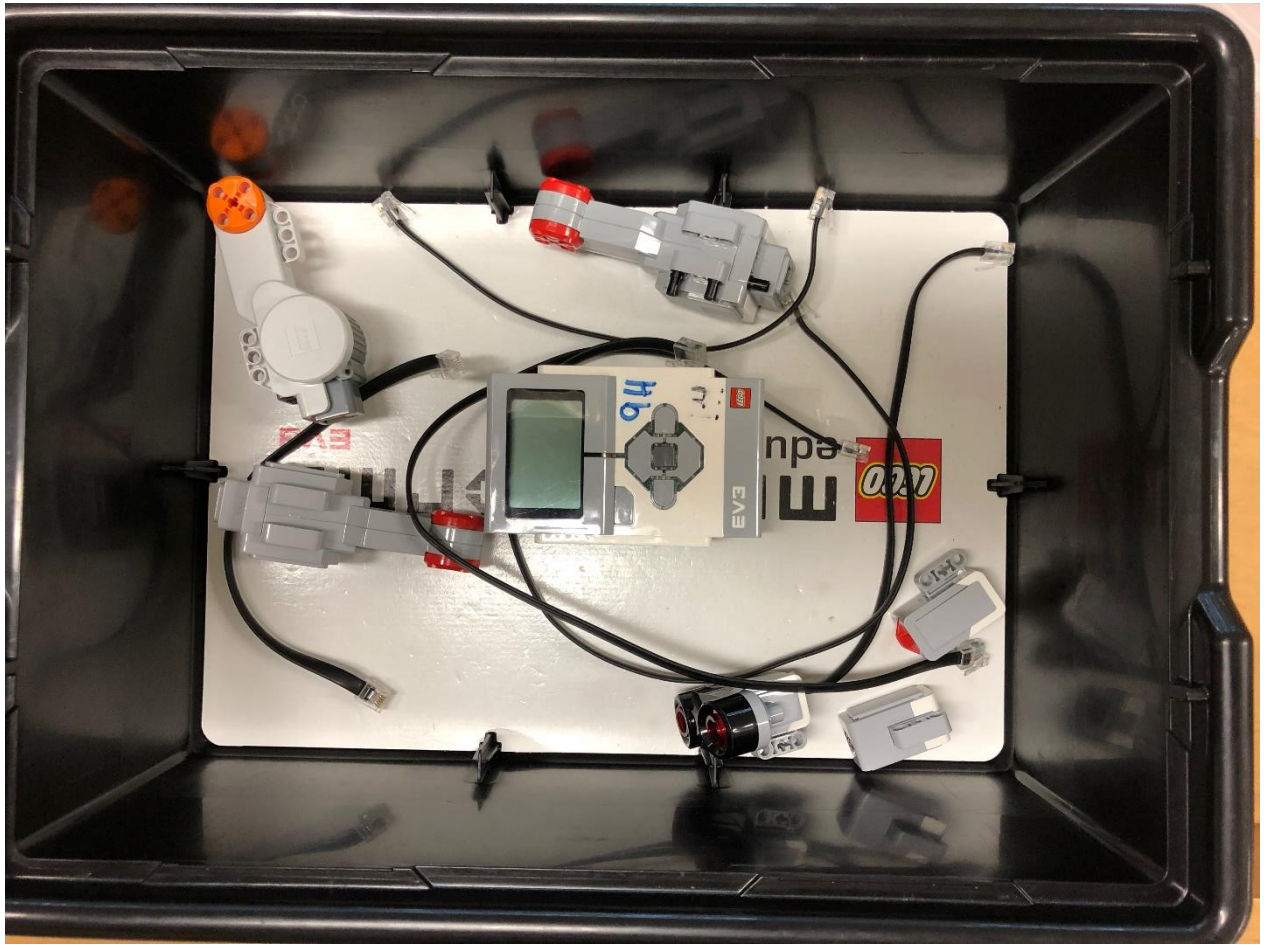
... ...

X. STEM Expertise

The Southport School
Robotics and Engineering Program


2*2=
4=?
“Open ended learning!”

