REFRACTION MEDIA

mla
MEAT & LIVESTOCK AUSTRALIA

Science and Sustainability
Years 5–6

Future Foods

Primary guide stage 3

Stage 3 – Future Foods

Our global population recently passed the seven billion mark and is predicted to reach nine billion people by 2050. That's an extra two billion people that will need to be fed every year. Most of this increase is predicted to take place in the developing world – such as Africa and India – where much of the current population already doesn't receive enough food.

Despite being the world's second driest continent, Australia already plays an important role in feeding the world's population, producing 4% of the world's beef and 6% of the lamb and mutton that is consumed globally. As the demand for meat grows, however, supplying enough protein to satisfy the world's rapidly expanding population has become an important issue.

In this guide, you'll read about the challenges cattle and sheep farmers face and how they are working with scientists and funding new research that can help us to meet the challenge of feeding the world.

The FIVE Es Model

This guide employs the 'Five Es' instructional model – a constructivist or inquiry-based approach to learning, in which students build new ideas on top of the information they have acquired through previous experience. Its components are:

Engage Students are asked to make connections between past and present learning experiences and become fully engaged in the topic to be learned.

Explore Students actively explore the concept or topic being taught. It is an informal process where the students should have fun manipulating ideas or equipment and discovering things about the topic.

Explain This is a more formal phase where the theory behind the concept is taught. Terms are defined and explanations given to models and theories.

Elaborate Students develop a deeper understanding of sections of the topic.

Evaluate Teacher and students evaluate what they have learned in each section.

Meat & Livestock Australia for a sustainable future

Meat & Livestock Australia is an initiative by Australian cattle and sheep farmers, along with the broader industry, to deliver more sustainable farming by 2020. It's a commitment to take positive action, both big and small, to continually improve how farmers operate, and improve sustainability in the beef and lamb supply chain. As caretakers of the land, farmers are committed to leaving it in better shape than when they found it by improving efficiency and reducing resources used.

Meat & Livestock Australia is also about sharing ideas, celebrating successes and providing a focal point for environmental, social and ethical farming action to ensure we all enjoy a sustainable food supply into the future.

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Farming today and in the future

Food – we all need it, yet ensuring we have enough for the future is one of the biggest issues we face. Australian cattle and sheep farmers are rising to the challenge of feeding a world that is changing rapidly in terms of climate and population.

Australian cattle and sheep farmers care for almost half of Australia's land. Farmers also produce 93% of our food, using science and technology to help them farm in the best way to manage and improve the soil, water and biodiversity (the number of species) of the farm area.

In this guide, you'll find out how we farm today, some of the challenges Australian cattle and sheep farmers will face in the future, and how science and technology is helping them address these challenges.

Climate challenge

Climate is the pattern of changing weather across time. Managing climate variability is one of the biggest challenges for all farmers. Their business depends on rain and sunshine to grow grass for their animals to eat and grow

crops for humans and animals. If it doesn't rain or there is too much rain, farmers must be prepared to manage this variability to care for their animals and land.

Australia has a naturally variable climate with periods of drought and heavy rain. Globally, the climate is also changing due to increased greenhouse gas emissions – from energy use, industrial operations, traffic and transport, and agriculture. In the future, Australia's climate is expected to be drier overall, with increased variability and more severe droughts.

Climate variability is something farmers have always had to live with. They can, however, manage their business to reduce the impact of climate variability in a number of ways, including:

- Managing the number of livestock they have on their land so pastures have a better chance of surviving. This allows farmers to cope better during dry periods because well-established, healthy pastures provide good ground cover and retain moisture in the soil.
- During good seasons, farmers can make hay from pasture or "stubble" – the remains of a crop after the grain is harvested. Hay is then stored away and used when it is needed during very wet or very dry times. (This is where the saying "Make hay while the sun shines" comes from.)
- Monitoring long-range weather forecasts and reducing numbers of cattle and sheep before a drought takes hold can reduce the impact of a long spell of dry weather.

A land of drought and rain

Australia is a big continent, with very different climate from north to south, and large areas of arid land. Only 8% of the Australian landscape is arable (able to be farmed) and cattle and sheep farming mainly takes place on land that isn't suited to any other agricultural purpose.

Fast facts

- As of May 2011, 236,200 people were directly employed on farms, full-time, in the Australian farm sector.
- Each Australian farmer produces enough food to feed 600 people – 150 at home and 450 overseas.
- Australian farmers produce almost 93% of Australia's daily domestic food supply.
- Australian cattle farmers use different breeds of cattle to suit the different climates in the north and south of Australia.
- In 2013, Australian live cattle exports totalled 850,923.
- The United Nations Food and Agriculture Organization estimates that by 2050, food production worldwide will need to increase by 70%.
- In 2012, the highest value of production from agriculture in Australia was, in order: cattle, wheat, dairy, vegetables, fruit and nuts, lamb meat and wool.

Different breeds (types) of animals are better or less suited to different climates. Northern Australia, where there are two main seasons (hot and wet, and hot and dry), is best suited to cattle farming, with animals raised on vast stations that may be tens of thousands of square kilometres in size.

There are around 50 different breeds of beef cattle in Australia and they fall into two categories:

- **Bos Taurus** – these breeds originate from the moderate climates of Europe and are better suited to southern Australia. Examples of Bos Taurus breeds are Hereford, Angus and Charolais.
- **Bos Indicus** – also referred to as 'exotic breeds', these have a been bred from cattle originally from southern Asia (known as zebu), which have loose skin and are able to withstand high temperatures without getting stressed. Typical Bos Indicus breeds are Brahman, Droughtmaster and Santa Gertrudis. They are distinguished by a hump on the back of the neck.

In southern Australia, where there are four seasons (autumn, spring, winter, summer), rainfall is more evenly distributed throughout the year than in the north. There are more rainy days in southern Australia and a higher average rainfall all along the east coast. Because feed and water is more plentiful, sheep and cattle are able to be farmed on smaller properties.

There are around 40 different sheep breeds in Australia and they fall into six categories:

- Sheep wool breeds such as Merinos, originally from Spain, are known for producing large amounts of soft wool.

In many ways, Australian cattle and sheep farmers and scientists are helping to tackle the big challenges of farming in the future.

- Sheep meat breeds with short wool, such as Poll Dorsets ("poll" means having no horns) developed in Australia.
- Sheep meat breeds with long wool, such as Border Leicesters originating from Britain.
- Sheep meat breeds that shed their wool, such as Dorpers originating from South Africa.
- Fat tail breeds, such as Awassi originating from the Arabian Peninsula and favoured by the Middle East markets.
- Sheep breeds that produce carpet wool, such as Elliotdale developed in Tasmania.

Science and technology on the farm

Science helps farmers manage their animals and in doing so, improve productivity in many ways. Scientists work with cattle and sheep farmers to improve breeding by selecting animals that have the best characteristics, which will in turn be inherited by their offspring.

Scientists also work with cattle and sheep farmers to ensure that animals are kept healthy and are well fed and watered as well as working to develop improved breeds that are better suited to climate conditions and less likely to catch diseases or get infected by parasites (bugs that live on, or in, animals and can make them sick).

They also help farmers with ways to save energy and improve the productivity of their land. One of the challenges that Australian cattle and sheep farmers face is to keep their land free from pests and predators – such as rabbits and foxes – and free of invasive weeds. Weeds cost the agricultural industry in Australia around $4 billion per year.

Because of the large size of farms in Australia, it can be difficult for farmers to monitor their land

and animals so it's important that they are confident that everything is working properly. Technology helps farmers manage their farms more efficiently. In more remote areas, light planes and ultralight aircraft make checking animals and water supplies much faster and easier. If there's a problem, the farmer can discover it and fix it sooner. Farmers can also control water supply to animals using an online system or iPhone app which measures water levels and allows farmers to turn water on or off. This technology is called Telemetry.

Small devices like an electric fence tester can make a big difference to the efficiency of the farm. If an electric fence isn't working, the farmer may not know until the cattle or sheep have moved through it and into areas where they shouldn't be. Farm work is very physical and farmers need to manage tasks to make sure they don't injure themselves or anyone working for them. Developments in labour-saving machinery and devices on the farm mean jobs can be done more efficiently. They also assist farmers in doing tasks safely and without risk of injury.

New technologies, such as satellite positioning systems, help farmers to manage their land, for example to map their soil or study patterns of vegetation change and rainfall. In the future, through improved computer data processing we will be better able to predict factors that affect farming – such as information on salt and moisture content of soil, or the extent of vegetation cover over a wide area.

Farmers are also finding better ways to save energy, and to reduce the emissions from cattle and sheep whose burps and farts contain methane, a greenhouse gas.

In many ways, Australian cattle and sheep farmers are using science and research to help tackle the big challenges of farming in the future.

Find out more

Meat & Livestock Australia: ***goodmeat.com.au/education***

Bill and Deb Bray
Walkerville, Vic

BILL BRAY'S FAMILY HAS been farming in Walkerville in South Gippsland, Victoria, for about 50 years. Thanks to the good pasture and high, reliable rainfall on the coast, farmers can run a lot of livestock in this area.

