AG KNOWLEDGE IN SCHOOLS

WHAT DO AUSTRALIAN PRIMARY AND SECONDARY STUDENTS KNOW ABOUT AGRICULTURE?

AGRI-TECH EDUCATION

CQUniversity AUSTRALIA

Cosby, A, Manning, J, Fogarty, E, Snowden, A, McCosker, A, McDonald, N, Lancaster, L, O'Dea, M. (2022). 'Ag Knowledge in Schools. What do Australian primary and secondary students know about Agriculture?', CQUniversity Australia.

This research has been approved by the CQU Human Research Ethics Committee, project number 21738. Approval was also granted by each state education department (except Western Australia), respective catholic dioceses, or independent school, relevant to each school type (Government, Catholic or Independent).

CQUniversity's Agri-Tech Education & Extension team are working to change the way the current and next generation of the agricultural workforce engage with research and industry leading practice change within the supply chain. We do this by delivering collaborative projects between researchers and educators to engage students with agri-tech and build the digital literacy of the current agricultural workforce. Our team work with students and professionals from foundation/kindergarten to tertiary, and from early-career to established career professionals across industries in rural and regional Australia.

The Agricultural Knowledge Survey was developed to expand on existing but dated research on the agricultural literacy of Australian students. The 2021 survey was designed for students in Grade 4-6 (Junior Survey) and Year 7-10 (Senior Survey) with 5,187 eligible students completing the survey from 157 schools across Australia.

The survey aimed to gain an understanding of student knowledge and awareness of the agricultural industry across Australia with results to be used by the Agri-Tech Education and Extension team to expand and further develop education programs and professional learning opportunities for teachers to increase knowledge, engagement, and appreciation of the agricultural industry.

The Australian education system lacks a formal framework for assessment of students' agricultural literacy. This represents a significant limitation, though it is common deficiency across many international jurisdictions. One exception is the United States, which developed the National Agricultural Literacy Outcomes (NALOs) to allows for national benchmarking of student knowledge. The survey results presented in this report were motivated by the NALOs and a similar interest to understand the knowledge of agriculture in Australian students.

Reference

Spielmaker, D. M., & Leising, J. G. (2013). National agricultural literacy outcomes. Utah State University, School of Applied Sciences & Technology. Retrieved 26 May 2022 from https://www.agliteracy.org/resources/outcomes/

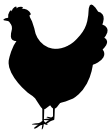
The findings of this survey have demonstrated that agricultural knowledge of Australian school students is moderate. There is room for improvement in several key areas.

FINDINGS

Agricultural knowledge increased for both primary and secondary students with each year level

School location and level of farm exposure had an impact on student agricultural knowledge

Students are more proficient in identifying animal-derived products compared to plant-derived products, particularly when the product has undergone substantial processing e.g., grain to produce bread



Many students, particularly those in primary school, are uncertain if chickens are given hormones to grow. As this practice has been banned for over 60 years, there is a clear need for consumer education

The majority of secondary students know that Australia exports most of its food and fibre

Stereotypes of the dairy sector are still apparent, with the common perception that commercial milking of dairy cows occurs by hand. Although the dairy industry has high adoption of agri-tech, these new practices are not being adequately portrayed to Australian students

Both primary and secondary students exhibited a moderate to high level of knowledge regarding healthy food choices, highlighting that students may learn about agriculture in other school subjects, e.g. food technology

Most student understood why different foods are consumed around the world. This could again reflect cross-curriculum learning in subjects other than agriculture (e.g., geography)

Most students were able to identify the natural resources needed to grow crops

The majority of students were able to identify that cotton, wool and leather are all produced on farm

Some secondary students incorrectly thought that cattle spend all of their life in a feedlot and/or that they do not spend anytime outside at all. This highlights current misconceptions of the beef sector

Agriculture is undergoing a period of rapid technological advancement. However, many students do not recognise technologies used on farm

Whilst students were aware of traditional careers in the sector, many students were unable to identify other relevant careers such as a scientist or journalist

Primary

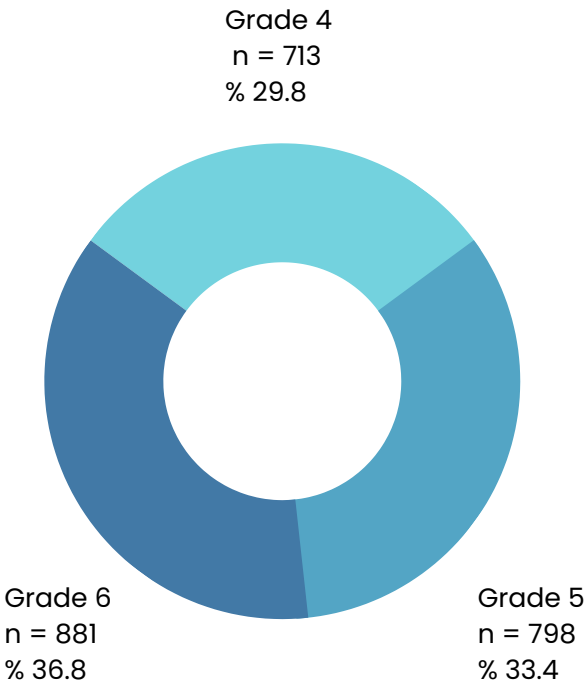
METHODOLOGY

Data collection

A total of 2477 surveys were collected, with a relatively even split between Grade 4, 5 and 6. Thirty-one surveys were immediately discarded due to students being outside of Grade 4 - 6 (n = 29) or because the survey was illegible (n = 2). The remaining 2446 surveys were then examined and excluded if they: (i) did not include their grade (n = 9); (ii) left all questions blank (n = 24); or (iii) responded with all possible answers (including 'I don't know') to three or more 'select all that apply' questions (n = 6). This threshold was chosen based on students having responded with all possible answers to 50% or more of the six 'select all that apply questions'. Additionally, if students had attempted three or less knowledge questions they were excluded (n = 15). For this final criterion, an 'attempt' was defined as any response other than 'I don't know' and the threshold was selected based on students attempting more than 25% of the survey.

Calculating Agricultural Knowledge

For the remaining 2392 surveys, student responses were coded for analysis using Microsoft Excel. Frequency statistics were calculated for all demographic variables. To assist in this, a location variable was generated based on school location and defined by the Australian Statistical Geography Standard Remoteness Structure (ABS, 2016). The structure defines five areas of relative remoteness across Australia: major city, inner regional, outer regional, remote, very remote. In this study, outer regional, remote and very remote were amalgamated into a single group. Descriptive statistics were calculated for agricultural knowledge questions.



Correct response options for 'select all tha apply' items were weighted based on the total number of selections required for a fully correct answer. For example, for a question with four correct responses, students were given a score of 0 for no correct response, 0.25 for one correct response, 0.5 for two correct responses and so forth. The total correct scores per student were then calculated out of a total of 13. The impact of demographic factors on agricultural knowledge was assessed using a Kruskal-Wallis test. Post-hoc pairwise comparisons were calculated using a Dunn's test with Bonferroni adjustment.