Year 7 and 8
Working in Pairs – Basic Hardware



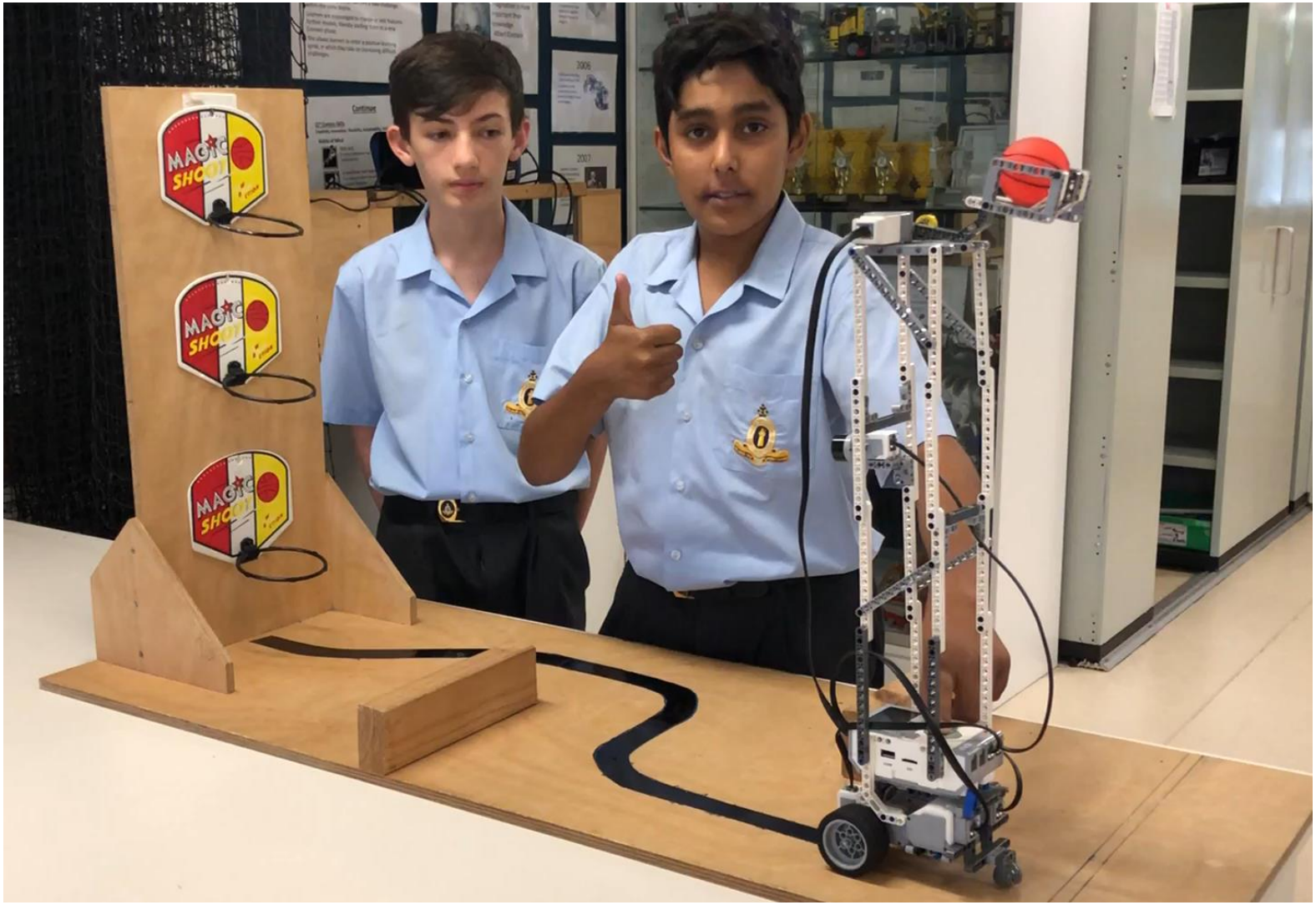
The Spares Cupboard

Unsorted Boxes

Adapt ideas to suit the available parts

Yr. 7 Robotics - Sports in the Future

Year 7 Robotics

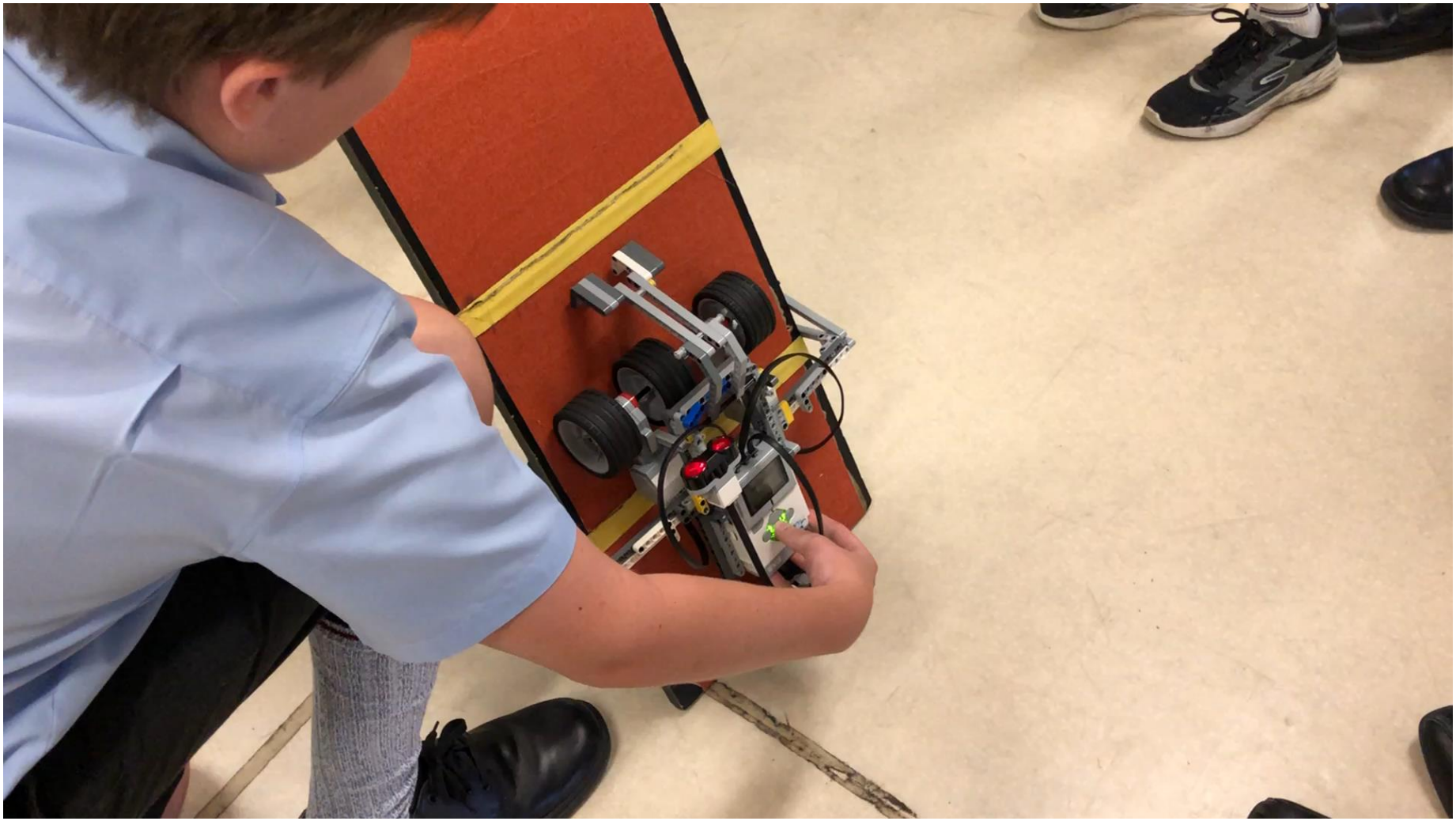


Feedback

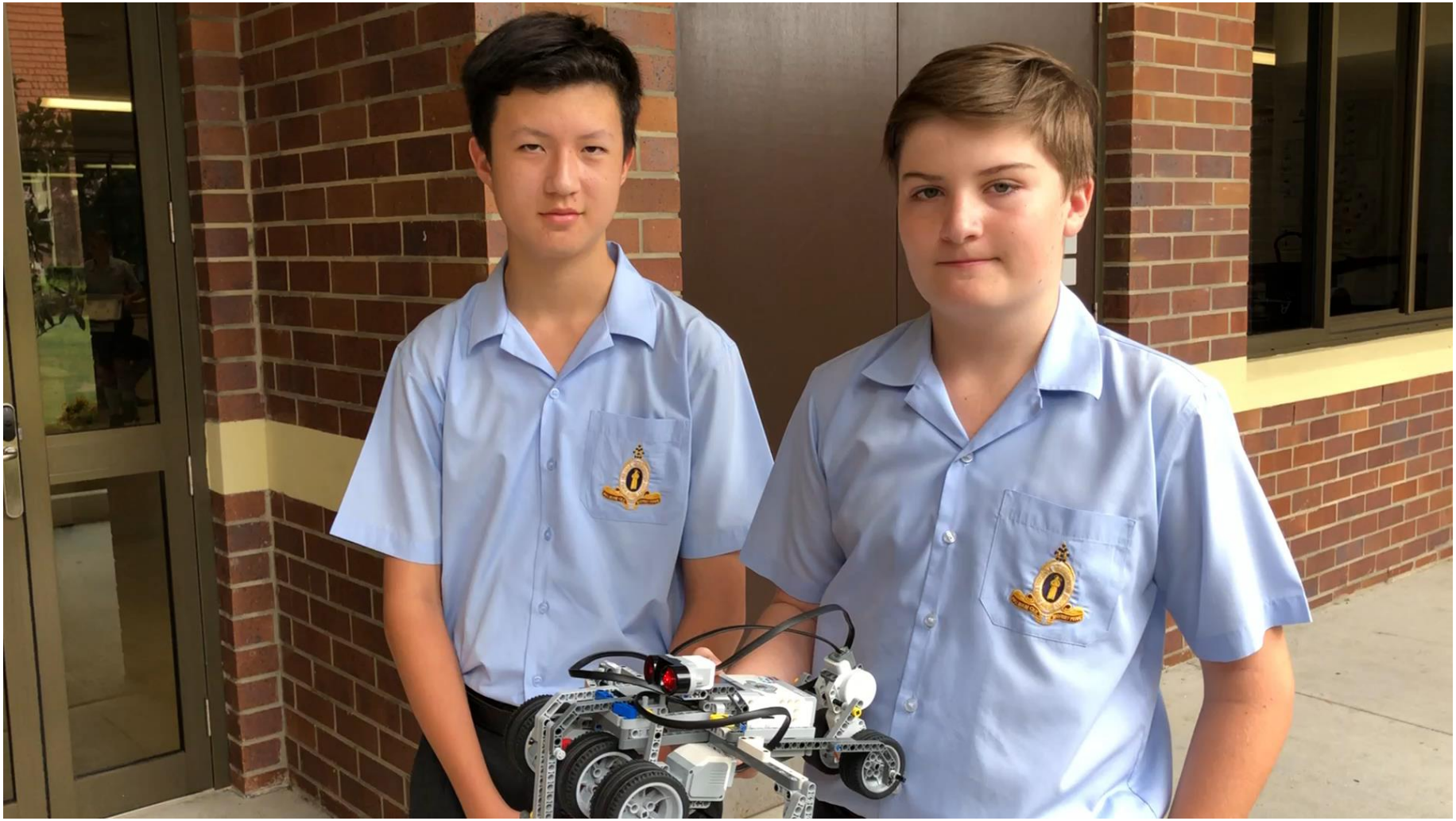
Yr. 8 Robotics – Hill Climb

Hill Climb

Year 8 Robotics