Bill and his wife Deb run sheep and cattle on an area of land that's around 6000 square kilometres in size. Their sheep are a Merino-Border Leicester cross, which they breed to produce prime lamb, while their cattle are Angus crossbreeds, which are bred to produce beef for the Australian market.

Like many British cattle breeds, the Angus is suited to the conditions in southern Australia and along the coastline, thriving in cold weather. The area's reliable rainfall (they get about 1000 mm of rain per year) means good soil, which produces long, rich, green grass for the cattle and sheep to graze on.

Even in good conditions like this, producers are starting to think more about their environment. Bill and Deb try to ensure that all of their farming activities will enhance, rather than compromise, the environment. This has resulted in a few changes to the property over the past 20 years.

We've seen our farm change into a fantastic environment to live and to work in.

In the early days, the land was covered with coastal bush. Bill says farmers were encouraged to clear this bush and replace it with pastures that needed good fertiliser and suited the reliable rainfall. But now he and his family are encouraging the native vegetation to grow again by planting more than 30,000 native trees and bushes on their property and fencing it off to protect it.

Bush plantations now surround the small paddocks. The plantations have double fencing to keep the livestock out because they rub against the trees, which strips away the bark and damages them. These native plants not only improve biodiversity, but they also protect the stock during winter.

"The protection of the livestock from cold, wintery winds and rain helps improve the productivity," Bill says, explaining that the plantations help keep the stock warm. "One of the main killers of young newborn stock is rough weather."

Managing the pastures takes constant work. Bill and Deb have to make sure the pastures aren't overgrazed and that weeds aren't growing. Fences need to be maintained and when any native species die they need to be replaced with a new seedling. The Brays have also begun fencing off watercourses to create wetlands for the native species and to further encourage biodiversity.

"We've seen our farm change into a fantastic environment to live and to work in," Bill says.

SOME LAMBS TRY TO STAND up just a few minutes after they are born and can be feeding from their mother within half an hour; others, however, can take a lot longer to get up. This 'get-up-and-go' quality, also known as vigour, is linked to survival, which makes it an important topic for farmers and scientists.

"If lamb vigour can be improved through genetic selection, then lamb survival could also be improved, which will lead to improved productivity of the Australian flock," says postgraduate researcher Rachelle Hergenhan, who recently studied the biology behind their vigour with the Sheep Cooperative Research Centre.

Rachelle has always had an interest in farm animal production, particularly cattle and sheep, which she says probably stemmed from growing up on a dairy farm.

"When I heard from my university Honours supervisor that there was the opportunity to do a project related to lambing and early lamb behaviour I jumped at the chance," she says. "I was keen to get my hands dirty and this research project gave me that opportunity!"

I was keen to get my hands dirty and this research project gave me that opportunity!

The previous methods of understanding lamb vigour focused only on how long it takes lambs to stand and feed but Rachelle wanted to find out more. Rachelle looked at how quickly the lambs moved from behind a wire barrier to a model of a bleating ewe, and carried out tests for the amount of sugar in the lambs' blood to see how much energy they had.

She carried out these tests a few hours after the lamb was born, instead of at birth, which is when previous testing has been done and which disrupts the early bonding between the lamb and its mother. Rachelle says she found it fascinating how important the lamb is in contributing to its own survival, in terms of being ready to follow and maintain contact with the ewe as she moves away from the birth site.

She is now planning more work to find the genes responsible for lamb vigour and determine if it's possible to use these genes to 'select' lambs that are more likely to survive. This research would require broader experiments with a range of sires (fathers).

Rachelle Hergenhan

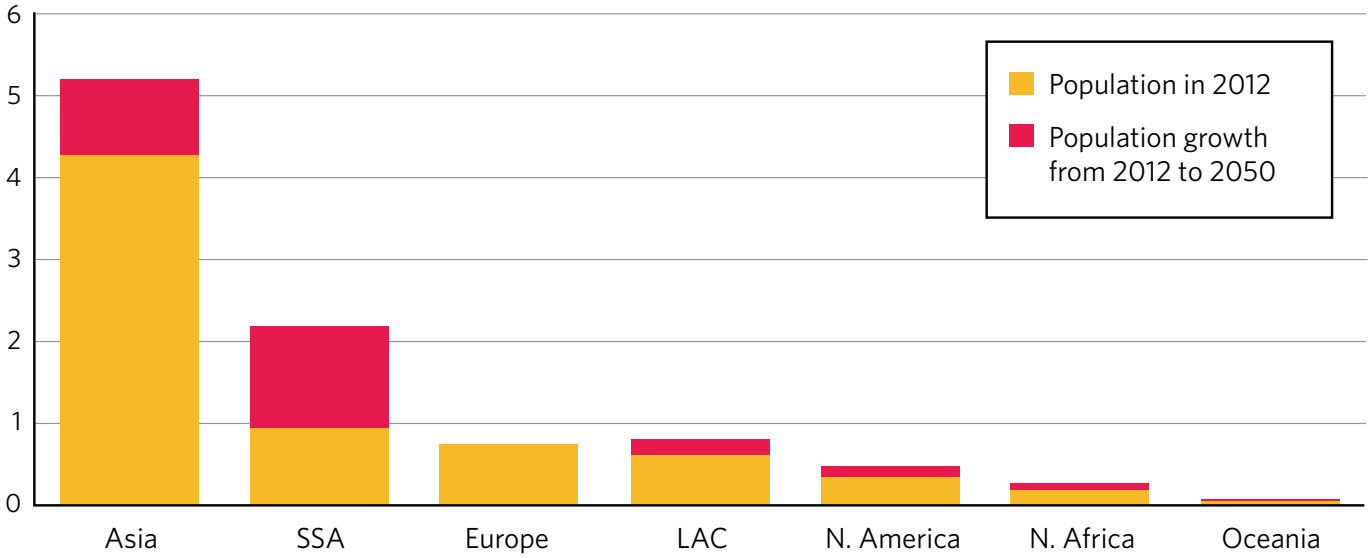
University of New England, NSW

bit.ly/1nYvDmp

The number of people in the world is growing every year. This means we need to be able to produce more and more food. Will there be enough to feed everyone?

Have a look at this graph, which shows world population.

Projected Population Growth (in billions)



Note: "SSA" = Sub-Saharan Africa, including Sudan, "LAC" = Latin America and Caribbean, "N. America" = North America, "N. Africa" = Rest of Africa, Oceania =Australia, New Zealand and Pacific Islands

Now look at this table showing how much meat and milk is eaten in different areas of the world.

Region	Livestock (KCal/Person/Day)			Beef and lamb (KCal/Person/Day)		
	2006	2050	% change	2006	2050	% change
European Union	864	925	7%	80	75	-6%
Canada & USA	907	887	-2%	117	95	-19%
China	561	820	46%	41	89	116%
Brazil	606	803	33%	151	173	15%
Former Soviet Union	601	768	28%	118	156	32%
Other OECD	529	674	27%	64	84	31%
Latin America (ex. Brazil)	475	628	32%	59	86	45%
Middle East and North Africa	303	416	37%	59	86	45%
Asia (ex. China, India)	233	400	72%	24	43	79%
India	184	357	94%	8	19	138%
Sub-Saharan Africa	144	185	29%	41	51	26%
World	413	506	23%	50	65	30%

The OECD (Organisation for Economic Co-operation and Development) is a group of democratic countries who work together to solve world problems. Australia and New Zealand are part of this group.

Working in pairs, or groups of three, brainstorm the questions posed below. Once you've had a think and talked about it with your group members, write down your answers to share with the rest of the class.

1. What predictions is the graph making about how the world's population will change over the coming years? (Hint: Which parts of the world will grow the most/least?)

2. What predictions is the table making about the amount of beef (cattle) and lamb (sheep) people will be eating in the future? (Hint: Who will be eating more/less?)

3. How do you think cattle and sheep farmers might react to this information? (Hint: What might you think about this if you were a cattle or sheep farmer? Is it good/bad news?)

4. If the predictions in the graph and table come true, what advice would you give to farmers to help them respond to the growing demand for food?

Come together as a class to listen to and discuss each group's answers. Did most groups give similar answers to the questions? What sort of advice did people have for today's farmers? What reactions did you have to what others have suggested?

Teacher's information

The aim of the Explore section is for the students to investigate some of the ideas around the farming of sheep and cattle, such as what characteristics are looked for in breeding, where we might farm animals and which foods contain protein. It is intended that the students make their own discoveries as they work around the stations in the room.

The equipment table below lists the equipment and preparation required for each activity station.

Station no. and activity	Materials list
1. Australian Guide To Healthy Eating	Collection of clean and empty food packages and cans of foods, many containing protein.
2. Farming and the local environment	Map of Australia, images of Australian landscapes and tropical and temperate cow breeds – provided.
3. Features of farm animals	Images of Australian cattle – provided.
4. Feeding the world	Computer with internet connection to access the video *Australian Agriculture: The Greatest Story Never Told* – ***youtube.com/watch?v=fFUZ_j2cCe0***

Carry out these activities at each of the stations in any order and start thinking about the different aspects to livestock farming and the challenges farmers face.