DEMOGRAPHICS

GENDER

Male
n = 1180
% 49.3

Female
n = 1165
% 48.7

Other
n = 41
% 1.7

Blank
n = 6
% 0.3

LOCATION

Outer regional/ remote
n = 862
% 36.0

Inner regional
n = 1077
% 45.1

Major City
n = 453
% 18.9

FARM EXPOSURE

How often do you visit a farm?

n = 696
% 29.1

n = 448
% 18.7

n = 298
% 12.5

n = 585
% 24.5

n = 295
% 12.3

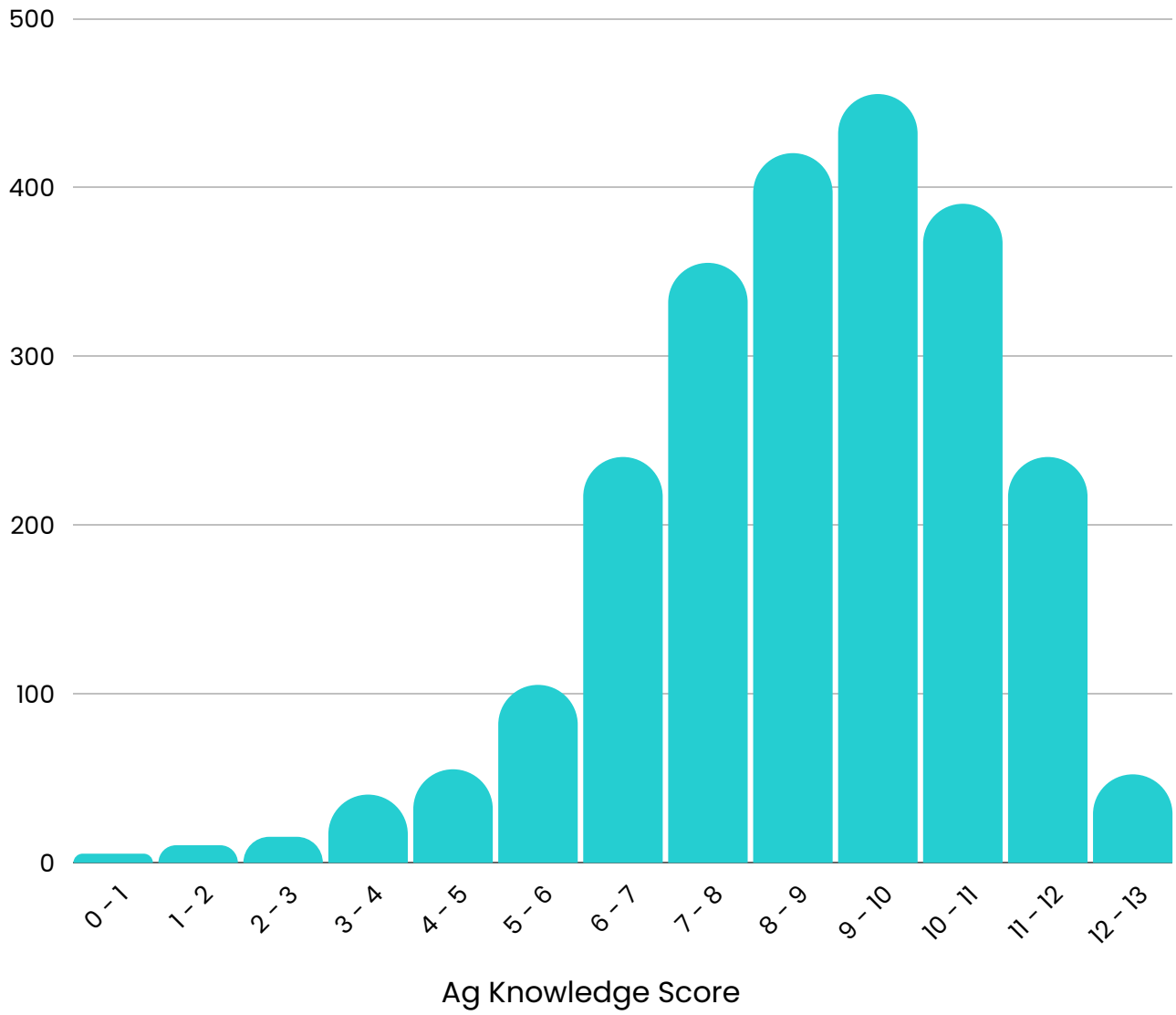
n = 70
% 2.9

AGRICULTURAL KNOWLEDGE SCORES

The maximum ag knowledge score that could be achieved was 13.

8.7	9.0	0.5 - 13.0
Mean	Median	Range

HISTOGRAM OF SCORES



WHAT IMPACTS PRIMARY STUDENT AGRICULTURE KNOWLEDGE SCORES?

KEY

✓ Significant impact

✗ No impact

GENDER ✗

There was no significant difference in agriculture knowledge scores based on gender (P = 0.1).

GRADE ✓

Primary student knowledge scores increased with grade (P < 0.001).

8.3	8.8	9.5
Grade 4	Grade 5	Grade 6

FARM EXPOSURE ✓

Farm exposure significantly impacted agricultural knowledge scores of primary students (P < 0.001).

9.5[a]	9.2[ab]	8.8[bc]	8.8[c]	8.1
I live on a farm	I visit a farm at least once per school term	I visit a farm at least once per year	I have been to a farm at least one time before	I have never been to a farm

*Scores with the same superscript are not significantly different

LOCATION ✓

School location had a significant impact on agriculture knowledge of primary students (P < 0.001).

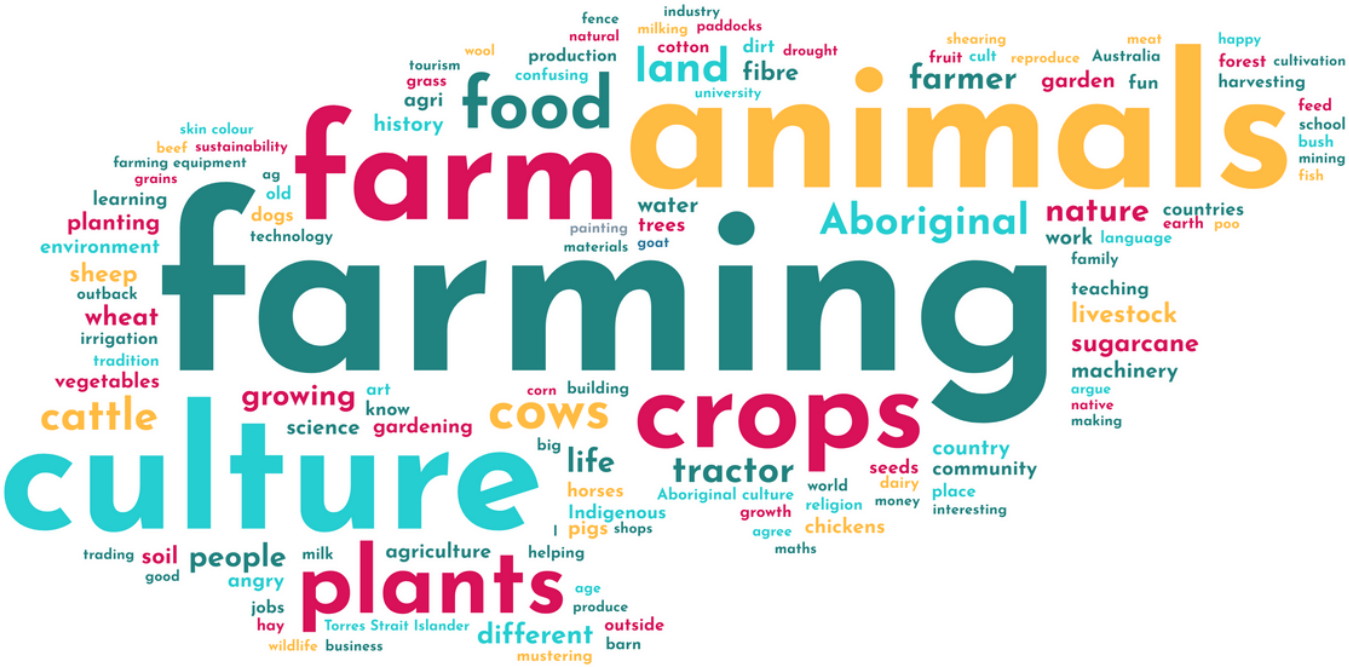
8.7[a]	9.2	8.8[a]
Major City	Inner Regional	Remote

