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Assessing science learning

A new school assessment resource provides teachers with information about individual students' achievement and progress in science.

Geoff Masters details the development of the Progressive Achievement Test in Science.



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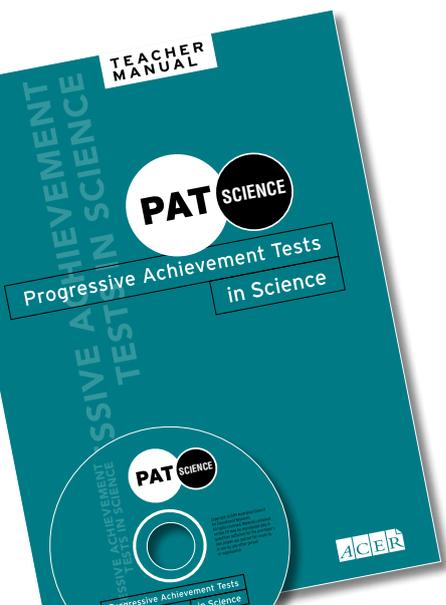
The most recent international tests of scientific literacy have shown that Australian students perform above the international average – yet many students make little overall progress in science across the years of schooling.

Less than 10 per cent of Australian students achieve an 'advanced' standard in science, while 13 per cent of Australian students are classified as 'at risk' of not having the basic levels of scientific understanding required to function in adult society, according to international tests of scientific literacy such as the Trends in International Mathematics and Science Study (TIMSS) for 2007 and the Organisation for Economic Cooperation and Development's Programme for International Student Assessment (PISA) for 2006.

TIMSS and PISA also reveal that many of our primary teachers report feeling unprepared to teach primary science; and, as in some other countries, there's been a decline over several decades in the percentage of senior secondary and university students choosing to study science at an advanced level.

While tests such as TIMSS and PISA can provide information on Australia's relative performance in science and are useful to inform educational policy, there is an identified need for better classroom information about the progress students make in their science learning between Year 3 and Year 10.

Improved levels of science achievement in Australian schools are likely to depend, in part, on greater



national clarity about what students are expected to learn in each year of school, better data on how well these expectations are being met and an improved basis for tracking individual science learning over time. Most existing classroom assessment resources do not describe students' science knowledge with any precision and do not quantify improvements in science learning over time.

A new school assessment resource in science from the Australian Council for Educational Research (ACER) has been introduced to fill this gap.

The launch of the *Progressive Achievement Tests in Science*, or PAT Science, follows more than two years of development and trial testing. PAT Science is a new addition to the Progressive Achievement Tests series, and complements PAT Reading and PAT Maths, which are widely used in Australian schools.

PAT Science follows the model of PAT Reading, PAT Maths and the National Assessment Program – Literacy and Numeracy, or NAPLAN, tests in that it consists of a series of increasingly difficult tests that can be used to monitor student learning. There are eight science tests of increasing difficulty for use in Years 3 to 10. The tests have no common items. Each test is appropriate for, and normed on, two or three year levels. Tests 1 to 4 are 30-minute tests; tests 5 to 8 are 40-minute tests.

The PAT Science tests have been developed to address a curriculum framework constructed from a detailed analysis of the science frameworks of all Australian states and territories. The PAT Science manual shows how each item on the tests maps to the science framework in each state and territory. The first edition of PAT Science predates the introduction of the national science curriculum, but has been informed and influenced by the National Curriculum Board's 2008 *National Science Curriculum Framing Paper*.

Although existing state and territory frameworks describe areas of science knowledge and knowledge about the processes of science in slightly different ways, there is a high degree of consistency across these frameworks which generally identify four broad areas of science learning. These can be summarised as: physical systems, for example, energy and change; chemical systems, for example, materials; geological and space systems, for example earth and space; and living systems, for example, life and living. The processes of science, which include knowledge about the culture of science and its impact on society, form a fifth area, for example, investigation.

Teachers are provided with two kinds of questions: multiple-choice and short-answer. Only multiple-choice questions are used in calculating students' PAT Science scores. Short-answer questions are provided for each test to illustrate how written responses can be used by teachers to explore students' understandings of scientific phenomena. Responses to multiple-choice questions can either be hand scored in schools or forwarded for computer scoring through ACER's test scoring service.

ACER has developed a number of PAT Science report forms to assist teachers and schools in their interpretation of students' test results. A diagnostic report outlines 10 described levels of achievement specifying what students at each level on the PAT Science scale typically know and are able to do. This report is likely to be particularly useful in making decisions about the best ways to target teaching on student needs, in describing the learning outcomes students have achieved and in reporting learning progress over time. This report also provides details of students' performances on individual test questions.

Norm tables have been developed to allow teachers and schools to compare students' test results with the performances of other students

in the same year level. In November 2008, trial PAT Science tests were administered to a nationally representative sample of more than 7000 Year 3 to Year 10 students in 86 schools in all states and territories and across all school sectors. The performances of these students were used in the construction of the norm tables.

For each student taking one of the science tests, schools are provided with:

- the student's score on the PAT Science scale, indicating the student's current level of science achievement and providing a basis for monitoring that student's progress over time using subsequent tests in the series
- an indication of how the student's score compares nationally with the performances of other students in the same year level – in the form of a percentile rank or stanine score
- a description of the kinds of science knowledge and skills typical of students at that level of achievement on the PAT Science scale, and
- a summary of how the student performed across different areas of scientific literacy, indicating areas of relative strength and weakness.

By providing this information, PAT Science gives schools the opportunity to offer parents more objective reports of student progress and achievement in science.

PAT Science reports science achievements on a scale that can be used to track progress from Year 3 to Year 10, and describes the knowledge, skills and understandings typical of students at varying levels along this scale. It is unique in offering teachers and schools an unparalleled resource for establishing current levels of science achievement and for monitoring student learning and school performance in this key area of the curriculum. ■