Station 1

Task

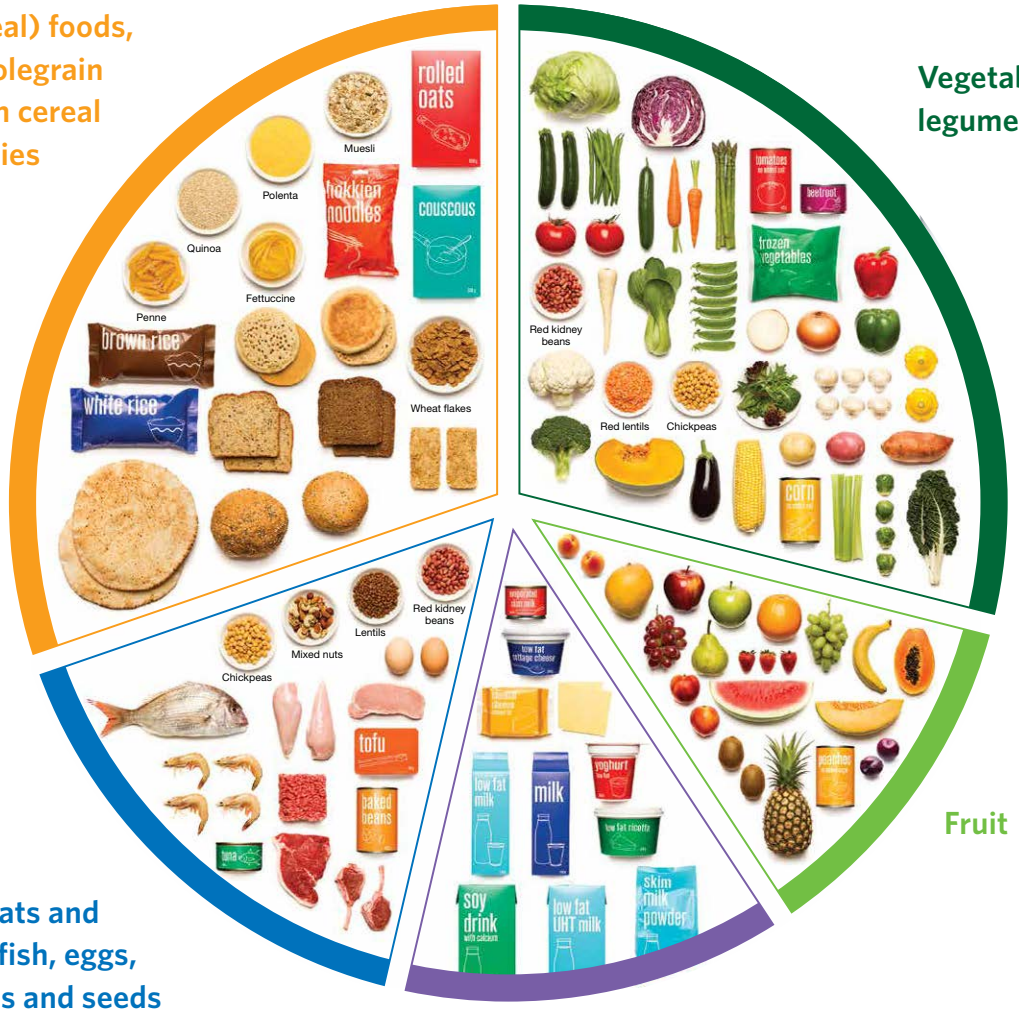
Australian Guide To Healthy Eating

1. Examine the nutrition labels on the variety of food packages provided.

2. What kind of information is given on the nutrition labels?

3. Think of at least two different ways you could group all this food into different categories. Write them here.

4. Have a go at arranging the empty food packages on the desk in front of you, similar to how food is arranged in the **Australian Guide To Healthy Eating** diagram below. As you arrange the packages, make sure that you can still read the labels with the nutrition information.



5. Which of the foods you've placed in your Australian Guide To Healthy Eating diagram contain at least some protein?

6. Which of the foods you've placed in your Australian Guide To Healthy Eating diagram contain the most protein?

7. Why do you think we need a balanced diet containing protein to keep us healthy?

8. What foods do you eat to get your daily protein?

Station 2

Task

Farming and the local environment

Australia has two main types, or breeds, of cattle: those that are raised in warm, tropical areas, and those that are raised in cooler, temperate areas.

1. Use the map of Australia below to identify the breed of cattle that is mostly likely to be farmed in the area where you live.

_____

_____

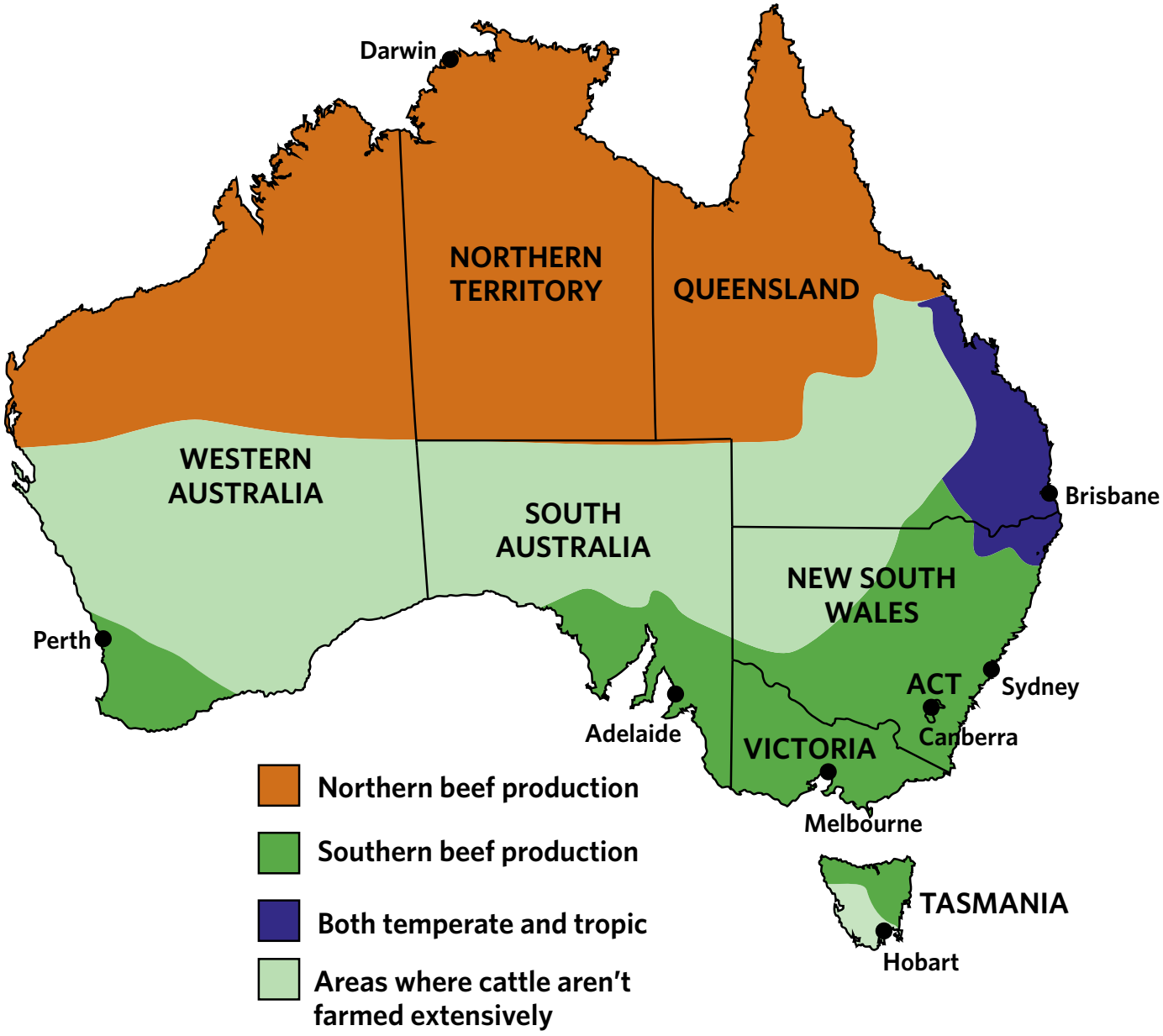
_____

_____

_____

_____

_____



2. a) In which areas of Australia are tropical breeds of cattle farmed?

b) What kind of weather conditions would you expect here?

3. a) Where do the temperate breeds of cattle live?

b) What kind of weather conditions would you expect here?

4. Have a look at the cattle in these images. How are they different? How are they the same? (Look at their hump, coat/skin, ears, legs)

5. Is it possible to tell that these two cattle are different breeds? Why or why not?

6. a) Describe what the cattle are feeding on. (What is on the ground below them?)

b) How would their diets be different if they were to be raised in each other's environment? (i.e. What if they swapped living places?)

7. a) Which do you think is the tropical breed and which is the temperate breed?

b) Why do you think this? Is there enough information provided by the images to make a decision?

