Stage 6 Agriculture – Animal production

## Reproduction in animals – student workbook

Student name:

Class:

Teacher:

## Reproduction in animals

This unit explores animal fertility and manipulation techniques used in industry. Students will explore the factors that limit fertility in livestock and the management techniques that farmers use to manipulate reproduction and improve reproductive performance.

## Outcomes

* **H1.1** explains the influence of the physical, biological, social, historical and economic factors on sustainable agricultural production.
* **H2.2** describes the inputs, processes and interactions of animal production systems.
* **H4.1** justifies and applies appropriate experimental techniques, technologies, research by methods and data presentation and analysis in relation to agricultural problems and situations.

[Agriculture Stage 6 Syllabus](https://educationstandards.nsw.edu.au/wps/portal/nesa/11-12/stage-6-learning-areas/technologies/agriculture-syllabus) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2013.

## Factors that limit fertility in livestock

Identify the factors that limit fertility of farm animals including genetics, environment, pests and diseases, management and nutrition.

1. For the syllabus content point above:

* Highlight the HSC verb and write a definition of what it means.
* Underline the key ideas and focus points.
* Break the point down into simplified steps of what is required.

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2. Define the term “fertility”. Use an examples to describe what a fertile animal is according to a farmer.

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3. Define the term “infertility”. Use an example to describe what an infertile animal is according to a farmer.

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4. Using the Venn diagram below, show the similarities and differences between an infertile animal (for example a free-martin heifer) and an animal with reduced fertility.

5. Define the term fecundity. Explain why a sow is considered more fecund than a cow.

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### Factors that limit fertility

Each of the following factors can reduce the fertility of both male and female livestock in an enterprise. In the spaces provided:

* Describe what the limiting factor is.
* How or why is an animal exposed to it?
* How it can reduce the fertility of the male and/or female animal.
* Provide examples.

Genetics

| **Below is a model answer to get you started:**  **Description of the limiting factor.**  Genetics are the instructional make up of an animal that defines what characteristics are inherited from the parents. This will determine the upper most limit of an animals fertility, regardless of the environment it is in.  **How an animal is exposed?**  Genetics are passed from the parents, half from the mother and half from the father at conception. Genetics are not a factor that cannot be changed easily.  **How can it reduce fertility?**  There are genetic differences in fertility between species of animals and between breeds within a species. For example, a sow produces two litters of piglets each year with approximately 11 piglets in each litter. A ewe produces one or two lambs per year. Genetic differences between breeds can also occur. Some breeds of sheep, such as the border Leicester, have a higher percentage of twins than other breeds, such as the merino.  Some animals are infertile because they have a genetic abnormality in the anatomy of the reproductive or endocrine glands. |
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1. Environment

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2. Pests and disease

| Venereal diseases often reduce fertility of flocks and herds. Consider the effects of vibriosis or leptospirosis on fertility of animals in this section. |
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3. Management

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4. Nutrition

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5. Answer the following question from the 2015 HSC agriculture exam.

Question 21, c.

Describe the effect of two factors on the fertility of farm animals. (Four marks).

[Agriculture HSC exam paper 2015](https://educationstandards.nsw.edu.au/wps/portal/nesa/resource-finder/hsc-exam-papers/2015/agriculture-2015-hsc-exam-pack) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2015. Refer HPRM: MAIL20/149940.

**Describe:** provide characteristics and features of.

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## Techniques to manipulate reproduction

Evaluate management techniques available to farmers to manipulate reproduction in farm animals including artificial insemination, multiple ovulation, flushing, embryo transfer and oestrus synchronisation.

For the syllabus content point above:

* Highlight the HSC verb and write a definition of what it means.
* Underline the key ideas and focus points.
* Break the point down into simplified steps of what is required.

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### On farm reproductive management techniques

Each of the following practices are used to manipulate the reproductive performance of livestock:

* Artificial insemination.
* Embryo transfer.
* Multiple ovulation.
* Flushing.
* Oestrus synchronisation.

For each of these practices, create an information board that includes the following:

* Definition for the practice (what is it?).
* A step by step flow diagram explaining how it is carried out.
* A table of advantages and disadvantages of using the technique to manipulate reproduction.
* A written evaluation (judgement based on criteria) of the techniques ability to improve/manipulate reproduction in livestock.

**Note:** focus on one animal enterprise that has been studied in class to answer all parts of this section, for continuity. For example, cattle or sheep.

1. Artificial insemination

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2. Embryo transfer

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3. Multiple ovulation

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4. Flushing

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5. Oestrus synchronisation

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6. Answer the following question from the 2017 HSC agriculture exam.

Question 24, b.

Explain how one management strategy that is used by farmers improves the reproductive performance of breeding stock. (Three marks).

[Agriculture HSC exam paper 2017](https://educationstandards.nsw.edu.au/wps/portal/nesa/resource-finder/hsc-exam-papers/2017/agriculture-2017-hsc-exam-pack) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2017. Refer HPRM: MAIL20/149940.

