SCIENCE LEARNING

Fact sheet 3/2019

Peter Underwood Centre

WHAT IS SCIENCE?[1,8]

Science is built on questions that emerge through making observations and gathering evidence about the world around us. Systematic investigations of these questions lead to answers. Science is both the process of discovery that leads to the answers and the body of knowledge made up of those answers. This body of knowledge is continually changing because the process of asking questions, finding answers and building scientific knowledge is ongoing.

Science **IS** about:

- ✓ making observations.
- ✓ asking questions.
- ✓ testing, recording, discovering.
- ✓ changing based on discoveries.

Science **IS NOT** about:

- ✓ just rigid facts.
- ✓ a tidy package of knowledge.
- ✓ simply a step-by-step approach.
- ✓ only lab coats and test tubes.

WHY DOES IT MATTER?[1,15]

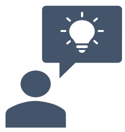
It is important for everyone to be scientifically literate because we are surrounded by so much information in our lives. Scientific literacy involves being able to:

- ➢ discuss socio-scientific issues such as climate change and vaccination.
- ➢ identify and investigate claims and questions, in a careful and systematic way.
- ➢ draw conclusions that are based on sound evidence.

Science plays a critical role in:

Economic & Social Prosperity
Science and technology drive positive change, transform and enrich our world, and help us solve real problems such as finding a cure for polio or a clean form of energy.

Education
Science helps us evaluate information carefully. The prevalence of bogus and inaccurate news and information requires us to put a sceptical eye over information and evaluate information based on sound evidence.



Personal Decision Making
Science helps us understand the world around us better. A greater understanding in science influences the decisions we make and how we live, including decisions related to our health, safety and wellbeing.

SCIENCE ACHIEVEMENT AND ENJOYMENT FROM INTERNATIONAL SURVEYS

Two international assessment bodies collect data about Australian students' science achievements and attitudes. Trends and International Mathematics and Science Study (TIMSS)[4] collects data from Year 4 and Year 8 students every four years, and Programme for International Student Assessment (PISA)[3] collects data from 15-year-olds (usually Year 10) every three years. Data from these surveys indicate that, since the early 2000s:

- ➢ Australian students performed **better** than the average of 26 to 72 other countries on the surveys' science achievement scale.

TIMSS and PISA both identify the proportions of students who performed at the (a) advanced or high level, (b) intermediate level, and (c) below the international benchmark related to science achievement. Findings from the past three data cycles (Figure 1) indicate that:

- For Year 10/11, the proportion of low performers in Tasmania increased by about 7% between 2009 and 2015. However, the majority of students performed in the intermediate range.
- For Year 8, the gap in terms of the proportion of low performers between Tasmania and throughout Australia is closing, with the proportions being comparable in 2015.

Comparisons between Tasmania and Australia: Science achievement by performance level over the years

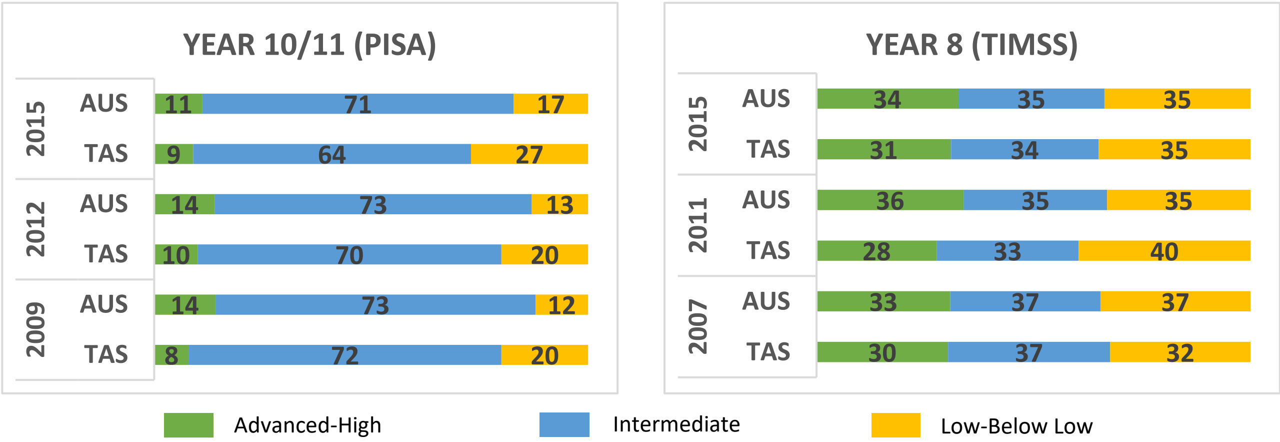


Figure 1. Percentage of Australian and Tasmanian students whose science achievement fall within the advance-high, intermediate, and low-below range. ****Note****: PISA and TIMSS have different guidelines for identifying high, intermediate, and low performers. Therefore, the percentages may not be comparable between grade levels.

Both surveys also asked students about their sense of enjoyment when learning science (Figure 2). Overall:

- Students' enjoyment in science declines as they progress in their education. Research argues that this decline may be attributed to:
  - a change in how science is being taught and offered in the upper secondary curriculum; and
  - students' developing perceptions of subject difficulty and their own ability in the subject[10,11].