Station 3

Task

Features of farm animals

Imagine you are at an agricultural show such as the Royal Easter Show and you have to judge the 'Best Cow' and 'Best Ram' competitions.

1. Before you start, list the features you will be looking for, and judging the animals on, when you choose the best cow and the best ram. (Hint: think about what makes cattle and sheep most useful and valuable to a farmer.)

	Features	Why you chose these features (Write a new sentence for each feature.)
Cow		
Ewe		

2. The cattle and sheep below are the ones you have to judge.

Give each photo a tick for every feature you can see it has from your list of things you are looking for in a winning animal.

3. Add up the ticks and draw a first prize ribbon on the winning cow and the winning ram that each has the most ticks.

4. Prepare a short speech that you will use to announce the winners that explains what impressed you and why you chose each of these animals as prize-winners.

Announcement speech for the winning cow: _____

_____

_____

_____

_____

_____

_____

Announcement speech for the winning ram: _____

_____

_____

_____

_____

_____

_____

5. People have been farming animals such as cattle and sheep for hundreds of years. Over this time, farmers have been choosing which animals they think will produce the most food (and other products, like wool), based on their features, and making sure these animals reproduce to make more animals like them. This is called 'selective breeding'.

a) Identify the features of **cattle** you think farmers are most likely to have selected for, and suggest why you think this.

Features	Why farmers might select cattle with these features for breeding

b) Identify the features of **sheep** you think farmers are most likely to have selected for, and suggest why you think this is so.

Features	Why farmers might select sheep with these features for breeding

Station 4

Task

Farming and the future

Watch the video *Australian Agriculture: The Greatest Story Never Told* (***www.youtube.com/watch?v=fFUZ_j2cCe0***).

1. What do you think the main message in the video is?

2. Who do you think the video was made for?

3. Write down three things you learnt from the video that you didn't know before.

1. _____
2. _____
3. _____

4. What does the video suggest is the biggest challenge for farmers now and in the future?

5. Explain why population growth is such a big challenge for farming.

6. What does the video say about how farming can meet this challenge? (What will help solve the problem of how to produce more food for more people in the future?)

7. Do you think farmers will always be able to grow enough food for people to eat, no matter how many people there are? (Give reasons for your answer.)

Future farm resources

Student literacy activities

In this section, we explain the science of farming cattle and sheep by inviting students to read articles and watch videos about relevant issues and applications. This section suggests discussion topics and activities linked to those articles.

Each article/video will have its own literacy and/or numeracy activities, which include:

- Brainstorming
- Glossary
- Comprehension and summary
- Question builder

Stimulus One – Meat & Livestock Australia videos

These short videos give a great insight into what modern day cattle and sheep farming in Australia involves, including the types of technology farmers are using in their day-to-day work on the farm.

Stimulus Two – The importance of protein

Protein is an important nutrient to stay healthy. This article examines how protein is used in our bodies, why we need to eat protein and the consequences of not eating enough.

Stimulus Three – Climate variability

Climate plays a vital role in the decisions a cattle or sheep farmer makes to best look after his animals. The maps provided here are examples of how the Bureau of Meteorology supports the farmer by providing up-to-date information on a variety of climate conditions.

Stimulus Four – Choosing the right breed

Different breeds of cattle are suited to different Australian climates. This article looks at the two main breeds of cattle farmed in Australia and how well they are suited to survival here.

Meat & Livestock Australia videos

Task

Go to ***You Tube*** and watch these two short videos about modern cattle and sheep farming in Australia:

1. *Sustainable Sheep and Cattle Farmers in Australia: Meat & Livestock Australia* (1:01mins)
   www.youtube.com/watch?v=GdDgUVAaLuU
2. *Innovative Cattle Stations in Australia* (5:06mins)
   www.youtube.com/watch?v=pdISOUfd4fo

Solutions
1. True. Cattle and sheep farmers care for around 50% of Australia's total land area. **2.** True. **3.** True. **4.** True. Farmers export about 60% of what they grow. **5.** False. There are more cows (about 28 million cows in 2014, compared to about 24 million people). **6.** True. **7.** True. **8.** True. There are about 75 million sheep in 2014, compared to about 24 million people. **9.** False. About 90% of farm land is for grazing on native pastures, occurring mostly in the arid and semi-arid zones. **10.** True. Australia is one of the world's top lamb consumers.

Activity 1 – Brainstorming

Task

How much do you know about cattle and sheep farming in Australia? Before you watch the videos, take this quick True or False (T or F) quiz to find out.

	True	False
1. About half of the land in Australia is owned by cattle and sheep farmers.		
2. A typical cattle or sheep farm in Australia produces enough food to feed 600 people.		
3. 99% of farms in Australia are owned and run by families.		
4. More than half of what Australian cattle and sheep farmers produce is exported.		
5. In Australia, there are almost as many cattle as there are people.		
6. Cattle are bred for their milk and meat.		
7. Beef is the name given to meat that comes from cattle.		
8. There are three times as many sheep in Australia as people.		
9. Most cattle and sheep farming occurs in pasture areas in the south.		
10. Australians eat more lamb than just about anyone in the world.		

Activity 2 – Glossary

Create a glossary. Use the table to define any words that are related to this article.

Word/Term	Definition
Sustainability	
Degrading (as in 'degrading the land')	
Custodians	
Innovation	
Pastoral	
Mustering	
Telemetry	
Chip (as in 'microchip')	
Solar panels	
Bore (as in 'water bore')	
Remotely	

Activity 3 – Summarising

VIDEO 1

Meat & Livestock Australia: Sustainable Sheep and Cattle Farmers in Australia

1. What does 'sustainable farming' mean? Describe it in your own words.

2. What attitude do the farmers in the video have towards looking after the land?

VIDEO 2

Meat & Livestock Australia: Innovative Cattle Stations in Australia

1. List at least three different types of vehicles you saw being used on the farm.

2. List five different types of smart technology (computer based) you saw being used on the farm.

1. _____
2. _____
3. _____
4. _____
5. _____

3. Why do you think modern farmers use technology like this?

_____

_____

_____

_____

4. Which technology did you find most interesting, and why?

_____

_____

_____

_____

5. Was there anything you saw in this video that surprised you? (If so, what was it, and why did it surprise you?)

_____

_____

_____

_____

Activity 4 – Question builder

Adapted from: Langrehr, John (2002). 'Question Time for the Gifted', Gifted. July, 124, 12–14.

Design a number of questions about the science of farming and then try to answer them. Each question should start with a word from Step 1 and a second word from Step 2.

The four-step question builder	
Step 1 **First word** (choose one for each question)	**Step 2** **Second word** (choose one to add to your first word)
What... When... Which... Who... Why... How...	...is/are/do (for a question in the **present**) ...did/was (for a question in the **past**) ...would/could/can (for a question about **possibility**) ...might (for a question about **prediction**)
Step 3 Write your two different questions in the spaces below.	
Example question: **Why do** cattle farmers need all this technology to run their farms?	
Write Question 1 here:	
Write Question 2 here:	
Step 4 Now have a go at answering your own questions, or swap with a friend and answer their questions or suggest some possible answers. You can give your answer in any form you like, e.g. as a PowerPoint presentation, a poem, a report, a letter, or a mind map.	

The importance of protein

A healthy eating plate shows the amount of food from each food group that we should eat to obtain the nutrients our bodies need.

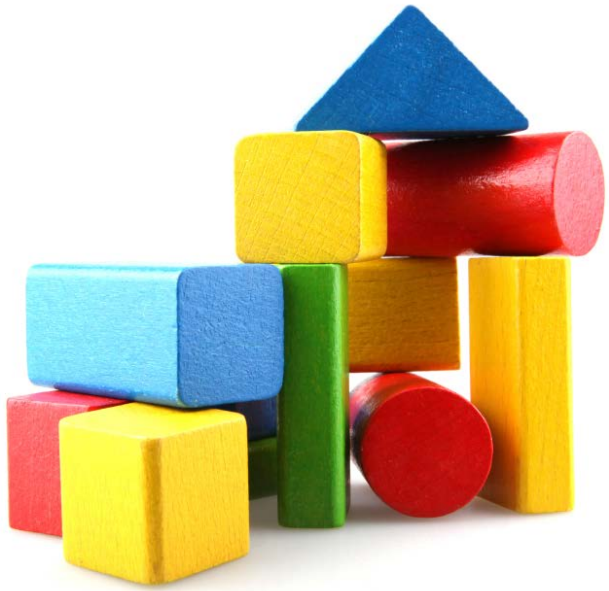
Nutrients are substances that provide the nourishment we need to live and to grow. The main nutrients – protein, carbohydrates, and lipids (fats and oils) – are called 'macronutrients.' Vitamins and minerals, which we only need in small quantities, are called 'micronutrients.' Nutrients are important as they provide the raw materials our bodies need to function.

You're a bag of protein!

The macronutrient protein is very important. Why? All animals, including humans, are bags of protein. If you removed all of the water from your body, protein would make up over half the dry weight. In fact, you contain over 100,000 different proteins!

On the outside, proteins make your hair, skin and fingernails. On the inside, it makes your muscles, heart, brain, kidneys and more. Proteins even help carry oxygen around your body and digest the food you eat.