**Explain:** relate cause and effect; make the relationships between things evident; provide why and/or how.

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## Objective measurement

Outline the role of objective measurement and heritability on the breeding programs of farms, using at least one specific industry program as an example.

For the syllabus content point above:

* Highlight the HSC verb and write a definition of what it means.
* Underline the key ideas and focus points.
* Break the point down into simplified steps of what is required.

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1. Define the terms “objective”, “subjective” and “heritability”.

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2. What is “objective measurement” in the agriculture industry? Outline why a farmer would choose to use this in their livestock enterprise? Use an example to support your answer.

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### Estimated breeding values

Watch the video [“what are estimated breeding values?”](https://www.youtube.com/watch?v=Yhsw3HJDtf4) (duration 4:00) from Meat and Livestock Australia. Answer the following questions about estimated breeding values.

1. Explain estimated breeding values and outline how they are calculated.

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2. State some of the limitations of using estimated breeding values for farmers.

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3. List the benefits of using estimated breeding values in a breeding program for livestock.

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### Breedplan

Use the ‘[a basic guide to breedplan EBV’s’](http://breedplan.une.edu.au/booklets/A%20Basic%20Guide%20to%20BP%20EBVs%20%28Complete%29.pdf) resource from International Beef Recording Scheme, breedplan and make notes in the following sections.

1. List the different cattle breeds that have a breedplan analysis available.

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2. Research one other species of livestock and list the available industry programs for objective measurement.

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Breedplan currently reports estimated breeding values for a range of traits they deem economically important. The resource explicitly explains each of these traits, how the value is calculated and how to read the numbers within the tables. For the following six traits, create a quick reference guide on how to interpret the table and why a farmer would be interested in this value for potential sires or dams.

The first one has been done for you.

Scrotal size

| **This is an example answer to get you started.**  What it is: estimate of scrotal circumference in centimetres at 400 days of age.  Why would a farmer want to know this information?  Increased scrotal size is associated with increased semen production and earlier puberty for progeny. Larger scrotal size also correlates to female progeny with shorter days to calving.  How to interpret the table:   * Positive numbers are desirable. * Larger positive numbers are desirable. |
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3. Birth weight

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4. 400-day weight

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5. Calving ease

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6. Days to calving

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7. Eye muscle area.

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8. Use the space provided to complete the bull selection exercises in the [“a basic guide to breedplan EBV’s”](http://breedplan.une.edu.au/booklets/A%20Basic%20Guide%20to%20BP%20EBVs%20%28Complete%29.pdf) resource. Show working out where possible.

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9. Answer the following question from the 2016 HSC agriculture exam.

Question 18.

The table shows the estimated breeding values of four bulls.

[Agriculture HSC exam paper 2016](https://educationstandards.nsw.edu.au/wps/portal/nesa/resource-finder/hsc-exam-papers/2016/agriculture-2016-hsc-exam-pack) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2016.

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| --- | --- | --- | --- | --- | --- |
| Bull | Birthweight | 200 day weight | 400 day weight | Eye muscle area | Rump fat |
| **W** | +18 | +50 | +180 | +9 | +1 |
| **X** | +3 | +60 | +30 | -6 | +6 |
| **Y** | -2 | +60 | +180 | +6 | +3 |
| **Z** | -8 | -18 | -6 | -2 | +8 |

10. Which of the bulls would be most suited to use as a sire on heifers in a herd which supplies steers to a feedlot?

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11. Answer the following question from the 2019 HSC agriculture exam.

Question 27, a.

Outline the meaning of the term heritability in relation to animal breeding (two marks).

[Agriculture HSC exam paper 2019](https://educationstandards.nsw.edu.au/wps/portal/nesa/resource-finder/hsc-exam-papers/2019/agriculture-2019-hsc-exam-pack) © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2019.

**Outline:** sketch in general terms; indicate the main features of.

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## Reproductive hormones and oestrus

Describe how hormones regulate reproduction and behaviour in animals including testosterone, oestrogen, progesterone, prostaglandin, follicle stimulating hormone and luteinising hormone.

Explain the interaction between hormones in an animal’s oestrus cycle.

For the syllabus content point above:

* Highlight the HSC verb and write a definition of what it means.
* Underline the key ideas and focus points.
* Break the point down into simplified steps of what is required.

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1. Define what a “hormone” is.

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2. Describe how hormones work and move around the body. Outline their effects on the bodily functions and animal behaviour.

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Each of the following hormones are produced in livestock.

* Testosterone.
* Oestrogen.
* Progesterone.
* Prostaglandin.
* Follicle stimulating hormone.
* Luteinising hormone.

For each of these hormones, create a study card that includes the following:

* Definition.
* Where it is produced in the body.
* Effects on reproduction.
* Effects on behaviours.