*Scores with the same superscript are not significantly different

AWARENESS OF AGRICULTURE

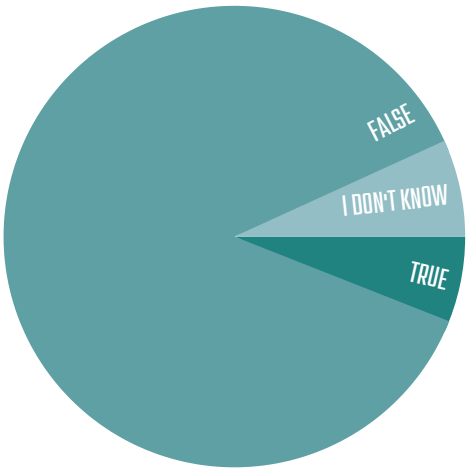
Write three words you think of when you hear the word 'agriculture'.

The size of the word reflects how often it was mentioned i.e. larger words were mentioned more often



ANIMAL PRODUCTION

All farm animals in Australia are kept in cages.



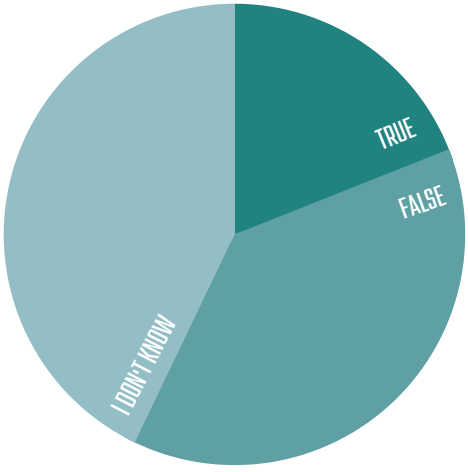
True
n = 143
% 6.0

False
n = 2086
% 87.2

I don't know
n = 163
% 6.8

Majority of primary students knew that not all farm animals are kept in cages

All chickens in Australia are given hormones to grow.



True
n = 454
% 19.0

False
n = 912
% 38.1

I don't know
n = 1026
% 42.9

Almost half of primary students were unsure if chickens are given hormones to grow

COTTON

Simon got a new pair of cotton socks for Christmas. Cotton is a fibre used in many types of clothing.

Where does cotton come from?

Animals	n = 460 % 19.2
Plants	**n = 1288** **% 53.8**
Animals and plants	n = 469 % 19.6
It is man made	n = 77 % 3.2
I don't know/blank	n = 98 % 4.1

Over half of primary students were able to identify that cotton comes from a plant

DAIRY

What path does milk take from the farm to your home?	n =	%
Farm > Refrigerated truck > Factory > Supermarket > Home	**1374**	**57.4**
Farm > Refrigerated truck > Supermarket > Home	350	14.6
Farm > Factory > Supermarket > Home	479	20.1
I don't know/blank	189	7.9

Amy is a dairy farmer.

Circle all the methods that farmers use to collect milk from cows on commercial dairy farms in Australia to sell to customers (you may choose more than one answer).

With milking machines n = 1873

By hand into a bucket n = 1865

In a robotic dairy n = 638

I don't know/ blank n = 76

Total correct

0	1	2
n = 416	n = 1441	n = 535
% 17.4	% 60.2	% 22.4

Under a third of primary students recognised that milking also occurs in a robotic dairy

HEALTHY FOODS

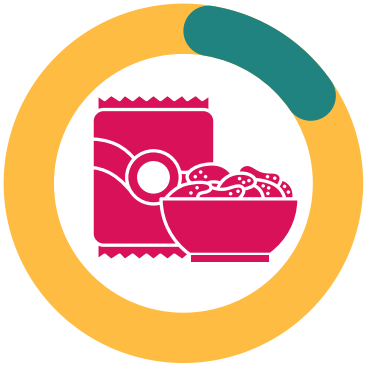
Samantha would like to take a healthy lunchbox to school.

Which of these foods is healthy? Circle all that apply
(you may choose more than one answer).

Ice-cream
n = 37

Soft drink
n = 34

Chocolate milk
n = 289



Potato chips
n = 595

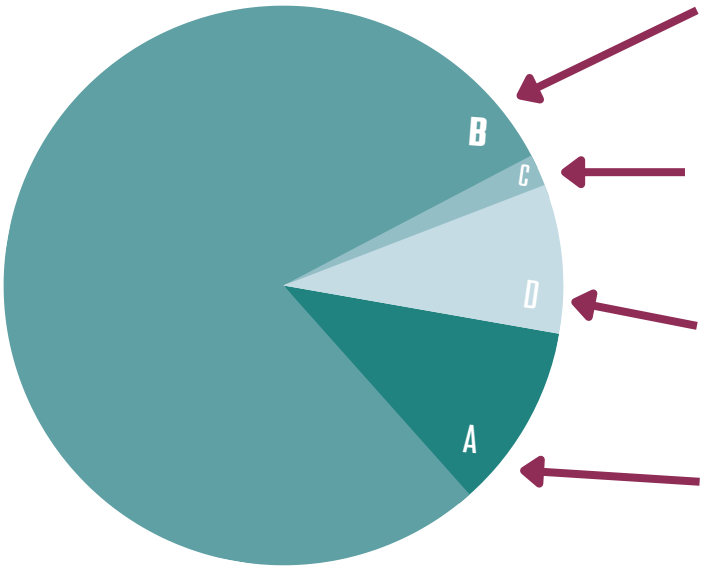
Apple
n = 2288

I don't know/blank
n = 69

GEOGRAPHY AND INTERNATIONAL FOODS

Farah lives in Malaysia and takes starfruit to school. Jane lives in Australia and takes an apple to school.

Why do people in different parts of the world eat different fruits and vegetables?



Because some fruits and vegetables grow better in certain areas of the world
n = 1887
% 78.9

Because their school tells them what fruit they can bring
n = 44
% 1.8

I don't know/blank
n = 206
% 8.6

Because Farah likes star fruits and Jane likes apples
n = 255
% 10.7

Knowledge in this area is positive, but could also highlight the influence of geography or cultural studies subjects.

NATURAL RESOURCES

Which of the following natural resources does a farmer need to grow their wheat crop?