Macro comes from the Greek word 'makros', meaning large.



If we're made of protein, why do we need to eat protein?

Proteins are made up of smaller building blocks called 'amino acids'. These building blocks are essential for building, maintaining and repairing the body. We can make some amino acids ourselves, but the others we must get from the food we eat. We call these 'essential amino acids'. When we eat protein-rich food, such as meat, our bodies break down the protein into its amino acids, which we can then use to build our own proteins.

There are about 20 different amino acids that can be put together in different combinations to make the millions of different proteins found in nature.

How much protein do we need to eat?

The amount of protein you need to eat depends on your age, size and activity level. For example: Children aged 9–18 need 2½ serves of protein per day.

Standard serve is 500–600 kJ	How much?
Cooked lean red meats such as beef or lamb	65g
Cooked fish fillet	100g
Eggs	2
Canned legumes, chickpeas or split peas	150g
Tofu	170g
Nuts or seeds	30g

People make a choice as to how they get their protein. It may depend on where they live, what food is available, their culture, religion, or their favourite food. Meat products such as beef and lamb are high in protein and contain all the essential amino acids we need. Beans, legumes (such a lentils and peas), nuts and seeds are also high in protein.

A gram is a unit of measurement. Instead of writing grams, we use the letter 'g'.

What happens if we don't eat enough protein?

Scientists believe that not eating enough protein can make you overeat. Your body needs a certain amount of protein, so if you eat foods that are low in protein (but high in carbohydrates and fats), your body will keep telling you you're hungry, and you'll eat more and more. You'll eventually eat enough protein, but will have eaten a huge amount of calories, which means you gain too much weight.

Not eating enough protein for a few days isn't a problem, but if you regularly don't eat enough protein you may develop protein deficiency. A deficiency is when you don't have enough of something. Symptoms of protein deficiency include muscles shrinking or wasting away, hair becoming thin and brittle, skin rashes, a feeling of weakness, and swelling of the feet and ankles.

Activity 1 – Brainstorming

What do you know about healthy foods? Beside each of the images, write what you know about these foods that makes them healthy.

Activity 2 – Glossary

Create a glossary. Use the table to define any science words that are related to this article.

Word/Term	Definition
Healthy eating plate	
Nutrients	
Lipids	
Dry weight	
Amino acid	
Essential amino acid	
Gram	
Legume	
Obese	
Deficiency	

Activity 3 – Summarising

1. Women aged 19–50 years need 2½ serves of protein per day, while men need three serves per day and pregnant women need 3½ serves per day . Why would a pregnant woman need to eat more protein?

2. The lunchbox below contains a bottle of water, a salad sandwich and an apple. Add two items that would improve its nutritional value. You can draw or write in your suggestions.

Explain – Stimulus Two

Use the nutritional information below to help answer Question 3.

Nutritional Facts
Cheddar cheese per 100g

Protein	Energy	Fat
20.9g	1304 kJ (311 cal)	24.9g

Nutritional Facts
Lean beef fillet steak per 100g

Protein	Energy	Fat
31.9g	746 kJ (178 cal)	5.5g

3. You would need to eat approximately 200g of cheddar cheese or 150g of lean beef steak to meet your daily protein needs.

a) How much fat would you consume if you ate 200g of cheddar cheese?

_____

_____

b) How much fat would you consume if you ate 150g of lean beef steak?

_____

_____

c) Based on this nutritional information, would it be healthier to eat 200g of cheddar cheese or 150g of lean beef steak? Give a reason for your choice.

_____

_____

_____

_____

_____

_____

4. In Australia, we have a variety of protein-rich foods such as beef and lamb to choose from. What would happen to your body if you lived somewhere with a limited food source and did not eat enough protein?

_____

_____

_____

_____

_____

_____

_____

Activity 4 – Question builder

Adapted from: Langrehr, John (2002). 'Question Time for the Gifted'. Gifted. July, 124, 12–14.

Design a number of questions about the science of farming and then try to answer them. Each question should start with a word from Step 1 and a second word from Step 2.

The four-step question builder	
Step 1 **First word** (choose one for each question)	**Step 2** **Second word** (choose one to add to your first word)
What... When... Which... Who... Why... How...	...is/are/do (for a question in the **present**) ...did/was (for a question in the **past**) ...would/could/can (for a question about **possibility**) ...might (for a question about **prediction**)
Step 3 Write your two different questions in the spaces below:	
Example question: **How do** we know that certain foods contain protein; is there a scientific test?	
Write Question 1 here:	
Write Question 2 here:	
Step 4 Now have a go at answering your own questions, or swap with a friend and answer their questions or suggest some possible answers. You can give your answer in any form you like, e.g. as a PowerPoint presentation, a poem, a report, a letter, or a mind map.	

Climate variability

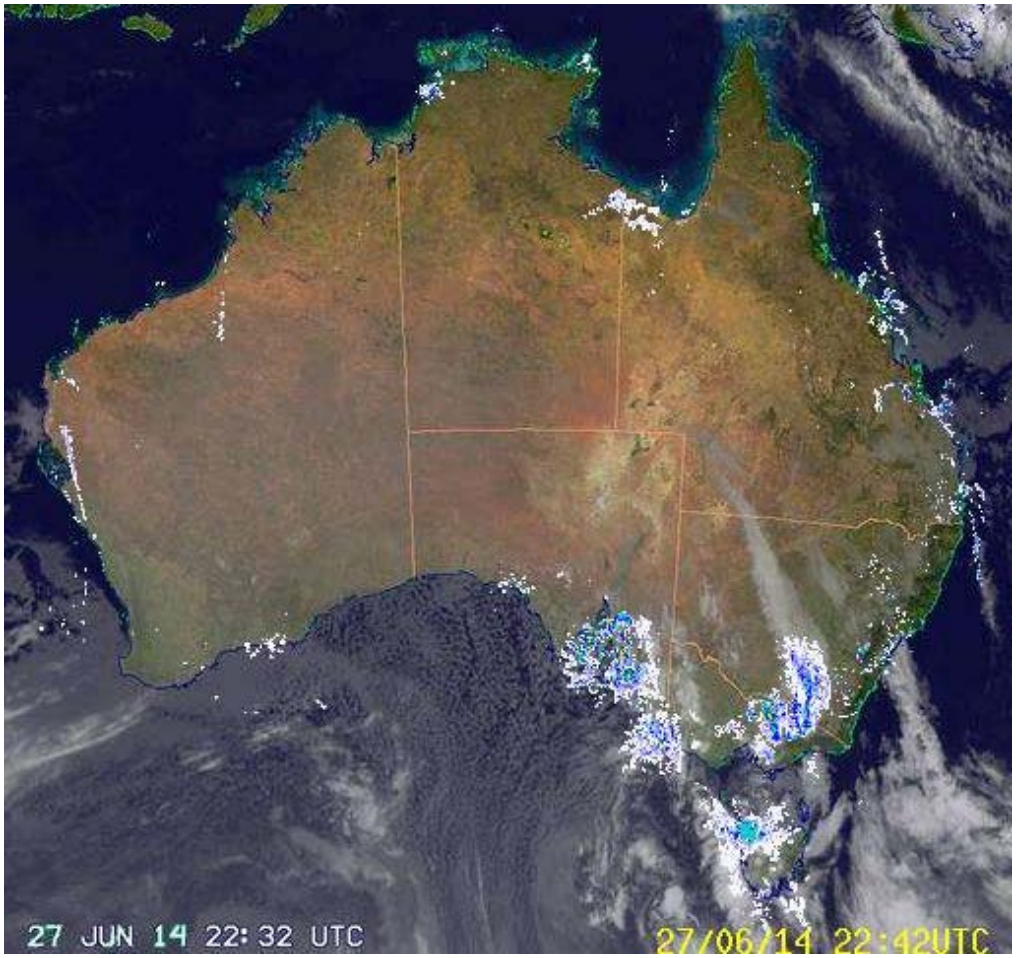
As seasons, weather and climate change, farmers adapt how they look after their animals and land.

The amount of grass available for cattle and sheep to graze on depends on the amount of rain that falls. Some years can be wet, resulting in plenty of grass, and some years can be dry, leaving less grass for grazing. Farmers need to manage the number of animals they have on their land, and the paddocks they have them in, to suit the amount of pasture available to feed them.

In very dry times, farmers will keep checking the pasture levels, and move or sell off stock if there is not enough food to feed them all. When it is very wet, pastures can become covered in water, leaving no food for the animals. At times like this, farmers need to make sure their stock aren't in danger of becoming stranded by flood waters, and that they have enough food to eat.

In some areas of Australia, farmers are noticing a change in climate cycles – rains might come earlier or later than they have in the past – and they need to change the way they work to fit in with the seasons. For example, if there is no rain forecast for a long period of time, farmers might sell their animals earlier so they don't have so many to feed over the dry months.

