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9–10 | LESSON PLAN

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Lesson 1

Intensive and extensive production systems

AUSTRALIAN CURRICULUM CONTENT



Analyse and make judgements on the ethical, secure and sustainable production and marketing of food and fibre enterprises. (ACTDEK044, AC9TDE10K04)

Analyse needs or opportunities for designing; develop design briefs; and investigate, analyse and select materials, systems, components, tools and equipment to create designed solutions. (ACTDEP048, AC9TDE10P01)

LESSON OBJECTIVE

Students will learn about the connection between plants and animals and the characteristics of intensive and extensive cattle production systems.

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Lesson 1

LESSON OVERVIEW

Activity 1.1	Interdependence of animals and plants	20–40 mins
Activity 1.2	Intensive and extensive systems	15 mins
Activity 1.3	Case study: Intensive and extensive systems	30 mins
Activity 1.4	Online learning task: Managing waste and feed on a feedlot	15–20 mins

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SUPPLEMENTARY MATERIALS

Ruminant digestive system poster

Resources and equipment

ACTIVITY 1.1 – Interdependence of animals and plants

1. Cattle and the Biogenic Carbon Cycle (0.48).
2. Worksheet 1.1a – *Investigating the relationship between plants and animals.*
3. Worksheet 1.1b – *Ruminant digestion*.
4. Digestive tract of a sheep (NB: order this in advance from select butchers).
5. Gloves, scalpel, probes, completed *risk assessment*.
6. Optional: Sheep Digestive Tract Dissection (35.11).
7. Balloons, cotton wool.

ACTIVITY 1.2 – Intensive and extensive systems

1. Worksheet 1.2a – *Intensive and extensive agricultural systems stimulus.*
2. Worksheet 1.2b – *Intensive and extensive agricultural systems.*
3. Worksheet 1.2c – *Feedlots v pasture.*

ACTIVITY 1.3 – Case Study: Intensive and extensive systems

1. Computer/digital device access.
2. Worksheet 1.3a – *Case Study: Intensive and extensive systems.*
3. Barb Madden and Jason and Andrew Shearer-Smith (7.34).
4. Adam & Jacynta Coffey - Miriam Vale QLD (7.16).
5. From City Life to Cattle Farming | Farmer Stories (3.18).

ACTIVITY 1.4 – Online learning task: Managing waste and feed on a feedlot

1. Computer/digital device access of Lesson 1 Online learning task.
2. Beef cattle feedlots: waste management and utilisation.

ADDITIONAL READING/RESOURCES

- How can livestock be a part of the climate solution? The natural carbon cycle explained (1.50).
- 2L1 Feedlot or Grain Bloat.
- The role of feedlots in the Australia beef industry.

Lesson guide

ACTIVITY 1.1 – Interdependence of animals and plants

a. Facilitate a discussion about what the term 'interdependence' between plants and animals means.
   - How do plants and animals rely on each other?
   - Ascertain any prior knowledge students have about cycles in nature.

b. View the video clip Cattle and the Biogenic Carbon Cycle (0.48).

c. Students read and highlight important components in the text Worksheet 1.1a – *Investigating the relationship between plants and animals.*

d. Students complete the labels on the diagram of the ruminant digestive system Worksheet 1.1b – *Ruminant digestion.* (Answers page 14)

e. Optional: teacher demonstration to examine a sheep's digestive system. Students observe the gross external anatomy of the digestive tract, or a more detailed dissection could be performed by the teacher. Refer to Sheep Digestive Tract Dissection (35.11) for a detailed explanation and practical demonstration.

   (NB: A risk assessment needs to be carried out by the teacher prior to this activity.)

f. Using two balloons, model how bloat occurs in ruminant digestive systems by following the steps.
   i. Label both balloons with the word "rumen".
   ii. Blow both balloons up to the same size and do not tie off. Pinch the necks of the balloons closed.
   iii. Still pinching the balloon closed, pack cotton wool firmly in the neck of one balloon being very careful not to let out the air. (This will represent the rumen with bloat.)
   iv. Do not place anything in the neck of the other balloon. (This will be the control/representation of the rumen without bloat.)
   v. Slowly release the pinch at the neck of both balloons for one second, holding onto the base of the balloon.
   vi. Continue releasing the air, one second at a time until the balloon with no cotton wool (control/rumen without bloat) is empty.
   vii. Discuss the results with students.
      - Which balloon lost air more quickly?
      - What did the balloons represent in regards to ruminant animals such as sheep, cattle and goats?
      - What did the balloon with cotton wool in the neck represent in relation to ruminant animals?
   viii. Students perform the experiment if time permits.