Circle all that apply (you may choose more than one answer).

	n=
Cars	52
Water	**2166**
Trees	413
Rocks	85
Sunlight	**2161**
Air	**1778**
Soil	**2151**
I don't know/blank	127

Total correct

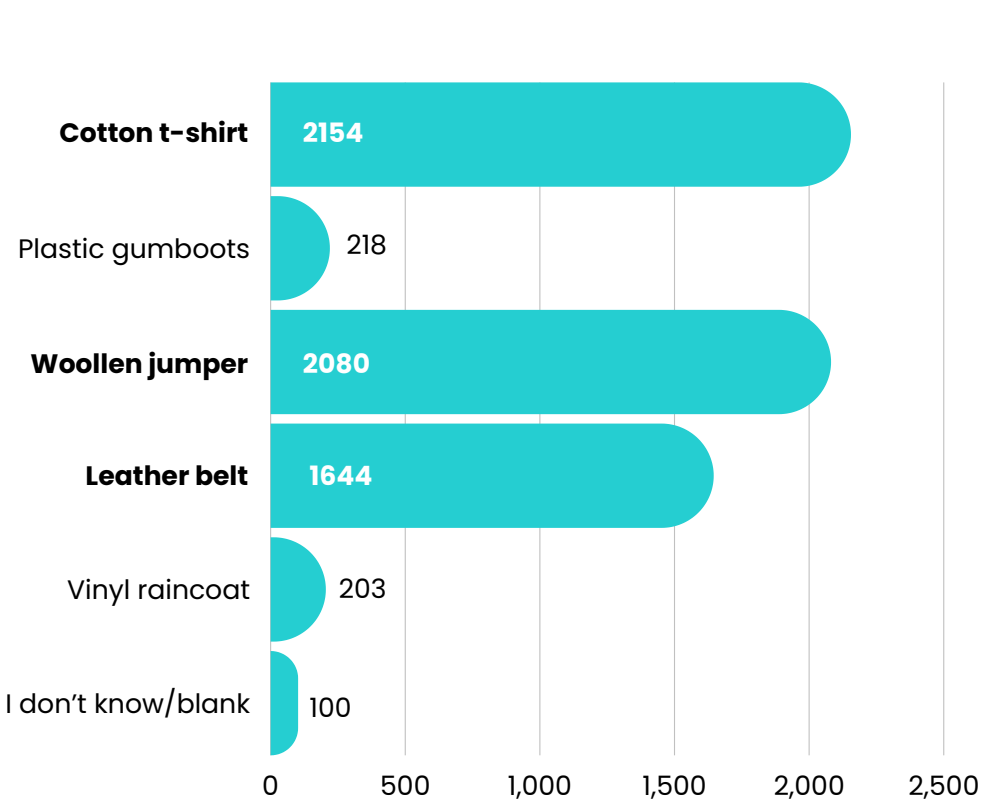
0	1	2	3	4
n = 148	n = 47	n = 67	n = 445	n = 1685
% 6.2	% 2.0	% 2.8	% 18.6	% 70.4

Primary student knowledge of natural resources was high

FARM PRODUCTS

Jessica would like to wear clothes made from products that are mostly grown on a farm.

Circle all the clothes she can wear (you may choose more than one answer).



Total correct

0
n = 112
% 4.6

1
n = 121
% 5.1

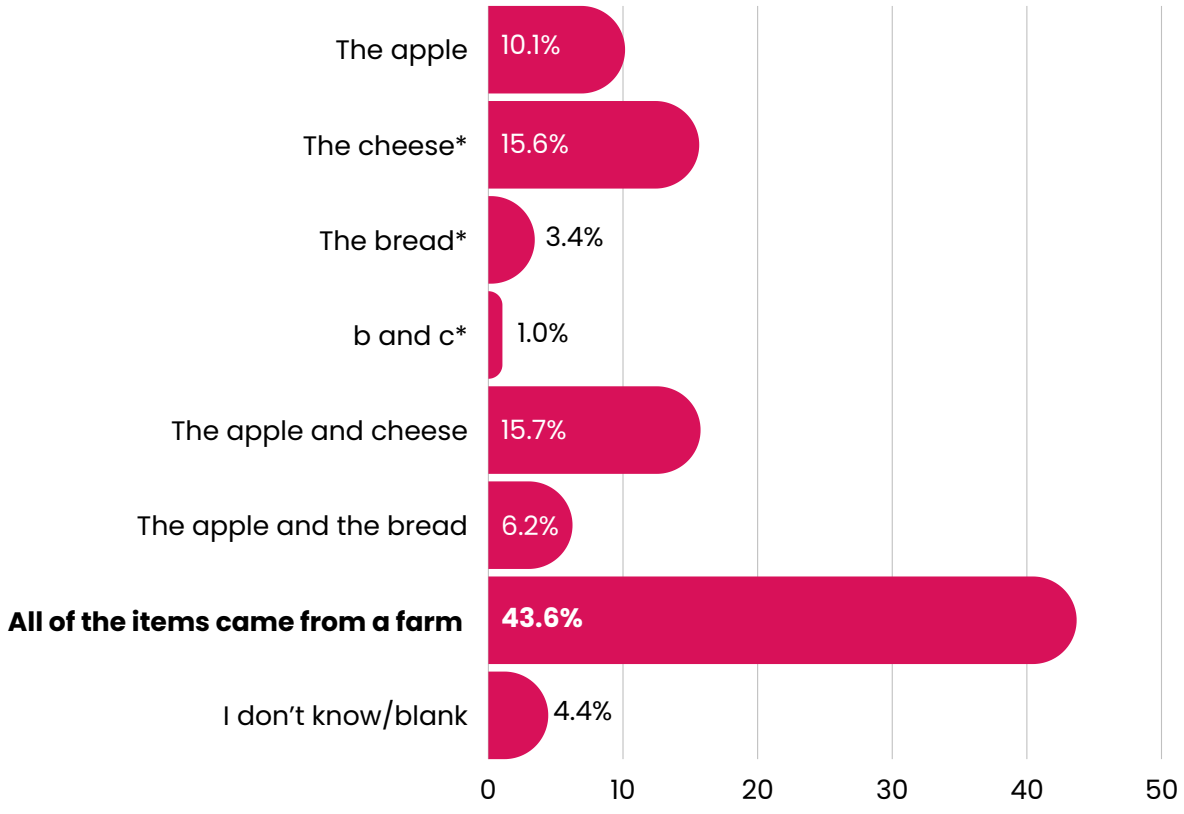
2
n = 720
% 30.1

3
n = 1439
% 60.2

Match the farm product to its end use								
	Beef		Orange		Bacon		Wool	
	n =	%	n =	%	n =	%	n =	%
Pig	29	1.2	5	0.2	**2325**	**97.2**	8	0.3
Cow	**2327**	**97.3**	6	0.3	27	1.1	3	0.1
Sheep	4	0.2	8	0.3	8	0.3	**2342**	**97.9**
Tree	3	0.1	**2342**	**97.9**	6	0.3	9	0.4
Blank	29	1.2	31	1.3	26	1.1	30	1.3

Ben has a cheese sandwich and an apple in his lunchbox.

Which foods in his lunchbox are produced from ingredients that came from a farm?