The following maps are taken from the Australian Government's Bureau of Meteorology website: *bom.gov.au*

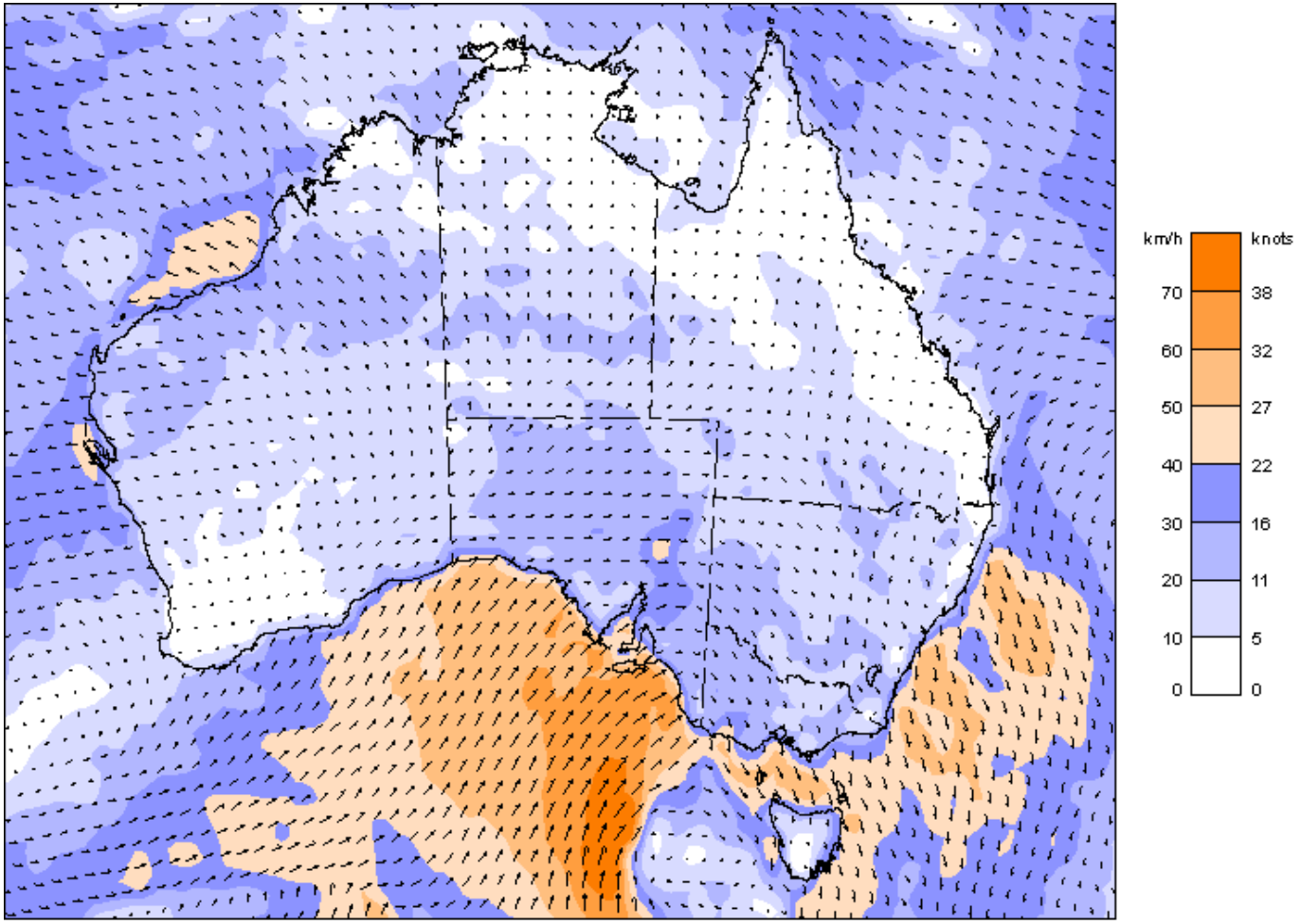


Map 1 – A satellite photo of Australia

This photograph was taken by a camera on board a satellite that orbits Earth. The image is beamed down to the Bureau of Meteorology and posted on their website.

Map 2 – Wind speed around Australia

This drawing was made to show the wind direction (arrows) and wind intensity (shading) both onshore and offshore Australia.

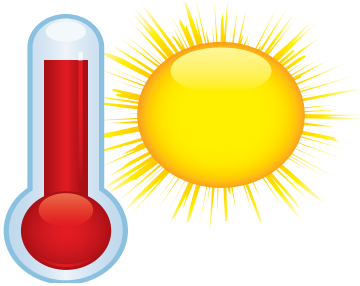


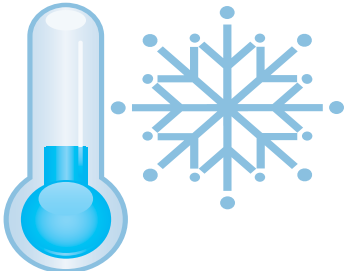
Wind Forecast for: 07:00 am EST 28/06/2014

Issued 27/06/2014

Activity 1 – Brainstorming

Use these images to brainstorm ways in which knowing various weather conditions might help cattle and sheep famers do their job better. A few things have been written in to help get you started.





If farmers know it's going to be a windy day, they will make sure that animals with babies have access to plenty of good shelter.

If farmers know that the day is going to be very hot, they'll put their animals in a shaded paddock with easy access to water.

Activity 2 – Glossary

Create a glossary. Use the table to define any science words that are related to this article.

Word	Definition
Stock	
Meteorology	
Satellite	
Knots	

Activity 3 – Summarising

1. Use the maps to answer the following questions:

a) Which Australian states are going to have rain on the day shown on the satellite photo?

_____

_____

_____

b) Which state will have the least gusty winds?

_____

_____

_____

c) Where in Australia is frost least likely?

_____

_____

_____

d) What is the direction of the wind as it hits Australia's southern coast?

_____

_____

_____

2. Write a weather report that could be read on the radio for a farm near the place you live, either using the information on the maps provided here or on the Bureau of Meteorology website: *bom.gov.au*

3. Why do you think cattle and sheep farmers would need to read or listen to weather reports every day?

4. Some farmers are noticing that annual climate patterns are changing. What might happen to cattle and sheep farmers and the communities they live in if there is a lot less rain, or a lot more rain, than there has been in the past?

5. Now that you have thought about these questions, go back to the brainstorm and see if you can add some more comments about the importance of climate to cattle and sheep farming.

Activity 4 – Question builder

Adapted from: Langrehr, John (2002). 'Question Time for the Gifted'. Gifted. July, 124, 12–14.

Design a number of questions about the science of farming and then try to answer them. Each question should start with a word from Step 1 and a second word from Step 2.

The four-step question builder	
Step 1 **First word** (choose one for each question)	**Step 2** **Second word** (choose one to add to your first word)
What... When... Which... Who... Why... How...	...is/are/do (for a question in the **present**) ...did/was (for a question in the **past**) ...would/could/can (for a question about **possibility**) ...might (for a question about **prediction**)
Step 3 Write your two different questions in the spaces below:	
Example questions: **How might** cattle and sheep farmers continue to feed the same or more people if the climate changes too much? **What do** farmers feed their animals if there hasn't been a lot of rain and therefore not a lot of grass?	
Write Question 1 here:	
Write Question 2 here:	
Step 4 Now have a go at answering your own questions, or swap with a friend and answer their questions or suggest some possible answers. You can give your answer in any form you like, e.g. as a PowerPoint presentation, a poem, a report, a letter, or a mind map.	

Choosing the right breed

In Australia, there are around 50 different breeds of beef cattle. These fall into two categories:

- **Bos Taurus** – these are cattle from temperate climates of Europe and are better suited to southern Australia. Examples of Bos Taurus breeds are Hereford, Angus and Charolais.
- **Bos Indicus** – also referred to as 'exotic breeds', these have a Zebu component, which originated from southern Asia. Typical Bos Indicus breeds are Brahman, Santa Gertrudis and Droughtmaster. They are distinguished from other breeds of cattle by a hump on the back of their neck.

Cattle can be grazed in most areas around Australia, as cattle farmers select the breed of cattle that is best-suited to the region they live in.

Brahman cattle are found throughout northern Australia, as they are well suited to the conditions there. The Brahman has developed as a major beef breed in the tropical humid and subtropical dry areas, particularly in Queensland, north-eastern Western Australia, the Northern Territory and the north coast of New South Wales. Brahman cattle have a number of characteristics that help them do well in this climate.

These include:

1. A digestive system that is very efficient and works well on the low-quality feed of the region.
2. Skin that has a dark pigment, so they don't burn in the hot sun.
3. A short, sleek coat that makes it difficult for ticks to attach themselves, and sweat glands that produce a natural tick repellent (tick fever is common in northern Australia).
4. Loose skin to keep them cool.
5. Long legs to help them walk greater distances to find food and water.

Angus cattle are better suited to southern Australia, which has more temperature conditions. Angus are popular in the higher rainfall areas of New South Wales, Victoria, Tasmania and Western Australia.

