



invite gifted Year 5 and 6 children

with a love of science and BIG ideas to

'Up and Atom!!!'

G.A.T.E.WAYS is an independent organisation offering challenging and enriching activities and experiences to develop and extend highly able children. Established in, G.A.T.E.WAYS runs a range of stimulating school programs as well as the Saturday *Brainwaves Club*. This *JOURNEY* for both girls and boys will run over four sessions. Matter has mass and takes up space. The word atom is derived from the Greek word '*atom*' which means indivisible. The Greeks concluded that matter could be broken down into particles too small to be seen. These particles were called *atoms*. There is more to atoms than that, but how do scientists be sure, when atoms are invisible? Imagine a stream of water from a garden hose directed at a brick wall. What would happen to the water as it struck the wall? Imagine how you would feel if the water went straight through the wall? The famous physicist Rutherford conducted an experiment to measure the characteristics of atoms indirectly using gold foil and alpha particles, which were like small bullets. The results of his experiment led him to conclude that an atom is mostly empty space with a small nucleus at its centre. This was a revolutionary finding at the time. In this Journey we will use lots of hands-on activities and concrete materials to explore some very abstract concepts, concepts which the best scientific brains have struggled to come to terms with over the years. We will work as scientists making both direct and indirect observations to study the behaviour of objects and try to come to some well-founded conclusions.

Requirements: *Bring a notebook, a ruler, a pencil, a pencil sharpener, an eraser, and a snack (no nuts please)

Session 1 Atoms away!

How can you prove something exists if it is invisible? Scientists are on a constant quest to answer the question, "What is the world made of and what holds it together?" Everything around you is made up of atoms – clouds, shoes, teeth – are all made from a combination of atoms. And atoms themselves are made up of small (subatomic) particles called protons, neutrons and electrons. Exactly how small are these particles – can we see them under a microscope? If not, how do we measure them? What exactly do these particles do? In this session we'll aim to find out as much as we can about the tiniest of particles and we will simulate some of the techniques physicists use to learn about things that are invisible.

Session 2 Take a quantum leap

What we know in science is based on evidence, models and explanations. As new evidence appears, new knowledge is formed. You may think a model is simply a toy or a copy of something real like a model car, but scientific models are much more complicated - they are used to test ideas. These theoretical scientific models are a great way to help us understand and make predictions about the behaviour of the world around us. But what if we have two very different models to explain the one thing? Which idea is correct, which model should we use? In this session you will be introduced to two models of an electron, the particle model and the wave model, that are designed to predict and explain what electrons are and do. Which model do you think is correct?

Session 3 Charge!

Atoms are mostly empty space but they are made up of smaller particles and each of these particles has a charge. How do scientists know this and how do these charges affect the behaviour of the atom? Through a series of activities involving modelling and small chemical reactions, you will discover how important charge is. You will be given an opportunity to experiment and explore in order to discriminate between the relative size, charge, and position of protons, neutrons, and electrons in the atom. Let's discover some important scientific principles through careful observation and experimental verification.

Session 4 Quarks

So, are protons, electrons and neutrons made of even smaller stuff? The answer is yes, quarks! These particles come in six flavours and they may appear strange, exotic, charmed or just plain weird. Quarks are social particles because they only exist in groups with other quarks and are never found alone. The number and combination of these quarks determines exactly what particle it makes. If you were 'master of the universe' and were able to combine quarks, what type of particles would you create? In this session we will also use the world's most famous formula $E=mc^2$ to investigate how some particles just suddenly appear where there were none before and how other particles simply disappear leaving a large mess behind them.

Work requirements & Assessment

Children may be asked to complete some homework between sessions.

At the end of the program a short written report will be completed on each student and forwarded home to parents.

ABOUT THE PRESENTER

Emma Carter has studied Mathematics and Physics at the University of Melbourne. She has taught secondary school maths up to VCE and worked at Scienceworks and as an outreach education officer for the Discovery Science and Technology Museum. Emma is passionate about her fields and has presented many wonderful science and mathematics workshops with G.A.T.E.WAYS.

