PISA

IN FOCUS

66

education **data** education **evidence** education **policy** education **analysis** education **statistics** education **data** education **evidence** education **policy**

How does PISA assess science literacy?

- The latest results from the PISA 2015 science, reading and mathematics tests will be released on 6 December 2016.
- PISA 2015 focused on students' proficiency in science. For the first time, most of the participating students took the test on computer.
- About 540 000 15-year-old students in more than 70 economies participated in the assessment – including, for the first time, students in Beijing, Jiangsu and Guangdong (China), and in Algeria, the Dominican Republic, Kosovo and Lebanon.

Every three years, in December, it's PISA time around the world. The education community in participating economies eagerly awaits the latest results from the OECD Programme for International Student Assessment (coming out on 6 December this year) to see how their school systems compare with others across the globe.

The most recent round of the assessment, PISA 2015, focused on 15-year-olds' science literacy, defined as "the ability to engage with science-related issues, and with the ideas of science, as a reflective citizen". To succeed on the PISA science test, students had to display their mastery of three skills: explaining phenomena scientifically (based on knowledge of scientific facts and ideas), evaluating and designing scientific enquiry, and interpreting data and evidence scientifically.

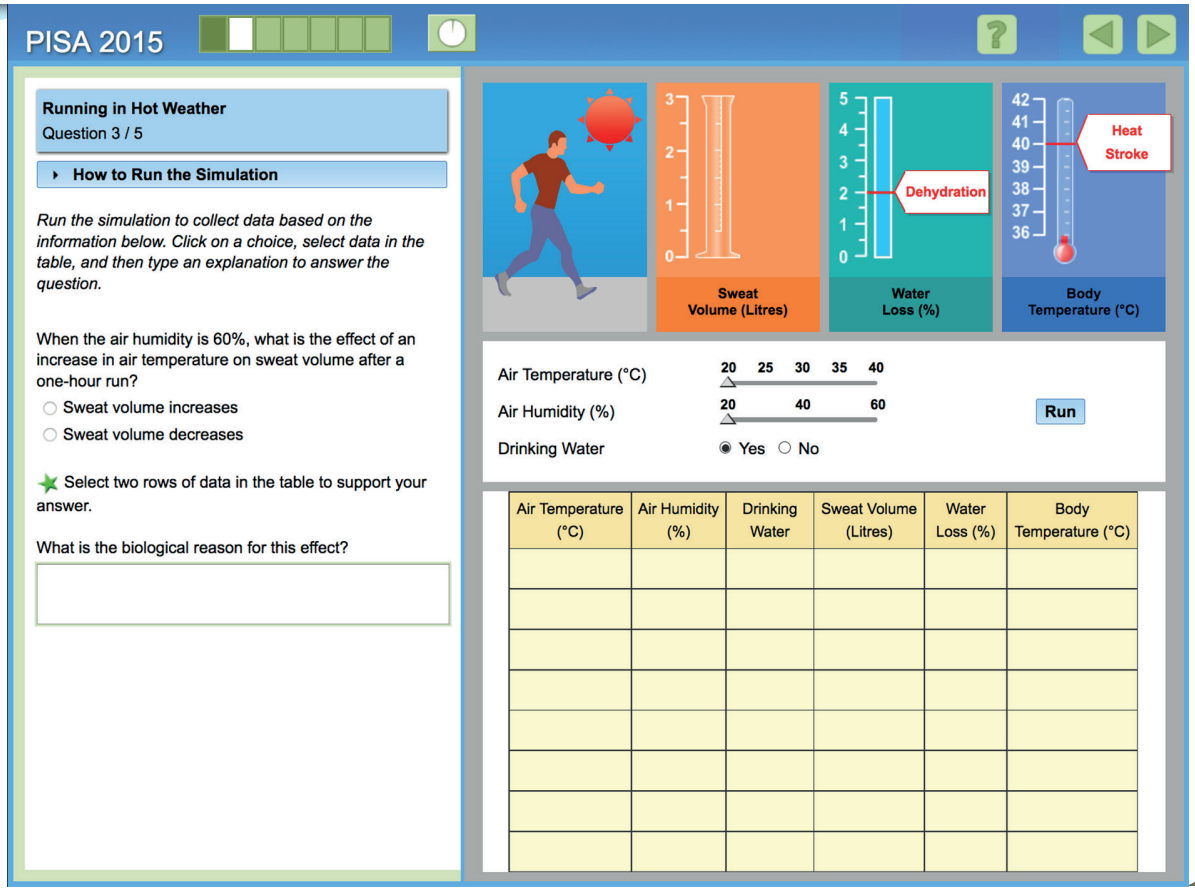
As this definition makes clear, remembering that a free-falling object on Earth has an acceleration of 9.8m/s^2, or what the difference between bacteria and viruses is, will not necessarily be rewarded with a high score in PISA (although it might be important to know those facts too). Rather, PISA emphasises that a science-literate person is one who uses that knowledge to navigate through today's world; and that all of us sometimes need to "think like a scientist" – to weigh evidence and come to a conclusion, and to understand that scientific "truth" may change over time, as new discoveries are made – particularly when we engage with science-related issues.