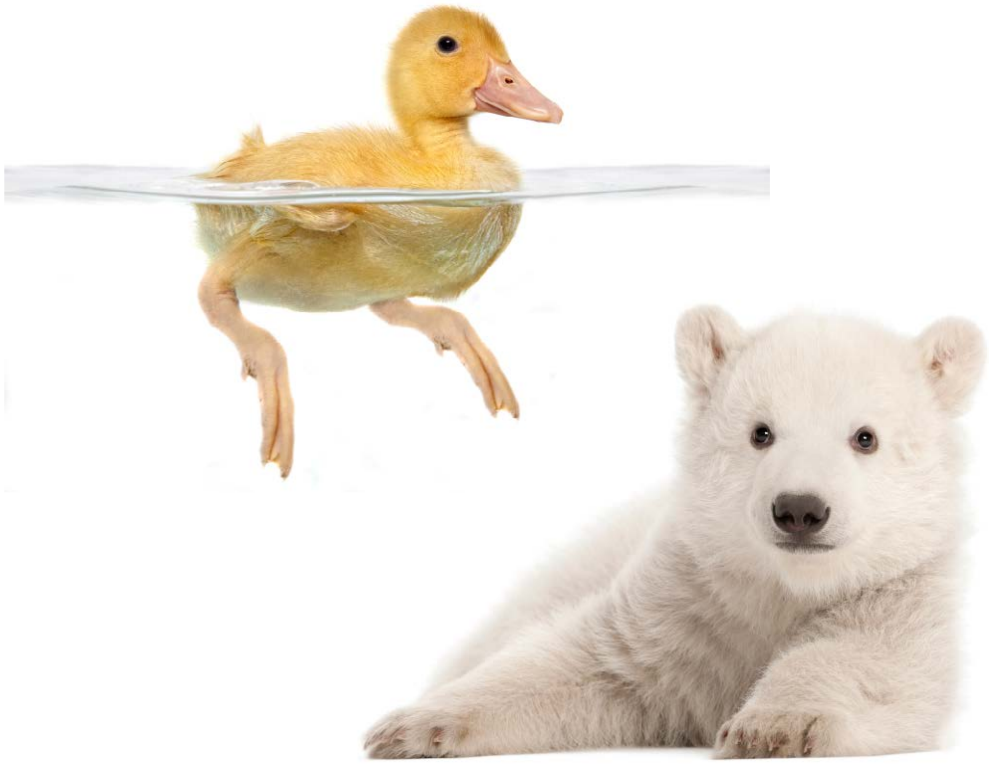
Their characteristics include:

1. Muscular, compact bodies.
2. Lack of horns (polled cattle).
3. Solid black colour (may have a small amount of white on their stomach).
4. Calve easily and raise fast growing calves.

Activity 1 – Brainstorming

These two animals are physically very different. Suggest how they are adapted to the environments they live in by labelling the characteristics they have that help them survive:

How is a duck adapted to living in and around water? How is a polar bear adapted to living in the cold?



Activity 2 – Glossary

Create a glossary. Use the table to define any science words that are related to this article.

Word	Definition
Breeds	
Temperate	
Exotic	
Distinguished	

Activity 3 – Question builder

Adapted from: Langrehr, John (2002). 'Question Time for the Gifted'. Gifted. July, 124, 12–14.

Design a number of questions about the science of farming and then try to answer them. Each question should start with a word from Step 1 and a second word from Step 2.

The four-step question builder	
Step 1 **First word** (choose one for each question)	**Step 2** **Second word** (choose one to add to your first word)
What... When... Which... Who... Why... How...	...is/are/do (for a question in the **present**) ...did/was (for a question in the **past**) ...would/could/can (for a question about **possibility**) ...might (for a question about **prediction**)
Step 3 Write your two different questions in the spaces below:	
Example question: **What might** happen if farmers tried farming Brahman cattle in the southern parts of Australia?	
Write Question 1 here:	
Write Question 2 here:	
Step 4 Now have a go at answering your own questions, or swap with a friend and answer their questions or suggest some possible answers. You can give your answer in any form you like, e.g. as a PowerPoint presentation, a poem, a report, a letter, or a mind map.	

Activity 4 – Bringing it all together

1. What did you enjoy learning about the most?

_____

_____

_____

_____

2. List the two most important things about cattle and/or sheep farming that you have learnt about from doing these activities.

_____

_____

_____

_____

_____

_____

3. Create a fun poster to show the different activities you did and the things you learnt.

The Science Matrix

	Description	Activity Suggestions
Scientific Procedure	Hands-on activities that follow the scientific method. Includes experiments and surveys. Great for kinaesthetic and logical learners, as well as budding scientists.	**1.** Food testing for protein. See Activity Sheet 1.
Science Philosophy	Thinking about science and its role in society. Includes discussion of ethical issues, debates and hypothetical situations. An important part of science in the 21st century.	**2.** How many more people can we feed in the future? Use the six thinking hats to explore the possibilities. See Activity Sheet 2.
Being Creative with Science	For all those imaginative students with a creative flair. Great for visual and musical learners and those who like to be innovative with the written word.	**3.** Interview a local cattle or sheep farmer. Ask a few questions about their work. What are some of the big challenges farmers face, now and in the future? **4.** Prepare an entry for the next Archibull Prize. Go to ***art4agriculture.com.au/archibull/index.html*** to find out the details.
Science Time Travel	Here we consider scientific and technological development as a linear process by looking back in time or travelling creatively into the future.	**5.** Use your imagination! How might farming look when you are old and grey? What might we be doing differently? What might become possible that isn't right now? Prepare a skit, for example, to show how a farmer might farm his or her herd of cattle or sheep 50 years from now. See Activity Sheet 3.
'Me' The Scientist	Personalising the science experience in order to engage students more deeply.	**6.** Students look at the 6 profiles of Cattle and Sheep Young Farming Champions, and create criteria to judge them. See Activity Sheet 4.

Activity 1
Experiment to identify protein in food

Background information

Protein is an important part of our diet and can be found in high proportions in food products provided by other animals. Protein is important because it helps us make new cells to replace old ones. Some proteins can help your body fight disease, and others (called enzymes) are needed for important chemical reactions that take place in the body. In this investigation, you will test various foods to see if they contain protein.

Aim: To find out which food types contain protein

What you need:

- Selection of food types such as beef mince, cheese, tin of tuna, milk, egg, bread, cereal.
- Water.
- Pestle and mortar.
- Small plastic containers such as individual jelly containers.
- Biuret solution (borrowed from local high school science lab or ordered from laboratory chemical suppliers, such as *chemsupply.com.au/home.aspx*).
- Eye dropper.

What to do:

1. Discuss with your teacher any safety procedures you might need to follow during this experiment.
2. Read through all the instructions before you start, so you will know exactly what you will be doing.
3. Choose 4 different food types to test. List them in the first column in the Results table.
4. Predict whether or not each of these foods will contain protein. Record your ideas in the second column in the Results table.
5. Choose a piece of food from your selection. Make a runny paste that you can pour by mixing it with water and, if necessary, mashing it with the pestle and mortar.
6. Pour a very small amount of your mashed solution into a clean container (use an eye dropper if you need to).
7. Use a clean eye dropper to add a few drops of biuret solution to your mashed food sample. Record the colour change in the third column in the Results table.
8. Choose a second piece of food and make it into a runny paste.
9. Add a very small amount of the second food sample to a clean container and then add a few drops of Biuret solution.
10. Note the colour of the mixture in the Results table.
11. Test the remaining two types of food the same way you did the first two.
12. When you have recorded all your results, throw all used food in the bin, return unused food to the place you got it from, and wash containers thoroughly before packing away all equipment.

Results:

1. List of food types you will test	2. Tick if you think they will contain protein	3. Reaction to biuret solution	4. Does it contain protein? Yes or No

Thinking about the experiment:

1. Describe one challenge you faced when doing this experiment. Explain how you overcame that challenge.

2. What are the benefits of working with others when doing an experiment like this?

3. Where you surprised by any of the results you got? Explain.

4. How many of the foods you tested contained protein?
Which foods were they?

Summarise your results:

Activity 2
How many more people can we feed?

Use Edward de Bono's 'Six Thinking Hats' to make notes and ask questions about feeding a growing global population. For each box, put on a different coloured hat to see the situation in a different way or from a different perspective. A few questions have been added to help you.

White Hat – Information What are the facts?	**Black Hat – Negative points** What is wrong with it? Will it work?
What will the global population be in 20 years' time? How many people are cattle and sheep farmers currently feeding?	Will the environment be affected by farming more cattle and sheep?
Yellow Hat – Positive points Why is it worth doing? How can it help?	**Red Hat – Emotions** How do I feel about this right now?
How does sustainable farming work?	How do you think the farmers feel about this?
Green Hat – Creativity What are some ways to work this out?	**Blue Hat – Organisation of thinking** What have we done so far? What do we want to do next?
Make suggestions and recommendations for cattle and sheep farmers.	Summarise all of the ideas.

Activity 3 Cattle and sheep farming in the future

Follow the steps below to create a skit on farming in the future. Make sure you record all your ideas as you go – this will help you develop a storyline.