Feedback



Real World Link

Disk Collector

Build and program a Robot to knock out 10 disks from a circular arena. The robot must comply with width and length restrictions.

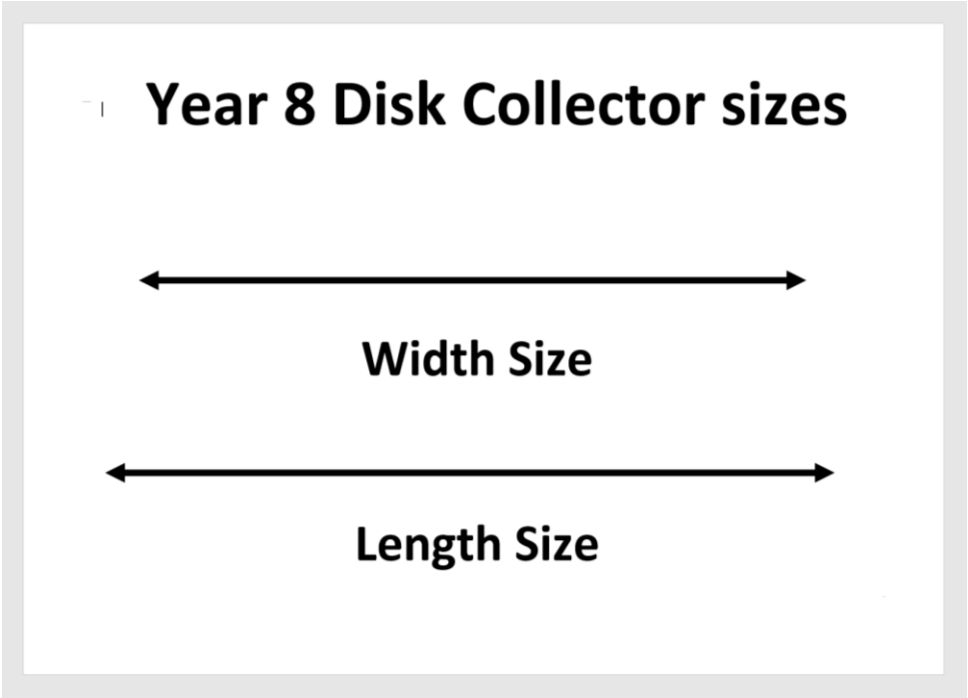
Your grade will be determined by how fast the disks are knocked out the arena. A disk is classes as being knock out if over half of it is on the black line