Comparisons between Tasmania and Australia: Science Enjoyment between grade levels

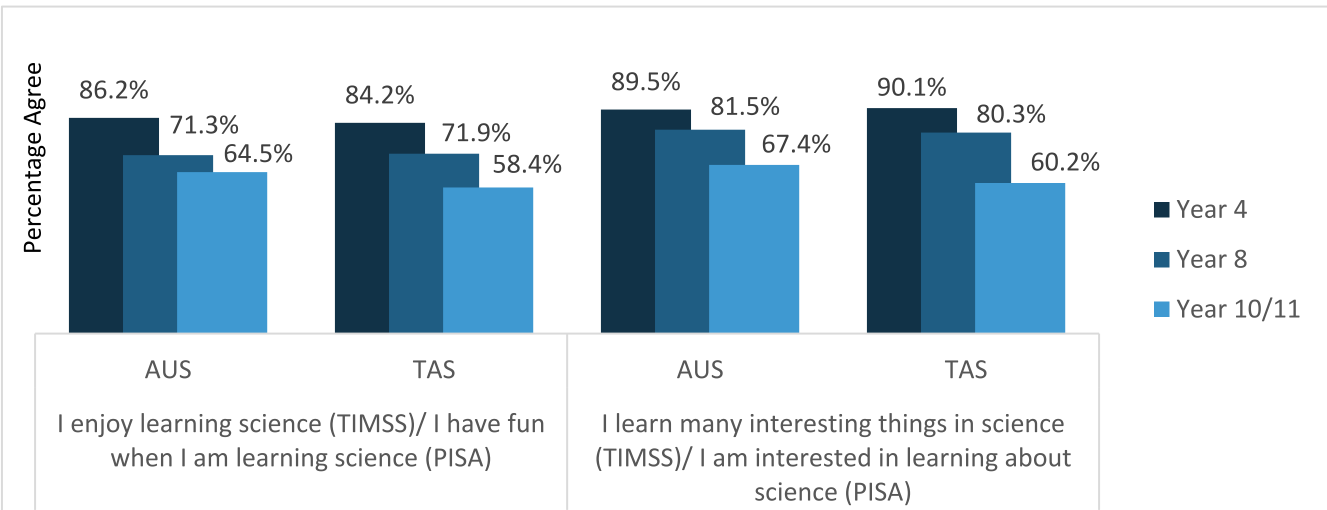


Figure 2. Percentage of Australian and Tasmanian students who agree (a little or a lot) that they enjoy learning science and are interested in science.

SUPPORTING SCIENCE LEARNING

As parents and educators, you can model your own curiosity and ways for exploring that curiosity to young learners. The WISDOM approach models the process of scientific thinking[7]:

Wonder	Seeing the wonder in the world and wondering about how it works.
Investigate	Investigating answers to the questions through a hands-on process.
Systematic Doubt	Not accepting at face value, asking questions and ensuring information is based on good and robust evidence.
Open Mindedness	Exploring different approaches and changing based on evidence.

Key principles for supporting science learning[5,13]:

CHILDREN ARE BORN INVESTIGATORS

- Connect to children's interests and experiences. Invite curiosity:
    - Call attention to significant details (What is it doing? How does it feel?).
    - Generate more precise information (How many? How heavy?).
    - Foster analysis (How are they alike? How different?).
    - Explore properties and make predictions (What happens if…?).
    - Try solutions to problems (How could we …?).
    - Encourage reflection and construction of new ideas (What do you think?).

SCIENCE REQUIRES BOTH TIME AND PRACTICE

- Provide time and space for children to experiment, to try things out and to think on their own:
    - Include hands-on explorations in nature (mud or water play).
    - Get messy and experiment[2] (See examples on Kitchen Chemistry[12]).
    - Introduce projects that allow children to design and engineer solutions to problems.
    - Explore various forms of representations to support understanding (charts, 3D models).
- Embrace failures as opportunities for growth. Most progress in science occurs by learning from failures and then trying again.

ENGAGE IN CONVERSATIONS ABOUT SCIENCE

- Encourage children to explore and produce diverse forms of science communication such as media presentations, blogs, infographics, play or science fair.
- Schools may consider collaborating with business and practising scientists to promote science conversations at school (e.g. Young Tassie Scientists[17], UTas STEM Community Outreach[9]).
- Participate in the National Science Week and Tasmania's Festival of Bright Ideas to learn about various kinds of work in science and technology.

PROMOTE EQUITY SO ALL STUDENTS CAN ENGAGE WITH SCIENCE

- Promote early-learning science and technology initiatives[16] to build a positive foundation from the early age.
- Develop accessible science outreach programs to close opportunity gaps for underrepresented groups in science (e.g. Curious Minds and digIT summer school[6], Children's University Tasmania activities[14]).

REFERENCES & USEFUL LINKS

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Launched in 2015, the Peter Underwood Centre is a partnership between the University of Tasmania and the Tasmanian Government in association with the Office of the Go

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