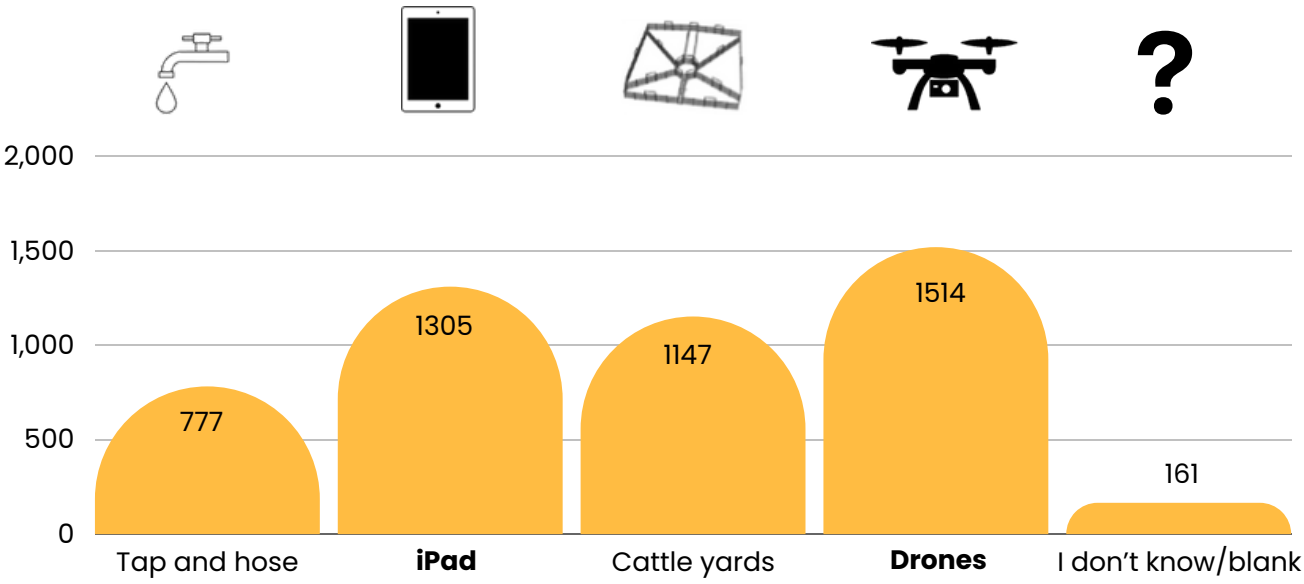


*Some students who completed the survey in written format circled both cheese and bread

AGRI-TECH

Farmer Ted uses his computer to keep track of his business records.

What other kinds of new technology can a farmer use? Circle all that apply (you may choose more than one answer).



Total correct

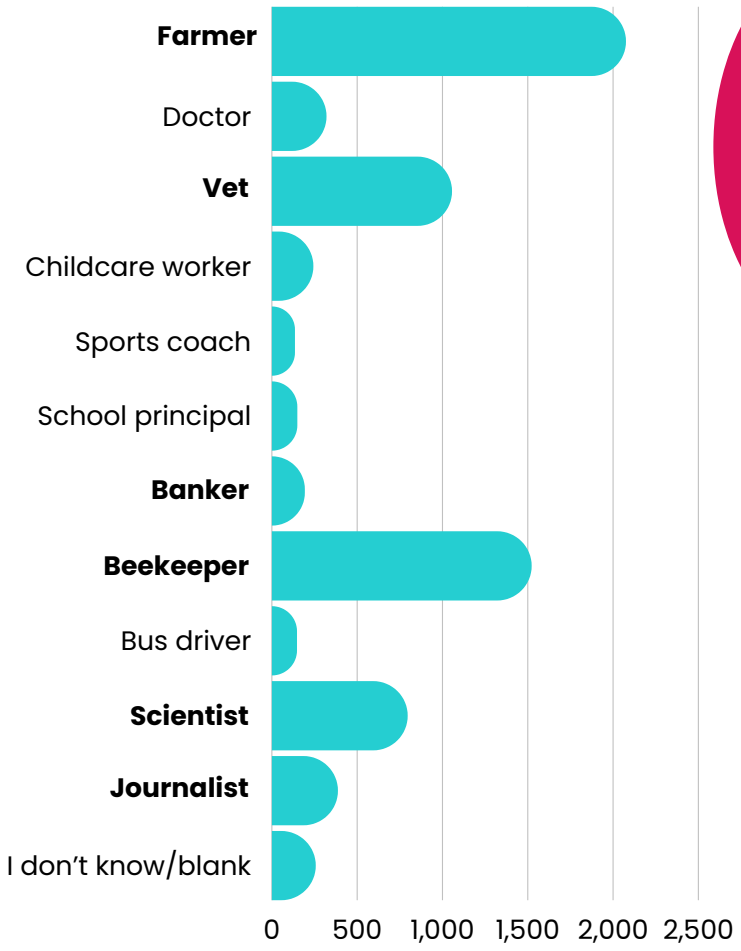
0	1	2
n = 640	n = 685	n = 1067
% 26.8	% 28.6	% 44.6

Many primary school students believed that cattle yards as well as taps and hoses were among new technology being used on-farm

CAREERS

There are many types of jobs in agriculture.

Circle all the jobs that can be done in the agriculture industry below.



Total correct

0	1	2	3
n = 272 % 11.4	n = 299 % 12.5	n = 609 % 25.4	n = 613 % 25.6

4	5	6
n = 397 % 16.6	n = 143 % 6.0	n = 59 % 2.5

Generally, primary students can make the connection between more traditional careers and agriculture, though struggle to understand possible career paths that are not typically associated with the sector

Secondary

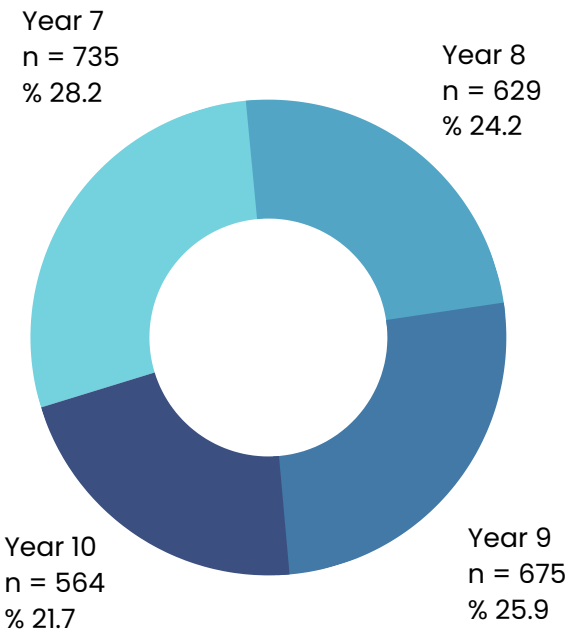
METHODOLOGY

Data collection

A total of 2763 surveys were collected. Twenty-two surveys were immediately discarded due to surveys being illegible (n = 22). The remaining 2741 surveys were then examined and excluded if they: (i) did not include their year (n = 8); (ii) left all questions blank (n = 73); or (iii) responded with all possible answers (including 'I don't know') to three or more 'select all that apply' question (n = 13). This threshold was chosen based on students having responded with all possible answers to more than half of the five 'select all that apply questions'. Additionally, students must have attempted four or more knowledge questions to be retained. For this final criterion, an 'attempt' was defined as any response other than 'I don't know' and the threshold was selected based on students attempting more than 25% of the survey. Forty-four surveys were discarded at this step.

Calculating Agricultural Knowledge

For the remaining 2603 surveys, student responses were coded for analysis using Microsoft Excel. Frequency statistics were calculated for all demographic variables. To assist in this, a location variable was generated based on school location and defined by the Australian Statistical Geography Standard Remoteness Structure (ABS, 2016). The structure defines five areas of relative remoteness across Australia: major city, inner regional, outer regional, remote, very remote. Similar to the primary analysis, outer regional, remote and very remote were amalgamated into a single group



Agricultural knowledge scores were calculated using the same methodology as for the primary analysis. Additionally, the impact of demographic factors on knowledge scores were also assessed using a Kruskal-Wallis test, with post-hoc evaluation using a Dunn's test with Bonferroni adjustment

DEMOGRAPHICS

GENDER

Male
n = 1392
% 53.5

Female
n = 1093
% 42.0

Other
n = 111
% 4.3

Blank
n = 7
% 0.2

LOCATION

Outer regional/ Remote
n = 784
% 30.1

Inner regional
n = 1316
% 50.6

Major city
n = 470
% 18.1

Blank
n = 33
% 1.2

FARM EXPOSURE

How often do you visit a farm?

n = 851
% 32.7

n = 645
% 24.8

n = 316
% 12.1

n = 495
% 19.0

n = 146
% 5.6

n = 150
% 5.8

AGRICULTURAL KNOWLEDGE SCORES

The maximum ag knowledge score that could be achieved was 13.