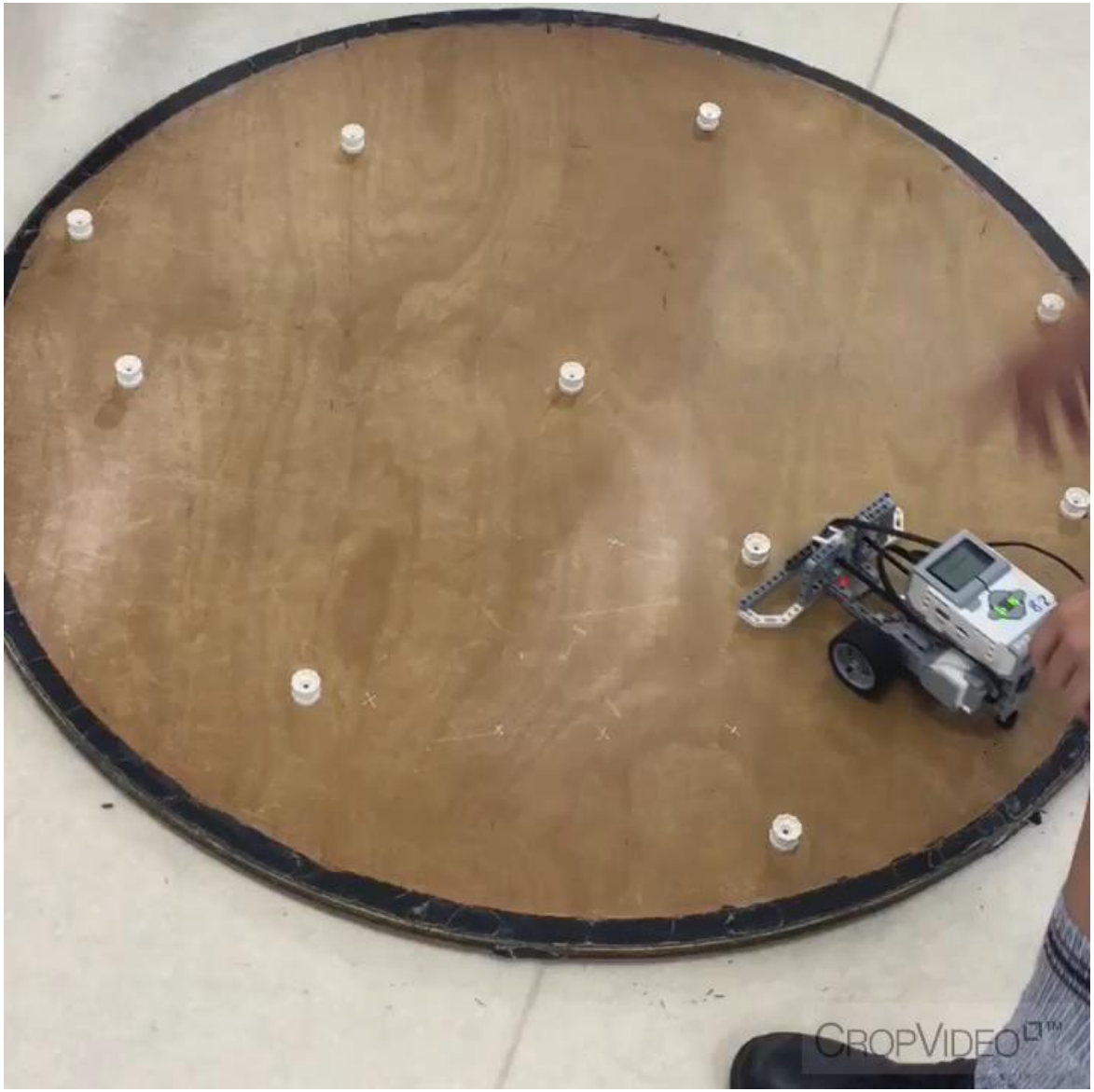
The robot must start with all parts of the robot within the black line of the arena.

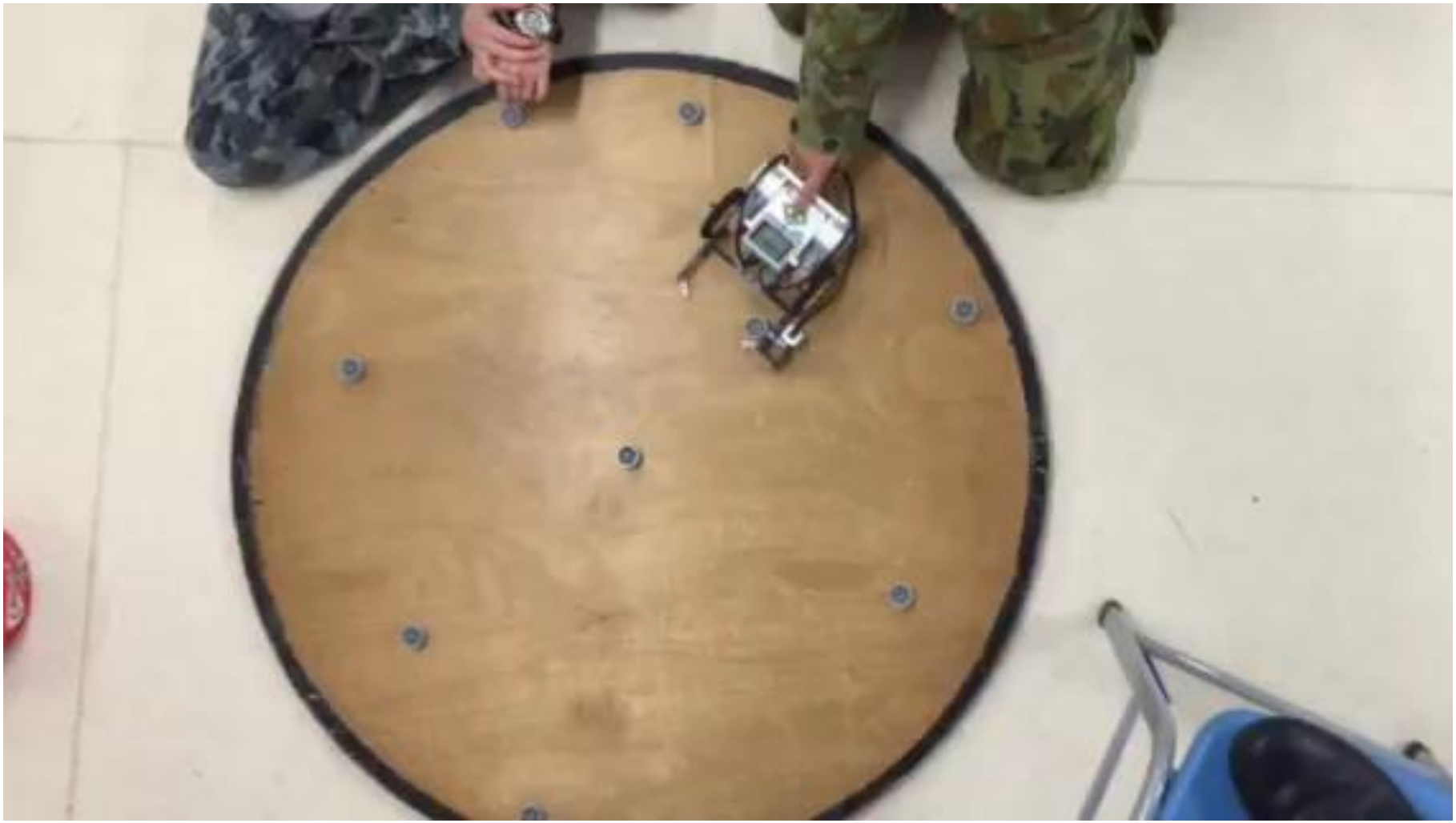
Grading and Limitations

Disk Collector Scoring Times

A+	14 seconds or less ☺
A	16 seconds
A-	18 seconds
B+	22 seconds
B	26 seconds
B-	28 seconds 😐
C+	33 seconds
C	38 seconds
C-	43 seconds
D	Goes forward but does not see black
E	Does nothing. ☹