***Lesson guide** continued next page*

Lesson guide *continued*

ACTIVITY 1.2 – Intensive and extensive systems

a. Distribute Worksheet 1.2a – *Intensive and extensive agricultural systems stimulus* to students and use it to generate a discussion about the differences between intensive and extensive agriculture. Students should observe the pictures and consider the differences in the following:
   - The amount of produce that is generated in each area
   - The size of the farms
   - Employee numbers
   - Day-to-day operations of producers
   - The potential environmental impacts and considerations for each system.

b. Discuss the reasons why both systems are important in the future. Remind students that food production will need to double in the next 30 years to ensure that a global population is sustained when it reaches the expected 10 billion by 2050.

c. Distribute Worksheet 1.2b – *Intensive and extensive agricultural systems* and use the answers on page 15 to provide students with definitions and features of both systems.

d. Provide students with Worksheet 1.2c – *Feedlots v pasture.* Read the features of both systems to examine examples of intensive and extensive cattle systems.

ACTIVITY 1.3 – Case study: Intensive and extensive systems

a. Provide students with computer/digital device access and explain that they will view three case studies of Australian cattle production systems. Each is located in a different area and utilises varying land sizes to manage/produce beef cattle.

b. Using Worksheet 1.3a – *Case Study: Intensive and extensive systems,* students use the links/access QR codes Smithfield Cattle Co (7.34), Miriam Vale QLD (7.16), Yougawalla Station (3.18), to view the video clips and answer information in the provided spaces. If information is not available, students write 'unknown'.

c. Discuss the features of each property with students at the conclusion of the task (Answers page 16). Focus time on the environmental considerations given by each case study/producer.

ACTIVITY 1.4 – Online learning task: Managing waste and feed on a feedlot

a. Students access the Online learning task 1 and answer the questions on managing waste and feed on a feedlot.

Student resources

ACTIVITY 1.1 – Interdependence of animals and plants

Worksheet 1.1a	Investigating the relationship between plants and animals.
Worksheet 1.1b	Ruminant digestion.

ACTIVITY 1.2 – Intensive and extensive production systems

Stimulus 1.2a	Intensive and extensive agricultural systems
Worksheet 1.2b	Intensive and extensive agricultural systems
Worksheet 1.2c	Feedlots v pasture

ACTIVITY 1.3 – Case study: Intensive and extensive systems

Worksheet 1.3a	Case study: Intensive and extensive systems

ACTIVITY 1.4 – Online learning task: Managing waste and feed on a feedlot

Lesson 1 Online learning task	Managing waste and feed on a feedlot

Worksheet 1.1a

Investigating the relationship between plants and animals



Plants are producers, they use photosynthesis to convert sunlight, water and carbon dioxide into sugar to provide the energy that they need to grow and reproduce. They also release oxygen during this process, which all animals, including humans, need to survive.

Animals are consumers and they all depend on plants for survival. Animals depend on plants for food. Some eat plants directly (herbivores and omnivores), while others eat animals that eat plants (carnivores and omnivores). Plants also provide habitat, protection from predators and shelter from weather for many species of animals.

Plants also depend on animals for pollination or to help spread their seeds, and animals produce carbon dioxide that plants use during photosynthesis. Decomposing animal carcasses and their excretions can also provide nutrients for plants to grow.

Animals and plants depend on each other for their survival. They are important for maintaining the natural cycles of nutrients on Earth.