Prostaglandin

| **Definition.**   * A group of hormone-like substances that participate in a wide range of body functions such as the contraction and relaxation of smooth muscles.   **Where it is produced in the body.**   * Prostaglandins are known to be produced in the uterus and placenta in large quantities.   **Effects on reproduction.**   * Prostaglandins assist in regulating the reproductive systems. They can start labour and control ovulation. * If a female does not become fertilised after ovulation, prostaglandin is produced and causes the reduction in size of the corpus luteum and thus the amount of progesterone production. * Prostaglandins have both positive and negative effects on reproduction; they are used to synchronise oestrus, induce parturition, and treat retained placentas. |
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3. Oestrogen

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4.Progesterone

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5. Follicle stimulating hormone

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6. Luteinising hormone

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7. Testosterone

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### Hormones and oestrus

Watch the video, [“Chapter 2 anatomy and physiology”](https://www.youtube.com/watch?v=Liu_S7MPRyA) (video duration 6:06)

Read the article, [“What is the basic oestrus cycle of the cow?”](https://dairy-cattle.extension.org/what-is-the-basic-estrous-cycle-of-the-cow/)

8. Use the information from these two sources to develop a diagram that explains how the reproductive hormones work together to control oestrus in cattle.

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Watch the video, [“Estrous cycle of cattle”](https://www.youtube.com/watch?v=9O3qxqTxxYg) (video duration 2:57)

9. Draw a timeline of oestrus from day 0 to day 21. Include the names of the stages that occur and the hormones present at each stage.

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## Summary

Watch the video, [“Raising the steaks the science of cattle breeding”](https://www.youtube.com/watch?v=wtP7q6W8cvY&t=74s) (video duration 23:18)

10. Create an extended concept map modelling how each of the topics within this unit influence the farm manager’s decision-making processes. Identify other influences on farm decision-making processes discussed in the video and include these.

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## Marking rubric

The following marking rubric is to be used as a guide only. Individual teacher judgement and knowledge of specific students’ needs is required.

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| Limiting factors for fertility | Grade |
| Students communicate their understanding of the terminology by providing a clear and concise definition of the key terms.  Students can clearly and concisely explain the primary factors that limit fertility of livestock. | A |
| Students communicate a general understanding of the terminology by providing a definition of the key terms.  Students communicate a general understanding of the primary factors that limit fertility of livestock. | B |
| Students communicate some understanding of the terminology by providing a basic definition of the key terms.  Students communicate some understanding of the primary factors that limit fertility of livestock. | C |
| Students communicate little understanding of the terminology by providing only a limited definition of the key terms.  Students communicate little understanding of the primary factors that limit fertility of livestock. | D |
| Little or no attempt to complete the limiting factors affecting fertility. | E |

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| Management techniques that manipulate reproduction | Grade |
| Students undertake extensive research with a comprehensive analysis of their findings on the management techniques used by farmers to manipulate reproduction. | A |
| Students undertake research with an analysis of their findings on the management techniques used by farmers to manipulate reproduction. | B |
| Students undertake basic research with some analysis of their findings on the management techniques used by farmers to manipulate reproduction. | C |
| Students undertake limited research with incomplete analysis of their findings on the management techniques used by farmers to manipulate reproduction. | D |
| Little or no attempt to carry out research or analyse the findings. | E |

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| Objective measurement | Grade |
| Students communicate their understanding of objective measurement providing clear and concise definitions for key terms and analysis of industry data using breedplan. | A |
| Students communicate their understanding of objective measurement providing definitions for key terms and analysis of industry data using breedplan. | B |
| Students communicate their understanding of objective measurement providing basic definitions for key terms and some analysis of industry data using breedplan. | C |
| Students communicate their understanding of objective measurement providing limited definitions for key terms and little analysis of industry data using breedplan. | D |
| Little or no attempt made to analyse industry data. | E |

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| Hormones and oestrus | Grade |
| Students undertake extensive research with a comprehensive analysis of their findings on livestock hormones and their interactions during oestrus. | A |
| Students undertake research with an analysis of their findings on livestock hormones and their interactions during oestrus. | B |
| Students undertake basic research with some analysis of their findings on livestock hormones and their interactions during oestrus. | C |
| Students undertake limited research with incomplete analysis of their findings on livestock hormones and their interactions during oestrus. | D |
| Little or no attempt to carry out research on hormones and their interactions during oestrus. | E |

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| Summary | Grade |
| Students extensively link the different aspects of livestock reproduction together as demonstrated on the sample farm. | A |
| Students thoroughly link the different aspects of livestock reproduction together as demonstrated on the sample farm. | B |
| Students show sound links between the different aspects of livestock reproduction together as demonstrated on the sample farm. | C |
| Students show basic links between the different aspects of livestock reproduction together as demonstrated on the sample farm. | D |
| Students show limited links between the different aspects of livestock reproduction together as demonstrated on the sample farm. | E |