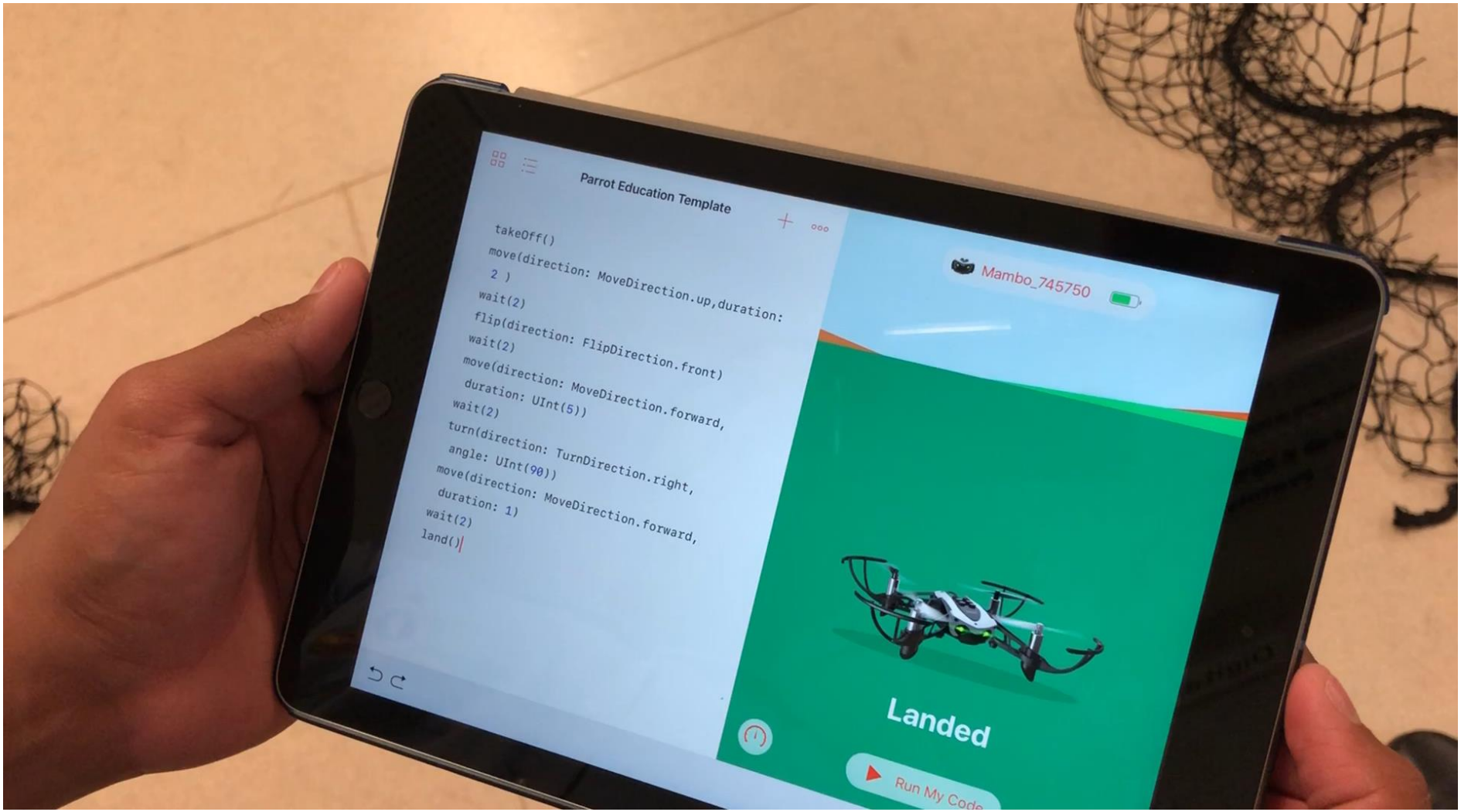

CropVideo™



Feedback

Swift Playgrounds Drone Course


This is a shared room
Students:
Do not move the Computers.
Do not unplug cables.

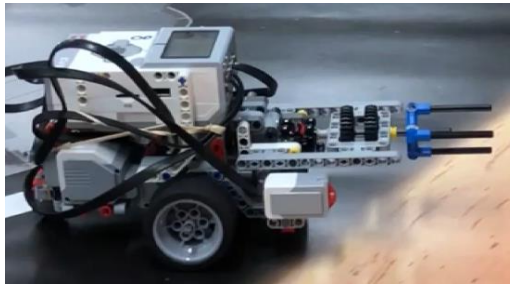

Parrot Education Template
takeOff()
move(direction: MoveDirection.up,duration:
2)
wait(2)
flip(direction: FlipDirection.front)
wait(2)
move(direction: MoveDirection.forward,
duration: UInt(5))
wait(2)
turn(direction: TurnDirection.right,
angle: UInt(90))
move(direction: MoveDirection.forward,
duration: 1)
wait(2)
land()
Mambo_745750
Landed
Run My Code