8.6	8.8	0.6 - 13.0
Mean	Median	Range

HISTOGRAM OF SCORES

WHAT IMPACTS SECONDARY STUDENT AGRICULTURE KNOWLEDGE SCORES?

KEY

✓ Significant impact

✗ No impact

GENDER ✗

There was no significant difference in the agriculture knowledge scores of males and females (P = 1.0).

YEAR LEVEL ✓

Secondary student knowledge scores increased with year level (P < 0.001). Students in Years 7 and 8 has significantly lower scores than students in Years 9 and 10 (P < 0.001).

Year 7	Year 8	Year 9	Year 10
8.2[a]	8.4[a]	9.5[b]	9.7[b]

*Scores with the same superscript are not significantly different

FARM EXPOSURE ✓

Farm exposure significantly impacted agricultural knowledge scores of secondary students (P < 0.001).

I live on a farm	I visit a farm at least once per school term	I visit a farm at least once per year	I have been to a farm at least one time before	I have never been to a farm
9.9	9.1	8.5[a]	8.2[a]	6.8

*Scores with the same superscript are not significantly different

LOCATION ✓

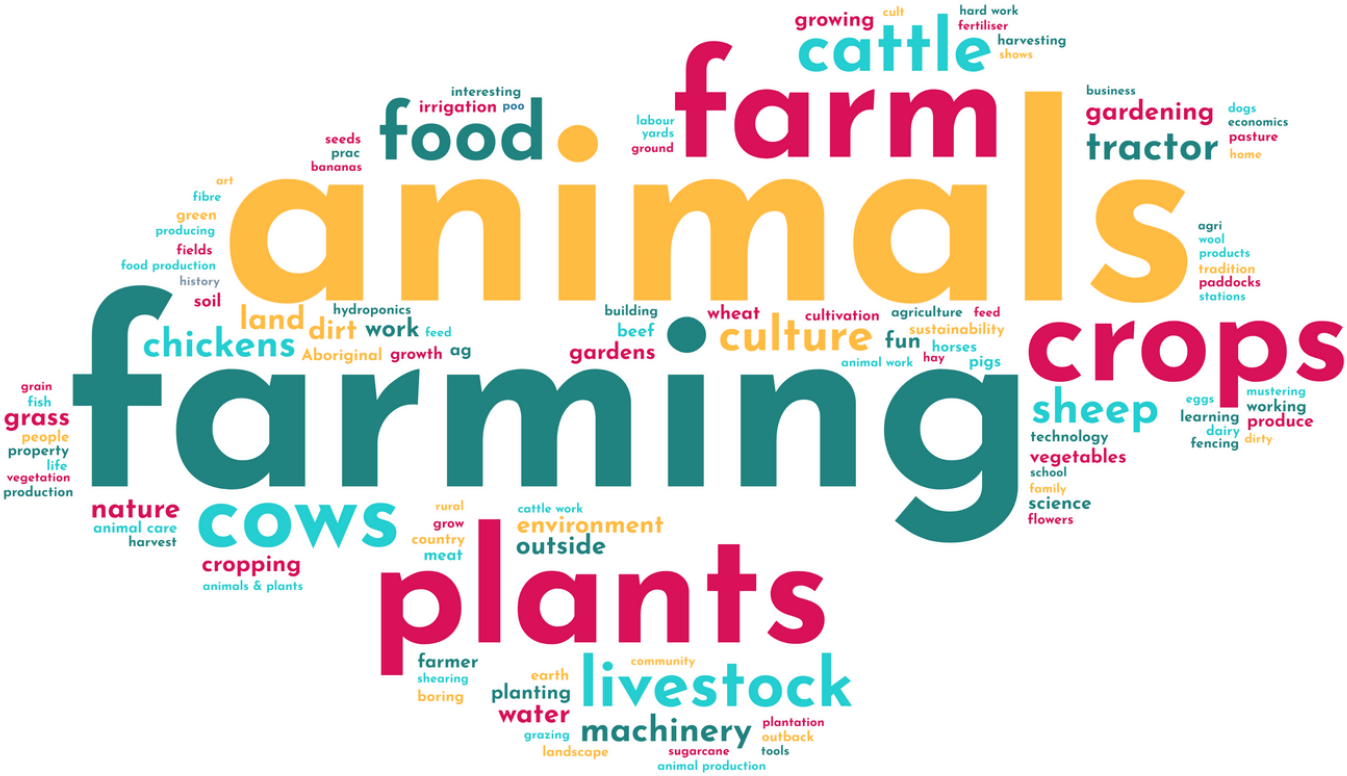
School location had a significant impact on agriculture knowledge of secondary students (P < 0.001). All locations had significantly different scores from each other.

Major City	Inner Regional	Remote
8.3	9.3	8.7

AWARENESS OF AGRICULTURE

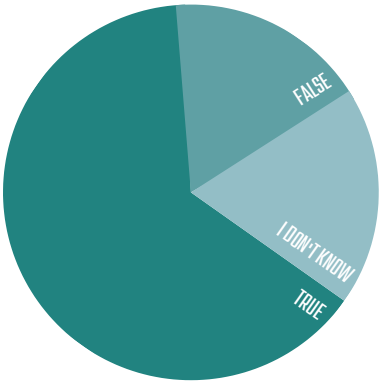
Write three words you think of when you hear the word 'agriculture'.

The size of the word reflects how often it was mentioned i.e. larger words were mentioned more often



POULTRY PRODUCTION

There are some benefits of producing eggs in a caged system.



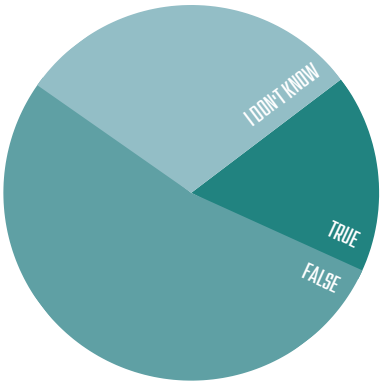
True
n = 1664
% 63.9

False
n = 448
% 17.2

I don't know
n = 491
% 18.9

Most secondary students correctly identified that there are some benefits of caged egg production

All chickens in Australia are given hormones to grown.



True
n = 445
% 17.1

False
n = 1378
% 52.9

I don't know
n = 780
% 30.0

Just over half of secondary students understand that hormones are not given to chickens to make them grow

COTTON

Simon got a new pair of cotton socks for Christmas. Cotton is a fibre used in many types of clothing.

Where does cotton come from?

Animals	n = 223 % 8.6
Plants	**n = 1892** **% 72.7**
Animals and plants	n = 341 % 13.1
It is man made	n = 58 % 2.2
I don't know/blank	n = 89 % 3.4

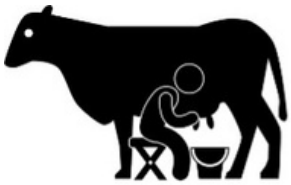
The majority of secondary students were able to identify that cotton is derived from a plant

DAIRY

Amy is a dairy farmer.