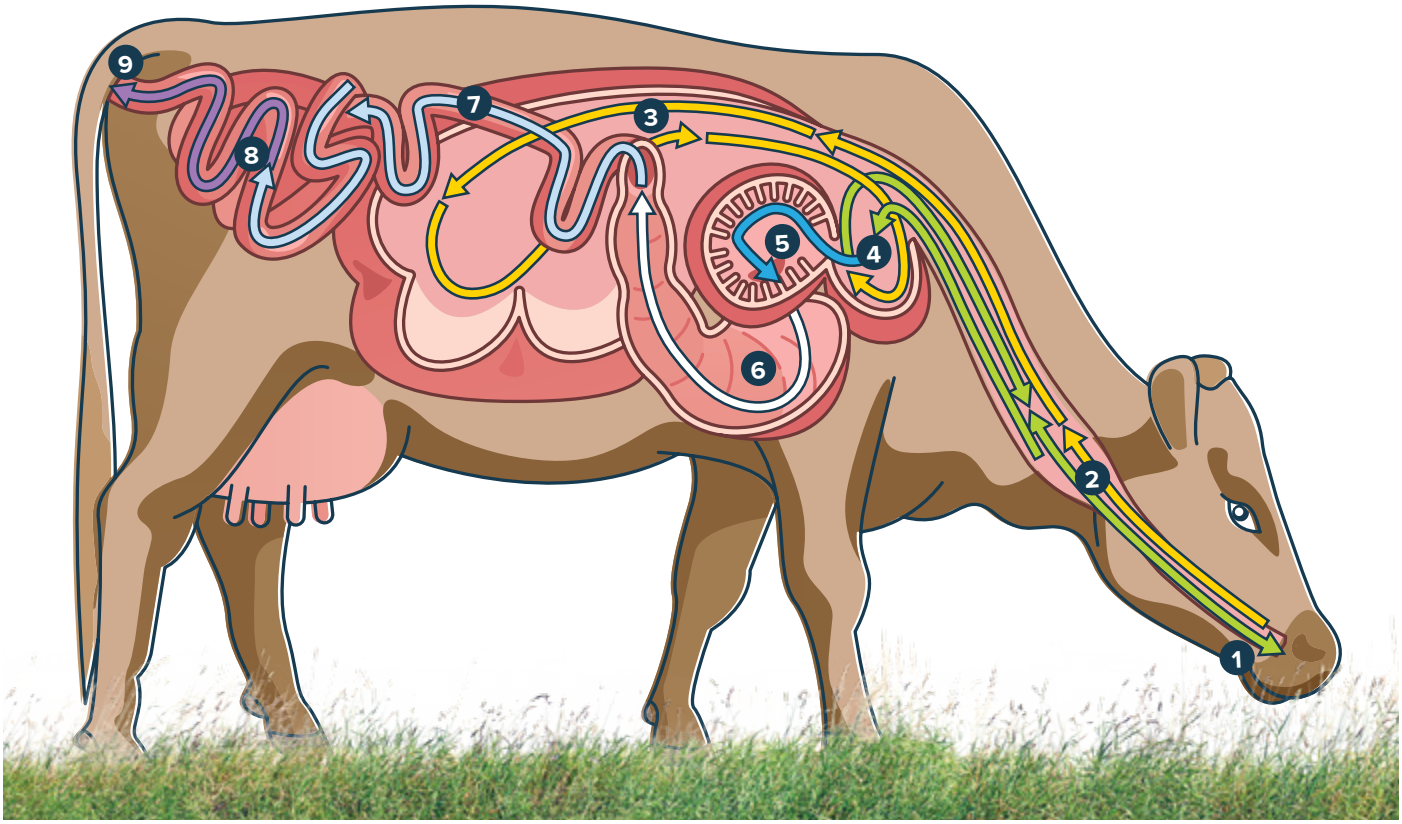
Worksheet 1.1b

Ruminant digestion

Cattle, sheep and goats are herbivores.

They consume plant matter, such as grasses, which have a lot of roughage including cellulose and complex starches. In order to break down this difficult to digest material, they have a ruminant digestive system that consists of four stomach compartments (rumen, reticulum, omasum and abomasum) filled with billions of microorganisms. Without a specialised digestive system and the microorganisms which ferment the plant material, the animals would not be able to extract enough glucose to produce energy for survival.

a. Use the descriptions in the table[1] (see references) on following page or Ruminant digestive system poster to label the digestive system of this ruminant animal.



