A G.A.T.E.WAYS JOURNEYS PROGRAM

for gifted Year 5 and 6 children with a love of

science, technology and construction

'Medical Emergency…

RoboDocs To The Rescue'

G.A.T.E.WAYS is an independent organisation offering challenging and enriching activities and experiences to develop and extend highly able children. This *JOURNEY* for both *boys and girls* will run over four sessions.

Medical robots assist surgeons with surgery, and other medical professionals with assistive technologies (such as the development of artificial limbs) and patient rehabilitation. Biomedical engineers develop all these types of robotics. Each and every day, we benefit from the work of scientists, biomedical engineers, and doctors. Their work protects us from disease, helps our injuries heal, cures our sicknesses, and allows us to lead healthier lives. In this journey we will explore the cutting-edge world of Biomedical Engineering to discover innovative ways to repair injuries, overcome genetic predispositions, and maximize the body's potential.

Working in teams of four, children will build and program an autonomous robot using Lego Mindstorms NXT and RCX technology Following that, they will solve a range of different challenges or Missions using computer programing, concrete materials and an operating mat with Lego props.

Session 1: Meet Your Team Of Fellow Medicos

We'll begin the session by exploring Lego robotics equipment and software. You will be introduced to the programmable NXT Brick which provides on-brick programming and data logging, three interactive servo motors, ultrasonic, sound, light and two touch sensors as well as other pieces. Following that, you will need to complete your first challenge: to make sure the medical team meets the patients on time. In this challenge the RoboDoc is required to move the doctors to a meeting place on the ground floor of the hospital. To achieve this mission your team will need to program the robot to navigate a number of obstacles. You will need to test each process of the journey to make sure the program and robots are following their instructions.

Session 2: You've Got Heart!

Today we will help patients with their heart problems! Having a hole in the heart is quite a rare condition, but if you had one you would certainly be glad that biomedical engineers are hard at work developing modern solutions. One current solution is to place special human cardiac cells onto a mesh to form new heart tissue, which can then be placed on the heart to seal the hole. At the moment these patches don't grow as a child's heart grows, so repeat operations are needed. Solving this issue is a great challenge for the biomedical engineer!
Your first mission today, the *Cardiac Patch Mission*, will require you to program the robotic doctor to put a cardiac patch on the heart. Your second mission will be to install a pacemaker. A pacemaker is a small device, roughly the size of a 50-cent piece, that's placed under the skin near your heart to help control a patient's heartbeat. People may need a pacemaker for a variety of reasons — mostly due to one of a group of conditions called arrhythmias, in which the heart's rhythm is abnormal.

Session 3: Let's Fix That Fracture

Have you ever broken a bone? One of the most common reasons for heading off to a hospital Emergency Department is a bone fracture. For your first mission today, you will design and program features on your robot to enable it to repair a broken Lego 'bone' by first aligning the arm bone and then applying a cast. The 'cast' is made out of material that softly conforms to the bone, and then hardens like a rock. When it comes off, the process

doesn't crush, cut, burn, or dissolve your body! The cast needs to be all the way over the break to completely cover the injury so the patient is not in pain.

Some severe fractures, including some cases where bone is missing, can't be fixed with a cast. Biomedical engineers are now developing a way to bridge these voids of missing bone by introducing special bone growing cells to the area on a material called "scaffolding." These cells are able to grow new bone in ways our normal healing processes cannot. Your second mission today is to insert a bone bridge in the leg. To test the success of the repair your robot must be able to move the leg so the foot kicks a ball, hopefully scoring a goal

Session 4: What a Helping Hand

We begin this session by exploring a couple of physiological terms. The first, "range of motion", refers to the number of degrees a joint can move. For example, an elbow might flex (bend) 90 degrees. "Functional mobility" refers to the ability of a limb to serve its intended purpose through motion. Your hand can reach into your pocket, pull out a set of keys, identify the right one, put it into the lock, and unlock a door, all in the dark. No other artificial mechanism in the world can do this! However, biomedical engineers are developing better and better artificial prostheses for people who have lost limbs. It takes a lot of sophisticated engineering to produce an artificial hand, which can find the correct angles for the many pivots and extensions of human movement, as well as a lot of training and therapy on the part of the user. Your first mission today is to get a mechanical hand to hold a patent on an operating table.

Force is another important factor to consider when designing prosthesis. It takes a lot less force to grip a sandwich than a rock... What about handling eggs – or kittens? How is the correct force found? Your second mission today is to take your robotic doctor to the Lego gym, find a weight and get her to move the weight to the upright position by following certain criteria and using the correct force.

Homework:

Children will be given a biomedical engineer's journal. This will contain a short article to read as background research into the different operations with some space for reflection and planning on strategies and solutions for the weekly missions.

Requirements:

Bring a plastic pocket book to hold handouts, a pencil case with a ruler or measuring tape; a snack (no nuts please); a small labelled photograph of yourself and a stamped, self-addressed DL envelope for the return of your report.

About the presenter:

Carla Maxwell is an Art, Design Technology and Robotics teacher who has completed a Masters of Information Technology in Education (by Research) at the University of Melbourne. Her Bachelor of Fine Art also gives her a unique perspective on teaching in a creative and integrated manner. Carla continues to plan activities for students that are fun, hands-on and experience based, taking into account aspects of mathematical and scientific principles.