Circle all the methods that farmers use to collect milk from cows on commercial dairy farms in Australia to sell to customers (you may choose more than one answer).

With milking machines
n **= 2277**



By hand into a bucket
n = 1525

In a robotic dairy
n **= 1370**

I don't know/blank
n = 91

Total correct

0	1	2
n = 196	n = 1167	n = 1240
% 9.5	% 44.8	% 47.6

Whilst over 90% of secondary students correctly reported that commercial milking of dairy cows occurs with milking machines, a large proportion also stated that milking occurs by hand

BEEF

Which of the following statements is true for beef produced in Australia?

Circle all that apply (you may choose more than one answer).

	n =
Some cattle spend all their life eating grass	**1712**
Some cattle spend most of their life eating grass and 90 days in a feedlot eating grain	**1914**
Some cattle spend all their life in a feedlot eating grain	1069
Some cattle do not spend anytime outside and live in sheds	781

Total correct

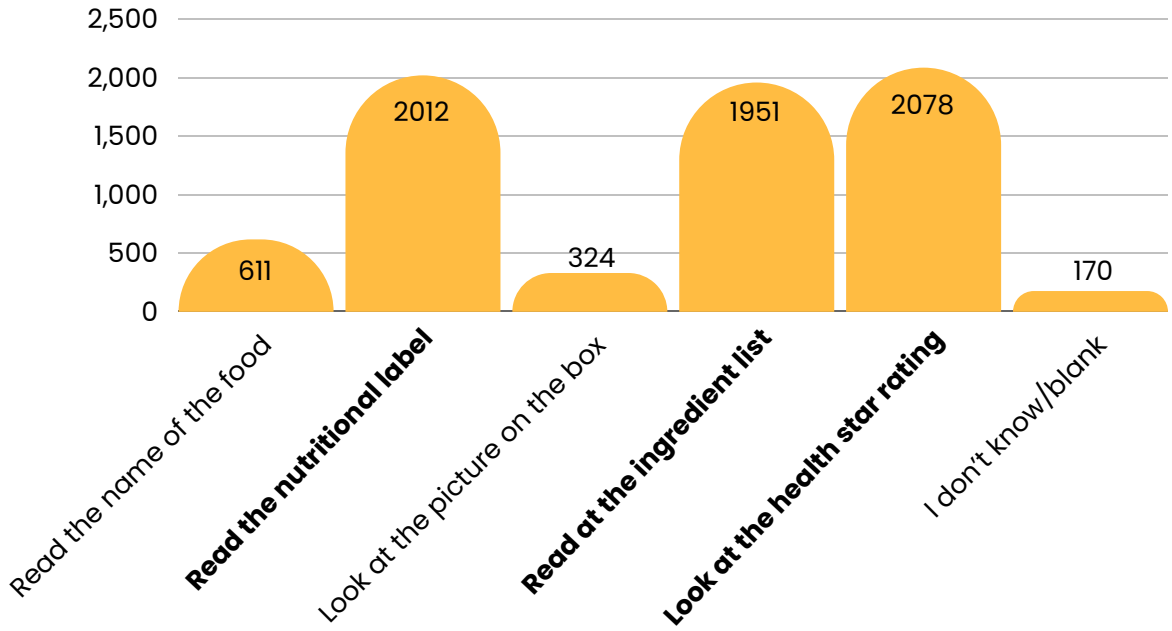
0	1	2
n = 200	n = 1180	n = 1223
% 7.7	% 45.3	% 47.0

Under half of secondary students identified both correct responses, reinforcing that sufficient education of the next-generation consumer is essential for continued industry support

HEALTHY FOODS

Looking at the image below, how would you decide if this food is healthy?

Circle all that apply (you may choose more than one answer).



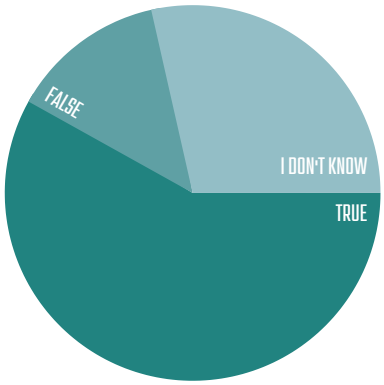
Total correct

0	1	2	3
n = 208	n = 345	n = 454	n = 1596
% 8.0	% 13.3	% 17.4	% 61.3

GEOGRAPHY AND INTERNATIONAL FOODS

Why do people in different parts of the world traditionally eat different fruits and vegetables?	n=	%
Because people in different countries don't like the same fruits and vegetables	205	7.9
Because some fruits and vegetables grow better in certain areas of the world	**2124**	**81.6**
Because people in other countries are told by the government what they can eat	60	2.3
I don't know/blank	214	8.2

Australia exports (sells) the majority of food and fibre it grows to other countries.



True
n = 1512
% 58.1

False
n = 348
% 13.4

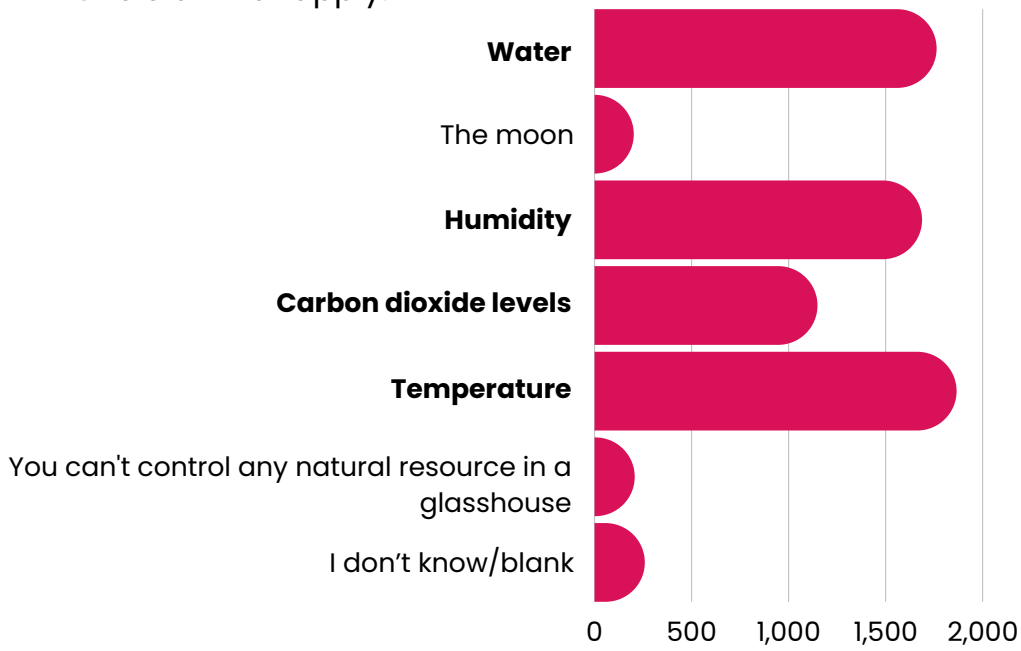
I don't know
n = 743
% 28.5

Knowledge in this area is high, but could also highlight the influence of geography or cultural studies subjects.

NATURAL RESOURCES

Many vegetables, such as cucumbers and tomatoes, are grown in glasshouses in some parts of Australia. Which of the following natural resources can be controlled in a glasshouse?