Worksheet 1.1b continued next page

Worksheet 1.1b continued

Worksheet 1.1b

No.	Label	Description
	Omasum	Made up of lots of leaf-like projections, creating a large surface area to absorb water.
	Mouth	The tongue is used to grasp a clump of grass and pull it into the mouth. Teeth in the mouth chew fresh plant material and regurgitated material from the rumen known as the 'cud'.
	Small intestine	About 40 metres long and is where additional digestion and absorption of nutrients occurs.
	Oesophagus	Muscle contractions move the food down from the mouth to the rumen and also back up to the mouth again so it can be chewed again.
	Anus	A circular muscle that controls the expulsion of waste from the digestion process.
	Rumen	The largest part of the stomach. It is here that billions of microorganisms begin to ferment the plant material. It is also used for storage of chewed vegetation that will be passed back into the mouth for more chewing (rumination).
	Abomasum	The last part of the stomach. It functions like stomachs found in non-ruminant animals, using acid and digestive enzymes to break down food.
	Large intestine	The final part of the digestive tract. Its main function is to absorb water and minerals.
	Reticulum	Acts as a filter, trapping larger particles that require further chewing. A small tissue fold lies between the reticulum and rumen, but the two aren't separate compartments.

The ruminant digestive system is an excellent adaptation for animals such as cattle, sheep and goats that enables them to efficiently extract nutrients from food that other animals cannot digest.



Ewe with bloat[2] (see references).

However, there are some disadvantages of this system. Ruminant animals produce large volumes of gas during their normal process of digestion. This gas either is burped up or passes through the gastrointestinal tract. If something interferes with gas escaping from the rumen, it can build up and bloat occurs. The build up of gas affects their ability to breathe and can lead to death from suffocation. Bloat can be caused by introducing ruminants onto lush pastures too quickly, particularly if the pasture has a high legume content (clover or lucerne). It can also be caused when ruminants are introduced to grain rations too quickly for example in a feedlot if rations are not gradually introduced.

Stimulus 1.2a

Intensive and extensive agricultural systems

Intensive systems







Extensive systems







Worksheet 1.2b

Intensive and extensive agricultural systems

Intensive systems

Features

Extensive systems

Features

Feedlots v pasture

Feedlot



Large numbers of animals can be managed in feedlots.

A feedlot is an example of a managed intensive agricultural system. It is a confined yard area where cattle are watered and fed a specific diet (ration), which generally consists of a mix of barley, wheat and sorghum.

Feedlots play an essential role in 'drought proofing' Australia's beef industry, by enabling a consistent supply of quality beef to domestic and international markets. There are approximately 450 accredited feedlots in Australia.

Cattle spend most of their lives on pasture before moving to a feedlot for 50-120 days. In 2020, about 36% of Australia's total beef produced were 'finished' in feedlots. Finishing cattle in a feedlot results in cattle increasing their weight and fat deposition prior to processing.

Grain-fed beef results in a buttery flavour with pure white fat.

Pasture



Australian beef is predominately pasture-fed.

Animals that are pasture-fed are usually rotated around areas on a farm. This provides the animals with a feeding period on fresh pasture (when protein levels are high) before they are moved to a different paddock, allowing the pasture to recover and regenerate.

Growth rates of pasture are affected by a number of environmental factors, such as, temperature and water availability. Careful grazing management by producers is needed to ensure animals have access to a suitable plane of nutrition for their growth and development, and therefore profitability.

Grass-fed beef is generally described as having a complex, robust flavour with yellowish fat colour.

Worksheet 1.3a

Case study: Intensive and extensive systems

a. Access the sources/QR codes below and view the media clips of extensive and intensive cattle production systems.

b. Provide a summary of the case studies in the spaces.

