A G.A.T.E.WAYS JOURNEY

for gifted Year 3 and 4 students

with a love of science and technology

'I, ROBOT'

G.A.T.E.WAYS is an independent organization offering challenging and enriching activities and experiences to develop and extend highly able children. This *JOURNEY* for both girls and boys will run over four sessions. Robots arrived in our lives some time ago and now most households can afford to own one, even if it's only a first-generation robot such as a washing machine. The most exciting robots have always existed in science fiction, and these androids, or humanoids as they are sometimes known, tend to look and or sound just like us. They dwell in a fourth-generation future that may not be far away! Mostly, though, current robots are simple machines capable of some movement, sometimes using their own energy supply, and a range of sensors. The more complex robots possess some form of intelligence, usually embedded in a computer chip.

This series of workshops aims to explore the world of robotics, from simple toys and basic mechanisms to complex A.I. (Artificial Intelligence). We'll investigate a range of different robots ranging in sophistication from those that clean pools to others that can explore Mars. Students will make some basic models, which move like a robot but may lack sensors or intelligence. In the fourth session, we'll investigate the workings of a Sphero SPRK.

Please note this program is almost wholly run on simple household materials and, except for the *Sphero SPRK,* does not use any commercially available robot kits.

Session One: Lend Me A Hand?

What is a robot? Robots can take many forms. Many robots are mobile and move on wheels or tracks but most robots are stationary. Humanoid robots are rare outside film and science fiction and most robots could simply be described as a box with some small moving parts, like a vending machine. In Japan, where vending machines and robot development are advanced, Honda has created ASIMO (Advanced Step in Innovative Mobility). ASIMO is the world's most sophisticated working android, standing at 130 centimetres or about the height of a student in Year Three. It is capable of walking through a crowd and running at speeds of 6 kilometres per hour. ASIMO is also capable of speaking several languages, interacting with people and some simple tasks like shaking hands. This seemingly simple task requires sensitive touch sensors; after all, an android needs to be able to handle an egg without crushing it. Our first task is to make a working model of the human hand. The challenge is to use the model hand to hold a ping pong ball, an egg and a pencil. After the robotic hand, we will go one step further and construct a hydraulic lift. Hydraulic systems are the basis of many robot movements, with hydraulics themselves being the machine equivalent of muscles.

Session Two: Sensor-bility

This session we will investigate robot autonomy. Full autonomy requires lots of artificial intelligence because an autonomous robot is able to operate independently of humans. Instead, many robots are operated by humans from a distance. These tele-operated robots don't need as much intelligence because the human operator is making the decisions. Some tele-operated robots are used to safely dispose of bombs, dive deep under water to work on oil rigs or find sunken treasures. Another common tele-operated robot is the drone. Some unmanned aerial vehicles are used to fire weapons in war, but other drones are using flight to give us a better view of the planet or even deliver pizza! We will look at how else drones are being used. Scientists working in the Jet Propulsion Laboratory in California are controlling robots from millions of kilometres away on another planet. We will look at the way the Mars rovers work and some of their exciting discoveries.

This session, we'll spend some time learning how to operate Sphero SPRK robots. This sphere-shaped robot is transparent and makes its inner workings visible. We will design a robot that can function under specific weather conditions or on different terrain, either on Earth or another planet. We will design a tele-operated robot or one that is semi-autonomous and fit for purpose. A range of materials will be available to take our designs one step further to make a proto type.

Session Three: Robot Control

This week we'll have fun investigating the walking skills of robots. Firstly, we'll assemble a small robot, which will move under its own autonomous energy system. Having done that, we will make a maze to challenge our robot. These sorts of robots are sometimes called nanobots and seem to have the intelligence of a small insect. What are some of the vital sensors for such a robot? We will reverse engineer some other devices to work out how we could add sensors. We will investigate the world of sensors. How many sensors does a human have? Where are they? How many different kinds of sensors exist? What do they do? What sensors are in our cars and homes? A smartphone has lots of sensors; do you know of any? How do they improve the way a smart phone works? We will also make a sensor for our bedroom from scratch, using a battery and wires to make a door alarm.

Session Four: The Mind of a Robot

These days we use a lot of smart devices. How do they work? What is artificial intelligence or A.I.? What is machine intelligence? Can a machine think? Could a machine think like us one day? Some science fiction films have included a machine that has a personality and can sometimes act independently of its maker's controls. While it appears reality still has a way to catch up with our imagination, some of our most popular films involve thinking robots or highly evolved A.I. such as HAL in the film *2001: A Space Odyssey*, R2D2 in *Star Wars*, Sonny in *I, Robot,* the T-series in *Terminator,* the replicants in *Blade Runner,* The Machines in *The Matrix* and even the cutest robot of all, Wall-E.

Finally, we will construct a robot modelled on the Dalek from *Dr Who*. This robot looks cool but has very little autonomy as it has the capacity for movement and an energy supply, but no real sensors or intelligence – to begin with! How will you retrofit improvements? We will also have time to complete any unfinished robots in this session.

What to bring:

Each week bring a hat, pencil, an exercise book, a nut-free snack, and a hat

Week One: Any robot toy/model you may have for show and tell (or a photo if the robot is too precious to bring).

Week Two: Bits and pieces that could help construct prototype robot e.g. small boxes for a body, dysfunctional electronic components such as dials, switches and leads.

Week Three: One 9v battery

Week Four: Your unfinished prototype

About the Presenter

Tim Byrne worked at the Melbourne Museum and Scienceworks for 16 years and has presented for G.A.T.E.WAYS since 2012. He has been an avid fan of science fiction since reading *The Black Cloud* by Fred Hoyle. Recent films such as *The Arrival, Passengers*, *Ex Machina*, *Her,* and *Star Trek* continue to intrigue and challenge because of the A.I. connection. Yet in everyday life, it's the mundane robots that vacuum the floor, wash clothes and cook which give the most pleasure. Tim has been drawn to creating a program about simple machines that illustrate the design craft of robotics.

Extra levy: Please note that this program incurs a $5 material levy.