

reSolve: Promoting a spirit of inquiry

THE AUSTRALIAN ACADEMY OF SCIENCE IS AT THE FOREFRONT OF AN EXCITING PROJECT THAT AIMS TO FOSTER STUDENT CURIOSITY AND A DESIRE TO KNOW WHY IN MATHEMATICS, PROMOTING A SPIRIT OF ENQUIRY.

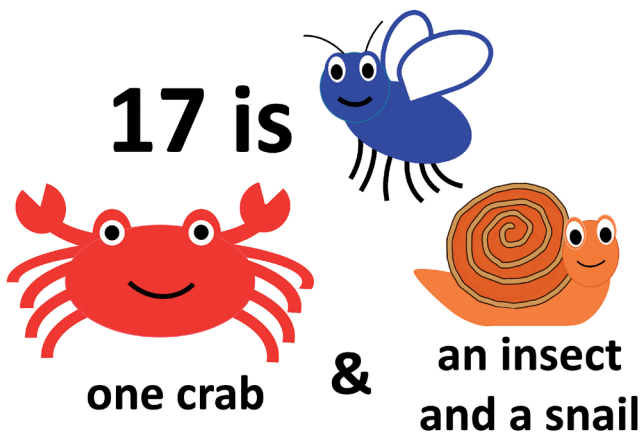
In his 2010 speech to young researchers in mathematics at Cambridge University, renowned mathematician, Fields medallist and Abel Prize winner Sir Michael Atiyah looked back on 60 years of mathematics. Upon reflections, Atiyah referred to the “views I have seen from the heights” and the “challenges [that] lie ahead for the next generation” (Atiyah, 2010). He suggested there were many more “mountain ranges” to explore in Mathematics, and talked about what motivates mathematicians: understanding, curiosity, exploration and ideas.

These concepts lie at the heart of an exciting new Australian government funded project, managed by the Australian Academy of Science in collaboration with the Australian Association of Mathematics Teachers. The project, reSolve: Maths by Inquiry, produces classroom and professional resources to promote a spirit of inquiry in school Mathematics from

Foundation to Year 10. But what is a spirit of inquiry? The reSolve team describes it as a desire to know why an answer has been developed and a curiosity for this, as opposed to simply understanding the methodology behind each individual problem. It will also develop the knowledge and skills of more than 240 teachers across Australia who will become the champions to take the messages of the project out into the world.

THE PROTOCOL

The guiding principles behind the project are described in what the academy has called the Protocol – a vision for the teaching of mathematics and numeracy that emphasises mathematical purpose, challenge and access, and a collaborative knowledge-building culture. The three principal elements of the Protocol stress that mathematics



is more than covering content, that if we design the tasks well everyone can be part of a rich mathematical experience, and that classrooms are learning environments focused on developing deep understanding.

One of the resources that the reSolve team has developed for Foundation is based on the children's book *One is a Snail, Ten is a Crab* (Sayre & Sayre, 2006). In the book, children create numbers based on the total number of legs in the picture. A snail alone is the number one, a person is two, and a snail and a person is three. The book, perhaps surprisingly, goes from ten (a crab) to twenty (two crabs). Our first inquiry question is what numbers are missing? The second is how do you calculate those numbers? Children conclude that if seven is made with an insect and a snail, then 17 is a crab, an insect and a snail. So it begins to develop early understanding of place value.

The third inquiry is how many different ways you could make numbers, which relates directly to the



INQUIRY AND EXPLICIT TEACHING

The word explicit comes from the Latin words *ex* (out) and *plicare* (to fold). To make something explicit literally means “to unfold”. This is completely in line with the reSolve team's view of inquiry, which focuses on unfolding important mathematical ideas, such as coming to understand the structure of number via the book “One is a Snail, Ten is a Crab”. The reSolve resources are carefully designed and structured to help the teacher lead students to a deep understanding of purposeful mathematics. Students learn through the teacher's active intervention, such as the use of enabling prompts to reduce cognitive load and provide access, attention to misconceptions, and unpacking of alternative strategies. They do much more than reproduce an approach demonstrated by the teacher, they understand the mathematical concepts underpinning the method and appreciate why it is accurate and efficient.

mathematics of partitions. The number 4, for example, can be partitioned in exactly five ways: 4 , $3 + 1$, $2 + 2$, $2 + 1 + 1$, and $1 + 1 + 1 + 1$. For the number 70, the number of partitions is a staggering four million. In 1748, the mathematician Leonhard Euler described a method for finding the number of partitions of a number, but this is time-consuming, even with a computer.

In the 300 years since Euler's work, the theory of partitions has been the subject of ongoing research, including by the Indian mathematician Ramanujan, who, with G.H. Hardy, in 1918 published a formula that is quick to calculate and that very closely matches the exact answer.

By engaging in a simple inquiry, children come to see mathematics as a living discipline, involving characters such as Ramanujan whose life has been so richly described in the book and film *The Man Who Knew Infinity*.

THE RESOURCES

reSolve: Maths by Inquiry is developing three types of resources that capture the spirit of inquiry in maths, exemplify the Protocol and promote fluency, deep understanding, strategic problem solving and mathematical reasoning.

More than 88 exemplary lesson plans will highlight

key ideas in every strand of the Australian Curriculum: Mathematics at every year level from Foundation to Year 10.

Each is carefully designed to develop progressive understanding through tasks that promote a spirit of inquiry.

The special topics are significant resources that address the needs of 21st century learners. They provide imaginative opportunities for creatively using new technologies in real world contexts such as coding, modelling and engineering.

The professional resources provide the link between the Protocol and the teaching and learning resources. They are designed to inform individual teacher and whole school change.

CONCLUSION

The example above captures the spirit of inquiry that we hope permeates all our resources.

The resources do not eliminate the need for carefully constructed intentional teaching, nor do they eliminate the need for activities that will sustain the learning.

But like the young mathematicians addressed by Sir Michael Atiyah, through activities such as these we hope that students begin to find their own mountain ranges to explore, motivated by understanding, curiosity, exploration and ideas. We hope that they, too, can experience the joy and delight of mathematical discovery.

We invite you and your colleagues to join us in the exciting venture that is reSolve: Maths by Inquiry. Visit our website at www.resolve.edu.au or email us at mbi@science.org.au.

References

Atiyah, M. (2010). *A Panoramic View of Mathematics*. Retrieved from <http://sms.cam.ac.uk/media/753316;jsessionid=30C071FEDDCBDOEBBE3014FB9797C443>
Sayre, A.P. & Sayre, J. (2006). *One is a Snail, Ten is a Crab*. Cambridge, MA: Candlewick Press