Year 9 Robotics

Robotic Engineering

Start of Lesson

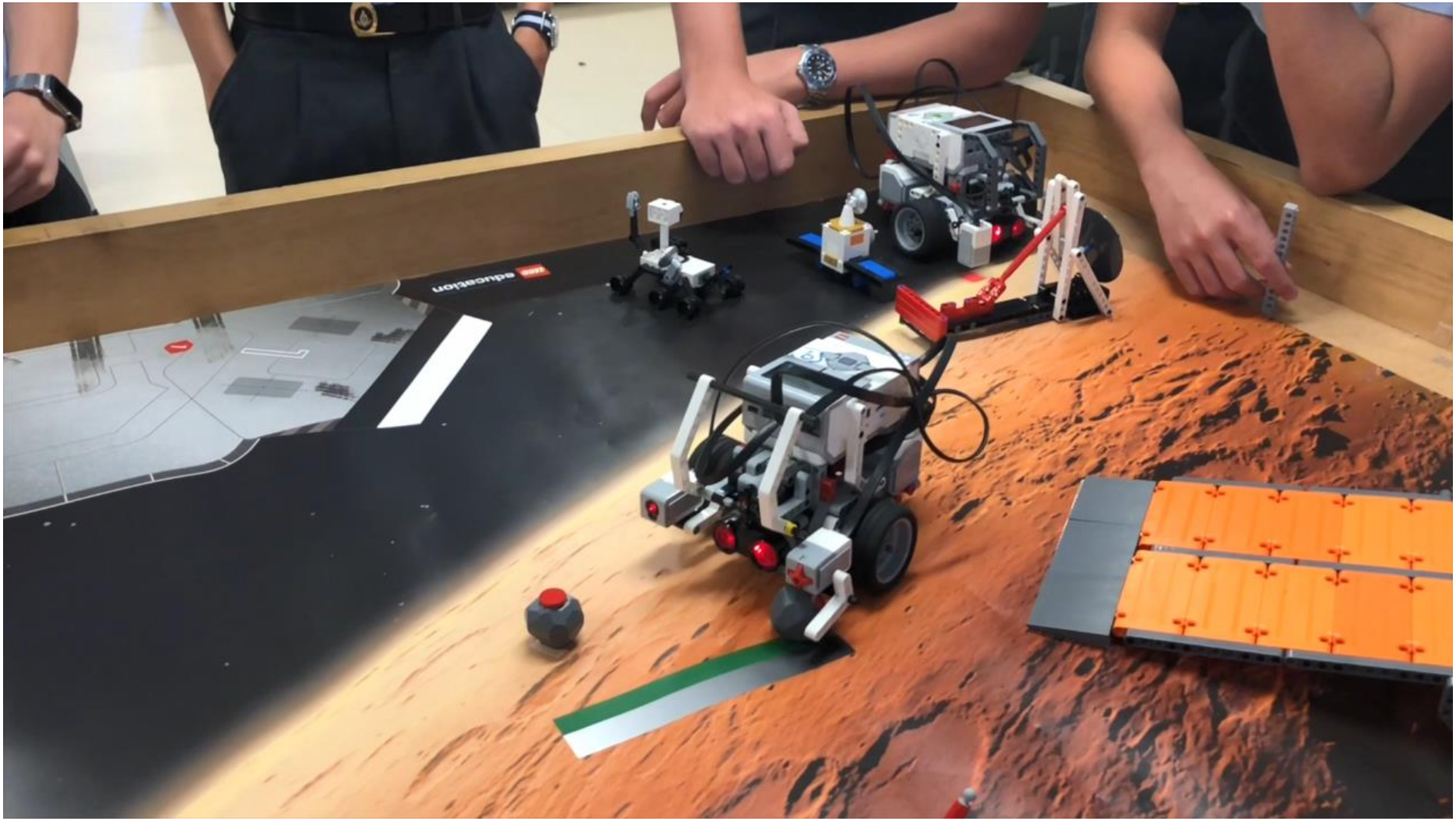
Build and Test



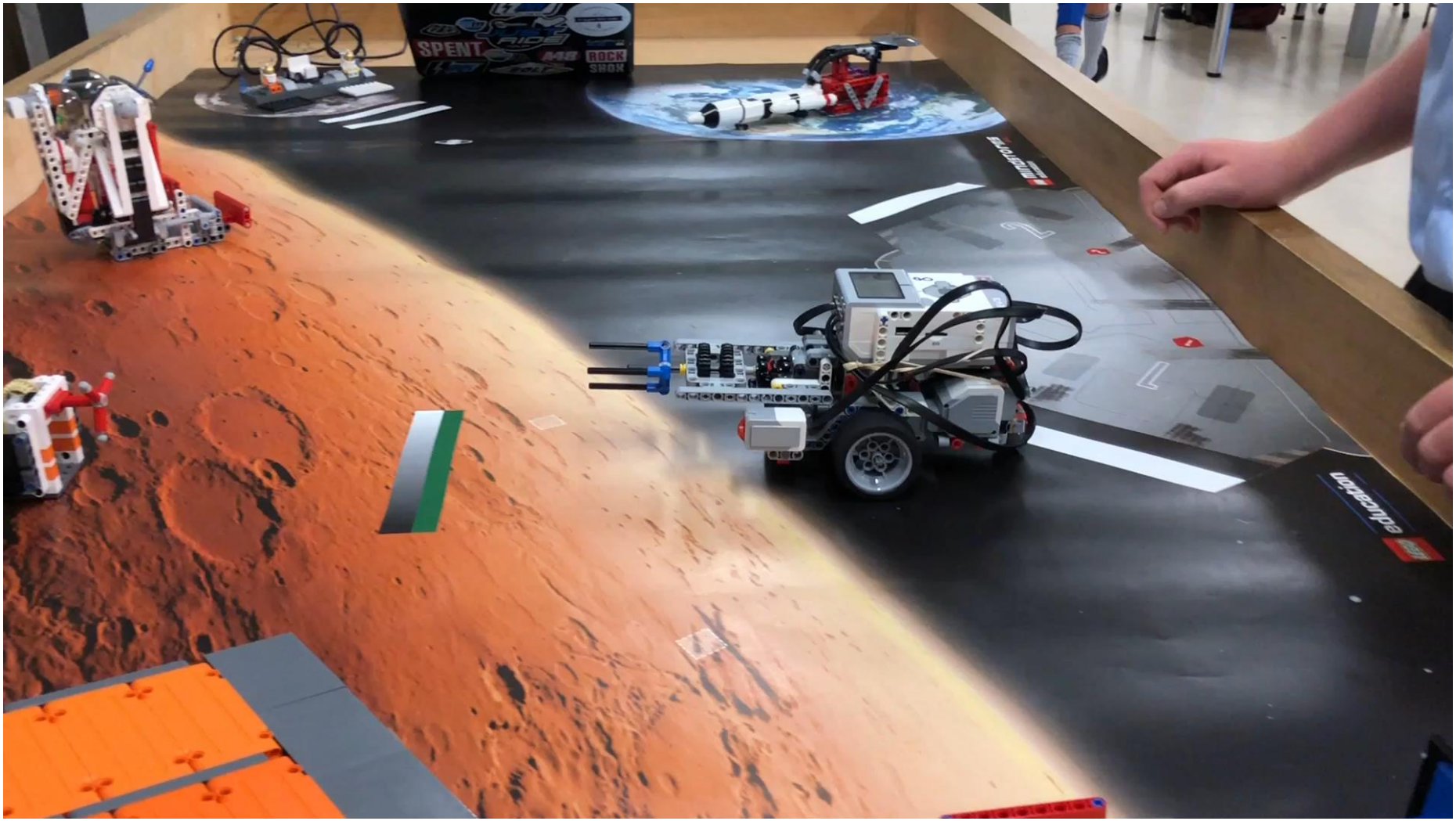
End of Lesson

Adaptability

Mars Mission



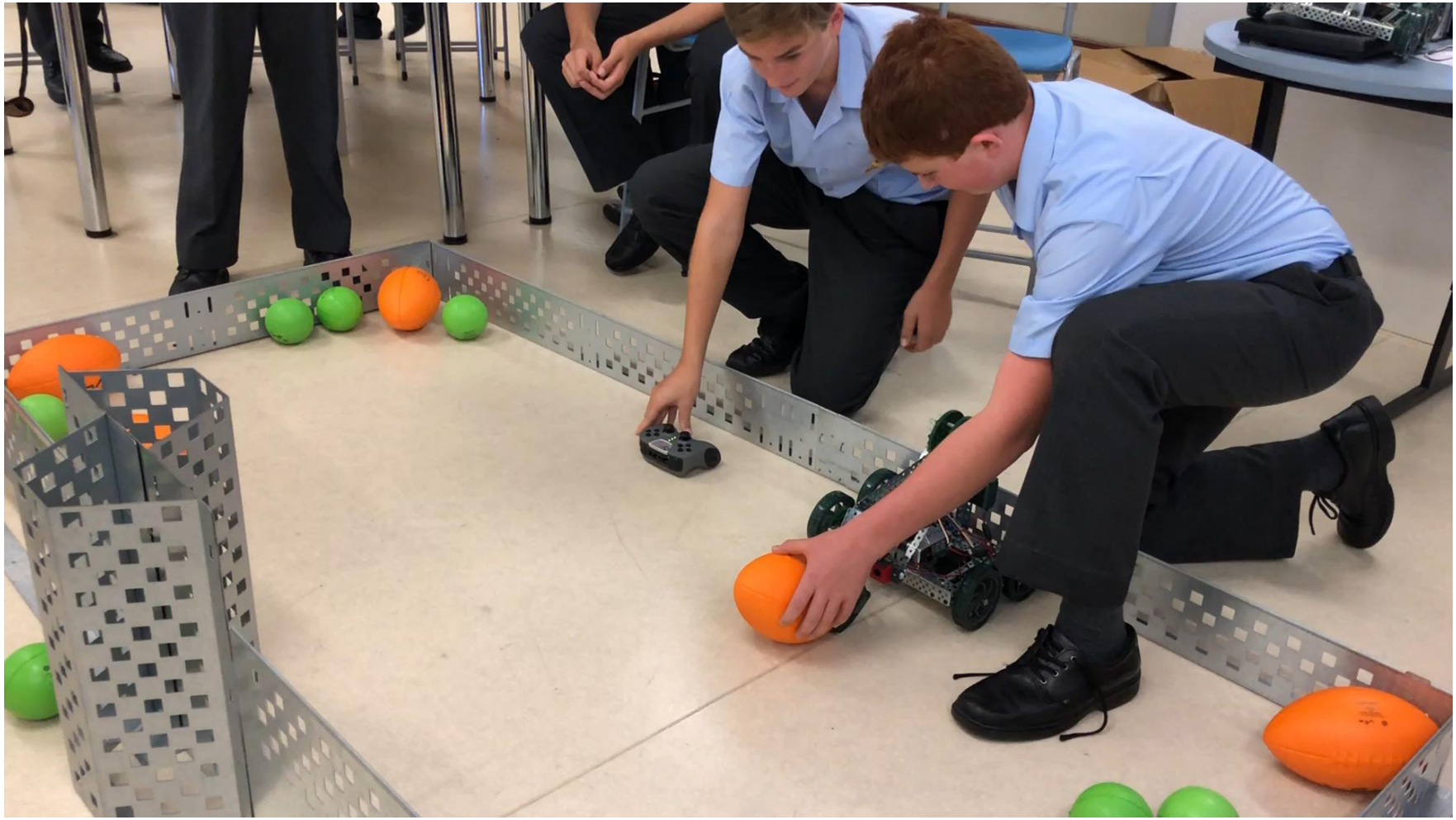
Out takes!



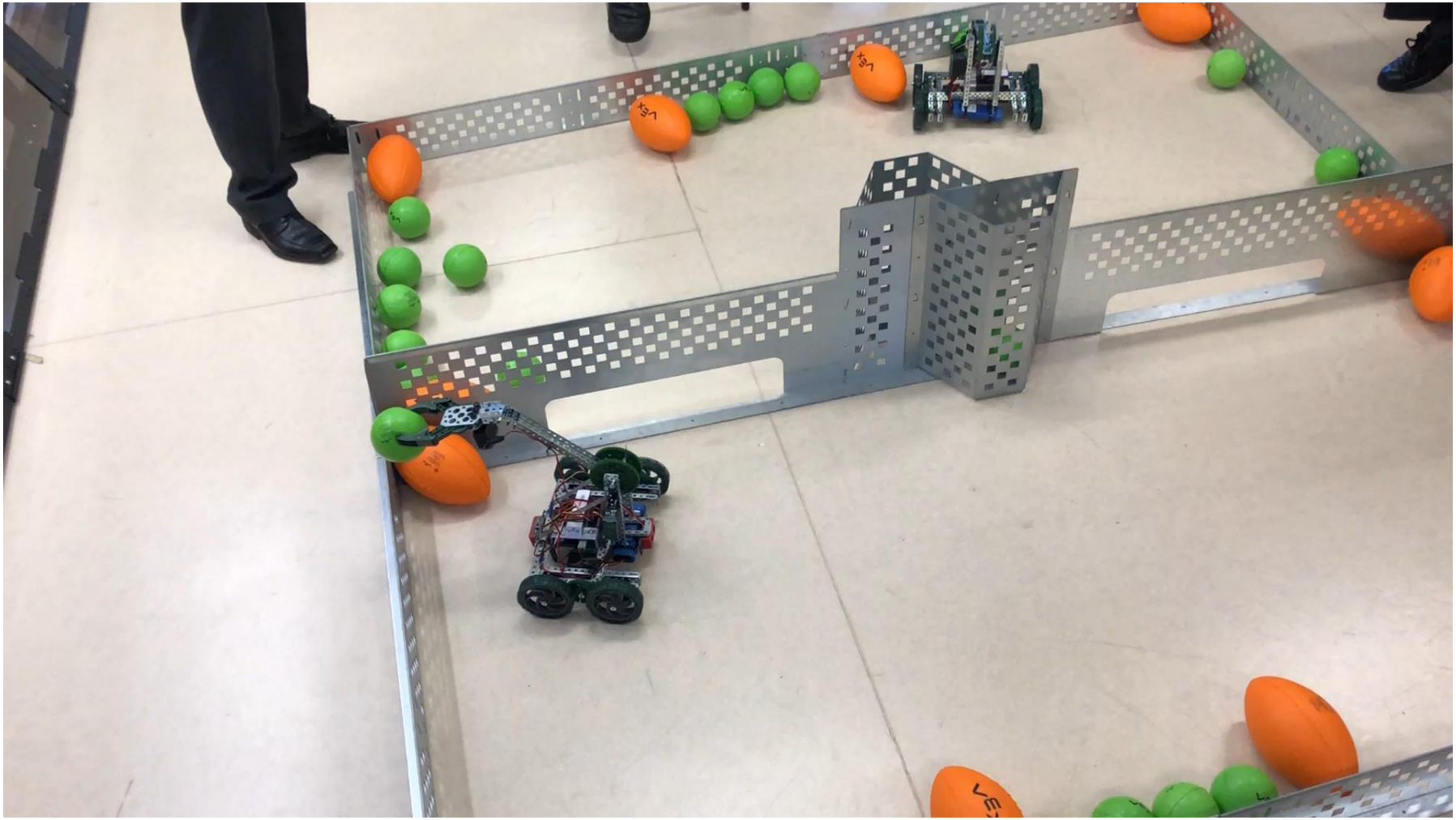
RobotC and VEX

```
#pragma config(Sensor, dgtl6,  touchSensor,          sensorTouch)
#pragma config(Motor,  port2,           rightMotor,    tmotorNormal, openLoop, reversed)
#pragma config(Motor,  port3,           leftMotor,     tmotorNormal, openLoop)



//*!!Code automatically generated by 'ROBOTC' configuration wizard               !!*//

//*********************************************| MAIN |*********************************************
task main()
{
  wait1Msec(2000);                        // Robot waits for 2000 milliseconds before executing program

  while(SensorValue(touchSensor) == 0)    // Loop while robot's bumper/touch sensor isn't pressed in
  {
    motor[rightMotor] = 63;               // Motor on port2 is run at half (63) power forward
    motor[leftMotor]  = 63;               // Motor on port3 is run at half (63) power forward
  }
}
//*************************************************************************************************
```