What is happening today	How it might look in the future
Smart technology is starting to be used, such as tagging cattle with GPS.	What kinds of smart technology might be used in the future?
Cattle and sheep farmers are feeding more people now than they used to.	How many more people will cattle and sheep farmers need to feed and how will they do it?
People are starting to take more of an interest in where their food comes from and how it's produced.	What will the attitude to sustainable cattle and sheep farming be?
Write in any other ideas here:	

Step 1 – Futuristic ideas table

Use your imagination to invent new tools, machines or ways of doing things by extending today's trends into the future.

Step 2 – Working out a plot

Answer the following questions to figure out exactly what your skit is about and what you'll need to do to perform it.

Feature of skit	Ideas
What will your main message be? Which idea(s) about the future will you talk about?	
How many characters will you need and who are they?	
How will you create tension or a problem to be solved?	
How will you resolve the problem?	
Which props will you need?	
How will you make the presentation interesting?	

Step 3 – Setting the scenes

You now need to decide on a basic storyline. Write an outline of what will happen in your skit and then break it up into bite-size scenes.

Step 4 – Writing the script

Write a dialogue (conversation) for each scene. Remember that you don't have to give everyone a large number of lines to learn. Think about how you can communicate your idea in the simplest way.

Step 5 – Rehearsing the script

Be sure to do a few run-throughs of your skit before you perform it to the class. Work in some props to help tell the story.

Activity 3
Cattle and Sheep Young Farming Champions

Imagine you are an agricultural scientist who has been asked to choose one Cattle and Sheep Young Farming Champion to be awarded a grant of $20,000 for their excellent work. It is up to you to write the criteria you will judge the champions on, and then use these criteria to choose who you think should receive the money.

As a class, you can all put forward a vote for your favourite Young Farming Champion. The one that receives the least votes can be eliminated. You can all vote again for the remaining Champions, and again eliminate the one with the least votes. You can continue until the winner has been found.

What to do:

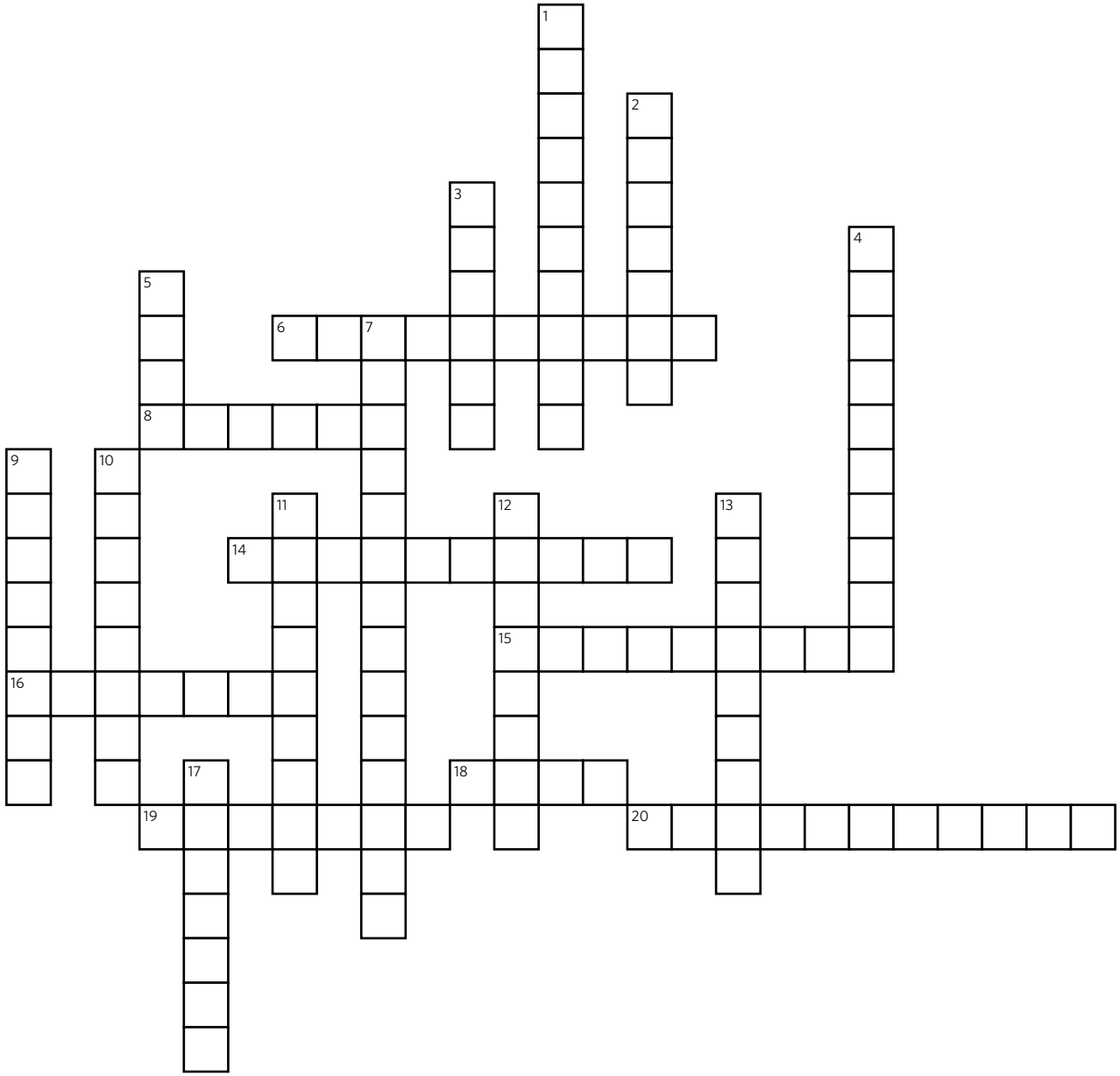
1. Go to the webpage *https://www.art4agriculture.com.au/yfc/theteam.html* and write the names of the six Cattle and Sheep Young Farming Champions in the list of competitors on the score sheet below.
2. Brainstorm five things you would like to judge the Young Farming Champions on. Write each idea on the score sheet (the first one has been created to help you). You may choose criteria such as: who has the brightest future, whose work is the most important, or who has achieved the most so far.
3. Read each of the blog posts and Meat & Livestock Australia profiles of the Cattle and Sheep Young Farming Champions. Judge them on each of the criteria you have written by giving them a score out of 3. (1 = low, 2 = medium, 3 = high.)
4. Add up the total scores.
5. Complete the certificate for the winner.

Score sheet:

Name of Champion	**1.** How passionate does this farmer seem?	**2.**	**3.**	**4.**	**5.**	**Total points**


CERTIFICATE
THIS CERTIFICATE IS PRESENTED TO
NAME SURNAME
YOUR SAMPLE TEXT HERE YOUR SAMPLE TEXT HERE
YOUR SAMPLE TEXT HERE YOUR SAMPLE TEXT
YOUR SAMPLE TEXT HERE
DATE 24.04.2013
SIGNATURE

Section 1 – Crossword: Farming now and in the future



Across

6. People who keep and take care of something valuable, e.g. the land.

8. Different types of an animal, suited to different conditions.

14. When you don't have enough of something such as iron or protein in your diet.

15. Automated communications process that collects data from remote instruments and transmits it to receiving equipment for measurement, monitoring.

16. Patterns in weather over a long period of time.

18. Meat that comes from cattle.

19. An essential part of our diet.

20. The branch of science concerned with the Earth's atmosphere, including climate.

Down

1. The number of people in the world.

2. How sheep and cattle eat; the process of eating grass.

3. To sell and send to another country.

4. Devices, software, etc, that allow farmers to keep up with the times.

5. Meat that comes from sheep.

7. The ability to keep producing into the future, without harming the environment.

9. Very hot and humid.

10. Farmers use this to produce more of certain types of cattle or sheep.

11. A climate that is moderate in temperature; not extremely hot or cold.

12. Characteristics of a living thing, e.g. horns, udders.

13. A device designed to be launched into orbit, e.g. around Earth.

17. A breed of cattle suited to hot and dry conditions.

Solutions
Across: **6.** custodians **8.** breeds **14.** deficiency **15.** telemetry **16.** climate **18.** beef **19.** protein **20.** meteorology
Down: **1.** population **2.** grazing **3.** export **4.** technology **5.** lamb **7.** sustainability **9.** tropical **10.** breeding **11.** temperate **12.** features **13.** satellite **17.** Brahman

Section 2 – Create your own 'Farming now and in the future' quiz

1. As a class, brainstorm words and terms that relate to a farming topic, e.g. sustainability.

2. Pick three terms from the board and write a definition for each.

3. Pick another three terms from the board and write a paragraph about farming that uses all of these words.

4. Create your own mind map using as many words from the board as possible, showing the connections between them.

Section 3 – Individual unit review

What did you enjoy?	Drawing
Describe your favourite activity during this unit of study.	Create an image that sums up this unit of work for you.
Learning summary	**Your philosophy**
Write five dot points of things that you have learnt about Australian cattle and sheep farming.	Describe your overall thoughts about Australian cattle and sheep farming after doing this unit of work. Has this unit changed the way you think about farming or farmers?
More questions	**What do you think?**
Write three questions that you still have about cattle and sheep farming, which you would like to find out the answers to.	Which activities in this unit did you think you learnt most from? Which activities did you find it easiest to learn from? Why?