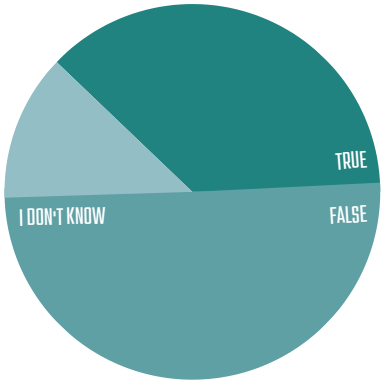
Circle all that apply.



Total correct

0 n = 362 % 13.9	**1** n = 286 % 11.0
2 n = 434 % 16.7	**3** n = 784 % 30.1
4 n = 737 % 27.3	

All crops in Australia need to be irrigated (watered by sprinklers).



True	**False**	I don't know
n = 965	**n = 1309**	n = 329
% 37.1	**% 50.3**	% 12.6

FARM PRODUCTS

Match the farm products to their end use

	Steak		T-shirt		Cheese		Beanie		Bread	
	n =	%	n =	%	n =	%	n =	%	n =	%
Wool	28	1.1	508	19.5	9	0.3	**1949**	**74.9**	9	0.4
Milk	18	0.7	16	0.6	**2443**	**93.9**	10	0.4	12	0.5
Beef	**2445**	**93.9**	10	0.4	13	0.5	17	0.6	15	0.6
Wheat	2	0.1	14	0.5	14	0.5	20	0.8	**2448**	**94.1**
Cotton	10	0.4	**1952**	**75.0**	20	0.8	501	19.2	14	0.5
Blank	100	3.8	103	4.0	104	4.0	106	4.1	105	4.0

Most secondary students correctly matched all products to their end use

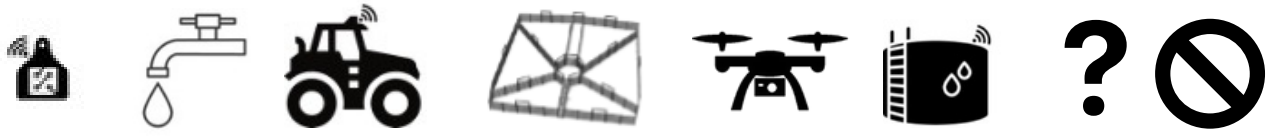
AGRI-TECH

Farmers use computers to keep track of business records.
What other kinds of new technology can a farmer use?

Circle all that apply (you may choose more than one answer).

n =

Electronic identification tags	**1904**
Tap and hose	908
Auto-steer tractor	**1425**
Cattle yards	1529
Drones	**1762**
Water tank sensor	**1751**
They don't use any other technology	66
I don't know/blank	242



Total correct

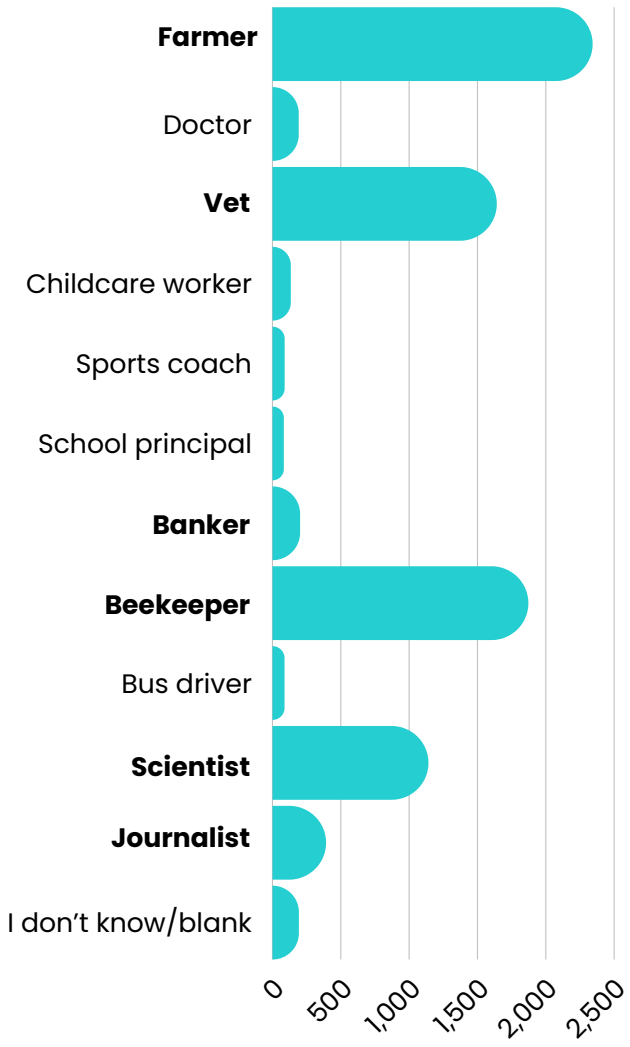
0 n = 306 % 11.8	**1** n = 264 % 10.1	**2** n = 473 % 18.2
3 n = 608 % 23.3	**4** n = 952 % 36.6	

Adequate portrayal of the technological advancements in the agricultural sector are essential to encourage student pursuit of these new and emerging career roles

CAREERS

There are many types of jobs in agriculture.

Circle all the jobs that can be done in the agriculture industry below.



Total correct

0	1	2	3
n = 220 % 8.5	n = 175 % 6.7	n = 531 % 20.4	n = 719 % 27.6

4	5	6
n = 677 % 26.0	n = 222 % 8.5	n = 59 % 2.3

Secondary students can readily identify traditional agriculture careers, but struggle to identify less obvious career paths in the sector

RECOMMENDATIONS

Agricultural education is important for primary and secondary school students in order to:

1. Attract and develop the next generation agricultural workforce
2. Ensure accurately informed consumers of the future
3. Promote Australia's reputation as sustainable producers of safe and high-quality food and fibre
4. Accelerate the digital transformation of the agricultural industry

We propose the following six recommendations to improve agricultural education in Australia

RECOMMENDATION 1:

Develop a formal framework for the assessment of agricultural literacy including knowledge of production methods, consumer choice information and careers in Australia to enable monitoring and benchmarking between Australian populations and identify areas for targeted intervention

RECOMMENDATION 2:

Improve connections with industry organisations, private businesses and the education sector through locally based partnership initiatives

RECOMMENDATION 3:

Provide varied and accessible teacher professional development opportunities, including pre-service teachers, to improve their knowledge, self-efficacy and skills to integrate agricultural literacy concepts into their teaching programs

RECOMMENDATION 4:

Expose primary and secondary school students to authentic experiences of the skills and knowledge used in the world of agricultural work and contact with role models to aspire to

RECOMMENDATION 5:

Increase student and teacher knowledge and skills of agri-tech tools and systems which can be used to improve economic, social, and environmental outcomes across the agriculture supply chain

RECOMMENDATION 6:

Consistent measurement and evaluation of agricultural education initiatives including their impact on student attitudes and agricultural literacy levels

To implement these recommendations the following is required:

1. Industry bodies prioritise agricultural education through their strategic plans
2. Commitment to sustained investment across urban, regional and rural areas
3. Collaboration between government, industry organisations, employers and education sectors to provide opportunities for engagement with agriculture
4. Consensus on national agricultural literacy standards

FURTHER READING

Cosby, A, Manning, J.K, Lovric, K and Fogarty, E.S (2022). The future agricultural workforce – is the next generation aware of the abundance of opportunities? Farm Policy Journal, Winter 2022: Securing agriculture's future workforce, pp. 18-30

AGRI-TECH EDUCATION

CQUniversity AUSTRALIA