Autonomous Mode



Driver Control Mode

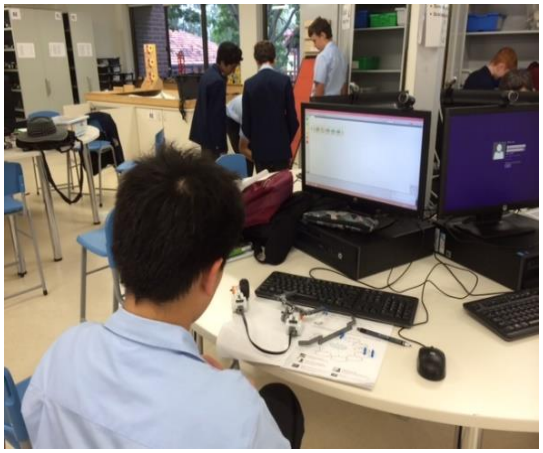


Yr 10, 11 and 12 Senior Engineering

Drone Crumple Zones

Drone Pilot Licence

Young Engineers' Society/Makerspace

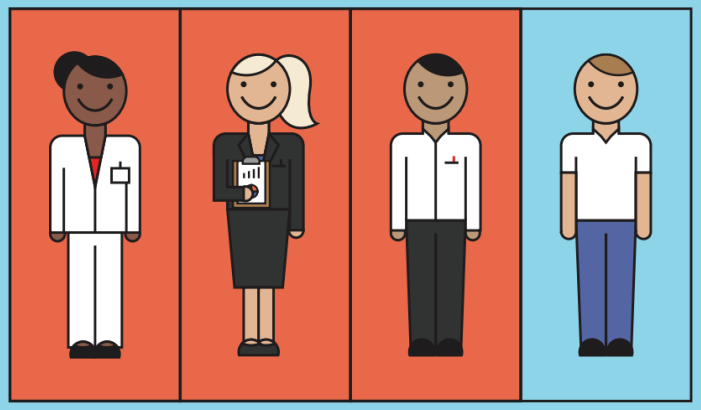


Robotics Competitions

International FIRST Competition

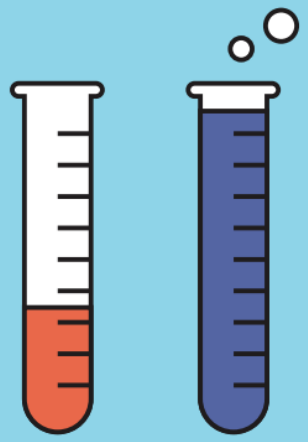
Gold Coast VEX Competition@TSS

Gains in STEM Interest through Robotics Competitions



OVER 75%

of *FIRST* Alumni are in a STEM FIELD AS A STUDENT OR PROFESSIONAL

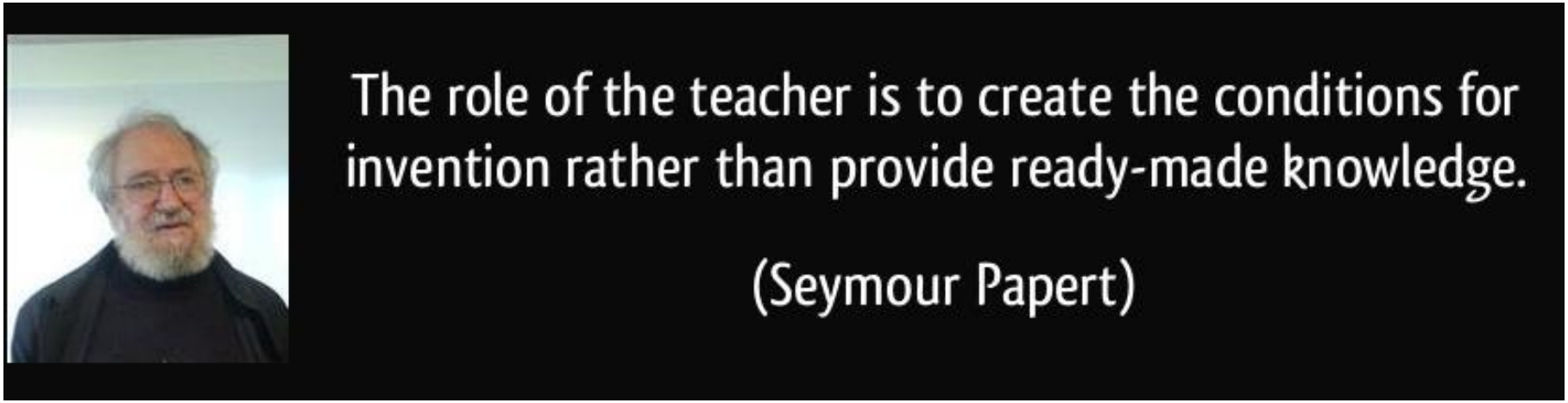


THEY ARE OVER 2X

as likely to show gains in their interest of STEM

(than a matched comparison group of students)

Tell me, and I will forget.
Show me, and I may remember.
Involve me, and I will understand.
- Confucius, 450 B.C.



Times are a changing ..

Future STEM classrooms

Contact Details

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You can keep your ducks ☺

Thank you for listening.