And science-related issues are ubiquitous. Every day, the public is bombarded with new messages based on science – from the advertising claims that a toothpaste kills "99% of bacteria" to the nutritional information on packaged food or the report about the latest Mars mission in the evening news. An understanding of science, and of science-based technology,

is necessary not only for those whose careers depend on it directly, but also for any citizen who wishes to make informed decisions related to the many controversial issues under debate today – from more personal concerns, such as maintaining a healthy diet, to local dilemmas, such as how to manage waste in big cities, to more global and far-reaching considerations, such as the costs and benefits of genetically modified crops or how to prevent and mitigate the catastrophic consequences of global warming.

When reading about or discussing science-related topics, students must be able to separate science from spin, identify misrepresentations of findings, and assess the level of uncertainty, or the trustworthiness, associated with a particular claim. This requires knowledge of scientific facts, but also of the nature and origin of scientific knowledge. Some questions in the PISA assessment (see www.oecd.org/pisa) focus precisely on these latter aspects: the ability to draw appropriate conclusions from data, perform and evaluate scientific enquiry, and reflect on the uncertainty of measurements when interpreting data.

Take the example question from the test unit, "Running in hot weather" (below), where a runner doing a one-hour workout in hot weather provides the context for several science-related questions. To answer the first part of the question correctly, students must be able to design a simple experiment and investigate how one factor – air temperature – affects the volume of sweat produced by the runner, if the level of humidity in the air remains constant. This measures the ability to design a scientific enquiry (in a simple setting, and using a computer-based simulation), and requires knowledge of the procedures used by scientists to establish cause and effect. To answer the second part of the question, students must draw on their knowledge of biology to explain that sweating cools the body at higher temperatures.



This sample question also highlights one of the important changes made to the PISA tests: the move from a paper-based test to a computer-based test (countries also had the option to deliver the test in a paper-based version, as in previous cycles of PISA). In fact, it would not have been possible to ask or answer the first question in a pencil-and-paper format. Computer delivery of the test allows PISA to measure students' proficiency in science both more extensively and with greater nuance. This change should also be seen as an acknowledgement that not only are most of today's 15-year-olds already fluent in computer use, but that no matter what occupation they may ultimately choose for themselves, that kind of fluency will be required if these students are to participate fully in their societies.

The use of computers, rather than pencils and paper, to assess students is perhaps just the most obvious change in PISA. In the nine years between PISA 2006 – the previous assessment that focused on science – and PISA 2015, several other things changed too:

How PISA evolved between 2006 and 2015

	PISA 2006	PISA 2015
Number of participating countries/economies	57	72
New countries/economies joining PISA for the first time in 2015	The municipality of Beijing and the provinces of Jiangsu and Guangdong in China, whose results will be reported together with those of Shanghai as B-S-J-G (China); Algeria; the Dominican Republic; Kosovo; Lebanon.	
Top-performing country in science	Finland	Will be revealed on 6 December 2016
Test-takers	about 400 000 students	about 540 000 students
...in	14 365 schools	18 618 schools
...representing	over 25 million 15-year-olds	over 29 million 15-year-olds
Main mode of assessment	Pencil and paper	Computer
Number of questions used in the assessment of science	103	184 (of which 85 common to PISA 2006)
Length of the assessment for students	2 hours (every student is given only a subset of all questions, and different students receive different sets of questions)	

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The bottom line: So what should you look for on 6 December when the latest results from PISA are made public? Among many other things, the answers to these questions:

- Which country or economy has the highest average score in science, reading and mathematics? How do the countries and economies new to PISA compare?
- Which countries were able to increase the share of students performing at the highest levels in PISA? Are there countries that reduced the number of low-achieving students?
- How many students expect to work in science-related careers in their future? Are these expectations related to students' performance in science? To their enjoyment of learning science?
- Which teaching practices are associated with better results on the science test?
- In which countries/economies do disadvantaged students have the best chances of performing among the top students across all countries?

For more information

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