Smithfield Cattle Co (7.34)

Miriam Vale QLD (7.16)

Yougawalla Station (3.18)

Type of system	Type of system	Type of system
Size of land	**Size of land**	**Size of land**
Number of animals	**Number of animals**	**Number of animals**
Type of feed consumed	**Type of feed consumed**	**Type of feed consumed**
Environmental considerations	**Environmental considerations**	**Environmental considerations**

Interdependence of animals and plants

Worksheet 1.1b - Ruminant digestion

No.	Label	Description
5	Omasum	Made up of lots of leaf-like projections, creating a large surface area to absorb water.
1	Mouth	The tongue is used to grasp a clump of grass and pull it into the mouth. Teeth in the mouth chew fresh plant material and regurgitated material from the rumen known as the 'cud'.
7	Small intestine	About 40 metres long and is where additional digestion and absorption of nutrients occurs.
2	Oesophagus	Muscle contractions move the food down from the mouth to the rumen and also back up to the mouth again so it can be chewed again.
9	Anus	A circular muscle that controls the expulsion of waste from the digestion process.
3	Rumen	The largest part of the stomach. It is here that billions of microorganisms begin to ferment the plant material. It is also used for storage of chewed vegetation that will be passed back into the mouth for more chewing (rumination).
6	Abomasum	The last part of the stomach. It functions like stomachs found in non-ruminant animals, using acid and digestive enzymes to break down food.
8	Large intestine	The final part of the digestive tract. Its main function is to absorb water and minerals.
4	Reticulum	Acts as a filter, trapping larger particles that require further chewing. A small tissue fold lies between the reticulum and rumen, but the two aren't separate compartments.

Intensitve and extensive systems

Worksheet 1.2b - Intensive and extensive agricultural systems

Intensive systems

Method of production that produces a large number of plants or animals on a smaller area of land compared to extensive systems.

Management methods endeavour to control environmental factors, such as: exact rations/nutrition, temperature, water, etc.

Features

Size of land
Properties tend to be smaller than extensive farms.

Number of animals/plants
A large number of plants/animals are produced in the area.

Location of enterprises
Close to areas with higher population densities that have efficient transport systems linking them to processing or markets.

Labour
A high number of workers are needed due to the amount of product on site, technology requirements and intensity of daily operations.

Inputs into the system
Large amounts of inputs are needed to produce a large number of products at the expected quality.

Extensive systems

Method of production that uses a large area of land to produce plants and/or animals.

Management methods are more reliant on adapting to seasonal conditions and variability, rather than controlling them.

Features

Size of land
Properties tend to be larger in scale than intensive farms.

Number of animals/plants
A smaller number of plants/animals are produced, per unit of area.

Location of enterprises
Generally located further from urban areas and may require produce to be transported greater distances.

Labour
Requirements for labour are less. Workers are more likely to be employed on a seasonal/ operational requirement.

Inputs into the system
Lower amounts of inputs are needed to produce products at the expected quality.

Case study: Intensive and extensive systems

Worksheet 1.3a - Intensive and extensive agricultural systems

Smithfield Cattle Co (7.34)

Type of system
Intensive feedlot.
Size of land
Unknown.
Number of animals
40,000.
Type of feed consumed
Grain ration, milled feed, steamed flaking.
Environmental considerations
Passing on land in a better condition; accredited as following environmental guidelines; regenerative journey is starting (manure applications); multi-species mix; renewable energy (solar).

Miriam Vale QLD (7.16)

Type of system
Extensive cattle grazing.
Size of land
2,500 hectares.
Number of animals
Unknown.
Type of feed consumed
Pasture (multi-species).
Environmental considerations
Solar; water reticulation system (bores); improving soil biology with multi-species mixes; consideration to stocking density and pasture recovery; drought-proofing; soil carbon agreement; soil carbon credits; increasing organic matter.

Yougawalla Station (3.18)

Type of system
Extensive cattle grazing.
Size of land
2,500,000 acres.
Number of animals
20,000.
Type of feed consumed
Pasture (desert grassland).
Environmental considerations
Not a lot of water, therefore need to spread the animals; erosion control; fencing areas; encouraging biodiversity; minimal impact on the natural environment.

***Activity 1.3** continued next page*

Online learning task:
Managing waste and feed on a feedlot

2. The risk of nutrient loss from utilisation areas can be prevented or mitigated by selecting areas that provide suitable land and buffers to sensitive sites, by using appropriate spreading or irrigation practices, and by regularly monitoring soil nutrient levels and responding appropriately.
3. Refer to the table below:

